



Final Report

Report No.:	21-43564-1		
Initial Date of Issue:	16-Dec-2021		
Client	Quantum Geotechnic Ltd		
Client Address:	13A Bishops Court Gardens Clyst St Mary Exeter EX5 1DH		
Contact(s):	Adam Parnell Ben Tucker Jim Dennis Logan Richmond-Clarke Ross McDermott		
Project	Q0652 Global Centre of Rail Excellence		
Quotation No.:	Q21-24761	Date Received:	07-Dec-2021
Order No.:		Date Instructed:	09-Dec-2021
No. of Samples:	1		
Turnaround (Wkdays):	5	Results Due:	15-Dec-2021
Date Approved:	16-Dec-2021		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Leachate

Project: Q0652 Global Centre of Rail Excellence

Client: Quantum Geotechnic Ltd	Chemtest Job No.:		21-43564			
Quotation No.: Q21-24761	Chemtest Sample ID.:		1336944			
Order No.:	Client Sample Ref.:		1			
	Sample Location:		BH32			
	Sample Type:		SOIL			
	Top Depth (m):		0.20			
Determinand	Accred.	SOP	Type	Units	LOD	
Cyanide (Total)	U	1300	10:1	mg/l	0.050	< 0.050
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	15
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	9.1
Mercury (Dissolved)	U	1455	10:1	µg/l	0.05	< 0.05
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	1.7
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	5.6
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	13
Chromium (Total)	N	1455	10:1	µg/l	0.50	1.1
Naphthalene	N	1800	10:1	µg/l	0.010	< 0.010
Acenaphthylene	N	1800	10:1	µg/l	0.010	< 0.010
Acenaphthene	N	1800	10:1	µg/l	0.010	< 0.010
Fluorene	N	1800	10:1	µg/l	0.010	< 0.010
Phenanthrene	N	1800	10:1	µg/l	0.010	< 0.010
Anthracene	N	1800	10:1	µg/l	0.010	< 0.010
Fluoranthene	N	1800	10:1	µg/l	0.010	< 0.010
Pyrene	N	1800	10:1	µg/l	0.010	< 0.010
Benzo[a]anthracene	N	1800	10:1	µg/l	0.010	< 0.010
Chrysene	N	1800	10:1	µg/l	0.010	< 0.010
Benzo[b]fluoranthene	N	1800	10:1	µg/l	0.010	< 0.010
Benzo[k]fluoranthene	N	1800	10:1	µg/l	0.010	< 0.010
Benzo[a]pyrene	N	1800	10:1	µg/l	0.010	< 0.010
Indeno(1,2,3-c,d)Pyrene	N	1800	10:1	µg/l	0.010	< 0.010
Dibenz(a,h)Anthracene	N	1800	10:1	µg/l	0.010	< 0.010
Benzo[g,h,i]perylene	N	1800	10:1	µg/l	0.010	< 0.010
Total Of 16 PAH's	N	1800	10:1	µg/l	0.20	< 0.20
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030

Results - Soil

Project: Q0652 Global Centre of Rail Excellence

Client: Quantum Geotechnic Ltd	Chemtest Job No.:		21-43564		
Quotation No.: Q21-24761	Chemtest Sample ID.:		1336944		
Order No.:	Client Sample Ref.:		1		
	Sample Location:		BH32		
	Sample Type:		SOIL		
	Top Depth (m):		0.20		
	Asbestos Lab:		COVENTRY		
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
Moisture	N	2030	%	0.020	22
pH	U	2010		4.0	[A] 8.1
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	[A] < 0.40
Cyanide (Total)	U	2300	mg/kg	0.50	[A] < 0.50
Arsenic	U	2450	mg/kg	1.0	23
Cadmium	U	2450	mg/kg	0.10	0.77
Chromium	U	2450	mg/kg	1.0	10
Copper	U	2450	mg/kg	0.50	27
Mercury	U	2450	mg/kg	0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	28
Lead	U	2450	mg/kg	0.50	26
Selenium	U	2450	mg/kg	0.20	0.78
Zinc	U	2450	mg/kg	0.50	120
Total Organic Carbon	U	2625	%	0.20	[A] 6.9
Mineral Oil (TPH Calculation)	N	2670	mg/kg	10	< 10
TPH >C6-C10	N	2670	mg/kg	1.0	[A] < 1.0
TPH >C10-C25	N	2670	mg/kg	1.0	[A] < 1.0
TPH >C25-C40	N	2670	mg/kg	1.0	[A] < 1.0
Total TPH >C6-C40	U	2670	mg/kg	10	[A] < 10
Naphthalene	U	2800	mg/kg	0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	0.45
Anthracene	U	2800	mg/kg	0.10	0.11
Fluoranthene	U	2800	mg/kg	0.10	0.86
Pyrene	U	2800	mg/kg	0.10	0.56
Benzo[a]anthracene	U	2800	mg/kg	0.10	0.45
Chrysene	U	2800	mg/kg	0.10	0.47
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	0.90
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	0.29
Benzo[a]pyrene	U	2800	mg/kg	0.10	0.52
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	0.48
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	0.24
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	0.40
Total Of 16 PAH's	N	2800	mg/kg	2.0	5.7

Results - Soil

Project: Q0652 Global Centre of Rail Excellence

Client: Quantum Geotechnic Ltd	Chemtest Job No.:		21-43564		
Quotation No.: Q21-24761	Chemtest Sample ID.:		1336944		
Order No.:	Client Sample Ref.:		1		
	Sample Location:		BH32		
	Sample Type:		SOIL		
	Top Depth (m):		0.20		
	Asbestos Lab:		COVENTRY		
Determinand	Accred.	SOP	Units	LOD	
Total Phenols	U	2920	mg/kg	0.10	< 0.10

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1336944	1		BH32		A	Amber Glass 250ml
1336944	1		BH32		A	Amber Glass 60ml
1336944	1		BH32		A	Plastic Tub 1000g

Test Methods

SOP	Title	Parameters included	Method summary
1300	Cyanides & Thiocyanate in Waters	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Continuous Flow Analysis.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters by GC-MS	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Pentane extraction / GCMS detection
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and Trimethylphenols Note: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	Compliance Test for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com



Final Report

Report No.: 22-00477-1

Initial Date of Issue: 19-Jan-2022

Client Quantum Geotechnic Ltd

Client Address: Plas Newydd
Llanedi
Pontarddulais
Swansea
SA4 0FQ

Contact(s): Steffan Picton

Project Q0652 GCRE - ONLLWYN

Quotation No.: Q21-24761 **Date Received:** 11-Jan-2022

Order No.: **Date Instructed:** 14-Jan-2022

No. of Samples: 4

Turnaround (Wkdays): 5 **Results Due:** 20-Jan-2022

Date Approved: 19-Jan-2022

Approved By:

Details: Stuart Henderson, Technical
Manager

Results - Soil

Project: Q0652 GCRE - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				22-00477	22-00477	22-00477	22-00477
Quotation No.: Q21-24761	Chemtest Sample ID.:				1349251	1349252	1349255	1349256
Order No.:	Client Sample Ref.:				1	2	2	3
	Client Sample ID.:				ES	ES	ES	ES
	Sample Location:				TP1	TP1	TP2	TP2
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.2	1.0	0.3	1.0
	Date Sampled:				07-Jan-2022	07-Jan-2022	07-Jan-2022	07-Jan-2022
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD				
ACM Type	U	2192		N/A	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	13	22	8.1	8.8
Soil Colour	N	2040		N/A	Black	Black		Black
Other Material	N	2040		N/A	Stones and Roots	Stones		Stones
Soil Texture	N	2040		N/A	Loam	Gravel		Gravel
pH	M	2010		4.0	8.2	9.0	8.5	8.5
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40	< 0.40	< 0.40	< 0.40
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	M	2450	mg/kg	1.0	12	17	14	17
Cadmium	M	2450	mg/kg	0.10	0.26	0.46	0.11	0.34
Chromium	M	2450	mg/kg	1.0	18	13	11	5.5
Copper	M	2450	mg/kg	0.50	69	260	38	62
Mercury	M	2450	mg/kg	0.10	< 0.10	0.15	0.10	0.13
Nickel	M	2450	mg/kg	0.50	34	26	18	18
Lead	M	2450	mg/kg	0.50	26	69	23	47
Selenium	M	2450	mg/kg	0.20	0.61	1.1	1.0	1.7
Zinc	M	2450	mg/kg	0.50	110	240	41	150
Chromium (Hexavalent)	N	2490	mg/kg	0.50		< 0.50		< 0.50
LOI	M	2610	%	0.10		22		65
Total Organic Carbon	M	2625	%	0.20	22	43	39	44
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	3700
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	3700
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: Q0652 GCRE - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				22-00477	22-00477	22-00477	22-00477
Quotation No.: Q21-24761	Chemtest Sample ID.:				1349251	1349252	1349255	1349256
Order No.:	Client Sample Ref.:				1	2	2	3
	Client Sample ID.:				ES	ES	ES	ES
	Sample Location:				TP1	TP1	TP2	TP2
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.2	1.0	0.3	1.0
	Date Sampled:				07-Jan-2022	07-Jan-2022	07-Jan-2022	07-Jan-2022
	Asbestos Lab:				COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD				
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	1100	< 1.0	< 1.0	2300
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	1100	< 5.0	< 5.0	2300
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	1100	< 10	< 10	6000
Benzene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	0.0014	< 0.0010
Toluene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	0.0013	< 0.0010
Ethylbenzene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
m & p-Xylene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
o-Xylene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Naphthalene	M	2800	mg/kg	0.10	1.2	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	0.22	< 0.10	< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	0.22	< 0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	0.30	< 0.10	< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	2.4	2.8	1.4	2.6
Anthracene	M	2800	mg/kg	0.10	0.46	0.64	0.25	0.48
Fluoranthene	M	2800	mg/kg	0.10	4.3	4.0	1.0	2.5
Pyrene	M	2800	mg/kg	0.10	4.1	3.3	0.83	2.0
Benzo[a]anthracene	M	2800	mg/kg	0.10	2.3	1.7	0.37	1.1
Chrysene	M	2800	mg/kg	0.10	2.5	2.0	0.55	1.3
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	2.9	2.5	0.57	1.4
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	1.1	0.82	0.20	0.41
Benzo[a]pyrene	M	2800	mg/kg	0.10	2.0	1.6	0.26	0.76
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	1.4	1.2	< 0.10	0.46
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	0.35	0.24	< 0.10	0.14
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	1.3	1.2	< 0.10	0.45
Total Of 16 PAH's	N	2800	mg/kg	2.0	27	22	5.4	14
PCB 81	N	2815	mg/kg	0.0010	< 0.0010			
PCB 77	N	2815	mg/kg	0.0010	< 0.0010			
PCB 105	N	2815	mg/kg	0.0010	< 0.0010			
PCB 114	N	2815	mg/kg	0.0010	< 0.0010			
PCB 118	N	2815	mg/kg	0.0010	< 0.0010			
PCB 123	N	2815	mg/kg	0.0010	< 0.0010			
PCB 126	N	2815	mg/kg	0.0010	< 0.0010			
PCB 156	N	2815	mg/kg	0.0010	< 0.0010			
PCB 157	N	2815	mg/kg	0.0010	< 0.0010			
PCB 167	N	2815	mg/kg	0.0010	< 0.0010			

Results - Soil

Project: Q0652 GCRE - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:					22-00477	22-00477	22-00477	22-00477
Quotation No.: Q21-24761	Chemtest Sample ID.:					1349251	1349252	1349255	1349256
Order No.:	Client Sample Ref.:					1	2	2	3
	Client Sample ID.:					ES	ES	ES	ES
	Sample Location:					TP1	TP1	TP2	TP2
	Sample Type:					SOIL	SOIL	SOIL	SOIL
	Top Depth (m):					0.2	1.0	0.3	1.0
	Date Sampled:					07-Jan-2022	07-Jan-2022	07-Jan-2022	07-Jan-2022
	Asbestos Lab:					COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD					
PCB 169	N	2815	mg/kg	0.0010	< 0.0010				
PCB 189	N	2815	mg/kg	0.0010	< 0.0010				
Total PCBs (12 Congeners)	N	2815	mg/kg	0.0010	< 0.0010				
Total Phenols	M	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Single Stage WAC

Project: Q0652 GCRE - ONLLWYN

Chemtest Job No: 22-00477					Landfill Waste Acceptance Criteria		
Chemtest Sample ID: 1349252					Limits		
Sample Ref: 2					Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID: ES							
Sample Location: TP1							
Top Depth(m): 1.0							
Bottom Depth(m):							
Sampling Date: 07-Jan-2022							
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	M	%	43	3	5	6
Loss on Ignition					--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	M	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg	41	100	--	--
pH					--	>6	--
Acid Neutralisation Capacity					--	To evaluate	To evaluate
Eluate Analysis			10:1 Eluate mg/l	10:1 Eluate mg/kg	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg		
Arsenic	1455	U	0.0050	0.050	0.5	2	25
Barium	1455	U	0.018	0.18	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	0.0056	0.056	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0011	0.011	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0005	0.4	10	40
Lead	1455	U	0.0005	0.0054	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	< 0.0005	< 0.0005	0.1	0.5	7
Zinc	1455	U	0.005	0.050	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.29	2.9	10	150	500
Sulphate	1220	U	18	180	1000	20000	50000
Total Dissolved Solids	1020	N	72	710	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	5.1	51	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	22

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - Single Stage WAC

Project: Q0652 GCRE - ONLLWYN

Chemtest Job No: 22-00477					Landfill Waste Acceptance Criteria		
Chemtest Sample ID: 1349256					Limits		
Sample Ref: 3					Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID: ES							
Sample Location: TP2							
Top Depth(m): 1.0							
Bottom Depth(m):							
Sampling Date: 07-Jan-2022							
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	M	%	44	3	5	6
Loss on Ignition					--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	M	mg/kg	6000	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg	12	100	--	--
pH					--	>6	--
Acid Neutralisation Capacity					--	To evaluate	To evaluate
Eluate Analysis			10:1 Eluate mg/l	10:1 Eluate mg/kg	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg		
Arsenic	1455	U	0.0002	0.0024	0.5	2	25
Barium	1455	U	0.017	0.17	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	0.0012	0.012	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0006	0.0059	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0005	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	< 0.0005	< 0.0005	0.1	0.5	7
Zinc	1455	U	0.003	0.027	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.21	2.1	10	150	500
Sulphate	1220	U	8.6	86	1000	20000	50000
Total Dissolved Solids	1020	N	46	460	4000	60000	100000
Phenol Index	1920	U	0.35	3.5	1	-	-
Dissolved Organic Carbon	1610	U	5.3	53	500	800	1000

Solid Information

Dry mass of test portion/kg	0.090
Moisture (%)	8.8

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazine.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)

Test Methods

SOP	Title	Parameters included	Method summary
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com



Final Report

Report No.: 22-00598-1

Initial Date of Issue: 20-Jan-2022

Client Quantum Geotechnic Ltd

Client Address: Plas Newydd
Llanedi
Pontarddulais
Swansea
SA4 0FQ

Contact(s): Steffan Picton

Project Q0652 GCRR - ONLLWYN

Quotation No.: Q21-24761

Date Received: 12-Jan-2022

Order No.:

Date Instructed: 14-Jan-2022

No. of Samples: 15

Turnaround (Wkdays): 5

Results Due: 20-Jan-2022

Date Approved: 20-Jan-2022

Approved By:

Details: Stuart Henderson, Technical
Manager

Results - Soil

Project: Q0652 GCRR - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				22-00598	22-00598	22-00598	22-00598	22-00598	22-00598	22-00598	22-00598	22-00598
Quotation No.: Q21-24761	Chemtest Sample ID.:				1349746	1349747	1349750	1349751	1349752	1349755	1349756	1349757	1349758
Order No.:	Client Sample Ref.:				ES	ES	ES	ES	ES	ES	ES	ES	ES
	Client Sample ID.:				1	2	1	2	3	2	3	4	1
	Sample Location:				TP3	TP3	TP4	TP4	TP4	TP5	TP5	TP5	TP6
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.2	0.8	0.2	1.0	2.0	1.0	2.0	3.0	0.2
	Date Sampled:				10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022
	Asbestos Lab:				DURHAM	DURHAM	DURHAM		DURHAM	DURHAM		DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD									
ACM Type	U	2192		N/A	-	-	-		-	-		-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected		No Asbestos Detected	No Asbestos Detected		No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	30	13	12	11	11	12	10	11	14
Soil Colour	N	2040		N/A	Brown		Black						Black
Other Material	N	2040		N/A	Stones and Roots		Stones						Stones
Soil Texture	N	2040		N/A	Sand		Sand						Sand
pH	M	2010		4.0	8.3	8.6	8.4		8.3	8.4		8.1	8.1
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40	< 0.40	0.46		0.49	< 0.40		< 0.40	< 0.40
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50		< 0.50	< 0.50		< 0.50	< 0.50
Arsenic	M	2450	mg/kg	1.0	15	15	14		20	23		20	20
Cadmium	M	2450	mg/kg	0.10	0.46	0.41	< 0.10		0.14	0.25		0.19	0.16
Chromium	M	2450	mg/kg	1.0	37	11	4.4		5.9	7.8		11	21
Copper	M	2450	mg/kg	0.50	52	67	51		110	84		60	77
Mercury	M	2450	mg/kg	0.10	0.12	0.10	0.17		0.27	0.24		0.13	0.22
Nickel	M	2450	mg/kg	0.50	21	37	22		88	39		37	36
Lead	M	2450	mg/kg	0.50	40	27	42		42	37		29	38
Selenium	M	2450	mg/kg	0.20	0.74	0.67	2.8		4.2	1.7		1.6	2.2
Zinc	M	2450	mg/kg	0.50	120	120	44		92	130		110	89
Chromium (Hexavalent)	N	2490	mg/kg	0.50									< 0.50
LOI	M	2610	%	0.10									15
Total Organic Carbon	M	2625	%	0.20	37	2.8	24		15	34		28	23
Mineral Oil (TPH Calculation)	N	2670	mg/kg	10					< 10			< 10	
TPH >C6-C10	N	2670	mg/kg	1.0					< 1.0			< 1.0	
TPH >C10-C25	N	2670	mg/kg	1.0					< 1.0			< 1.0	
TPH >C25-C40	N	2670	mg/kg	1.0					< 1.0			< 1.0	
Total TPH >C6-C40	M	2670	mg/kg	10					< 10			< 10	
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0			< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0			< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0			< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0			< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0			< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0			< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0			< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0			< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0			< 5.0			< 5.0

Results - Soil

Project: Q0652 GCRR - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				22-00598	22-00598	22-00598	22-00598	22-00598	22-00598	22-00598	22-00598
Quotation No.: Q21-24761	Chemtest Sample ID.:				1349746	1349747	1349750	1349751	1349752	1349755	1349756	1349757
Order No.:	Client Sample Ref.:				ES	ES	ES	ES	ES	ES	ES	ES
	Client Sample ID.:				1	2	1	2	3	2	3	4
	Sample Location:				TP3	TP3	TP4	TP4	TP4	TP5	TP5	TP5
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.2	0.8	0.2	1.0	2.0	1.0	2.0	3.0
	Date Sampled:				10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022
	Asbestos Lab:				DURHAM	DURHAM	DURHAM		DURHAM	DURHAM		DURHAM
Determinand	Accred.	SOP	Units	LOD								
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0		< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0		< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0		< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0		< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0		< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0		< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0		< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0			< 1.0		< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0			< 5.0		< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10			< 10		< 10
Benzene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010			< 0.0010		< 0.0010
Toluene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010			< 0.0010		< 0.0010
Ethylbenzene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010			< 0.0010		< 0.0010
m & p-Xylene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010			< 0.0010		< 0.0010
o-Xylene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010			< 0.0010		< 0.0010
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Phenanthrene	M	2800	mg/kg	0.10	0.69	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Fluoranthene	M	2800	mg/kg	0.10	0.71	< 0.10	< 0.10		< 0.10	0.36		0.31
Pyrene	M	2800	mg/kg	0.10	0.50	< 0.10	< 0.10		< 0.10	0.30		0.27
Benzo[a]anthracene	M	2800	mg/kg	0.10	0.48	< 0.10	< 0.10		< 0.10	0.16		0.14
Chrysene	M	2800	mg/kg	0.10	0.79	< 0.10	< 0.10		< 0.10	0.23		0.20
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	0.84	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	0.22	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	0.35	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	0.29	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	0.11	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	0.29	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	5.3	< 2.0	< 2.0		< 2.0	< 2.0		< 2.0
PCB 81	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
PCB 77	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
PCB 105	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
PCB 114	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
PCB 118	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010

Results - Soil

Project: Q0652 GCRR - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:					22-00598	22-00598	22-00598	22-00598	22-00598	22-00598	22-00598
Quotation No.: Q21-24761	Chemtest Sample ID.:					1349746	1349747	1349750	1349751	1349752	1349755	1349758
Order No.:	Client Sample Ref.:					ES	ES	ES	ES	ES	ES	ES
	Client Sample ID.:					1	2	1	2	3	2	1
	Sample Location:					TP3	TP3	TP4	TP4	TP4	TP5	TP6
	Sample Type:					SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):					0.2	0.8	0.2	1.0	2.0	1.0	0.2
	Date Sampled:					10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022
	Asbestos Lab:					DURHAM	DURHAM	DURHAM		DURHAM	DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD								
PCB 123	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
PCB 126	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
PCB 156	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
PCB 157	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
PCB 167	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
PCB 169	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
PCB 189	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
Total PCBs (12 Congeners)	N	2815	mg/kg	0.0010	< 0.0010		< 0.0010					< 0.0010
Total Phenols	M	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10		< 0.10	< 0.10		< 0.10

Results - Soil

Project: Q0652 GCRR - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				22-00598	22-00598	22-00598	22-00598	22-00598	22-00598
Quotation No.: Q21-24761	Chemtest Sample ID.:				1349759	1349760	1349762	1349763	1349764	1349765
Order No.:	Client Sample Ref.:				ES	ES	ES	ES	ES	ES
	Client Sample ID.:				2	3	2	3	4	5
	Sample Location:				TP6	TP6	TP7	TP7	TP7	TP7
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				1.0	2.0	1.0	2.0	3.0	4.0
	Date Sampled:				10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022
	Asbestos Lab:						DURHAM		DURHAM	
Determinand	Accred.	SOP	Units	LOD						
ACM Type	U	2192		N/A			-		-	
Asbestos Identification	U	2192		N/A			No Asbestos Detected		No Asbestos Detected	
Moisture	N	2030	%	0.020	13	11	20	15	19	19
Soil Colour	N	2040		N/A			Black			
Other Material	N	2040		N/A			Stones			
Soil Texture	N	2040		N/A			Sand			
pH	M	2010		4.0		5.6	7.4		7.8	7.3
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40		< 0.40	0.41		0.50	0.46
Cyanide (Total)	M	2300	mg/kg	0.50		< 0.50	< 0.50		< 0.50	< 0.50
Arsenic	M	2450	mg/kg	1.0		8.9	15		14	33
Cadmium	M	2450	mg/kg	0.10		0.13	0.38		0.46	0.64
Chromium	M	2450	mg/kg	1.0		23	120		11	14
Copper	M	2450	mg/kg	0.50		48	74		70	25
Mercury	M	2450	mg/kg	0.10		< 0.10	0.64		0.22	< 0.10
Nickel	M	2450	mg/kg	0.50		46	140		26	23
Lead	M	2450	mg/kg	0.50		28	59		54	17
Selenium	M	2450	mg/kg	0.20		0.52	1.6		1.7	0.29
Zinc	M	2450	mg/kg	0.50		130	130		140	84
Chromium (Hexavalent)	N	2490	mg/kg	0.50						
LOI	M	2610	%	0.10						
Total Organic Carbon	M	2625	%	0.20		1.2	36		37	1.6
Mineral Oil (TPH Calculation)	N	2670	mg/kg	10		< 10			< 10	69
TPH >C6-C10	N	2670	mg/kg	1.0		< 1.0			< 1.0	< 1.0
TPH >C10-C25	N	2670	mg/kg	1.0		< 1.0			< 1.0	50
TPH >C25-C40	N	2670	mg/kg	1.0		< 1.0			< 1.0	49
Total TPH >C6-C40	M	2670	mg/kg	10		< 10			< 10	98
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0			< 1.0			
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0			< 1.0			
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0			< 1.0			
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0			< 1.0			
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0			< 1.0			
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0			< 1.0			
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0			< 1.0			
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0			< 1.0			
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0			< 5.0			

Results - Soil

Project: Q0652 GCRR - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				22-00598	22-00598	22-00598	22-00598	22-00598	22-00598
Quotation No.: Q21-24761	Chemtest Sample ID.:				1349759	1349760	1349762	1349763	1349764	1349765
Order No.:	Client Sample Ref.:				ES	ES	ES	ES	ES	ES
	Client Sample ID.:				2	3	2	3	4	5
	Sample Location:				TP6	TP6	TP7	TP7	TP7	TP7
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				1.0	2.0	1.0	2.0	3.0	4.0
	Date Sampled:				10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022
	Asbestos Lab:						DURHAM		DURHAM	
Determinand	Accred.	SOP	Units	LOD						
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0			< 1.0			
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0			< 1.0			
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0			< 5.0			
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0			< 10			
Benzene	M	2760	mg/kg	0.0010			< 0.0010			
Toluene	M	2760	mg/kg	0.0010			< 0.0010			
Ethylbenzene	M	2760	mg/kg	0.0010			< 0.0010			
m & p-Xylene	M	2760	mg/kg	0.0010			< 0.0010			
o-Xylene	M	2760	mg/kg	0.0010			< 0.0010			
Naphthalene	M	2800	mg/kg	0.10		0.25	< 0.10		< 0.10	0.55
Acenaphthylene	N	2800	mg/kg	0.10		0.12	< 0.10		< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10		0.18	< 0.10		< 0.10	0.18
Fluorene	M	2800	mg/kg	0.10		0.22	< 0.10		< 0.10	0.15
Phenanthrene	M	2800	mg/kg	0.10		1.0	< 0.10		1.4	1.2
Anthracene	M	2800	mg/kg	0.10		0.39	< 0.10		0.27	0.25
Fluoranthene	M	2800	mg/kg	0.10		2.6	< 0.10		1.5	1.9
Pyrene	M	2800	mg/kg	0.10		2.5	< 0.10		1.2	2.3
Benzo[a]anthracene	M	2800	mg/kg	0.10		1.6	< 0.10		0.67	1.3
Chrysene	M	2800	mg/kg	0.10		1.7	< 0.10		0.77	1.6
Benzo[b]fluoranthene	M	2800	mg/kg	0.10		2.7	< 0.10		0.84	1.8
Benzo[k]fluoranthene	M	2800	mg/kg	0.10		1.0	< 0.10		0.32	0.57
Benzo[a]pyrene	M	2800	mg/kg	0.10		2.3	< 0.10		0.53	1.4
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10		1.9	< 0.10		0.34	0.78
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10		0.40	< 0.10		< 0.10	0.28
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10		1.7	< 0.10		0.33	0.78
Total Of 16 PAH's	N	2800	mg/kg	2.0		21	< 2.0		8.2	15
PCB 81	N	2815	mg/kg	0.0010			< 0.0010			
PCB 77	N	2815	mg/kg	0.0010			< 0.0010			
PCB 105	N	2815	mg/kg	0.0010			< 0.0010			
PCB 114	N	2815	mg/kg	0.0010			< 0.0010			
PCB 118	N	2815	mg/kg	0.0010			< 0.0010			

Results - Soil

Project: Q0652 GCRR - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:		22-00598	22-00598	22-00598	22-00598	22-00598	22-00598
Quotation No.: Q21-24761	Chemtest Sample ID.:		1349759	1349760	1349762	1349763	1349764	1349765
Order No.:	Client Sample Ref.:		ES	ES	ES	ES	ES	ES
	Client Sample ID.:		2	3	2	3	4	5
	Sample Location:		TP6	TP6	TP7	TP7	TP7	TP7
	Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):		1.0	2.0	1.0	2.0	3.0	4.0
	Date Sampled:		10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022	10-Jan-2022
	Asbestos Lab:				DURHAM		DURHAM	
Determinand	Accred.	SOP	Units	LOD				
PCB 123	N	2815	mg/kg	0.0010		< 0.0010		
PCB 126	N	2815	mg/kg	0.0010		< 0.0010		
PCB 156	N	2815	mg/kg	0.0010		< 0.0010		
PCB 157	N	2815	mg/kg	0.0010		< 0.0010		
PCB 167	N	2815	mg/kg	0.0010		< 0.0010		
PCB 169	N	2815	mg/kg	0.0010		< 0.0010		
PCB 189	N	2815	mg/kg	0.0010		< 0.0010		
Total PCBs (12 Congeners)	N	2815	mg/kg	0.0010		< 0.0010		
Total Phenols	M	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Single Stage WAC

Project: Q0652 GCRR - ONLLWYN

Chemtest Job No: 22-00598					Landfill Waste Acceptance Criteria		
Chemtest Sample ID: 1349758					Limits		
Sample Ref: ES					Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID: 1							
Sample Location: TP6							
Top Depth(m): 0.2							
Bottom Depth(m):							
Sampling Date: 10-Jan-2022							
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	M	%	23	3	5	6
Loss on Ignition					--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	M	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg	< 2.0	100	--	--
pH					--	>6	--
Acid Neutralisation Capacity					--	To evaluate	To evaluate
Eluate Analysis			10:1 Eluate mg/l	10:1 Eluate mg/kg	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg		
Arsenic	1455	U	< 0.0002	< 0.0002	0.5	2	25
Barium	1455	U	< 0.005	< 0.0005	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	< 0.0005	< 0.0005	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	< 0.0002	< 0.0002	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0005	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	< 0.0005	< 0.0005	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.003	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.078	< 1.0	10	150	500
Sulphate	1220	U	3.3	33	1000	20000	50000
Total Dissolved Solids	1020	N	13	130	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	< 2.5	< 50	500	800	1000

Solid Information

Dry mass of test portion/kg	0.090
Moisture (%)	14

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazine.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)

Test Methods

SOP	Title	Parameters included	Method summary
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com



Final Report

Report No.: 22-00969-1

Initial Date of Issue: 19-Jan-2022

Client Quantum Geotechnic Ltd

Client Address: Plas Newydd
Llanedi
Pontarddulais
Swansea
SA4 0FQ

Contact(s): Steffan Picton

Project Q0652 Global Centre of Rail Excellence

Quotation No.: Q21-24761 **Date Received:** 14-Jan-2022

Order No.: **Date Instructed:** 14-Jan-2022

No. of Samples: 4

Turnaround (Wkdays): 5 **Results Due:** 20-Jan-2022

Date Approved: 19-Jan-2022

Approved By:



Details: Stuart Henderson, Technical Manager

Results - Soil

Project: Q0652 Global Centre of Rail Excellence

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				22-00969	22-00969	22-00969	22-00969
Quotation No.: Q21-24761	Chemtest Sample ID.:				1351161	1351163	1351166	1351168
	Client Sample ID.:				1	3	2	4
	Sample Location:				TP08	TP08	TP09	TP09
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.2	2.0	1.0	3.0
	Asbestos Lab:				DURHAM	DURHAM	DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD				
ACM Type	U	2192		N/A	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	8.7	9.1	22	8.2
Soil Colour	N	2040		N/A			Black	
Other Material	N	2040		N/A			Stones	
Soil Texture	N	2040		N/A			Sand	
pH	M	2010		4.0	8.4	8.4	8.6	8.5
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40	< 0.40	< 0.40	< 0.40
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	M	2450	mg/kg	1.0	8.2	5.3	< 1.0	15
Cadmium	M	2450	mg/kg	0.10	0.18	0.13	< 0.10	0.23
Chromium	M	2450	mg/kg	1.0	7.3	6.5	2.9	5.6
Copper	M	2450	mg/kg	0.50	96	87	43	120
Mercury	M	2450	mg/kg	0.10	0.22	0.21	0.10	0.26
Nickel	M	2450	mg/kg	0.50	37	27	7.8	19
Lead	M	2450	mg/kg	0.50	57	48	28	60
Selenium	M	2450	mg/kg	0.20	2.0	1.9	1.6	2.7
Zinc	M	2450	mg/kg	0.50	96	73	15	96
Chromium (Hexavalent)	N	2490	mg/kg	0.50			< 0.50	
LOI	M	2610	%	0.10			31	
Total Organic Carbon	M	2625	%	0.20	16	13	61	41
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: Q0652 Global Centre of Rail Excellence

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				22-00969	22-00969	22-00969	22-00969
Quotation No.: Q21-24761	Chemtest Sample ID.:				1351161	1351163	1351166	1351168
	Client Sample ID.:				1	3	2	4
	Sample Location:				TP08	TP08	TP09	TP09
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.2	2.0	1.0	3.0
	Asbestos Lab:				DURHAM	DURHAM	DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD				
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10
Benzene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Toluene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Ethylbenzene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
m & p-Xylene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
o-Xylene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10	8.1	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	0.22	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	1.1	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10	1.7	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	< 0.10	< 0.10	6.9	0.91
Anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10	0.94	0.12
Fluoranthene	M	2800	mg/kg	0.10	< 0.10	0.13	3.9	0.59
Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10	2.9	0.55
Benzoanthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10	1.0	0.22
Chrysene	M	2800	mg/kg	0.10	< 0.10	< 0.10	2.2	0.37
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	1.9	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	0.31	< 0.10
Benzopyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10	0.45	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10	0.24	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	0.21	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10	< 0.10	0.46	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	33	2.8
Total Phenols	M	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1351161		1	TP08		A	Amber Glass 250ml
1351161		1	TP08		A	Amber Glass 60ml
1351161		1	TP08		A	Plastic Tub 500g
1351163		3	TP08		A	Amber Glass 250ml
1351163		3	TP08		A	Amber Glass 60ml
1351163		3	TP08		A	Plastic Tub 500g
1351166		2	TP09		A	Amber Glass 250ml
1351166		2	TP09		A	Amber Glass 60ml
1351166		2	TP09		A	Plastic Tub 500g
1351168		4	TP09		A	Amber Glass 250ml
1351168		4	TP09		A	Amber Glass 60ml
1351168		4	TP09		A	Plastic Tub 500g

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

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SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com



Final Report

Report No.: 22-00970-1

Initial Date of Issue: 21-Jan-2022

Client Quantum Geotechnic Ltd

Client Address: Plas Newydd
Llanedi
Pontarddulais
Swansea
SA4 0FQ

Contact(s): Steffan Picton

Project Q0652 Global centre of Rail Excellence

Quotation No.: Q21-24761 **Date Received:** 14-Jan-2022

Order No.: **Date Instructed:** 14-Jan-2022

No. of Samples: 1

Turnaround (Wkdays): 7 **Results Due:** 24-Jan-2022

Date Approved: 21-Jan-2022

Approved By:


Details: Stuart Henderson, Technical Manager

Results - 2 Stage WAC

Project: Q0652 Global centre of Rail Excellence

Chemtest Job No: 22-00970							Landfill Waste Acceptance Criteria			
Chemtest Sample ID: 1351170							Limits			
Sample Ref:							Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill	
Sample ID:										
Sample Location: TP09										
Top Depth(m): 1.0										
Bottom Depth(m): 2.0										
Sampling Date:										
Determinand	SOP	Accred.	Units							
Total Organic Carbon	2625	M	%				[A] 58	3	5	6
Loss On Ignition	2610	M	%				25	--	--	10
Total BTEX	2760	M	mg/kg				[A] < 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg				< 0.10	1	--	--
TPH Total WAC	2670	M	mg/kg				[A] 120	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg				6.5	100	--	--
pH	2010	M					8.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg				0.026	--	To evaluate	To evaluate
Eluate Analysis			2:1 mg/l	8:1 mg/l	2:1 mg/kg	Cumulative mg/kg 10:1	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg			
Arsenic	1455	U	0.0008	0.0006	0.0016	0.0059	0.5	2	25	
Barium	1455	U	0.094	0.034	0.19	0.43	20	100	300	
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5	
Chromium	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	70	
Copper	1455	U	0.0014	0.0013	0.0028	0.0021	2	50	100	
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2	
Molybdenum	1455	U	0.0062	0.0026	0.012	0.031	0.5	10	30	
Nickel	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.4	10	40	
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50	
Antimony	1455	U	0.0029	0.0014	0.0058	0.016	0.06	0.7	5	
Selenium	1455	U	0.0031	0.0024	0.0061	0.025	0.1	0.5	7	
Zinc	1455	U	0.003	< 0.003	0.006	0.005	4	50	200	
Chloride	1220	U	< 1.0	< 1.0	< 10	< 10	800	15000	25000	
Fluoride	1220	U	0.19	0.096	< 1.0	1.1	10	150	500	
Sulphate	1220	U	14	2.3	28	41	1000	20000	50000	
Total Dissolved Solids	1020	N	200	52	390	740	4000	60000	100000	
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-	
Dissolved Organic Carbon	1610	U	3.9	3.3	< 50	< 50	500	800	1000	

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	15

Leachate Test Information	
Leachant volume 1st extract/l	0.320
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.264

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1351170			TP09		A	Amber Glass 250ml
1351170			TP09		A	Amber Glass 60ml
1351170			TP09		A	Plastic Tub 500g

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge
650	Characterisation of Waste (Leaching WAC)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

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LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

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Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com



Final Report

Report No.: 22-03571-1

Initial Date of Issue: 04-Feb-2022

Client Quantum Geotechnic Ltd

Client Address: Plas Newydd
Llanedi
Pontarddulais
Swansea
SA4 0FQ

Contact(s): Steffan Picton

Project Q0652 Global Centre of Rail Excellence

Quotation No.: Q21-24761 **Date Received:** 01-Feb-2022

Order No.: **Date Instructed:** 01-Feb-2022

No. of Samples: 9

Turnaround (Wkdays): 5 **Results Due:** 07-Feb-2022

Date Approved: 04-Feb-2022

Approved By:


Details: Stuart Henderson, Technical Manager

Results - Water

Project: Q0652 Global Centre of Rail Excellence

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				22-03571	22-03571	22-03571	22-03571	22-03571	22-03571	22-03571	22-03571	22-03571
Quotation No.: Q21-24761	Chemtest Sample ID.:				1363311	1363312	1363313	1363314	1363315	1363316	1363317	1363318	1363319
	Sample Location:				BH15	BH16	BH25	BH29	BH30	BH31	BH32	BH33	BH34
	Sample Type:				WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
	Top Depth (m):				0.40	4.52	5.00	0.83	3.20	4.50	4.76	0.41	5.09
Determinand	Accred.	SOP	Units	LOD									
pH	U	1010		N/A	8.4	8.3	7.4	8	8.2	7.9	8.2	8.3	8.4
Alkalinity (Bicarbonate)	U	1220	mg CaCO ₃ /l	10	180	110	540	310	300	370	340	440	320
Chloride	U	1220	mg/l	1.0	10	10	22	16	170	49	51	17	28
Fluoride	U	1220	mg/l	0.050	0.14	0.11	0.17	0.29	0.14	0.12	0.18	0.15	0.15
Ammonia (Free)	N	1220	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.081	0.073	< 0.050	0.14	0.5
Nitrate	U	1220	mg/l	0.50	< 0.50	1.1	0.88	1.7	< 0.50	1.4	0.88	< 0.50	< 0.50
Sulphate	U	1220	mg/l	1.0	34	18	86	6.3	32	310	67	60	49
Cyanide (Total)	U	1300	mg/l	0.050	0.05	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Calcium	U	1455	mg/l	2.00	44	18	41	40	68	120	43	47	11
Potassium	U	1455	mg/l	0.50	0.71	5.8	31	11	29	11	17	40	8.3
Magnesium	U	1455	mg/l	0.20	16	14	28	11	16	38	13	18	28
Sodium	U	1455	mg/l	1.50	9.2	7.9	140	46	93	75	100	97	71
Total Hardness as CaCO ₃	U	1270	mg/l	15	170	100	220	140	240	450	160	190	140
Arsenic (Dissolved)	U	1455	µg/l	0.20	0.29	< 0.20	0.44	2.2	0.56	0.39	1.4	0.83	< 0.20
Cadmium (Dissolved)	U	1455	µg/l	0.11	< 0.11	< 0.11	< 0.11	< 0.11	< 0.11	< 0.11	< 0.11	< 0.11	< 0.11
Chromium (Dissolved)	U	1455	µg/l	0.50	14	9	9.6	< 0.50	8.9	< 0.50	8.8	0.66	< 0.50
Copper (Dissolved)	U	1455	µg/l	0.50	1.6	0.86	2.1	0.98	2.2	2.4	3.3	1.2	0.58
Mercury (Dissolved)	U	1455	µg/l	0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
Nickel (Dissolved)	U	1455	µg/l	0.50	17	1.7	23	1.2	2.4	4.4	2.8	2	3.3
Lead (Dissolved)	U	1455	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Selenium (Dissolved)	U	1455	µg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	1.4	< 0.50	< 0.50
Zinc (Dissolved)	U	1455	µg/l	2.5	48	9.6	54	16	17	11	33	21	12
Dissolved Organic Carbon	U	1610	mg/l	2.0	100	26	120	65	62	82	73	100	67
Aliphatic TPH >C5-C6	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C6-C8	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Aliphatic Hydrocarbons	N	1675	µg/l	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C7-C8	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Water

Project: Q0652 Global Centre of Rail Excellence

Client: Quantum Geotechnic Ltd	Chemtest Job No.:					22-03571	22-03571	22-03571	22-03571	22-03571	22-03571	22-03571	22-03571
Quotation No.: Q21-24761	Chemtest Sample ID.:					1363311	1363312	1363313	1363314	1363315	1363316	1363317	1363318
	Sample Location:					BH15	BH16	BH25	BH29	BH30	BH31	BH32	BH33
	Sample Type:					WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
	Top Depth (m):					0.40	4.52	5.00	0.83	3.20	4.50	4.76	0.41
Determinand	Accred.	SOP	Units	LOD									
Total Aromatic Hydrocarbons	N	1675	µg/l	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	1675	µg/l	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Benzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	1760	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Acenaphthylene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Acenaphthene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Fluorene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Phenanthrene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Anthracene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Fluoranthene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Pyrene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzoanthracene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Chrysene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo[b]fluoranthene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo[k]fluoranthene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzopyrene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Indeno(1,2,3-c,d)Pyrene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Dibenz(a,h)Anthracene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Benzo[g,h,i]perylene	N	1800	µg/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total Of 16 PAH's	N	1800	µg/l	0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
PCB 28	N	1815	µg/l	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB 52	N	1815	µg/l	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB 90+101	N	1815	µg/l	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB 118	N	1815	µg/l	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB 153	N	1815	µg/l	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB 138	N	1815	µg/l	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
PCB 180	N	1815	µg/l	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total PCBs (7 congeners)	N	1815	µg/l	0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010	< 0.0010
Total Phenols	U	1920	mg/l	0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030	< 0.030

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1363311			BH15		A	Coloured Winchester 1000ml
1363311			BH15		A	EPA Vial 40ml
1363311			BH15		A	Plastic Bottle 1000ml
1363312			BH16		A	Coloured Winchester 1000ml
1363312			BH16		A	EPA Vial 40ml
1363312			BH16		A	Plastic Bottle 1000ml
1363313			BH25		A	Coloured Winchester 1000ml
1363313			BH25		A	EPA Vial 40ml
1363313			BH25		A	Plastic Bottle 1000ml
1363314			BH29		A	Coloured Winchester 1000ml
1363314			BH29		A	EPA Vial 40ml
1363314			BH29		A	Plastic Bottle 1000ml
1363315			BH30		A	Coloured Winchester 1000ml
1363315			BH30		A	EPA Vial 40ml
1363315			BH30		A	Plastic Bottle 1000ml
1363316			BH31		A	Coloured Winchester 1000ml
1363316			BH31		A	EPA Vial 40ml
1363316			BH31		A	Plastic Bottle 1000ml
1363317			BH32		A	Coloured Winchester 1000ml
1363317			BH32		A	EPA Vial 40ml

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1363317			BH32		A	Plastic Bottle 1000ml
1363318			BH33		A	Coloured Winchester 1000ml
1363318			BH33		A	EPA Vial 40ml
1363318			BH33		A	Plastic Bottle 1000ml
1363319			BH34		A	Coloured Winchester 1000ml
1363319			BH34		A	EPA Vial 40ml
1363319			BH34		A	Plastic Bottle 1000ml

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1270	Total Hardness of Waters	Total hardness	Calculation applied to calcium and magnesium results, expressed as mg l-1 CaCO ₃ equivalent.
1300	Cyanides & Thiocyanate in Waters	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Continuous Flow Analysis.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1675	TPH Aliphatic/Aromatic split in Waters by GC-FID(cf. Texas Method 1006 / TPH CWG)	Aliphatics: >C5–C6, >C6–C8, >C8– C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44 Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Pentane extraction / GCxGC FID detection
1760	Volatile Organic Compounds (VOCs) in Waters by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics. (cf. USEPA Method 8260)	Automated headspace gas chromatographic (GC) analysis of water samples with mass spectrometric (MS) detection of volatile organic compounds.
1800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters by GC-MS	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Pentane extraction / GCMS detection
1815	Polychlorinated Biphenyls (PCB) ICES7 Congeners in Waters by GC-MS	ICES7 PCB congeners	Solvent extraction / GCMS detection
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com



Final Report

Report No.:	21-41633-1		
Initial Date of Issue:	06-Dec-2021		
Client	Quantum Geotechnic Ltd		
Client Address:	Plas Newydd Llanedi Pontarddulais Swansea SA4 0FQ		
Contact(s):	Steffan Picton		
Project	Q0652 Global Centre off Rail Excellence		
Quotation No.:	Q21-24761	Date Received:	26-Nov-2021
Order No.:		Date Instructed:	30-Nov-2021
No. of Samples:	2		
Turnaround (Wkdays):	5	Results Due:	06-Dec-2021
Date Approved:	06-Dec-2021		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Soil

Project: Q0652 Global Centre off Rail Excellence

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				21-41633	21-41633
Quotation No.: Q21-24761	Chemtest Sample ID.:				1328375	1328377
Order No.:	Client Sample Ref.:				ES3	ES9
	Sample Location:				BH34	BH34
	Sample Type:				SOIL	SOIL
	Top Depth (m):				1.0	3.0
	Date Sampled:				24-Nov-2021	24-Nov-2021
	Asbestos Lab:				DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD		
ACM Type	U	2192		N/A	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	12	8.8
Soil Colour	N	2040		N/A	Brown	
Other Material	N	2040		N/A	Stones and Roots	
Soil Texture	N	2040		N/A	Sand	
pH	M	2010		4.0	8.1	8.4
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40	< 0.40
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50	1.1
Arsenic	M	2450	mg/kg	1.0	11	17
Cadmium	M	2450	mg/kg	0.10	0.14	0.15
Chromium	M	2450	mg/kg	1.0	11	2.8
Copper	M	2450	mg/kg	0.50	47	63
Mercury	M	2450	mg/kg	0.10	0.14	0.39
Nickel	M	2450	mg/kg	0.50	44	25
Lead	M	2450	mg/kg	0.50	30	46
Selenium	M	2450	mg/kg	0.20	0.84	2.9
Zinc	M	2450	mg/kg	0.50	270	59
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	
LOI	M	2610	%	0.10	7.0	
Total Organic Carbon	M	2625	%	0.20	7.2	27
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	170	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	510	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	550	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	6.6	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	1200	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	11	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	120	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	170	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0

Results - Soil

Project: Q0652 Global Centre off Rail Excellence

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				21-41633	21-41633
Quotation No.: Q21-24761	Chemtest Sample ID.:				1328375	1328377
Order No.:	Client Sample Ref.:				ES3	ES9
	Sample Location:				BH34	BH34
	Sample Type:				SOIL	SOIL
	Top Depth (m):				1.0	3.0
	Date Sampled:				24-Nov-2021	24-Nov-2021
	Asbestos Lab:				DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD		
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	300	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	1500	< 10
Benzene	M	2760	mg/kg	0.0010	< 0.0010	0.0021
Toluene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010
Ethylbenzene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010
m & p-Xylene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010
o-Xylene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010
Naphthalene	M	2800	mg/kg	0.10	0.61	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	0.36	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	1.5	< 0.10
Fluorene	M	2800	mg/kg	0.10	1.9	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	8.9	< 0.10
Anthracene	M	2800	mg/kg	0.10	4.4	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	31	0.21
Pyrene	M	2800	mg/kg	0.10	23	0.20
Benzo[a]anthracene	M	2800	mg/kg	0.10	25	0.14
Chrysene	M	2800	mg/kg	0.10	26	0.21
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	34	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	12	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	21	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	17	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	4.8	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	13	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	220	< 2.0
PCB 81	N	2815	mg/kg	0.0010	< 0.0010	
PCB 77	N	2815	mg/kg	0.0010	< 0.0010	
PCB 105	N	2815	mg/kg	0.0010	< 0.0010	
PCB 114	N	2815	mg/kg	0.0010	< 0.0010	
PCB 118	N	2815	mg/kg	0.0010	< 0.0010	
PCB 123	N	2815	mg/kg	0.0010	< 0.0010	
PCB 126	N	2815	mg/kg	0.0010	< 0.0010	
PCB 156	N	2815	mg/kg	0.0010	< 0.0010	
PCB 157	N	2815	mg/kg	0.0010	< 0.0010	
PCB 167	N	2815	mg/kg	0.0010	< 0.0010	
PCB 169	N	2815	mg/kg	0.0010	< 0.0010	
PCB 189	N	2815	mg/kg	0.0010	< 0.0010	

Results - Soil

Project: Q0652 Global Centre off Rail Excellence

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				21-41633	21-41633
Quotation No.: Q21-24761	Chemtest Sample ID.:				1328375	1328377
Order No.:	Client Sample Ref.:				ES3	ES9
	Sample Location:				BH34	BH34
	Sample Type:				SOIL	SOIL
	Top Depth (m):				1.0	3.0
	Date Sampled:				24-Nov-2021	24-Nov-2021
	Asbestos Lab:				DURHAM	DURHAM
Determinand	Accred.	SOP	Units	LOD		
Total PCBs (12 Congeners)	N	2815	mg/kg	0.0010	< 0.0010	
Total Phenols	M	2920	mg/kg	0.10	< 0.10	< 0.10

Results - Single Stage WAC

Project: Q0652 Global Centre off Rail Excellence

Chemtest Job No: 21-41633					Landfill Waste Acceptance Criteria		
Chemtest Sample ID: 1328375					Limits		
Sample Ref: ES3					Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID:							
Sample Location: BH34							
Top Depth(m): 1.0							
Bottom Depth(m):							
Sampling Date: 24-Nov-2021							
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	M	%	7.2	3	5	6
Loss on Ignition					--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	M	mg/kg	1500	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg	220	100	--	--
pH					--	>6	--
Acid Neutralisation Capacity					--	To evaluate	To evaluate
Eluate Analysis			10:1 Eluate mg/l	10:1 Eluate mg/kg	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg		
Arsenic	1455	U	0.0007	0.0069	0.5	2	25
Barium	1455	U	0.035	0.35	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	0.0013	0.013	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0027	0.027	0.5	10	30
Nickel	1455	U	0.0007	0.0072	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0025	0.025	0.06	0.7	5
Selenium	1455	U	0.0008	0.0081	0.1	0.5	7
Zinc	1455	U	0.004	0.036	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.080	< 1.0	10	150	500
Sulphate	1220	U	9.5	95	1000	20000	50000
Total Dissolved Solids	1020	N	37	370	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	2.6	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	12

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazine.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)

Test Methods

SOP	Title	Parameters included	Method summary
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com



Final Report

Report No.:	21-41964-1		
Initial Date of Issue:	14-Dec-2021		
Client	Quantum Geotechnic Ltd		
Client Address:	Plas Newydd Llanedi Pontarddulais Swansea SA4 0FQ		
Contact(s):	Steffan Picton		
Project	Q0652 G.C.R.E - ONLLWYN		
Quotation No.:	Q21-24761	Date Received:	29-Nov-2021
Order No.:		Date Instructed:	07-Dec-2021
No. of Samples:	1		
Turnaround (Wkdays):	5	Results Due:	13-Dec-2021
Date Approved:	14-Dec-2021		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Leachate

Project: Q0652 G.C.R.E - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:					21-41964
Quotation No.: Q21-24761	Chemtest Sample ID.:					1329698
Order No.:	Client Sample Ref.:					ES1
	Sample Location:					BH33
	Sample Type:					SOIL
	Top Depth (m):					0.2
	Date Sampled:					25-Nov-2021
Determinand	Accred.	SOP	Type	Units	LOD	
Cyanide (Total)	U	1300	10:1	mg/l	0.050	0.14
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	< 0.20
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	3.0
Mercury (Dissolved)	U	1455	10:1	µg/l	0.05	< 0.05
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	2.2
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	< 2.5
Chromium (Total)	N	1455	10:1	µg/l	0.50	4.0
Naphthalene	N	1800	10:1	µg/l	0.010	0.67
Acenaphthylene	N	1800	10:1	µg/l	0.010	< 0.010
Acenaphthene	N	1800	10:1	µg/l	0.010	1.3
Fluorene	N	1800	10:1	µg/l	0.010	0.93
Phenanthrene	N	1800	10:1	µg/l	0.010	5.1
Anthracene	N	1800	10:1	µg/l	0.010	1.4
Fluoranthene	N	1800	10:1	µg/l	0.010	5.4
Pyrene	N	1800	10:1	µg/l	0.010	4.6
Benzo[a]anthracene	N	1800	10:1	µg/l	0.010	2.4
Chrysene	N	1800	10:1	µg/l	0.010	1.4
Benzo[b]fluoranthene	N	1800	10:1	µg/l	0.010	2.2
Benzo[k]fluoranthene	N	1800	10:1	µg/l	0.010	1.1
Benzo[a]pyrene	N	1800	10:1	µg/l	0.010	1.8
Indeno(1,2,3-c,d)Pyrene	N	1800	10:1	µg/l	0.010	< 0.010
Dibenz(a,h)Anthracene	N	1800	10:1	µg/l	0.010	< 0.010
Benzo[g,h,i]perylene	N	1800	10:1	µg/l	0.010	< 0.010
Total Of 16 PAH's	N	1800	10:1	µg/l	0.20	28
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030

Results - Soil

Project: Q0652 G.C.R.E - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				21-41964
Quotation No.: Q21-24761	Chemtest Sample ID.:				1329698
Order No.:	Client Sample Ref.:				ES1
	Sample Location:				BH33
	Sample Type:				SOIL
	Top Depth (m):				0.2
	Date Sampled:				25-Nov-2021
	Asbestos Lab:				DURHAM
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
Moisture	N	2030	%	0.020	11
Soil Colour	N	2040		N/A	Black
Other Material	N	2040		N/A	Stones
Soil Texture	N	2040		N/A	Clay
pH	M	2010		4.0	7.9
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40
Cyanide (Total)	M	2300	mg/kg	0.50	2.9
Arsenic	M	2450	mg/kg	1.0	7.8
Cadmium	M	2450	mg/kg	0.10	0.16
Chromium	M	2450	mg/kg	1.0	16
Copper	M	2450	mg/kg	0.50	39
Mercury	M	2450	mg/kg	0.10	0.15
Nickel	M	2450	mg/kg	0.50	42
Lead	M	2450	mg/kg	0.50	23
Selenium	M	2450	mg/kg	0.20	0.86
Zinc	M	2450	mg/kg	0.50	250
Total Organic Carbon	M	2625	%	0.20	5.7
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0

Results - Soil

Project: Q0652 G.C.R.E - ONLLWYN

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				21-41964
Quotation No.: Q21-24761	Chemtest Sample ID.:				1329698
Order No.:	Client Sample Ref.:				ES1
	Sample Location:				BH33
	Sample Type:				SOIL
	Top Depth (m):				0.2
	Date Sampled:				25-Nov-2021
	Asbestos Lab:				DURHAM
Determinand	Accred.	SOP	Units	LOD	
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10
Benzene	M	2760	mg/kg	0.0010	< 0.0010
Toluene	M	2760	mg/kg	0.0010	< 0.0010
Ethylbenzene	M	2760	mg/kg	0.0010	< 0.0010
m & p-Xylene	M	2760	mg/kg	0.0010	< 0.0010
o-Xylene	M	2760	mg/kg	0.0010	< 0.0010
Naphthalene	M	2800	mg/kg	0.10	2.0
Acenaphthylene	N	2800	mg/kg	0.10	0.28
Acenaphthene	M	2800	mg/kg	0.10	0.74
Fluorene	M	2800	mg/kg	0.10	0.95
Phenanthrene	M	2800	mg/kg	0.10	4.3
Anthracene	M	2800	mg/kg	0.10	1.8
Fluoranthene	M	2800	mg/kg	0.10	12
Pyrene	M	2800	mg/kg	0.10	9.4
Benzo[a]anthracene	M	2800	mg/kg	0.10	9.2
Chrysene	M	2800	mg/kg	0.10	11
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	13
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	4.3
Benzo[a]pyrene	M	2800	mg/kg	0.10	7.4
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	4.9
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	2.1
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	4.7
Total Of 16 PAH's	N	2800	mg/kg	2.0	88
PCB 81	N	2815	mg/kg	0.0010	< 0.0010
PCB 77	N	2815	mg/kg	0.0010	< 0.0010
PCB 105	N	2815	mg/kg	0.0010	< 0.0010
PCB 114	N	2815	mg/kg	0.0010	< 0.0010
PCB 118	N	2815	mg/kg	0.0010	< 0.0010
PCB 123	N	2815	mg/kg	0.0010	< 0.0010
PCB 126	N	2815	mg/kg	0.0010	< 0.0010
PCB 156	N	2815	mg/kg	0.0010	< 0.0010
PCB 157	N	2815	mg/kg	0.0010	< 0.0010
PCB 167	N	2815	mg/kg	0.0010	< 0.0010
PCB 169	N	2815	mg/kg	0.0010	< 0.0010
PCB 189	N	2815	mg/kg	0.0010	< 0.0010
Total PCBs (12 Congeners)	N	2815	mg/kg	0.0010	< 0.0010
Total Phenols	M	2920	mg/kg	0.10	< 0.10

Test Methods

SOP	Title	Parameters included	Method summary
1300	Cyanides & Thiocyanate in Waters	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Continuous Flow Analysis.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters by GC-MS	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Pentane extraction / GCMS detection
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
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T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

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All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com



Final Report

Report No.:	21-42327-1		
Initial Date of Issue:	08-Dec-2021		
Client	Quantum Geotechnic Ltd		
Client Address:	Plas Newydd Llanedi Pontarddulais Swansea SA4 0FQ		
Contact(s):	Steffan Picton		
Project	Q0652 GCRE (Onllwyn)		
Quotation No.:	Q21-24761	Date Received:	01-Dec-2021
Order No.:		Date Instructed:	02-Dec-2021
No. of Samples:	2		
Turnaround (Wkdays):	5	Results Due:	08-Dec-2021
Date Approved:	08-Dec-2021		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Soil

Project: Q0652 GCRE (Onllwyn)

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				21-42327	21-42327
Quotation No.: Q21-24761	Chemtest Sample ID.:				1331184	1331186
Order No.:	Client Sample Ref.:				ES1	ES6
	Sample Location:				BH29	BH29
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.2	2.0
	Date Sampled:				26-Nov-2021	26-Nov-2021
	Asbestos Lab:				COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD		
ACM Type	U	2192		N/A	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	5.1	1.7
Soil Colour	N	2040		N/A	Black	
Other Material	N	2040		N/A	Stones	
Soil Texture	N	2040		N/A	Sand	
pH	M	2010		4.0	8.9	7.3
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40	< 0.40
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50	< 0.50
Arsenic	M	2450	mg/kg	1.0	6.4	1.5
Cadmium	M	2450	mg/kg	0.10	0.16	< 0.10
Chromium	M	2450	mg/kg	1.0	9.6	3.7
Copper	M	2450	mg/kg	0.50	35	27
Mercury	M	2450	mg/kg	0.10	< 0.10	0.14
Nickel	M	2450	mg/kg	0.50	24	5.8
Lead	M	2450	mg/kg	0.50	19	10
Selenium	M	2450	mg/kg	0.20	0.49	0.44
Zinc	M	2450	mg/kg	0.50	63	19
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	
LOI	M	2610	%	0.10	3.5	
Total Organic Carbon	M	2625	%	0.20	16	46
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0

Results - Soil

Project: Q0652 GCRE (Onllwyn)

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				21-42327	21-42327
Quotation No.: Q21-24761	Chemtest Sample ID.:				1331184	1331186
Order No.:	Client Sample Ref.:				ES1	ES6
	Sample Location:				BH29	BH29
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.2	2.0
	Date Sampled:				26-Nov-2021	26-Nov-2021
	Asbestos Lab:				COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD		
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10
Benzene	M	2760	mg/kg	0.0010	< 0.0010	0.0013
Toluene	M	2760	mg/kg	0.0010	< 0.0010	0.0010
Ethylbenzene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010
m & p-Xylene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010
o-Xylene	M	2760	mg/kg	0.0010	< 0.0010	< 0.0010
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	0.97	< 0.10
Anthracene	M	2800	mg/kg	0.10	0.21	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	1.0	0.21
Pyrene	M	2800	mg/kg	0.10	0.83	0.22
Benzo[a]anthracene	M	2800	mg/kg	0.10	0.37	< 0.10
Chrysene	M	2800	mg/kg	0.10	0.56	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	0.61	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	0.18	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	0.30	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	5.0	< 2.0
PCB 81	N	2815	mg/kg	0.0010	< 0.0010	
PCB 77	N	2815	mg/kg	0.0010	< 0.0010	
PCB 105	N	2815	mg/kg	0.0010	< 0.0010	
PCB 114	N	2815	mg/kg	0.0010	< 0.0010	
PCB 118	N	2815	mg/kg	0.0010	< 0.0010	
PCB 123	N	2815	mg/kg	0.0010	< 0.0010	
PCB 126	N	2815	mg/kg	0.0010	< 0.0010	
PCB 156	N	2815	mg/kg	0.0010	< 0.0010	
PCB 157	N	2815	mg/kg	0.0010	< 0.0010	
PCB 167	N	2815	mg/kg	0.0010	< 0.0010	
PCB 169	N	2815	mg/kg	0.0010	< 0.0010	
PCB 189	N	2815	mg/kg	0.0010	< 0.0010	
Total PCBs (12 Congeners)	N	2815	mg/kg	0.0010	< 0.0010	

Results - Soil

Project: Q0652 GCRE (Onllwyn)

Client: Quantum Geotechnic Ltd	Chemtest Job No.:				21-42327	21-42327
Quotation No.: Q21-24761	Chemtest Sample ID.:				1331184	1331186
Order No.:	Client Sample Ref.:				ES1	ES6
	Sample Location:				BH29	BH29
	Sample Type:				SOIL	SOIL
	Top Depth (m):				0.2	2.0
	Date Sampled:				26-Nov-2021	26-Nov-2021
	Asbestos Lab:				COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD		
Total Phenols	M	2920	mg/kg	0.10	< 0.10	< 0.10

Results - Single Stage WAC

Project: Q0652 GCRE (Onllwyn)

Chemtest Job No: 21-42327					Landfill Waste Acceptance Criteria		
Chemtest Sample ID: 1331184					Limits		
Sample Ref: ES1					Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID:							
Sample Location: BH29							
Top Depth(m): 0.2							
Bottom Depth(m):							
Sampling Date: 26-Nov-2021							
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	M	%	16	3	5	6
Loss on Ignition					--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1	--	--
TPH Total WAC	2670	M	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg	2.1	100	--	--
pH					--	>6	--
Acid Neutralisation Capacity					--	To evaluate	To evaluate
Eluate Analysis			10:1 Eluate mg/l	10:1 Eluate mg/kg	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg		
Arsenic	1455	U	0.0021	0.021	0.5	2	25
Barium	1455	U	0.006	0.060	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0025	0.026	0.5	10	70
Copper	1455	U	0.0087	0.087	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0013	0.013	0.5	10	30
Nickel	1455	U	0.0008	0.0083	0.4	10	40
Lead	1455	U	0.0010	0.010	0.5	10	50
Antimony	1455	U	0.0025	0.025	0.06	0.7	5
Selenium	1455	U	0.0005	0.0055	0.1	0.5	7
Zinc	1455	U	0.004	0.044	4	50	200
Chloride	1220	U	2.1	21	800	15000	25000
Fluoride	1220	U	0.18	1.8	10	150	500
Sulphate	1220	U	17	170	1000	20000	50000
Total Dissolved Solids	1020	N	98	980	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	4.2	< 50	500	800	1000

Solid Information

Dry mass of test portion/kg	0.090
Moisture (%)	5.1

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Alkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2450	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazine.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenzo[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)

Test Methods

SOP	Title	Parameters included	Method summary
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenzo[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

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Final Report

Report No.:	21-42332-1		
Initial Date of Issue:	13-Dec-2021		
Client	Quantum Geotechnic Ltd		
Client Address:	Plas Newydd Llanedi Pontarddulais Swansea SA4 0FQ		
Contact(s):	Steffan Picton		
Project	Q0652 GCRE (Onllwyn)		
Quotation No.:	Q21-24761	Date Received:	01-Dec-2021
Order No.:		Date Instructed:	07-Dec-2021
No. of Samples:	1		
Turnaround (Wkdays):	5	Results Due:	13-Dec-2021
Date Approved:	13-Dec-2021		
Approved By:			
Details:	Glynn Harvey, Technical Manager		

Results - Soil

Project: Q0652 GCRE (Onllwyn)

Client: Quantum Geotechnic Ltd	Chemtest Job No.:		21-42332	
Quotation No.: Q21-24761	Chemtest Sample ID.:		1331207	
Order No.:	Client Sample Ref.:		ES12	
	Sample Location:		BH31	
	Sample Type:		SOIL	
	Top Depth (m):		4.0	
	Date Sampled:		30-Nov-2021	
	Asbestos Lab:		NEW-ASB	
Determinand	Accred.	SOP	Units	LOD
ACM Type	U	2192		N/A
Asbestos Identification	U	2192		N/A
				No Asbestos Detected

Test Methods

SOP	Title	Parameters included	Method summary
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry

Report Information

Key

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APPENDIX IX – GEOPHYSICAL SURVEY REPORT

GEOPHYSICAL SURVEY REPORT

Project

Geophysical survey to detect historical mine workings

Location

Onllwyn Coal Washery, Neath - Port Talbot

Client

Quantum

Unit 1
Link Trade Park
Penarth Road
Cardiff
CF11 8TQ
United Kingdom

Tel: +44 (0) 2920 700127
Web: www.terradata.co.uk



Job reference: 7591
Date: January 2022
Version: 1

GEOPHYSICAL SURVEY REPORT

Project

Geophysical survey to detect historical mine workings

Location

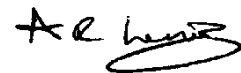
Onllwyn Coal Washery, Neath - Port Talbot

Client

Quantum

Project Geophysicists:

Alexander Lewis BSC (Hons)



Mag. Kathrin Zorn MSc FGS



Reviewer:

Dr S Hughes BSc FGS



Job Reference:

7591

Date:

January 2022

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- Magnetic survey
- Electromagnetic survey
- Microgravity survey

1 EXECUTIVE SUMMARY

TerraDat were commissioned to conduct a geophysical survey to locate a number of historical mine workings by Quantum (the Client) at the Onllwyn Coal Washery, Neath Port Talbot.

The survey areas were split into four zones which covered entry sites of historical mineshafts and adits. A magnetic and electromagnetic survey was conducted over all accessible areas within the zones to identify localised anomalies and general ground characteristics. Targeted microgravity surveys were undertaken on approximate 50m x 50m grids centred on the proposed adit and mineshaft locations given by the Coal Authority to identify shallow anomalous features which may relate to the presence of mine workings.

The magnetic and electromagnetic survey results correlate well and highlight different ground characteristics and potential structures or features buried in the subsurface. The microgravity surveys mapped ground density variations across the survey areas and highlighted a number of features that are recommended for intrusive investigation.

Surveys completed in Zone 1 characterised the ground and highlighted some anomalous instrument responses on the track, but no significant responses were mapped in close proximity to the mineshaft 284210-029. Some anomalous instrument responses were recorded at the location of 284210-035, which may warrant further investigation.

Surveys completed in Zone 2 were partially limited due to overgrown zones, metal structures and a building. The surveys indicate a number of features in close proximity to the four targeted mine workings, which are recommended for intrusive investigation.

Surveys completed in Zone 3 show the heterogeneity of the fill material and made ground, with some isolated features which may be targeted in further investigations.

Surveys in Zone 4 mapped a cluster of anomalous responses close to adit 285210-025, which may relate to mine workings and warrant further investigation.

It is recommended that the features identified by the geophysical surveys are ground-truthed to prove their origin.

2 INTRODUCTION

This report describes a geophysical survey that was conducted on the site of the Onllwyn Coal Washery plant, Neath-Port Talbot. The survey work was commissioned by Quantum (the Client) for Arup and took place between the 15th November and the 10th December 2021. The site is proposed for redevelopment, and the geophysical investigation forms part of a remediation package associated with numerous historical mine workings recorded at the site. The Coal Authority records identify numerous adits and mineshafts at the site, some of which are in key redevelopment zones and have been designated by the Client as areas requiring geophysical investigation.

2.1 Site description

The survey sites are situated within the boundary of The Onllwyn Coal Washery plant, east of Abercraf, Neath-Port Talbot. According to the location of historical mine workings, the survey areas were divided into four zones (Plate 1, Figure 1).



Plate 1: Overview of the survey Zones 1-4 indicating the proposed mineshaft and adit locations according to the Coal Authority (Google Imagery, 2021).

Zone 1 is in the northern part of the Coal Washery and targeted adits 284210-023 and 284210-035, and mineshaft 284210-029. Adit 284210-023 was located within an overgrown wooded zone that was not accessible at the time of the survey.

The main survey area comprised open land and a scrub-covered mound of spoil, and a flat area used for coal stockpiles in the south. The northern part of the survey area, including the spoil mound, was separated from the Coal Washery land by a fence and is believed to be underlain by several meters of colliery spoil. The southern part of Zone 1 is currently used as a coal storage area, and large piles of coal had to be moved during the surveys to make the area accessible. The western part of Zone 1 comprised small strips of land between buildings with considerable metallic surface debris, which caused instrument interference.

Zone 2 targeted adits 285210-001, 285210-026, 285210-028 and mineshaft 285210-27 and is in the northeastern area of the Coal Washery. It borders the main access road and comprises open land, a small wooded area north of the wheel-wash, a small zone within the Onllwyn Distribution centre (Coal Dealer) and the land south of the ponds in the east. The area close to the road was littered with metal debris, street furniture and fences, therefore making this area unsuitable for magnetic and ground conductivity surveying; a number of fences intersected this survey zone. The immediate location of mineshaft 285210-27 was accessible for the microgravity survey only (located in a wooded area). Adit 285210-026 is located adjacent to the boundary of an onsite coal dealer and is obstructed by a large metal fence and buildings. The microgravity survey was completed in this area where accessible, but the EM and magnetic survey could not be conducted in this area due to extreme interference that would overload the instruments.

Zone 3 targeted adits 284210-019 and 284210-019 and was in the southwestern area of the Coal Washery. It is comprised of a flat tarmacked area in the north, and an approximately 8m high spoil slope in the middle of the survey zone leading to an upper flat area used for coal storage and an access road.

The 50m zone around the adits was surveyed using the microgravity technique where accessible; however, the Electromagnetic conductivity (EM) and magnetic survey was limited due to the steep slope and uneven and overgrown ground; the flat area at the base of the slope in the north of the zone was obstructed by metallic tools, equipment and railings making this part of the survey area unsuitable for the magnetic and EM surveys.

Zone 4 is in the southeast of the Coal Washery site and was comprised of grass and scrubland believed to be underlain by spoil. This zone incorporates a public footpath, a field used for keeping horses and a fenced-off wooded area in the centre that needed some ground-level clearance. This zone targeted adit 285210-025, which is located within the wooden area; adit 285210-002 is situated within dense woodland and is awaiting clearance to complete the survey at a later phase of works.



Plate 2A: Flat area within the coal storage area in Zone 1, looking east.



Plate 2B: Area of adit 285210-028 in the east of Zone 2, looking east.



Plate 2C: Steep slope in the centre of Zone 3, looking west.



Plate 2D: North edge of woodland strip where adit may be located in Zone 4

2.2 Geological setting

The survey area is underlain by South Wales Lower Coal Measures Formation and described by the British Geological Survey (BGS) as interbedded mudstone, siltstone and sandstone. Several coal seams traverse the site that has been historically mined, resulting in surface adits and mineshaft entries.

All survey areas are underlain by made-ground and believed to be comprised of several meters of colliery spoil material.

2.3 Survey objectives

The primary survey objective is to characterise ground conditions and to confirm the location of the historical mine workings recorded by the Coal Authority. Overall, nine historical adit and mineshaft mine entries were targeted in this survey.

2.4 Survey design

Given the survey brief, it was decided to adopt an integrated survey approach comprising of the following techniques:

- **Magnetics (Geometrics G858)** – *to map distortions in the Earth's magnetic field due to the presence of buried ferrous material that may be related to mine workings.*
- **Electromagnetics (Geophex GEM-2)** – *to map variations in the near-surface ground conductivity and in-phase response associated with different shallow materials/structures.*
- **Microgravity (Scintrex CG-5)** – *to confirm the presence of any localised areas of mass deficiency within the subsurface that may be associated with voiding or less dense in-fill material associated with the mine entry features.*

2.5 Quality control

The geophysical data were collected in line with normal operating procedures as outlined by the instrument manufacturer and TerraDat company policy. On completion of the survey, the data was downloaded from the survey instrument onto a computer and backed up

appropriately. The acquired data set was initially checked for errors that may be caused by instrument noise, low batteries, positional discrepancies, etc., and any field notes were either written up or incorporated in the initial data processing stage. The data set is then processed using the standard processing routines, and once completed, the resulting plots are subject to peer review to ensure the integrity of the interpretation. Our quality control standards are BS EN ISO 9001:2015 certified.

3 SURVEY DESCRIPTION

The survey was carried out using the following geophysical techniques:

- Magnetism (Geometrics G-858)
- Electromagnetics (EM, Geophex GEM-2)
- Microgravity (Scintrex CG-5)

The extents of the survey zones are indicated in Figure 1. Some areas could not be surveyed with the magnetic and electromagnetic techniques due to access difficulties, overgrown land or woods and metallic inference from nearby objects or structures. The microgravity surveys were carried out over best fit 50m x 50m grids, centred on the recorded location of the mineshaft or adit.

The results of the surveys are presented in the form of interpreted data plans and sections indicating the location and physical characteristics of identified anomalous features, together with a description.

Background information for each of the survey technique is provided in the appendices, and descriptions of the actual survey work carried out on site are provided in the sections below.

3.1 Survey layout and topographic survey

A Network RTK dGPS system was used to set out a number of control points. The local survey grids were preferentially aligned to suit the alignment of the survey areas, which were consequently transformed to National Grid (OSTN02) using the Trimble network correction (+/- 2.5cm). For the microgravity survey technique, a Trimble R6 robotic Total Station was used to record the position and height of the gravity meter.

3.2 Magnetic survey (G-858)

A magnetic survey is a passive technique that measures local perturbations in the Earth's wider magnetic field caused by the presence of magnetically susceptible objects in the subsurface. These subtle perturbations are mainly a result of the presence of ferrous metals, but some ferrous-bearing materials, such as fired red brick, slags, and ash, can also give a measurable response.

3.2.1 Magnetism survey - field activity

A *GEOMETRICS G-858* magnetometer (Plate 3) was used to acquire total field data in “near-continuous” walking mode along a series of 2m-3m spaced parallel survey lines across the survey zones which were set out to incorporate adits and mineshafts as well as background for general ground characterisation. The magnetic dataset was acquired under *EGNOS* corrected GPS control to an accuracy of +/- 0.5m.

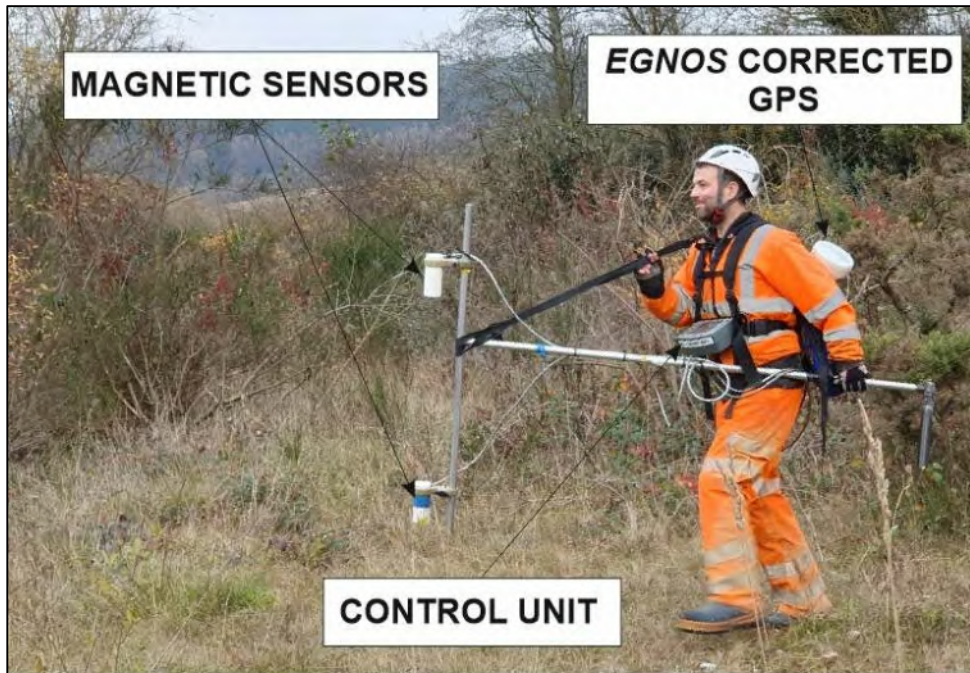


Plate 3: Magnetic survey set up on site in Zone 4.

3.2.2 Magnetism survey – data processing

The magnetic data were downloaded to a computer and edited for positional errors and rogue values. Depending on the length of the survey and atmospheric conditions, a drift correction may be applied. The data were then exported as an ‘XYZ’ file and, if required, translated into the appropriate coordinate system. The next step was to bring the data into *OASIS MONTAJ*, where they can be edited and manipulated to enhance any features of interest. The colour contour plots were then integrated with the base plan information, and the resulting plans were exported to *CORELDRAW* for final annotation.

3.3 Electromagnetic (EM) survey

An electromagnetic survey is based on measuring the response of the ground due to the propagation of an electromagnetic field. The magnitude of this response depends on the type and distribution of conductive material in the subsurface and can be broken into two components, namely the quadrature and in-phase components. The quadrature is usually converted to ground conductivity, which reflects the electrical properties of the subsurface (i.e. clay, water, ash, metal), while the in-phase component is dependent on the magnetic susceptibility of the subsurface.

3.3.1 Electromagnetic survey - field activity

The electromagnetic data were acquired using a multi-frequency *GEOPHEX GEM-2* instrument, which was carried in “near-continuous” walking mode along a series of 2m spaced parallel survey lines across the survey zones (Plate 4). The dataset was acquired at a nominal 0.5m interval along a series of 2m spaced parallel survey lines. For this particular survey, the instrument was primarily configured to investigate depths of up to 4m below ground level. The GEM-2 dataset was acquired under *EGNOS* corrected GPS control to an accuracy of $\pm 0.5\text{m}$.

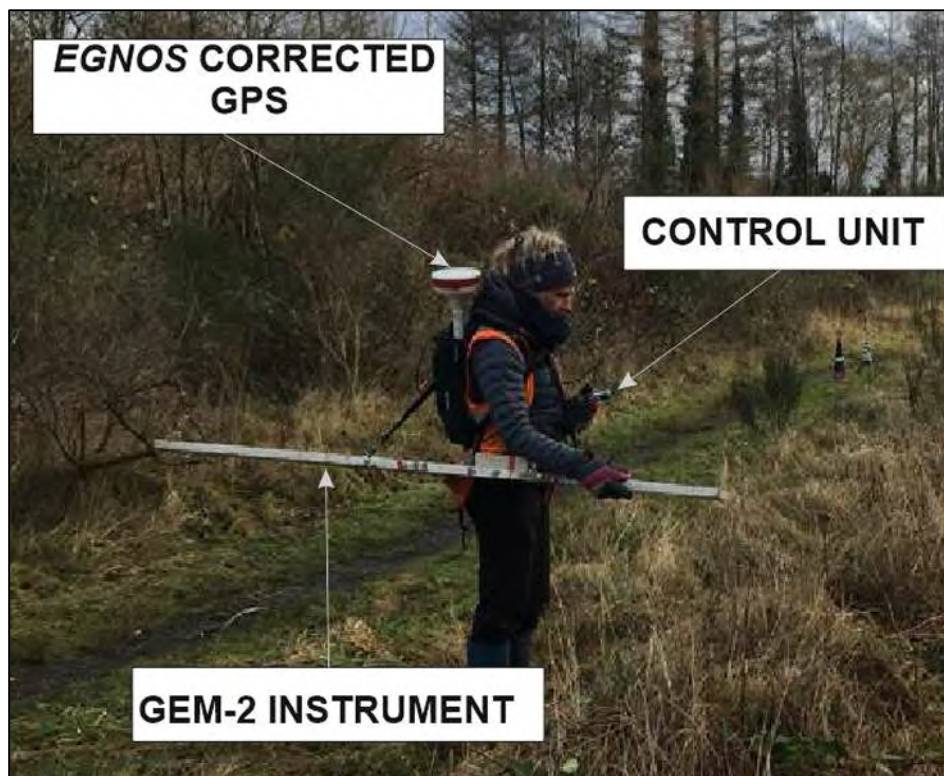


Plate 4: Electromagnetic survey set-up on site in Zone 4.

3.3.2 Electromagnetic survey – data processing

The conductivity data were downloaded from the data logger and compiled using dedicated software *WINGEM-3*. Initial editing was then carried out to remove positional errors and rogue values. The data was then exported as an 'XYZ' file and translated into the OSGB36 Coordinate system using the OSTN15 transformation. The next step was to bring the data into *GEOSOFT OASIS MONTAJ*, where it was compiled, edited and manipulated to enhance any features of interest. The colour contour plots were then integrated with the base plan information, and the resulting plans were exported to *CORELDRAW* for final annotation.

3.4 Microgravity Survey

The density contrast between different Earth materials provides a useful means for mapping subsurface structures through the measurement of associated localised variation in the Earth's gravitational field. The presence of an anomalously high (or low) density body in the subsurface causes a localised high (or low) anomaly in the measured gravitational field. The gravity effects described are small. However, modern instrumentation and exhaustive data processing techniques enable the detection of geological and artificial structures relevant to the engineering and groundwater industries.

An increase in both the size of a body and the density contrast with its host material proportionally increases its detectability using gravitational methods. However, there is a reduction in both spatial resolution and detectability with increased depth of burial. Typical targets for a microgravity survey include the location of buried channels, solution features, voiding, mine shafts, vertical structures, geological lineations, and groundwater movement through monitoring with time.

3.4.1 Microgravity survey - field activity

The microgravity survey was carried out using a very high precision *Scintrex CG-5* instrument (Plate 5). Microgravity surveying was conducted on a survey grid of 50m x 50m centred as reasonably as practicable on the recorded mineshaft and adit locations. The gravity readings were acquired on a staggered 5m x 5m spaced grid. For each reading station, the elevations of the gravity meter were acquired using a Total Station to a precision better than 0.5cm. One of the main advantages of the *Scintrex CG-5* is that it enables statistical averaging and filtering of readings taken every second over a fixed period (typically 2-3 minutes), thereby significantly reducing low-level noise from the wind, seismic activity and nearby roadways.



Plate 5: Microgravity survey with Scintrex CG-5 instrument in Zone 1

3.4.2 Microgravity survey – data processing

To remove (reduce) background gravitational effects, i.e. those that do not originate from the target features, some processing steps were applied to the acquired dataset using a combination of internal CG-5 software and TerraDat proprietary software *GRED*. The applied corrections include:

- Earth Tide, Temperature & Tilt Correction
- Un-modelled Temporal Residual Correction
- Latitude Correction
- Free-air Correction
- Bouguer Correction
- Terrain Correction

The resulting reduced gravity dataset (Bouguer Anomaly) was then assessed for terrain effects (topography, walls, known voids, etc.) and regional gravitational fields (trends). By removing these effects, a corrected plot was produced that was used to identify local anomalous features. The result is then presented as annotated colour contour plots overlaid on the base plan information using CORELDRAW.

4 RESULTS AND DISCUSSION

The results of the geophysical survey are presented as a series of interpreted colour contour plots in Figures 2 - 9. Figure 1 provides a site overview of the survey zones and technique coverage. A general description of the interpretation process and a broad discussion of the results for each technique is given below. Anomalous features/zones identified by the various techniques have been transposed onto a basic map to create the anomaly location plans in Figure 10.

Magnetic Survey

The results of the magnetic survey are presented as the total magnetic field as recorded by the top sensor (plot A within Figures 2, 4, 6 and 8) and the derived analytical signal of the total magnetic field (plot B in the same figures). As the top sensor is located further away from the ground surface, it is less prone to extreme responses in the presence of shallow magnetic material and therefore produces a smoother plot.

The total magnetic field records deviations superimposed onto the Earth's Total Magnetic Field (ETMF) by the presence of ferrous material within the subsurface. Several factors determine the character of a total field magnetic anomaly, such as magnetic susceptibility, size and the orientation of the causative body. The interpretation of a magnetic anomaly is based on observing the type (monopole/dipole), amplitude and wavelength of the anomalous feature.

As all magnetic fields are dipolar, the superimposition of a dipolar anomaly on the ETMF creates perturbations observed as localised relative increases and decreases in field strength intensity (i.e. 'positive' and 'negative'). Given these variations, total field magnetic anomalies are more difficult to interpret and are often much less closely related to the shape of the causative body than with other total field techniques (e.g. microgravity). The interpretation process is further complicated by the horizontal displacement of the anomalies relative to the source due to the non-vertical nature of the magnetic field. To counter this issue, the analytic signal routine is applied, and this is used to simplify magnetic dipoles into a single positive peak over the areas of the highest magnetic gradient (i.e. location of the source producing the response).

In terms of identifying shafts, the anomalies can either be discrete individual features or form a small cluster. These responses are usually associated with disturbed ground, ferrous backfill material, remnant foundations or metal capping structures.

Electromagnetic survey

The results of the electromagnetic survey are presented as a colour contoured plot of ground conductivity (plot C within Figures 2, 4, 6 and 8) and In-phase response (plot D in the relevant figures).

Following a review of the electromagnetic data, it was decided only to consider the response of the 40,925 MHz frequency channel. A relative increase in conductivity values usually indicates a localised increase in the clay/water content, which for example, could signify either a lateral change in lithology or a change in bedrock depth. However, it can also represent interference from adjacent metallic features (both above and below ground). Extreme fluctuations in conductivity/in-phase values are usually indicative of instrument ‘overload’ due to high metal content.

The interpretation of the conductivity data is based on both published electrical properties of typical sedimentary materials (Table 1) and, when available, correlation with onsite information.

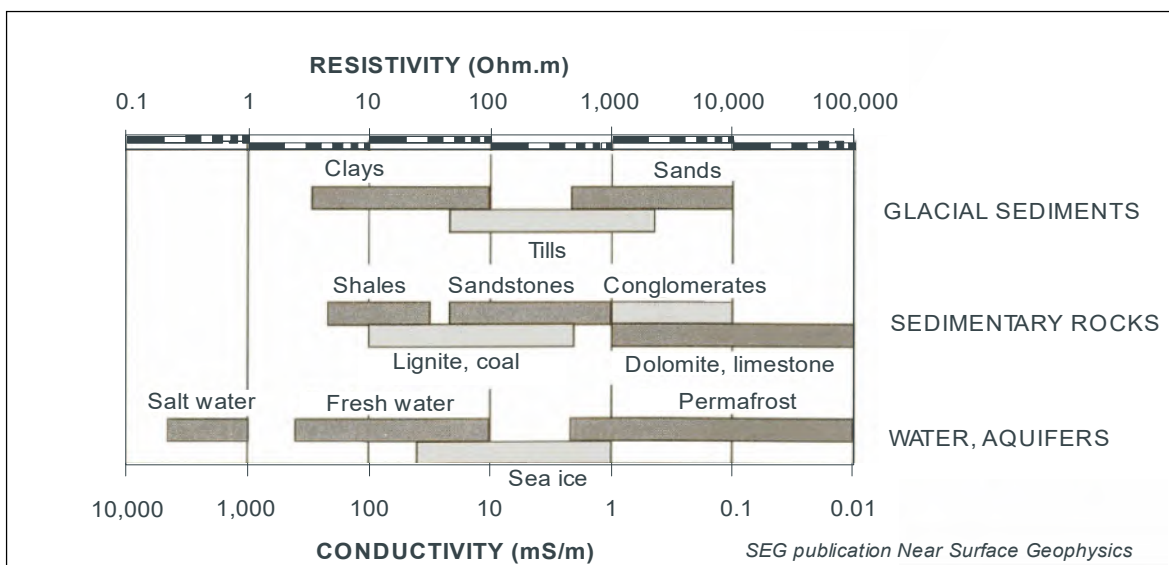


Table 1: Table of resistivity/conductivity of typical sedimentary materials.

The detection of mine workings/shafts using this particular technique typically involves looking for localised zones of ground heterogeneity which could either signify buried structures such as foundations or mineshaft capping structures or different material types such as backfill of a different composition to the natural ground. On a broader scale, it can be used to identify secondary effects of a shaft excavation, such as spoil distribution or preferential water drainage creating a drying out 'halo' at the surface.

Microgravity

The results from the microgravity survey are presented in Figures 3, 5, 7 and 9 as the corrected Bouguer Anomaly plots.

The gravity plots may be considered to represent variations in ground density targeting up to a maximum depth of approximately 10 m below ground level. For a given gravity feature or anomaly, its interpretation is based on observing its shape, amplitude and wavelength. For example, a localised decrease in the gravitational field indicates a zone of mass deficiency which could either represent void space, poorly compacted backfill material or an increase in the thickness of the superficial deposits.

4.1 Summary discussion of survey results for Zone 1

The results of the magnetic and the electromagnetic survey in Zone 1 correlate well and highlight different ground characteristics and potential structures or features buried in the shallow subsurface. Areas that show extreme values or instrument overload indicate buried metallic objects. There are some indications of anomalous responses in the vicinity of mineshaft 284210-029. Close to adit 284210-035, the magnetic survey has identified an isolated dipolar response that may be related to a borehole but may be related to the mine adit.

The main features detected in the surveys are highlighted and described in Table 2.

ID	Feature description
Z1-1	Isolated dipolar anomaly detected in the magnetic and EM survey, ferrous material buried in the shallow subsurface.
Z1-2	Large dipolar magnetic anomaly indicating ferrous material buried in the subsurface; due to its location at the edge of the grid, the full extent is unknown.
Z1-3	Extreme response believed to be caused by reinforced hard-standing.

Z1-4	Scattered high instrument responses associated with ferrous debris on the surface.
Z1-5	Area of reduced EM response over elevated mound (spoil heap).
Z1-6	Small, isolated dipolar response within the proposed location of the mineshaft.
Z1-7	Broad areas of elevated magnetic response in the ground off-site and in coal storage area, likely associated with ferrous material within the colliery spoil.
Z1-8	Area of high magnetic response east of proposed adit location; likely to be associated with made-ground.
Z1-9	Isolated magnetic dipolar anomaly, near proposed adit location.
Z1-10	High conductivity associated with fence and linear response from track.
Z1-11	High in-phase response and relatively low-density ground likely to be associated with the road edge construction, services and drainage.
Z1-12	Broad area of relatively homogenous ground density; correlating with relatively quiet ground conditions mapped in EM and magnetic survey. No evidence of adit feature.
Z1-13	Elongated zone of low gravity values representing low-density ground of unknown origin; this feature is offset to the west of the proposed mineshaft but close to the magnetic and EM anomalous feature (Z1-1).
Z1-14	Homogenous density area of lower-intermediate values associated with the spoil mound, surrounded by higher density material to the west, and lower density material (likely loose colliery spoil material) on the east edge of the mound; feature broadly correlating to Z1-5.
Z1-15	Area of low-density ground of unknown origin that is located along a zone of reduced ground density that appears to be associated with the access track.

Table 2: Main features identified by all three survey techniques in Zone 1.

4.2 Summary discussion of survey results for Zone 2

The results of the magnetic and the electromagnetic survey in Zone 2 correlate well and highlight different ground characteristics and potential structures or features buried in the subsurface. Areas that show extreme values or instrument overload indicate buried metal. The area of adit 285210-026 and mineshaft 285210-27 was only partially accessible. An elongated low gravity zone, a small distance to the north of adit 285210-026, has been identified, and a subtle circular low-density zone is also apparent to the west of shaft 285210-27. There are numerous EM and magnetic responses in the vicinity of adit 285210-001, as well as a large circular gravity anomaly indicating low-density ground centred close to the

proposed location of the adit. There are some changes in response close to adit 285210-028, which indicate changes in the ground composition.

The main features detected in the surveys are described in Table 3

ID	Feature description
Z2-1	Broad area of increased magnetic and EM response, indicating high ferrous composition of the made-ground (colliery spoil).
Z2-2	High instrument responses close to the road, interference from metallic debris, road, fencing and services.
Z2-3	Two isolated dipolar magnetic responses, indicating localised zone of ferrous material.
Z2-4	Circular zone of raised conductivity values in proximity to the proposed adit location indicating localised change in made-ground composition - increase in clay and moisture content in the subsurface, potentially related to adit 285210-001.
Z2-5	Circular, high magnetic instrument response in proximity to the proposed adit location, indicating localised concentration of ferrous material buried in the subsurface, potentially related to adit 285210-001.
Z2-6	Number of dipolar anomalous instrument responses in close proximity to the proposed adit location; may be related to adit 285210-001.
Z2-7	Isolated dipolar response, indicating manhole/service.
Z2-8	Linear anomalous response detected in the EM survey indicating trench or service in the shallow subsurface.
Z2-9	Isolated dipolar anomaly, indicating ferrous material.
Z2-10	Zone of scattered high magnetic responses associated with ferrous material or debris in the subsurface.
Z2-11	Broad area of increased magnetic responses, showing change in made-ground composition.
Z2-12	Linear zone of increased conductivity values, indicating change in made-ground composition - clay and moisture-rich material.
Z2-13	Linear zone of low gravity values (low-density ground) parallel to road at base of bank and along drainage channel.
Z2-14	Circular zone of low gravity values in proximity to proposed mineshaft location. Recommended for intrusive investigation.
Z2-15	Linear zone of low gravity values, near suggested adit 285210-026 location. Recommended for intrusive investigation.

Z3-16	Isolated zone of decreased gravity values indicating unknown change in ground composition to less dense material.
Z3-17	Distinct, large circular area of low gravity values, indicating lower density ground material. Due to its proximity to the proposed adit location and correlation with magnetic and EM anomalous features, it is recommended to ground-truth this area.
Z2-18	Linear zone of low gravity values coinciding with EM anomaly (Z2-12), in close proximity to proposed adit 285210-028 location. Recommended for intrusive investigation.

Table 3: Main features identified by all three survey techniques in Zone 2.

4.3 Summary discussion of survey results for Zone 3

Zone 3 can be divided north and south with a lower-lying flat area and sloped terrace base (north of steep-slope) to the north, and a flat area usually covered in coal stockpiles in the south (approximately 8m higher than the north area). Due to an uneven surface, large boulders and vegetation on the slope in the north part of the zone, the magnetic and EM survey could not be undertaken on the slope. The flat, lower-lying part of the north of Zone 3 was accessible in some parts; however, due to a large amount of metal interference (discarded rollers, rails and fencing), this area was not suitable to be surveyed with the EM and magnetic techniques.

The proposed location of adit 284210-020 was covered with all survey techniques; the proposed location of adit 284210-019 is on the break of slope at the top of the spoil, with limited accessibility for the geophysical surveys.

The results of the magnetic and electromagnetic surveys show relatively homogenous coal spoil material in this zone.

The main features detected in the surveys are described in Table 4

ID	Feature description
Z3-1	High instrument response/overload associated with reinforced access road.
Z3-2	Increase in magnetic response adjoining access road; may be linked to road construction, service or similar. Due to the relative proximity to the proposed adit 284210-020 location, this feature may warrant further investigation.
Z3-3	Instrument interference from metal containers bordering the survey grid.
Z3-4	Increase in magnetic values, indicating increase in ferrous material/spoil in the subsurface.
Z3-5	Relatively similar gravity values (homogenous ground) in south coal storage area.
Z3-6	Relatively broad zone of low gravity values associated with the sloped bank, indicating less dense material that would be expected on uncompacted, loose slip material. May warrant further investigation at closest proximity to proposed mine adit 284210-019 location.
Z3-7	Subtle localised decrease in ground density in proximity to proposed mine adit 284210-020 location that may warrant further investigation.

Table 4: Main features identified by all three survey techniques in Zone 3.

4.4 Summary discussion of survey results for Zone 4

This zone targets adits 285210-025 and 285210-002. Adit 285210-002 was located in the eastern part of Zone 4 and awaits tree clearance for the survey to be undertaken.

The area of adit 285210-025 was located within a narrow wooded zone, partially cleared for the survey to take place. The metallic fencing located within the survey area has caused some interference; however, large dipolar responses and a localised subtle decrease in ground density in close proximity to the adit may be related to mine workings and are recommended for intrusive investigation.

The results of the magnetic and the electromagnetic survey correlate well and highlight different ground characteristics and potential structures or features buried in the subsurface. Areas that show extreme values or instrument overload indicate buried metal.

The main features detected in the surveys are described in Table 5.

ID	Feature description
Z4-1	Zone of large dipolar instrument responses near suggested adit location.
Z4-2	Zone of high instrument response to the west of the proposed adit location, indicating high concentration of ferrous material and increased ground conductivity.
Z4-3	Overgrown, difficult to access area, with scattered high instrument responses indicating metallic debris or ferrous rich colliery spoil in the shallow subsurface.
Z4-4	Increased magnetic response in field likely indicates more ferrous rich colliery spoil.
Z4-5	Low gravity values close to the proposed adit location indicate less dense ground and correlating with a cluster of magnetic and EM anomalies. This area is recommended for intrusive investigation.
Z4-6	Low gravity zones likely indicate less dense areas of made-ground/colliery spoil.

Table 5: Main features identified by all three survey techniques in Zone 4.

5 CONCLUSIONS

- The geophysical survey provided a rapid means of obtaining information on the ground character and composition, as well as surveying the site for anomalous features that may indicate the presence of the proposed mineshafts and adits.
- Magnetic and electromagnetic surveys were conducted covering all accessible areas within the designated four zones, which were followed up with targeted microgravity surveys to identify shallow anomalous features which may relate to the presence of mine workings.
- Survey results for Zone 1 mapped general ground characteristics and highlighted some isolated responses. There are some indications of anomalous ground in the proximity of mineshaft 284210-029, and anomalous instrument responses were recorded close to the location of adit 284210-035, which may warrant further investigation.
- Surveys results in Zone 2 were partially limited due to trees and vegetation, metal structures and a building (area around adit 285210-026 and mineshaft 285210-27). There are a number of notable instrument responses in the area of adit 285210-001 and a gravity anomaly close to adit 285210-026, which are recommended to be intrusively investigated. There are some changes in instrument responses and a low-density zone close to adit 285210-028, which indicate changes in the ground composition and may warrant further investigation.
- Survey results in Zone 3 are partially limited due to accessibility issues and interference from metal structures and debris. There are minor localised anomalous responses near adit 284210-020 and adit 284210-019 within a generally homogenous ground composition.
- Survey results in Zone 4 mapped a cluster of anomalous responses near adit 285210-025, which may relate to the historical mine workings and warrant further investigation.
- It is recommended that some invasive work is carried out to ground truth the main anomalies identified by the geophysical survey. Following that process, it may be

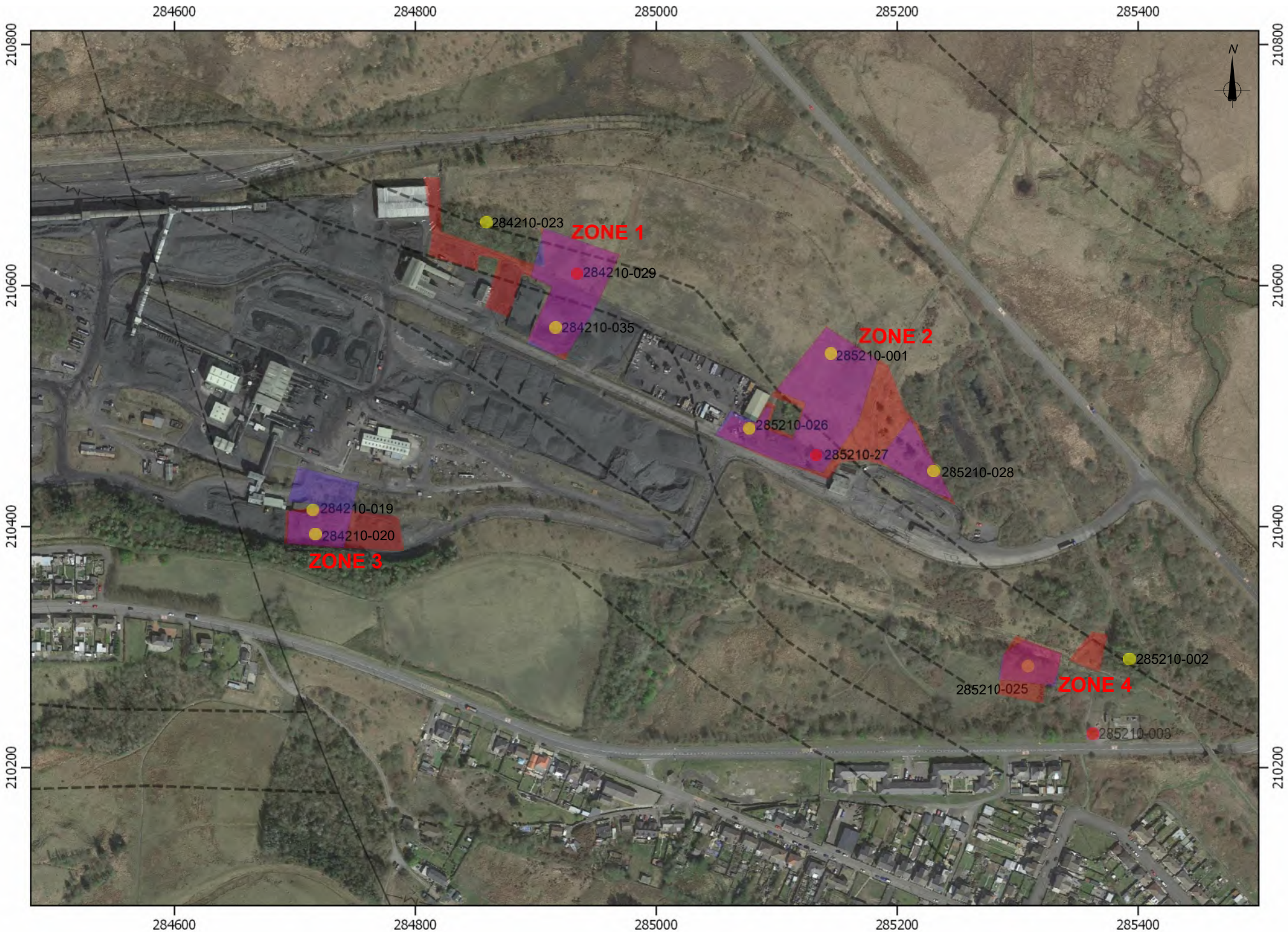
possible to extend the interpretation further and calibrate the datasets by incorporating the additional information.

Disclaimer

This report represents an opinionated interpretation of the geophysical data. It is intended for guidance with follow-up invasive investigation. Features that do not produce measurable geophysical anomalies or are hidden by other features may remain undetected. Geophysical surveys complement invasive/destructive methods and provide a tool for investigating the subsurface; they do not produce data that can be taken to represent all of the ground conditions found within the surveyed area. Areas that have not been surveyed due to obstructed access or any other reason are excluded from the interpretation.

Figures

1A - SURVEY ZONES WITH LOCATIONS OF TARGETED MINE WORKINGS



NOTES - Mine entry information from Coal Authority records

ZONE 1
Targeting adits 284210-023 and 284210-035, mineshaft 284210-029.
Adit 284210-023 is located within an overgrown wooded zone, therefore not accessible at time of survey.

ZONE 2
Targeting adits 285210-001, 285210-026, 285210-028 and mineshaft 285210-27. The immediate location of mineshaft 285210-27 was accessible for the microgravity survey only (located in wooded area). Adit 285210-026 is located close to steel fence, and potentially obstructed by a building. The microgravity survey was completed in this area where access permitted. The EM and magnetic survey could not be undertaken as there was too much interference from surrounding metallic structures.

ZONE 3
Targeting adits 284210-019 and 284210-020. Most of Zone 3 was accessible for the microgravity survey, however, the EM and magnetic survey could not be undertaken in the north of the zone due to steep and overgrown ground and obstructions from metal objects and railings.

ZONE 4
Targeting 285210-025 and 285210-002; Adit 285210-002 was inaccessible within tree area. Awaiting clearance of this survey area. Adit 285210-025 was located within a narrow strip of woodland surrounded by metallic fencing. The data therefore suffers from some interference and partial coverage of the survey area due to some obstructions within the trees.
Adit 285210-003 is outside area of interest.

KEY

- Approximate outline of survey areas covered with magnetic and electromagnetic (EM) techniques
- Approximate outline of the microgravity survey areas
- Expected Mineshaft location (according to Coal Authority)
- Expected Adit location (according to Coal Authority)
- Location of linear geological feature (BGS, 2021)

NOTE
-Maps produced in QGIS, 2021.
-Site topography overlain onto Google Satellite Image and Map data, Imagery ©2021, TerraMetrics, ©2021.

1B - SITE PHOTOS



A - Overlooking Zone 1, divided into area of grassed colliery spoil in the north and coal storage area in the south, looking southwest.



B - Northern part of Zone 2 on top of grassed colliery spoil, looking north.



C - Northern part of Zone 3 on the slope, looking east.



D - Southern part of Zone 3, coal storage area, looking east.



E - Partially accessible area in Zone 4, in between the two targeted adits, looking northeast.

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Title: **SITE OVERVIEW**

Project: **ONLLWYN COAL WASHERY, NEATH-PORT TALBOT**

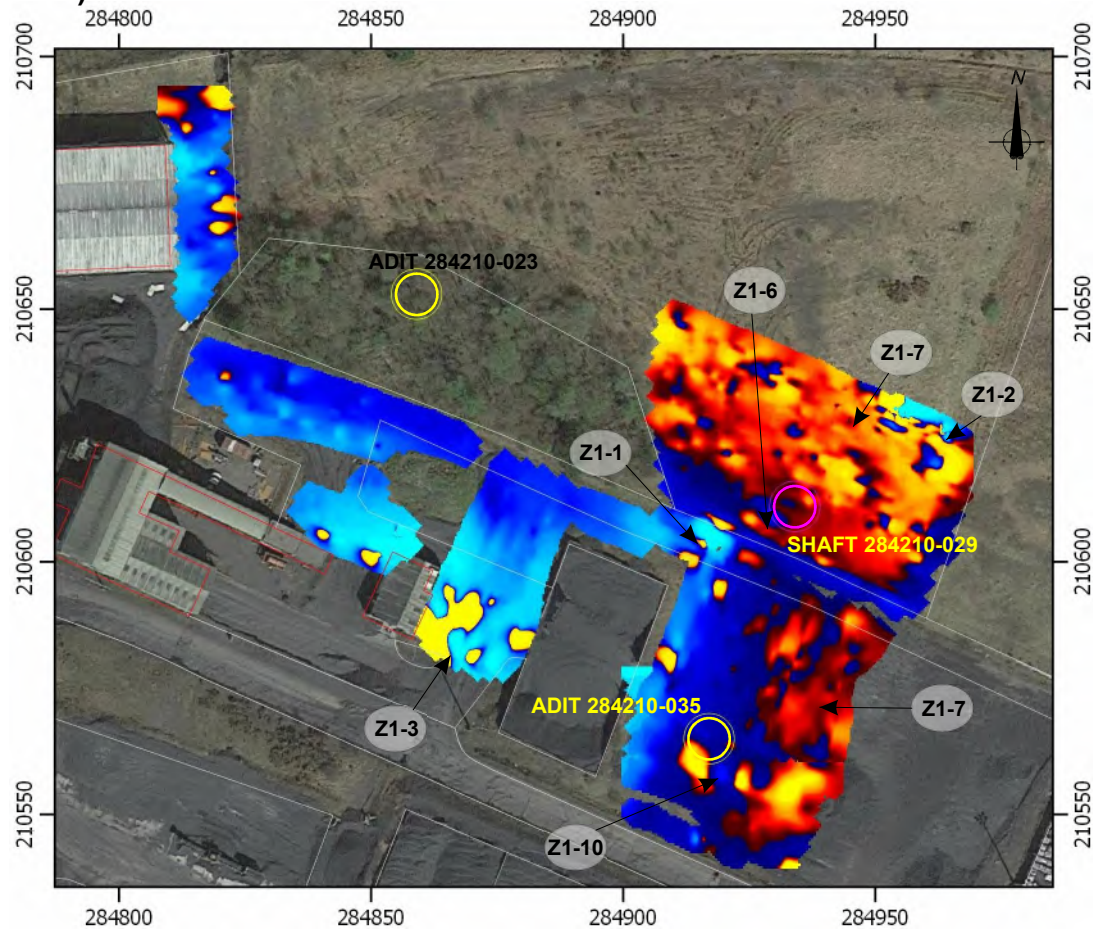
Scale: 1:4000 @ A3

Drawn by/Ref: KZ&AL/7591/1

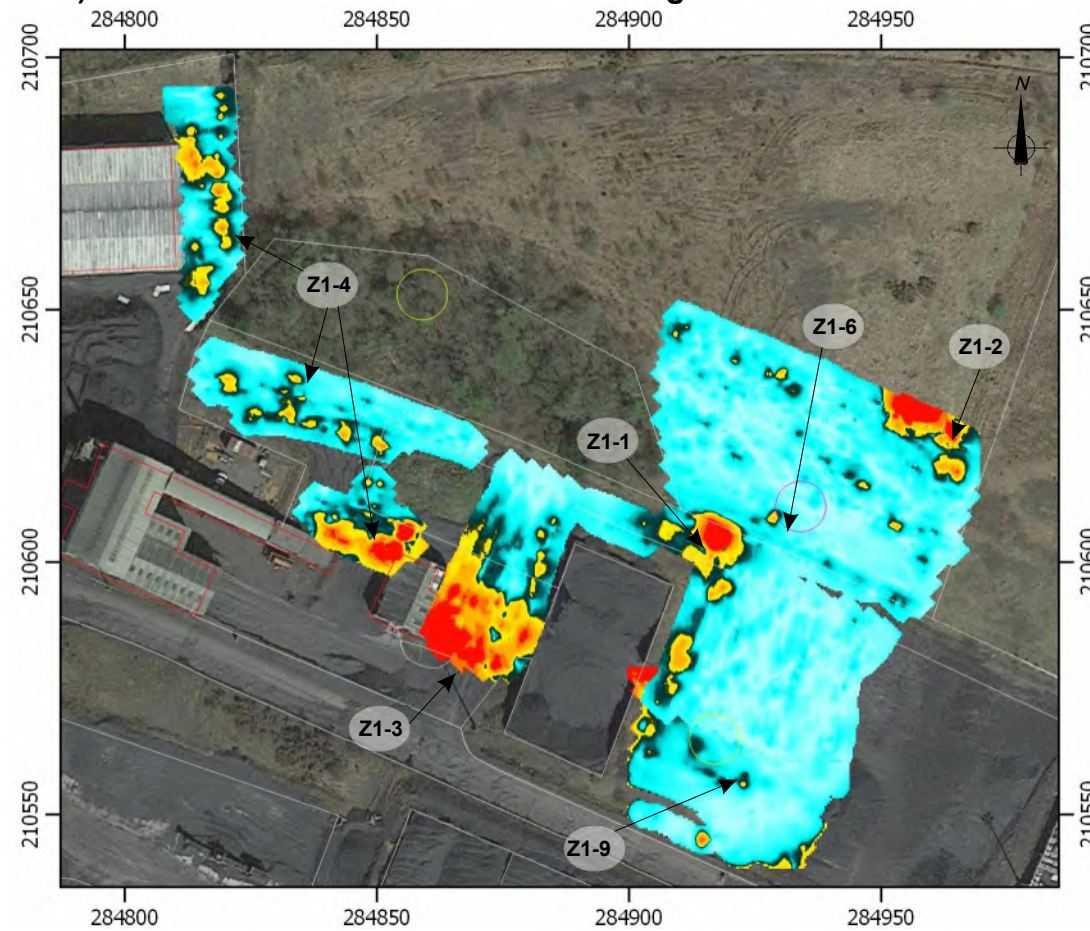
Date: December 2021

FIGURE 1

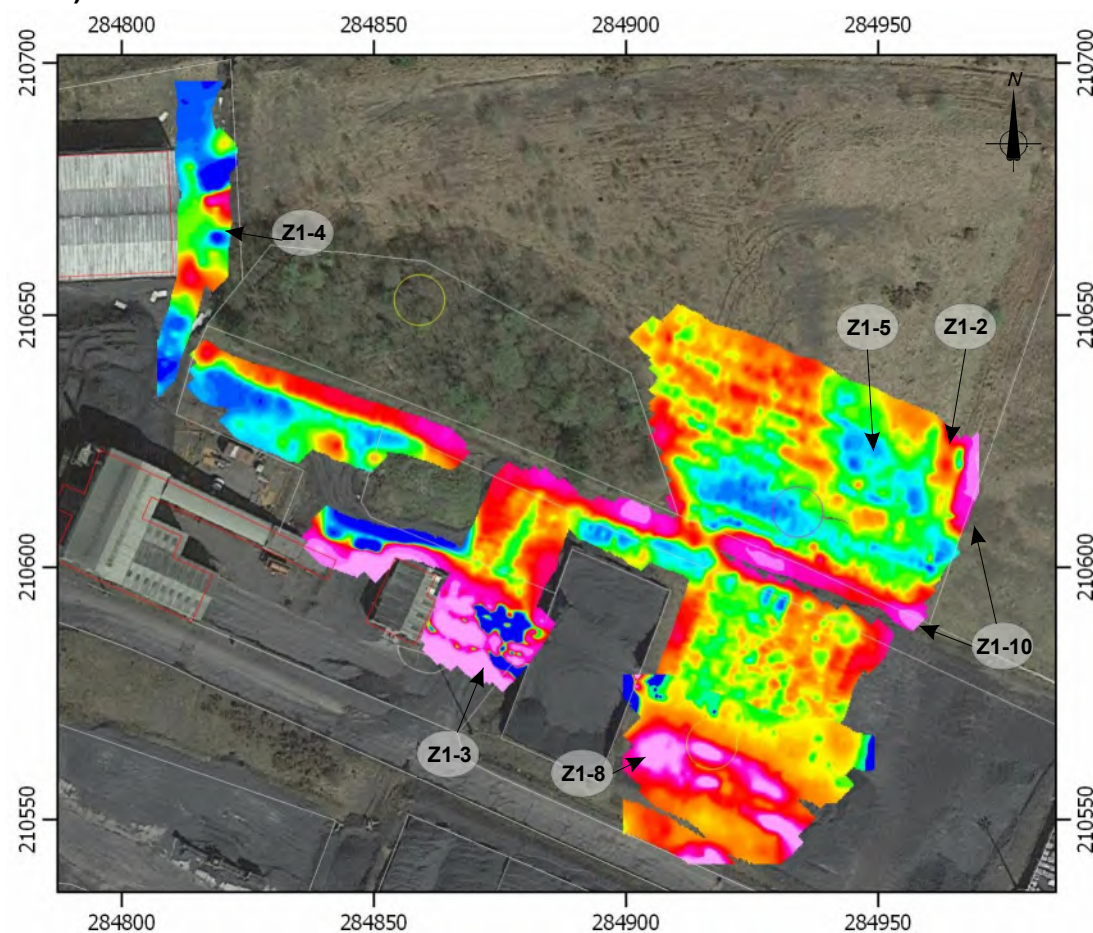
A) MAGNETIC TOTAL FIELD - Ferrous metal content



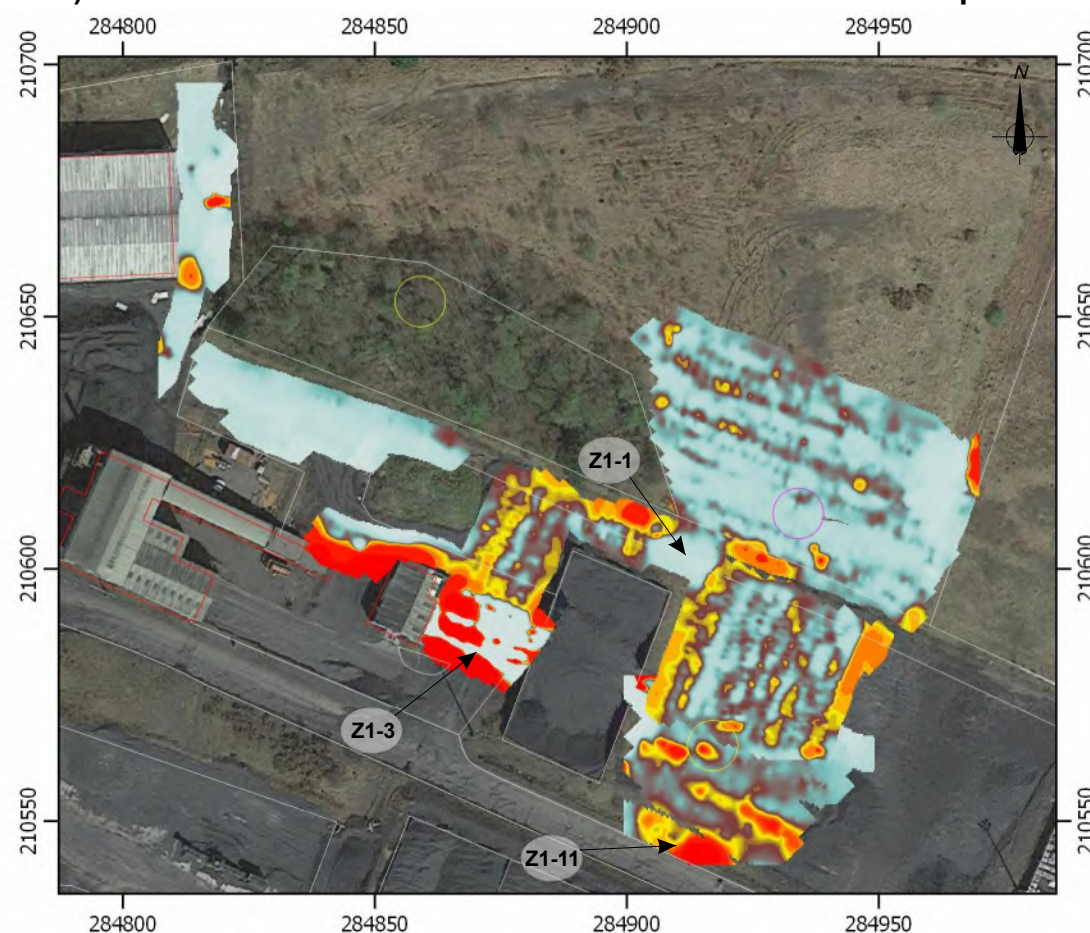
B) MAGNETIC ANALYTICAL SIGNAL - Significant ferrous metal anomalies



C) EM - GROUND CONDUCTIVITY

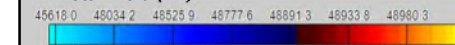


D) EM - IN-PHASE RESPONSE - Metal and cultural noise response

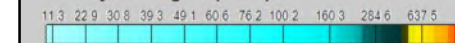


COLOUR SCALE

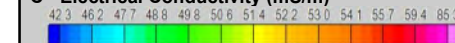
A - Total Field (nT)



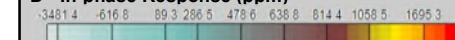
B - Analytical Signal (nT/m)



C - Electrical Conductivity (mS/m)



D - In-phase Response (ppm)



NOTES

The results of the magnetic and the electromagnetic survey correlate well and highlight different ground characteristics and potential structures or features buried in the shallow subsurface. Areas that show extreme values or instrument overload indicate buried metallic objects.

There are some indications of anomalous responses in close proximity of Mineshaft 284210-029. The zone of adit 284210-035 indicates an isolated dipolar response which may be related to the borehole or the potential location of the adit. Adit 284210-023 is inaccessible

Main features detected in the surveys are highlighted and described below.

ID DESCRIPTION

Z1-1: Isolated dipolar anomaly detected in the magnetic and EM survey, ferrous material buried in the shallow subsurface.

Z1-2: Large dipolar magnetic anomaly and high EM response indicating ferrous material or object buried in this area of the spoil mound.

Z1-3: Extreme response believed to be caused by reinforced hard-standing.

Z1-4: Scattered high instrument responses believed to be interference from ferrous debris on the surface.

Z1-5: Area of reduced EM response over surface mound (spoil heap).

Z1-6: Small, isolated dipolar response within the expected location of the mineshaft.

Z1-7: Broad areas of elevated magnetic response likely associated with high ferrous composition of the colliery spoil.

Z1-8: Area of high magnetic response east of expected mineshaft location; likely made-ground.

Z1-9: Isolated dipolar anomalous response, near to expected adit location

Z1-10: High conductivity associated with fence and track.

Z1-11: High in-phase response associated with road edge construction, services, drainage.

KEY

- Expected location of mineshaft
- Expected location of adit
- ID of detected feature



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Title: **ZONE 1 - MAGNETIC AND ELECTROMAGNETIC SURVEY RESULTS**

Project: **ONLLWYN COAL WASHERY, NEATH-PORT TALBOT**

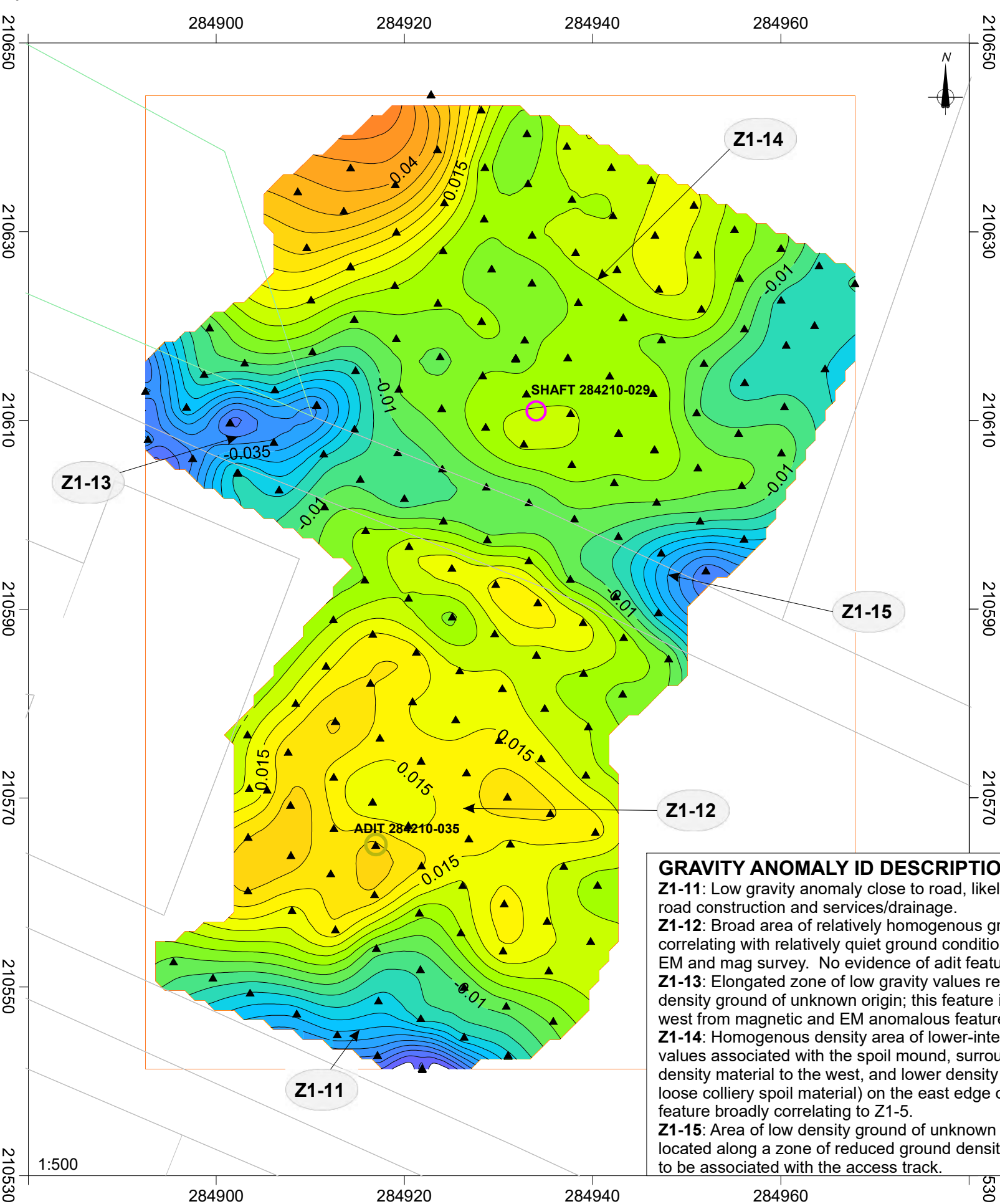
Scale: 1:1500 @ A3

Drawn by/Ref: KZ&AL/7591/2

Date: December 2021

FIGURE 2

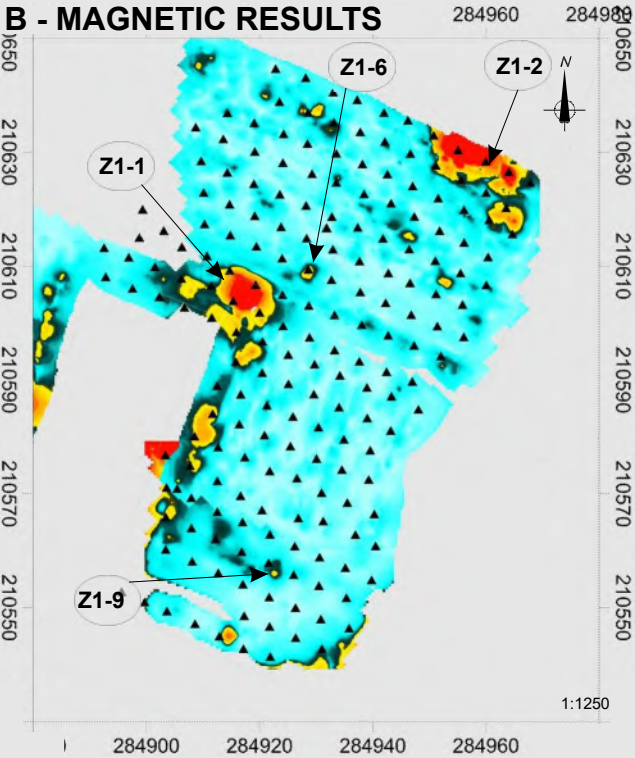
A) CORRECTED BOUGUER ANOMALY PLOT



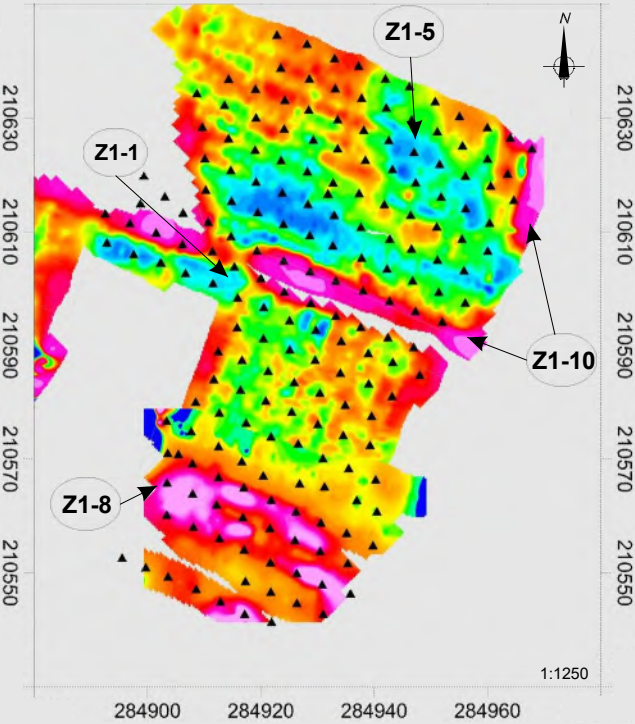
GRAVITY ANOMALY ID DESCRIPTION

Z1-11: Low gravity anomaly close to road, likely related to road construction and services/drainage.
Z1-12: Broad area of relatively homogenous ground density; correlating with relatively quiet ground conditions mapped in EM and mag survey. No evidence of adit feature.
Z1-13: Elongated zone of low gravity values representing low density ground of unknown origin; this feature is offset to the west from magnetic and EM anomalous feature (Z1-1).
Z1-14: Homogenous density area of lower-intermediate values associated with the spoil mound, surrounded by higher density material to the west, and lower density material (likely loose colliery spoil material) on the east edge of the mound; feature broadly correlating to Z1-5.
Z1-15: Area of low density ground of unknown origin that is located along a zone of reduced ground density that appears to be associated with the access track.

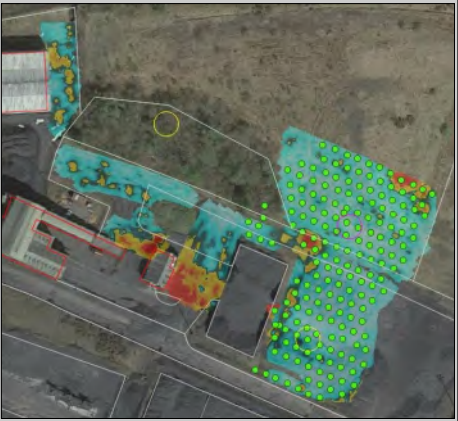
B - MAGNETIC RESULTS



C - ELECTROMAGNETIC RESULTS



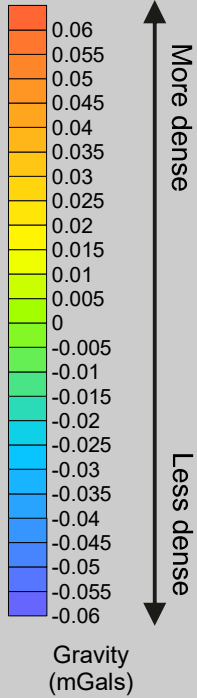
LOCATION MAP



KEY

- ▲ Gravity station and ID
- ▬ Simplified topographical plan
- Expected location of mineshaft
- Expected location of adit
- ID of detected feature

COLOUR SCALE



DATA NOTES

Reduction density used 1600 g/m³



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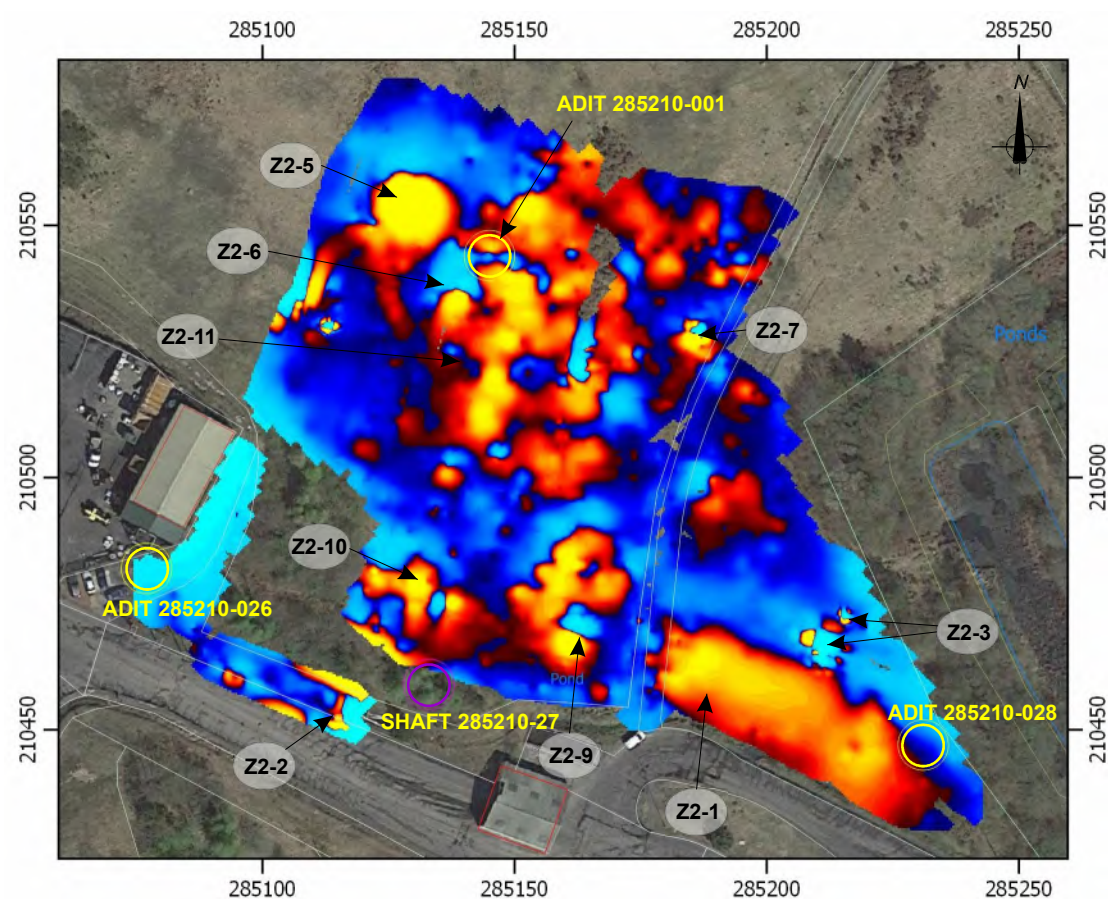
Title: **ZONE 1 - MICROGRAVITY SURVEY RESULTS**

Project: **ONLLWYN COAL WASHERY, NEATH-PORT TALBOT**

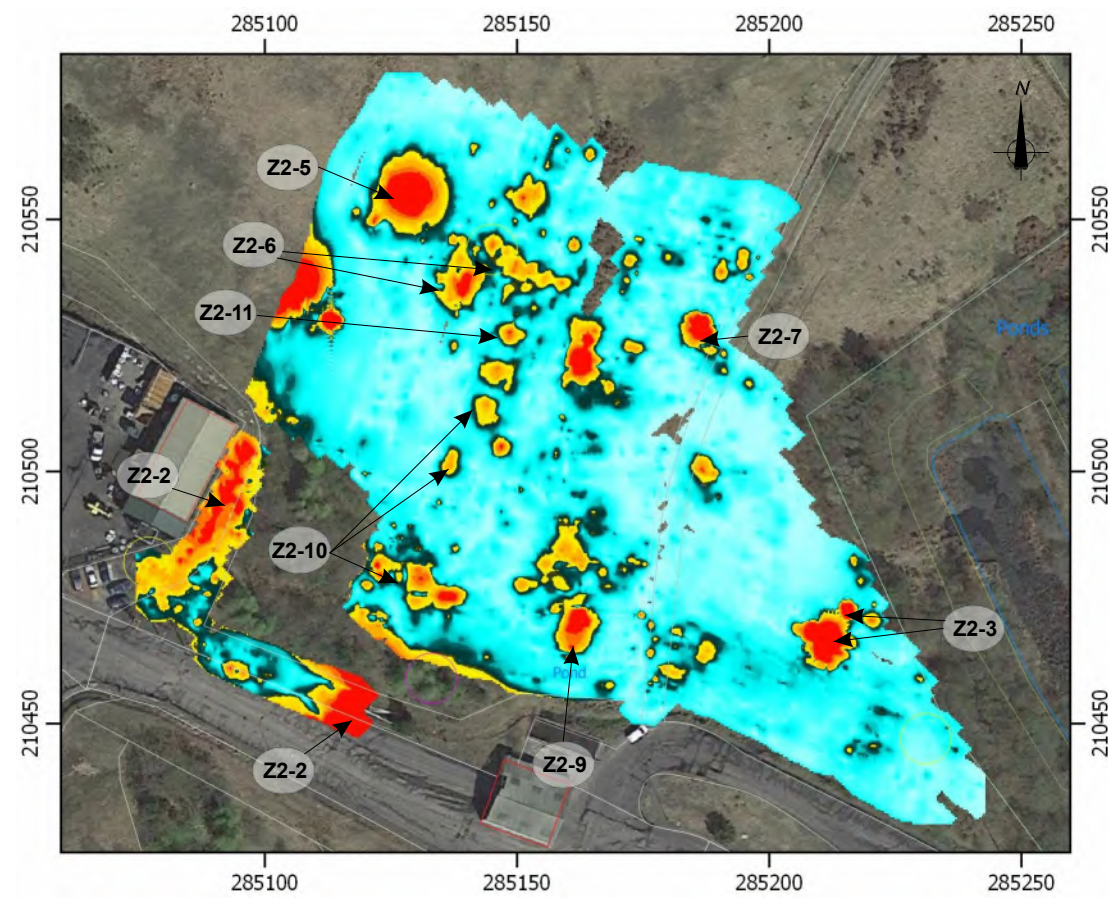
Scale: See individual plots
Drawn by/Ref: KZ&AL/7591/3
Date: December 2021

FIGURE 3

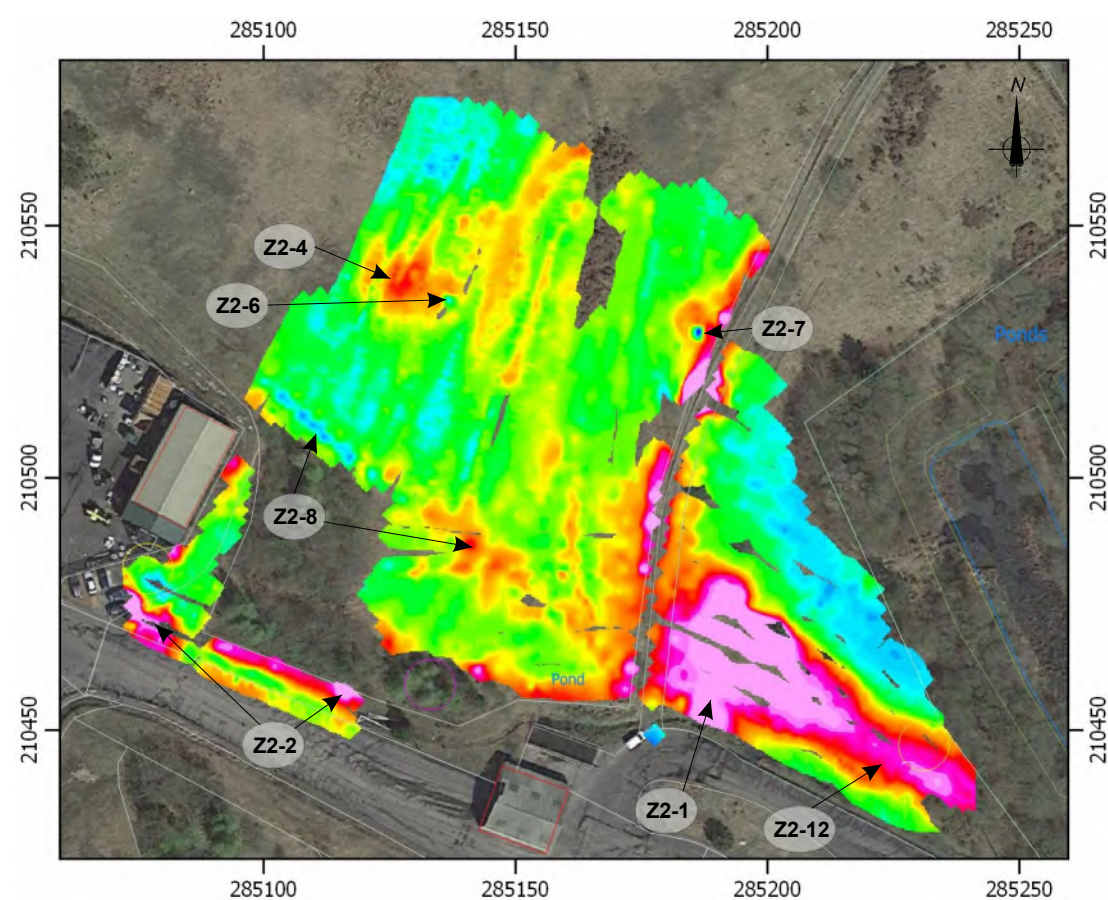
A) MAGNETIC TOTAL FIELD - Ferrous metal content



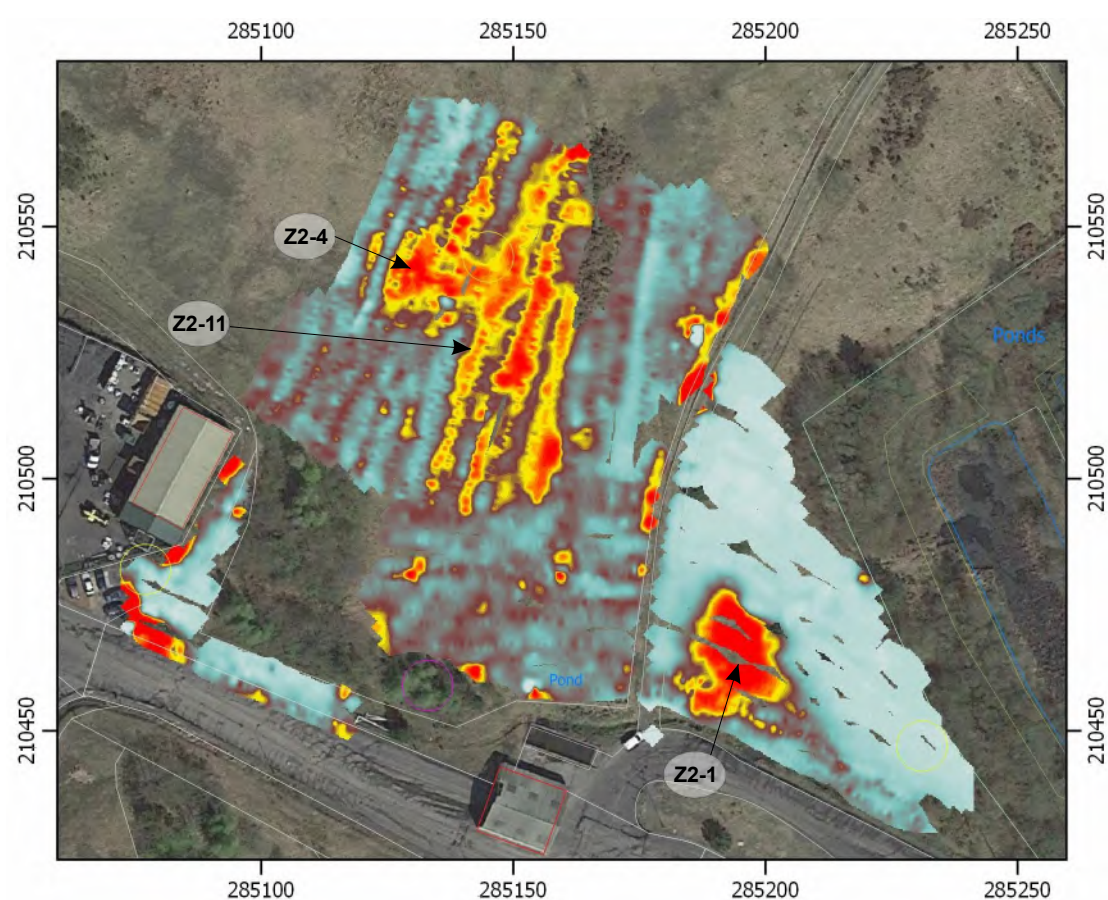
B) MAGNETIC ANALYTICAL SIGNAL - Significant ferrous metal anomalies



C) EM - GROUND CONDUCTIVITY

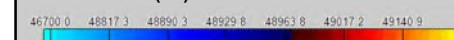


D) EM - IN-PHASE RESPONSE - Metal and cultural noise response

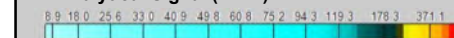


COLOUR SCALE

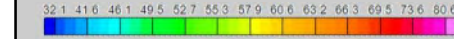
A - Total Field (nT)



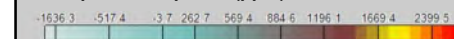
B - Analytical Signal (nT/m)



C - Electrical Conductivity (mS/m)



D - In-phase Response (ppm)



NOTES

The results of the magnetic and the electromagnetic survey correlate well and highlight different ground characteristics and potential structures or features buried in the subsurface. Areas that show extreme values or instrument overload indicate buried metal. The area of adit 285210-026 and mineshaft 285210-27 were only partially accessible. Metallic objects on the surface may mask subtle anomalous responses. There are a number of notable instrument responses in the zone of adit 285210-001, which are recommended to be intrusively investigated. There are some changes in response close to adit 285210-028 which indicate changes in the ground composition. Main features detected in the surveys are highlighted and described below.

ID DESCRIPTION

Z2-1: Broad area of increased magnetic and EM response, indicating high ferrous composition of the made-ground (colliery spoil).
Z2-2: High instrument responses close to the road, interference from metallic debris, road, fencing and services.
Z2-3: Two isolated dipolar magnetic responses in east area, indicating localised zone of ferrous material.
Z2-4: Circular zone of raised conductivity values in proximity to the expected adit location indicating localised change in made-ground composition - increase in clay and moisture content in the subsurface, potentially related to adit 285210-001.
Z2-5: Circular, high magnetic instrument response in proximity to the expected adit location, indicating localised concentration of ferrous material buried in the subsurface, potentially related to adit 285210-001.
Z2-6: Number of dipolar anomalous instrument responses in close proximity to the expected adit location; may be related to adit 285210-001.
Z2-7: Isolated dipolar response, indicating manhole/service.
Z2-8: Linear anomalous response detected in the EM survey indicating trench or service in the shallow subsurface.
Z2-9: Isolated dipolar anomaly, indicating ferrous material.
Z2-10: Zone of scattered high magnetic responses associated with ferrous material or debris in the subsurface.
Z2-11: Broad area of increased magnetic and in-phase responses, showing change in made-ground composition.
Z2-12: Linear zone of increased conductivity values, indicating change in made-ground composition - clay and moisture-rich material.

KEY

- Expected location of mineshaft
- Expected location of adit
- ID of detected feature

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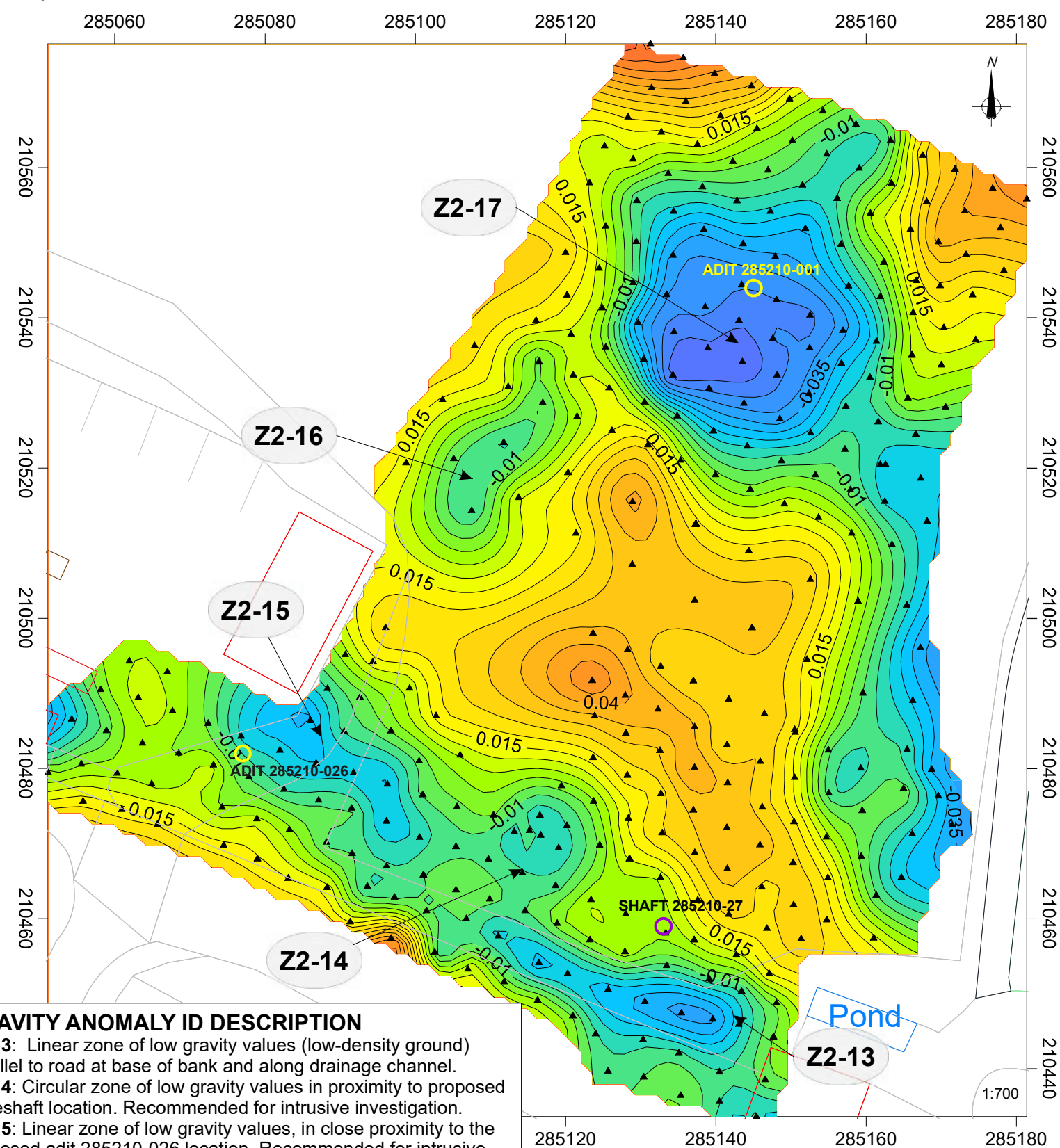
Title: **ZONE 2 - MAGNETIC AND ELECTROMAGNETIC SURVEY RESULTS**

Project: **ONLLWYN COAL WASHERY, NEATH-PORT TALBOT**

Scale: 1:1500 @ A3
 Drawn by/Ref: KZ&AL/7591/4
 Date: December 2021

FIGURE 4

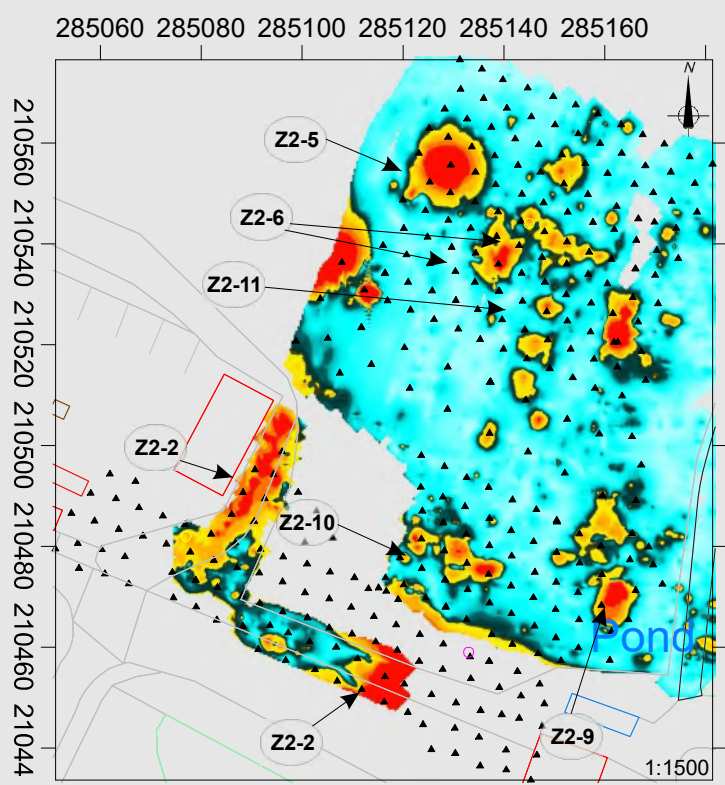
A) CORRECTED BOUGUER ANOMALY PLOT ZONE 2A



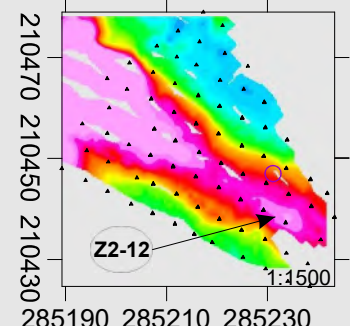
GRAVITY ANOMALY ID DESCRIPTION

Z2-13: Linear zone of low gravity values (low-density ground) parallel to road at base of bank and along drainage channel.
Z2-14: Circular zone of low gravity values in proximity to proposed mineshaft location. Recommended for intrusive investigation.
Z2-15: Linear zone of low gravity values, in close proximity to the proposed adit 285210-026 location. Recommended for intrusive investigation.
Z2-16: Isolated zone of decreased gravity values indicating unknown change in ground composition to less dense material.
Z2-17: Distinct, large circular area of low gravity values, indicating lower density ground material. Due to its proximity to the proposed adit location and correlation with magnetic and EM anomalous features, it is recommended to ground-truth this area.
Z2-18: Linear zone of low gravity values coinciding with EM anomaly (Z2-12), in close proximity to proposed adit 285210-028 location. Recommended for intrusive investigation.

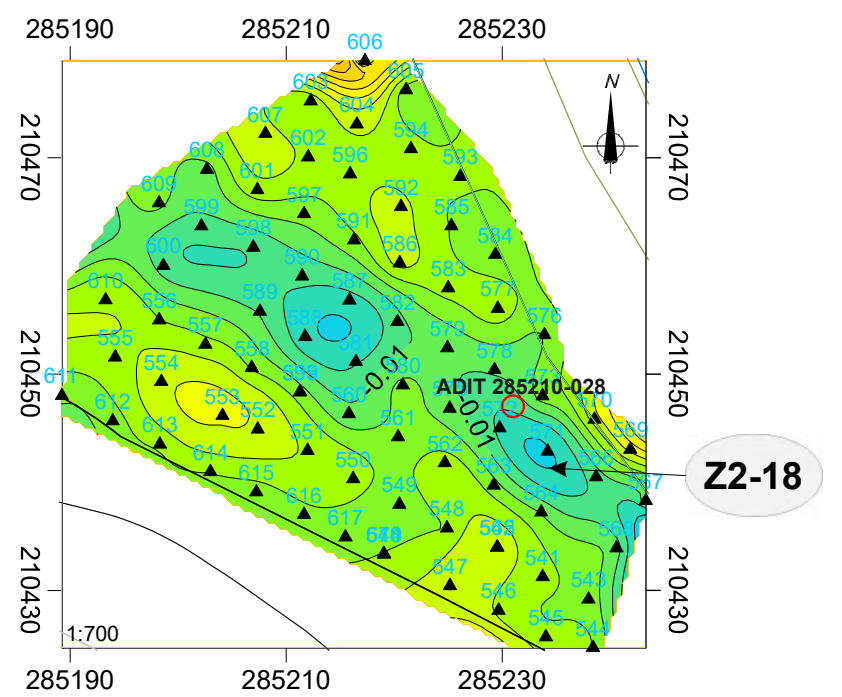
C - MAGNETIC RESULTS ZONE 2A



D - MAGNETIC RESULTS ZONE 2B



B - CORRECTED BOUGUER ANOMALY PLOT ZONE 2 B



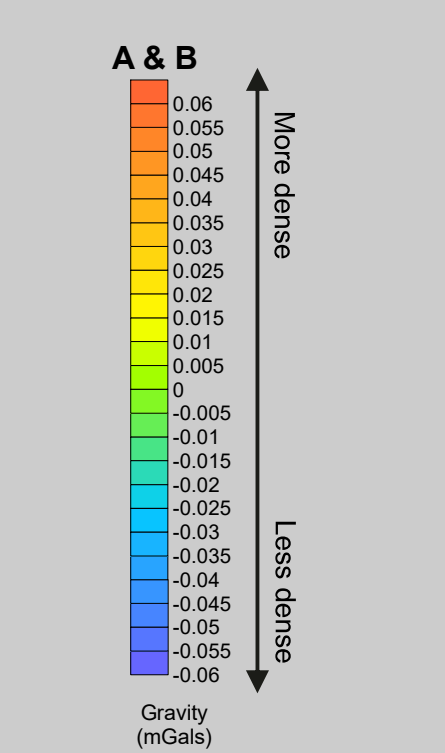
LOCATION MAP



KEY

- ▲ Gravity station and ID
- ▬ Simplified topographical plan
- Expected location of mineshaft
- Expected location of adit
- ID of detected feature

COLOUR SCALE



DATA NOTES

Reduction density used 1600 g/m³

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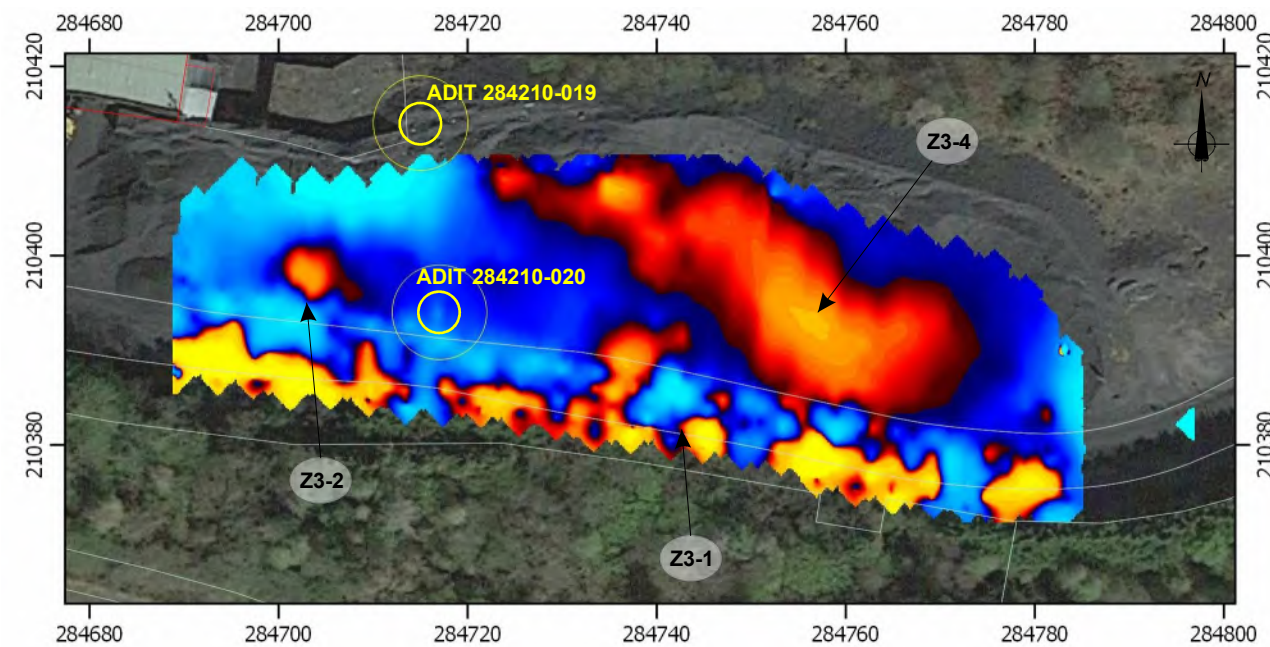
Title: **ZONE 2 - MICROGRAVITY SURVEY RESULTS**

Project: **ONLLWYN COAL WASHERY, NEATH-PORT TALBOT**

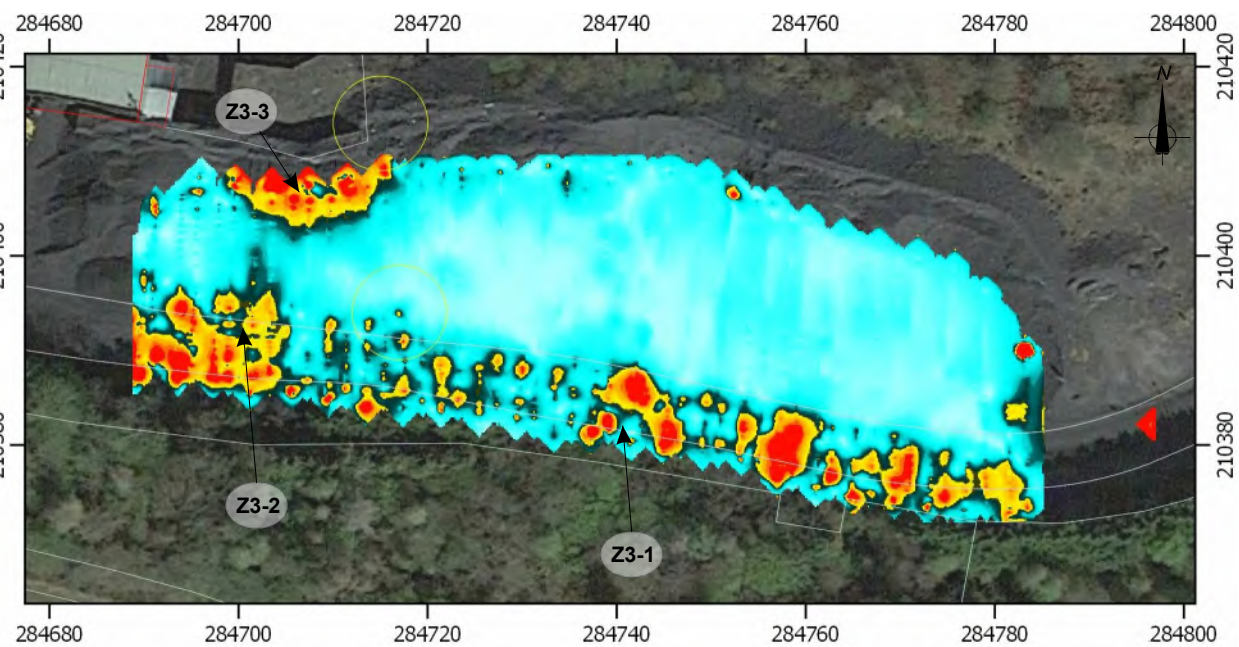
Scale: See individual plots
Drawn by/Ref: KZ&AL/7591/5
Date: December 2021

FIGURE 5

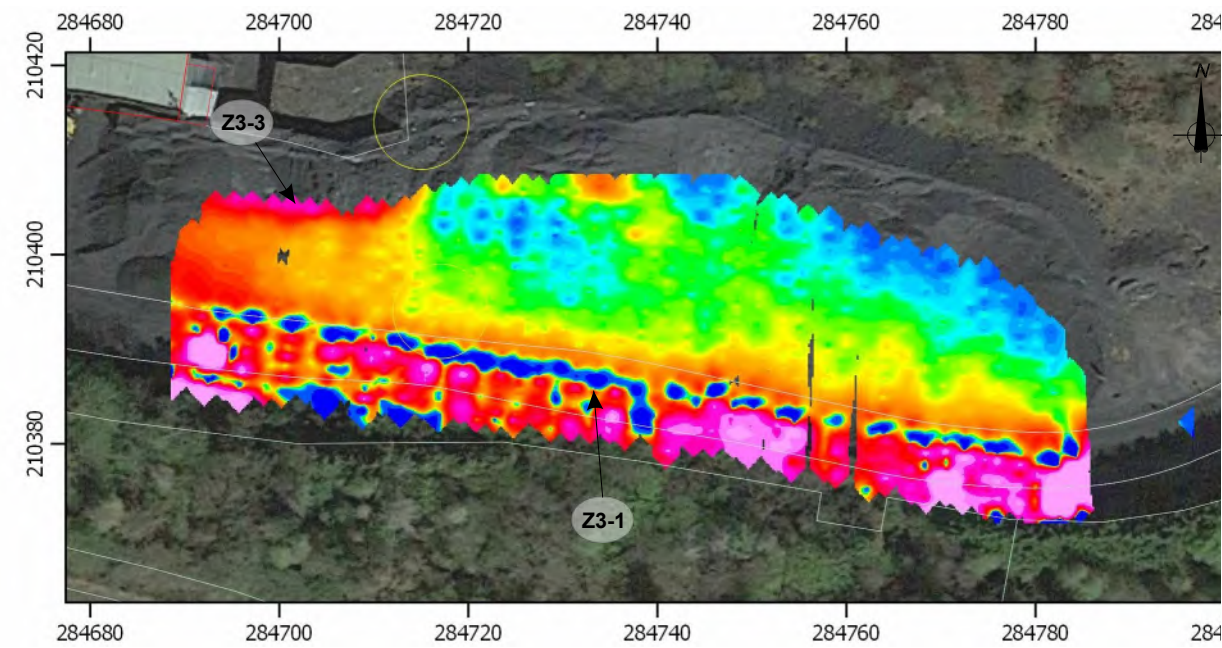
A) MAGNETIC TOTAL FIELD - Ferrous metal content



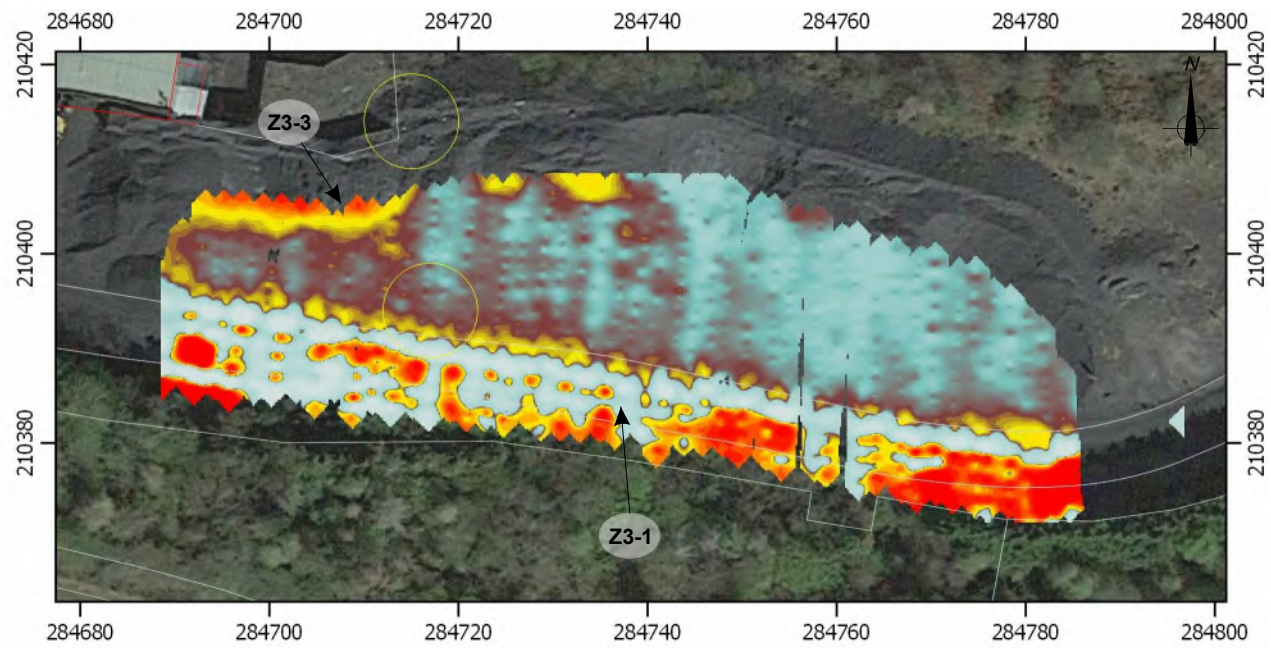
B) MAGNETIC ANALYTICAL SIGNAL - Significant ferrous metal anomalies



C) EM - GROUND CONDUCTIVITY

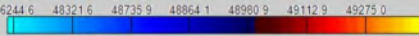


D) EM - IN-PHASE RESPONSE - Metal and cultural noise response

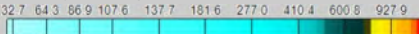


COLOUR SCALE

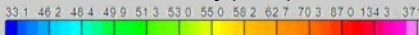
A - Total Field (nT)



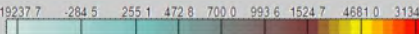
B - Analytical Signal (nT/m)



C - Electrical Conductivity (mS/m)



D - In-phase Response (ppm)



NOTES

Zone 3 can be divided into a lower lying flat area and sloped terrace base (north of steep slope), and a flat area usually covered in coal stock-piles in the south (approximately 8m higher than the north area). Due to an uneven surface, large boulders and vegetation on the slope in the north part of the zone, the magnetic and EM survey could not be undertaken on the slope. The flat, lower lying part of the north of Zone 3 was accessible in some parts, however, due to a large amount of metal interference (discarded rollers, rails and fencing), this area was not surveyed with the EM and magnetic techniques.

The expected location of adit 284210-020 was covered with all survey techniques; adit 284210-019 proposed location is on the break of slope with limited accessibility for the geophysical surveys.

The results of the magnetic and the electromagnetic surveys show relatively homogenous coal spoil material in this zone.

Main features detected in the surveys are highlighted and described below.

ID DESCRIPTION

- Z3-1:** High instrument response/overload associated with reinforced access road.
Z3-2: Increase in magnetic response adjoining access road; may be linked to road construction, service or similar. Due to the relative proximity to the proposed adit 284210-020 location, this feature may warrant further investigation.
Z3-3: Instrument interference from metal containers bordering the survey grid.
Z3-4: Increase in magnetic values, indicating increase in ferrous material/spoil in the subsurface.

KEY

- Expected location of mineshaft
- Expected location of adit
- ID of detected feature

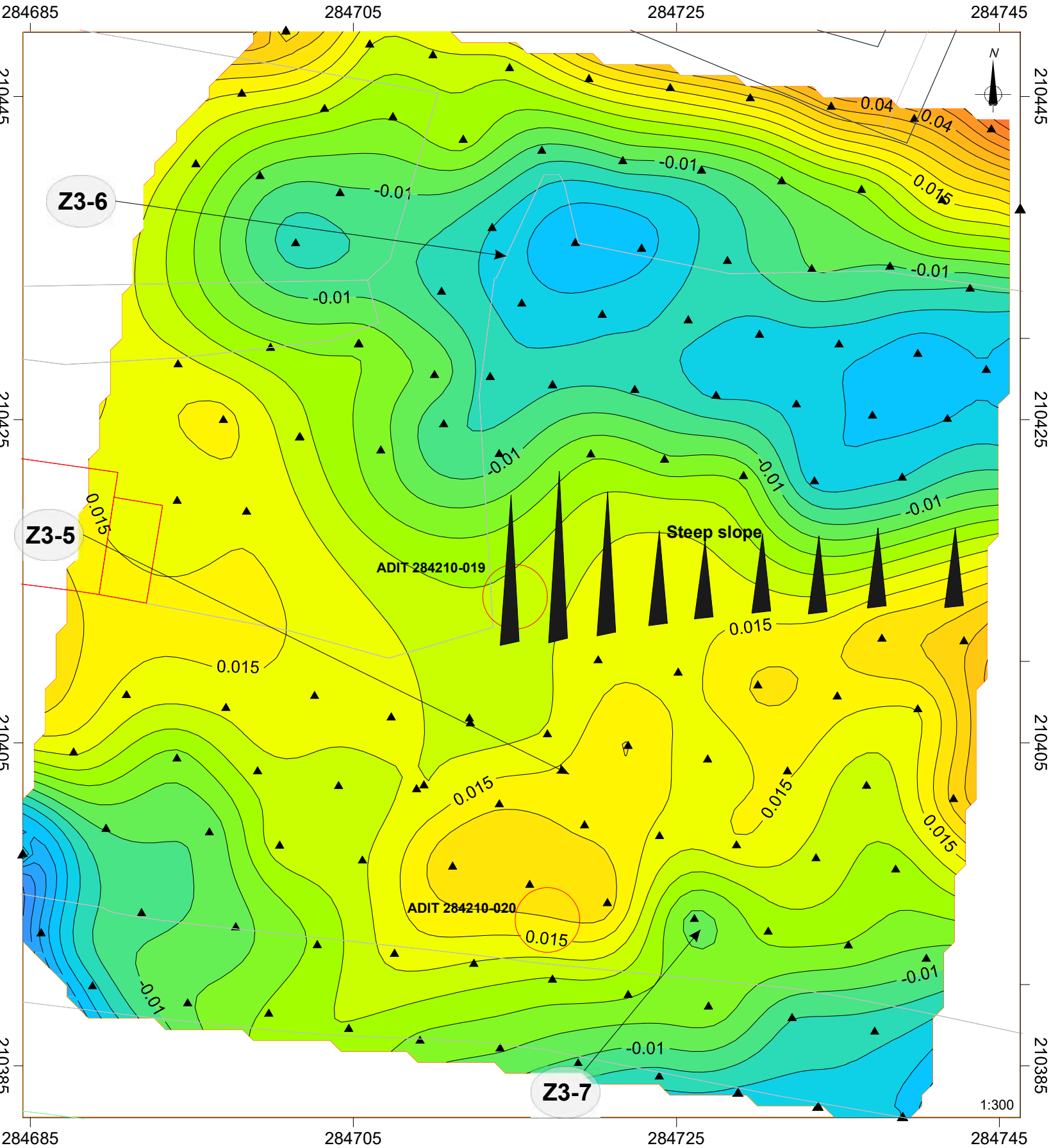
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ZONE 3 - MAGNETIC AND ELECTROMAGNETIC SURVEY RESULTS

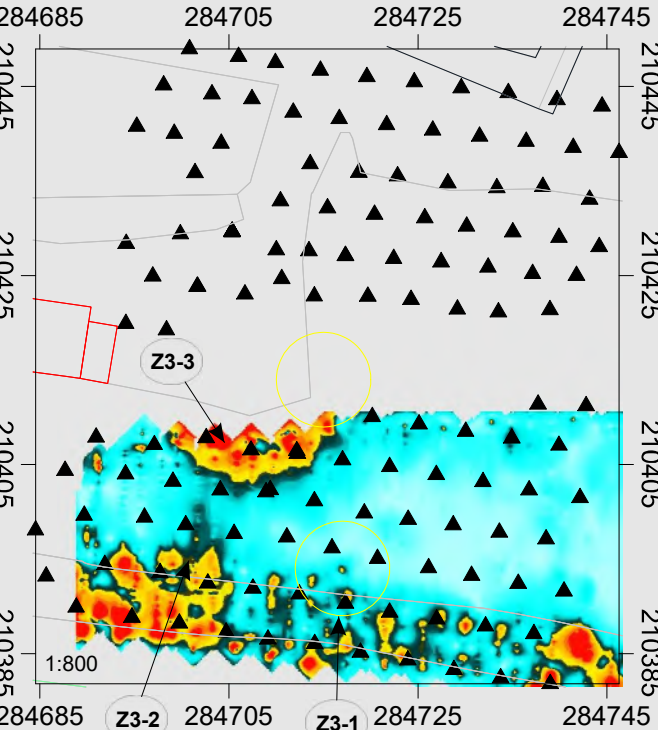
Project: ONLLWYN COAL WASHERY, NEATH-PORT TALBOT

Scale: 1:800 @ A3
Drawn by/Ref: KZ&AL/7591/6
Date: December 2021

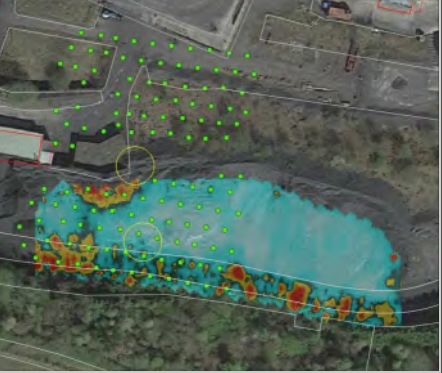
A) CORRECTED BOUGUER ANOMALY PLOT



B - MAGNETIC RESULTS



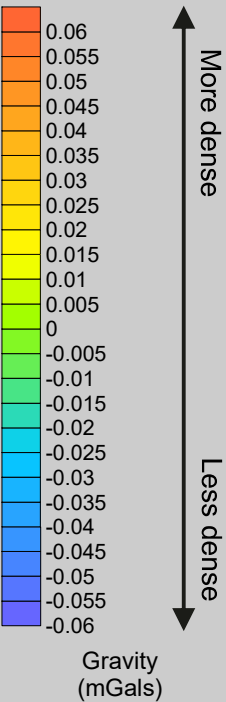
LOCATION MAP



KEY

- ▲ Gravity station and ID
- ▬ Simplified topographical plan
- Expected location of mineshaft
- Expected location of adit
- ID of detected feature

COLOUR SCALE



GRAVITY ANOMALY ID DESCRIPTION

Z3-5: Relatively similar gravity values (homogenous ground) in south coal storage area.

Z3-6: Relatively broad zone of low gravity values associated with the sloped bank, indicating less dense material that would be expected on uncompacted, loose slip material. May warrant further investigation at closest proximity to proposed mine adit 284210-019 location.

Z3-7: Subtle, localised decrease in ground density in proximity to proposed mine adit 284210-020 location. May warrant further investigation.

DATA NOTES

Reduction density used 1600 g/m³



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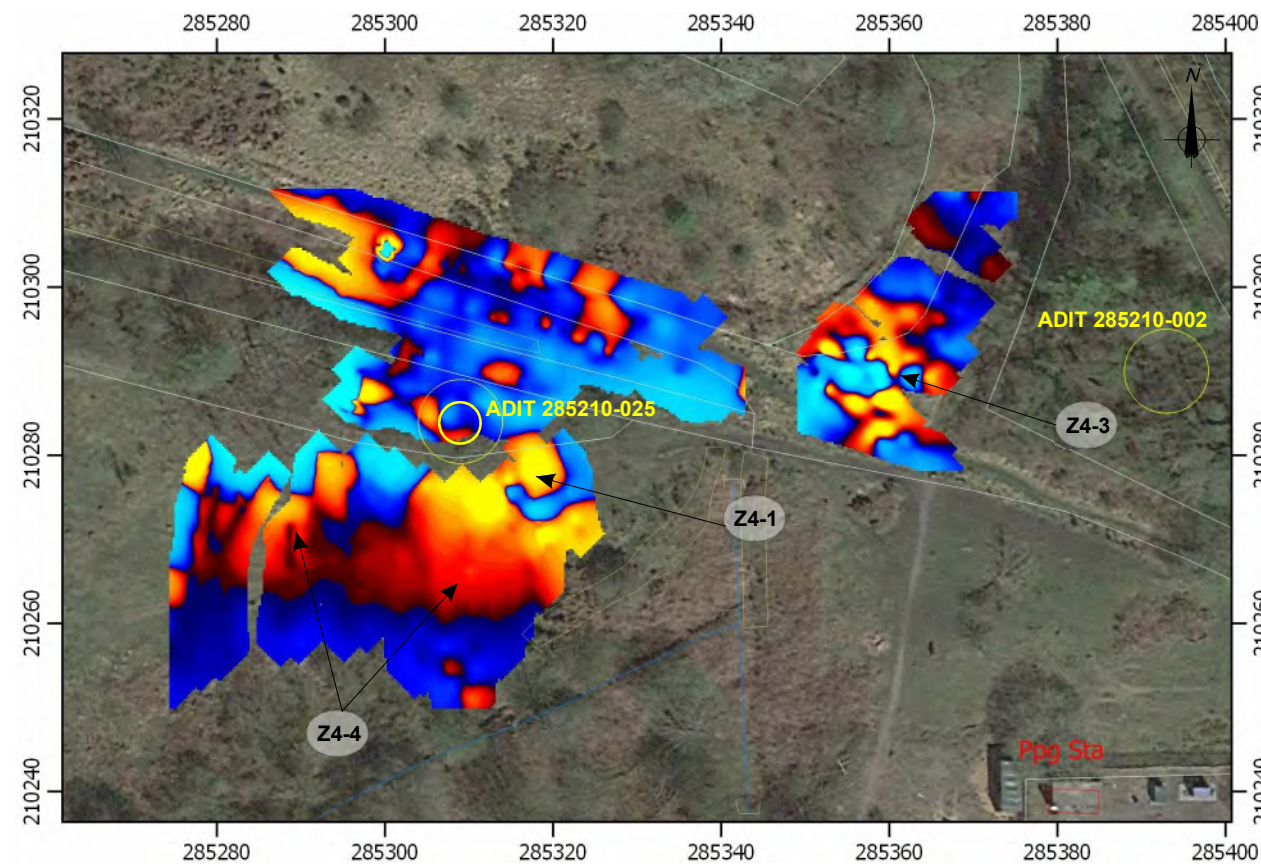
Title: **ZONE 3 - MICROGRAVITY SURVEY RESULTS**

Project: **ONLLWYN COAL WASHERY, NEATH-PORT TALBOT**

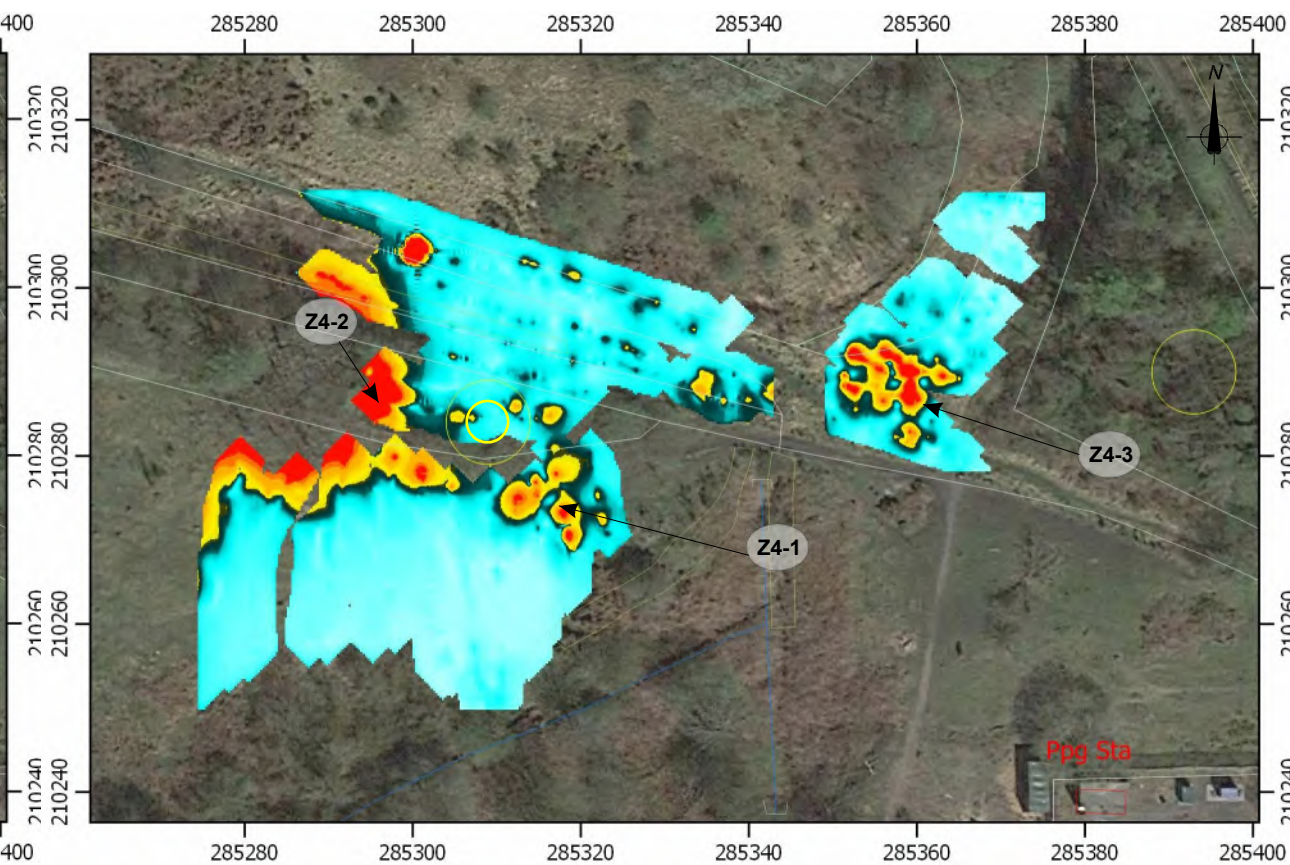
Scale: See individual plots
Drawn by/Ref: KZ&AL/7591/7
Date: December 2021

FIGURE 7

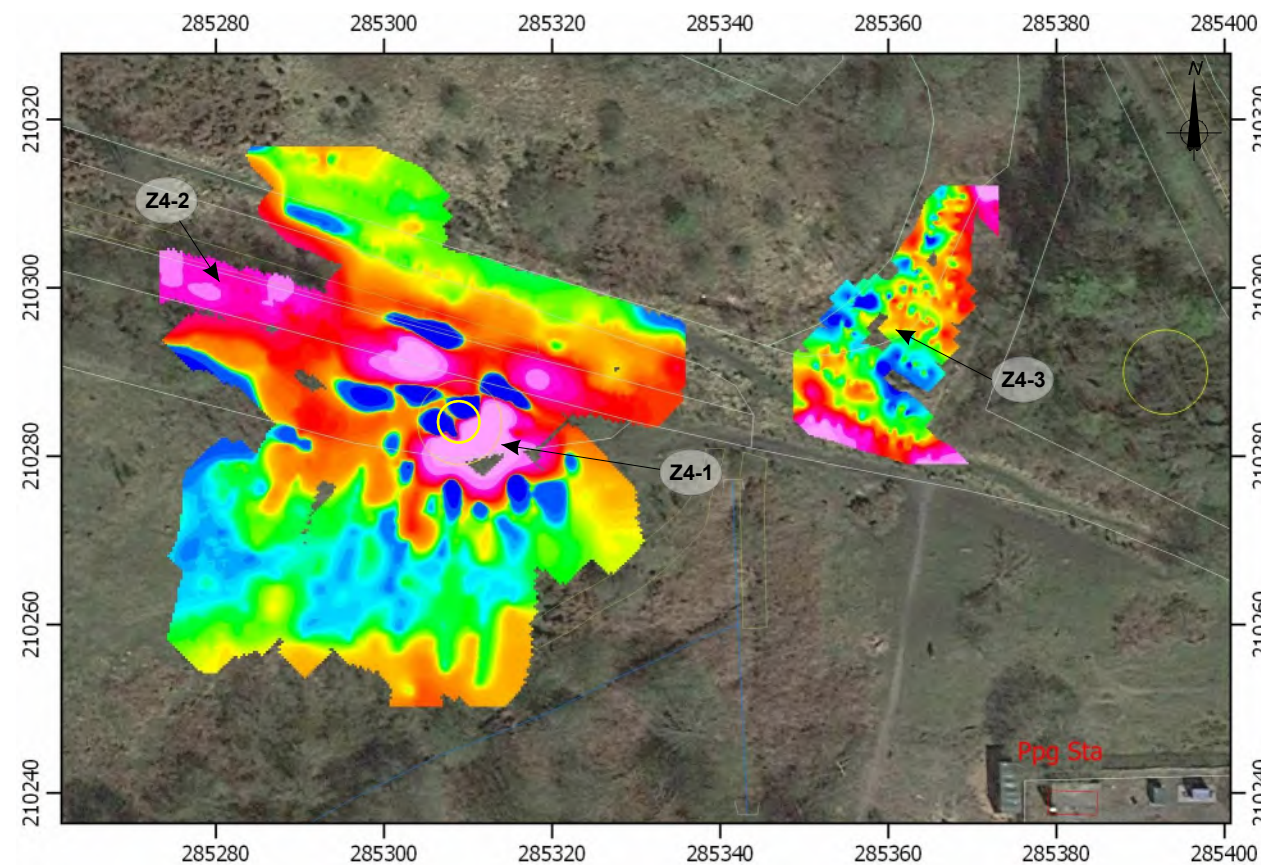
A) MAGNETIC TOTAL FIELD - Ferrous metal content



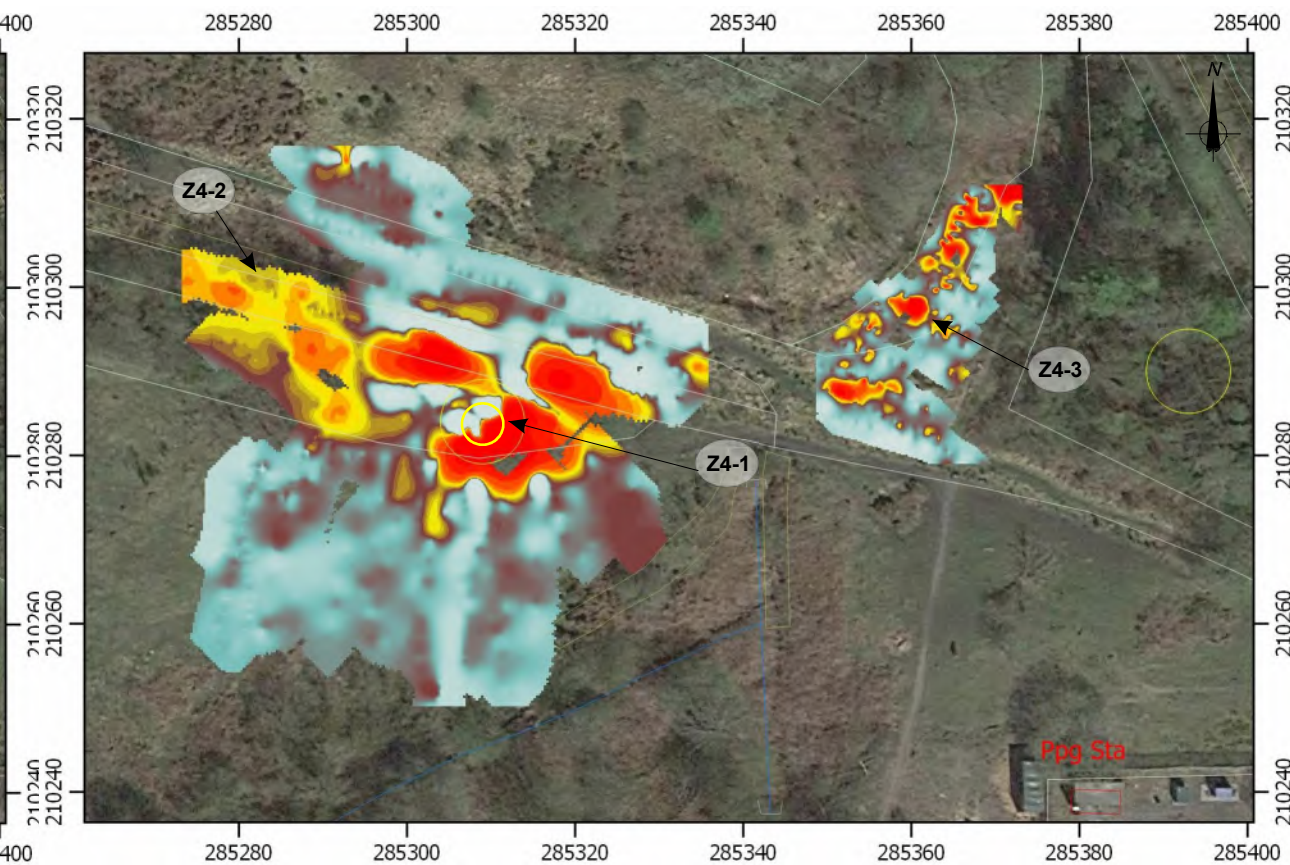
B) MAGNETIC ANALYTICAL SIGNAL - Significant ferrous metal anomalies



C) EM - GROUND CONDUCTIVITY



D) EM - IN-PHASE RESPONSE - Metal and cultural noise response



COLOUR SCALE

A - Total Field (nT)

48631.1 48803.9 48874.7 48930.4 48984.9 49041.5 49115.6

B - Analytical Signal (nT/m)

11.9 21.1 28.7 40.5 53.6 66.3 80.8 96.1 118.2 161.7 319.0 645.0

C - Electrical Conductivity (mS/m)

41.9 44.1 45.2 46.0 46.7 47.3 47.9 48.5 49.1 49.6 50.6 51.5 53.1

D - In-phase Response (ppm)

-946.4 -547.1 -363.8 -213.2 -73.6 35.9 130.9 272.2 493.7

NOTES

This zone targets adits 285210-025 and 285210-002. Adit 285210-002 was located in the eastern part of Zone 4 and awaits tree clearance for the survey to be undertaken.

The area of adit 285210-025 was located within a narrow wooded zone, partially cleared for the survey to take place. The metallic fencing located within the survey area has caused some interference, however, large dipolar responses in close proximity to the adit may be related to the mine workings and are recommended for intrusive investigation.

The results of the magnetic and the electromagnetic survey correlate well and highlight different ground characteristics and potential structures or features buried in the subsurface. Areas that show extreme values or instrument overload indicate buried metal.

Main features detected in the surveys are highlighted and described below.

ID DESCRIPTION

Z4-1: Zone of large dipolar instrument responses near to proposed adit location.

Z4-2: Zone of high instrument response to the west of the expected adit location, indicating high concentration of ferrous material and increased ground conductivity.

Z4-3: Overgrown, difficult to access area, with scattered high instrument responses indicating metallic debris or ferrous rich colliery spoil in the shallow subsurface.

Z4-4: Increased magnetic responses in field likely indicates more ferrous rich colliery spoil.

KEY

- Expected location of mineshaft
- Expected location of adit
- Z1-1 ID of detected feature



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Title: **ZONE 4 - MAGNETIC AND ELECTROMAGNETIC SURVEY RESULTS**

Project: **ONLLWYN COAL WASHERY, NEATH-PORT TALBOT**

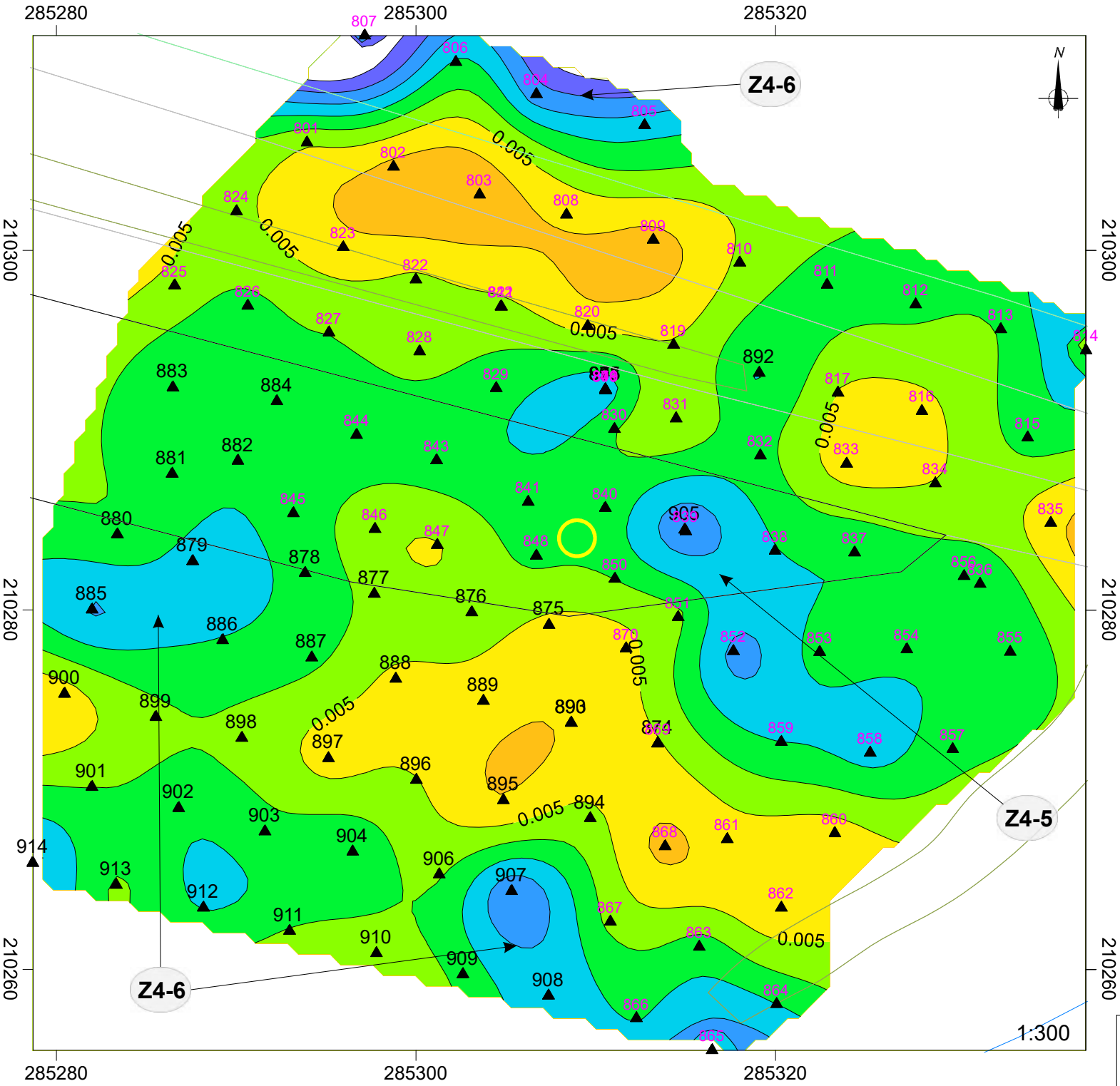
Scale: 1:900 @ A3

Drawn by/Ref: KZ&AL/7591/8

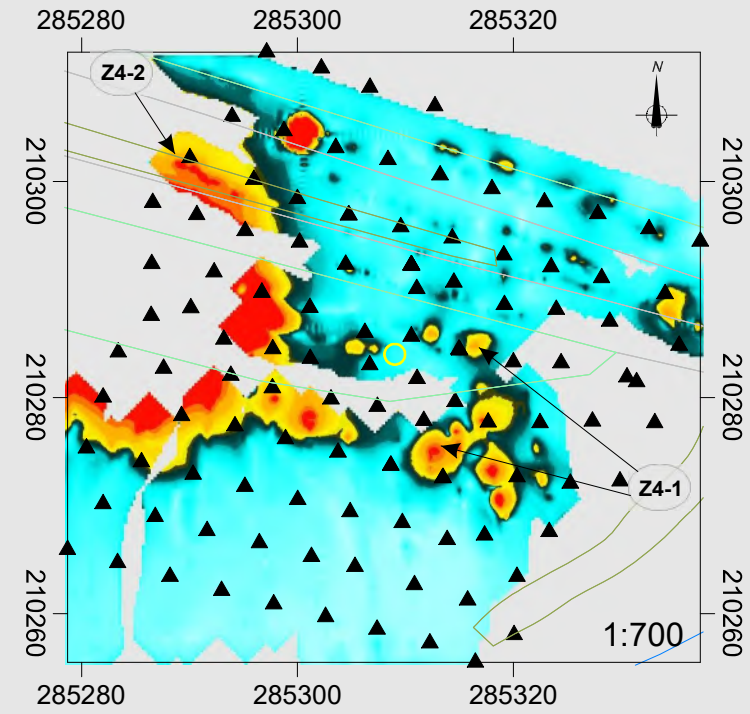
Date: December 2021

FIGURE 8

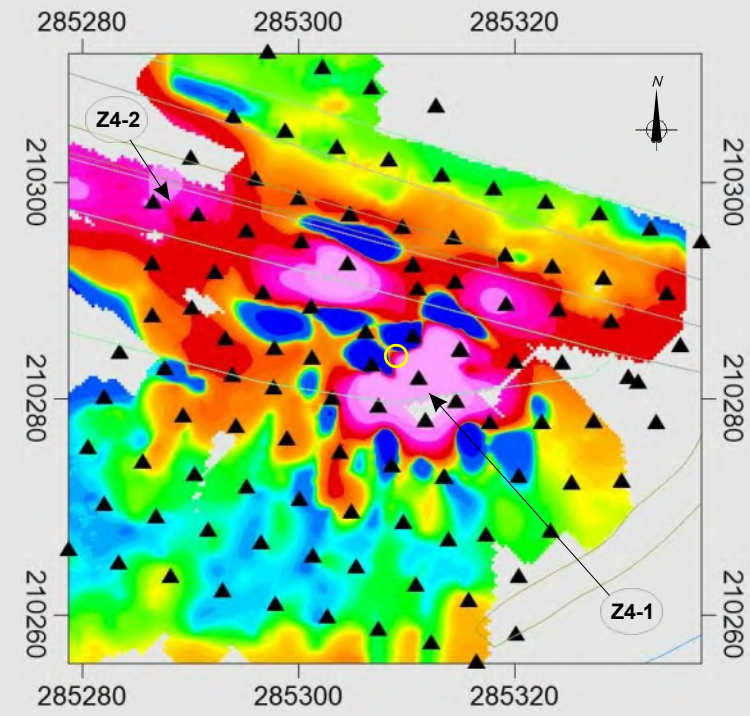
A) CORRECTED BOUGUER ANOMALY PLOT



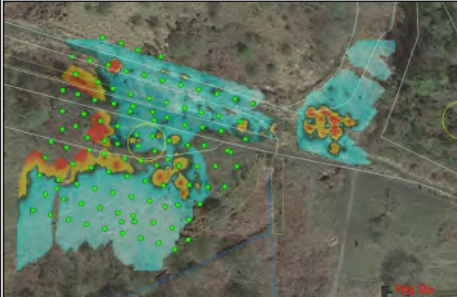
B - MAGNETIC RESULTS



C - GROUND CONDUCTIVITY



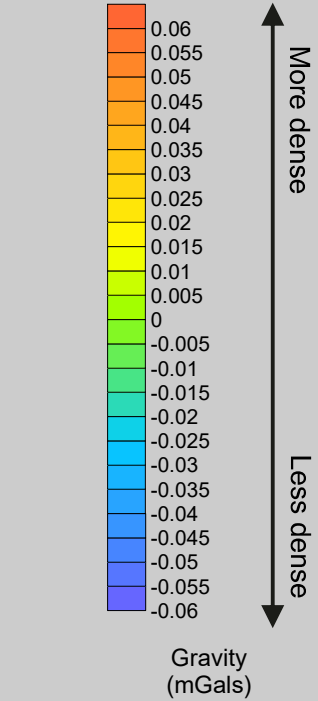
LOCATION MAP



KEY

- ▲ Gravity station and ID
- Simplified topographical plan
- Expected location of mineshaft
- Expected location of adit
- ID of detected feature

COLOUR SCALE



DATA NOTES

Reduction density used 1600 g/m³

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down to earth geophysics Web: www.terradata.co.uk
Email: web@terradata.co.uk

Title: **ZONE 4 - MICROGRAVITY SURVEY RESULTS**

Project: **ONLLWYN COAL WASHERY, NEATH-PORT TALBOT**

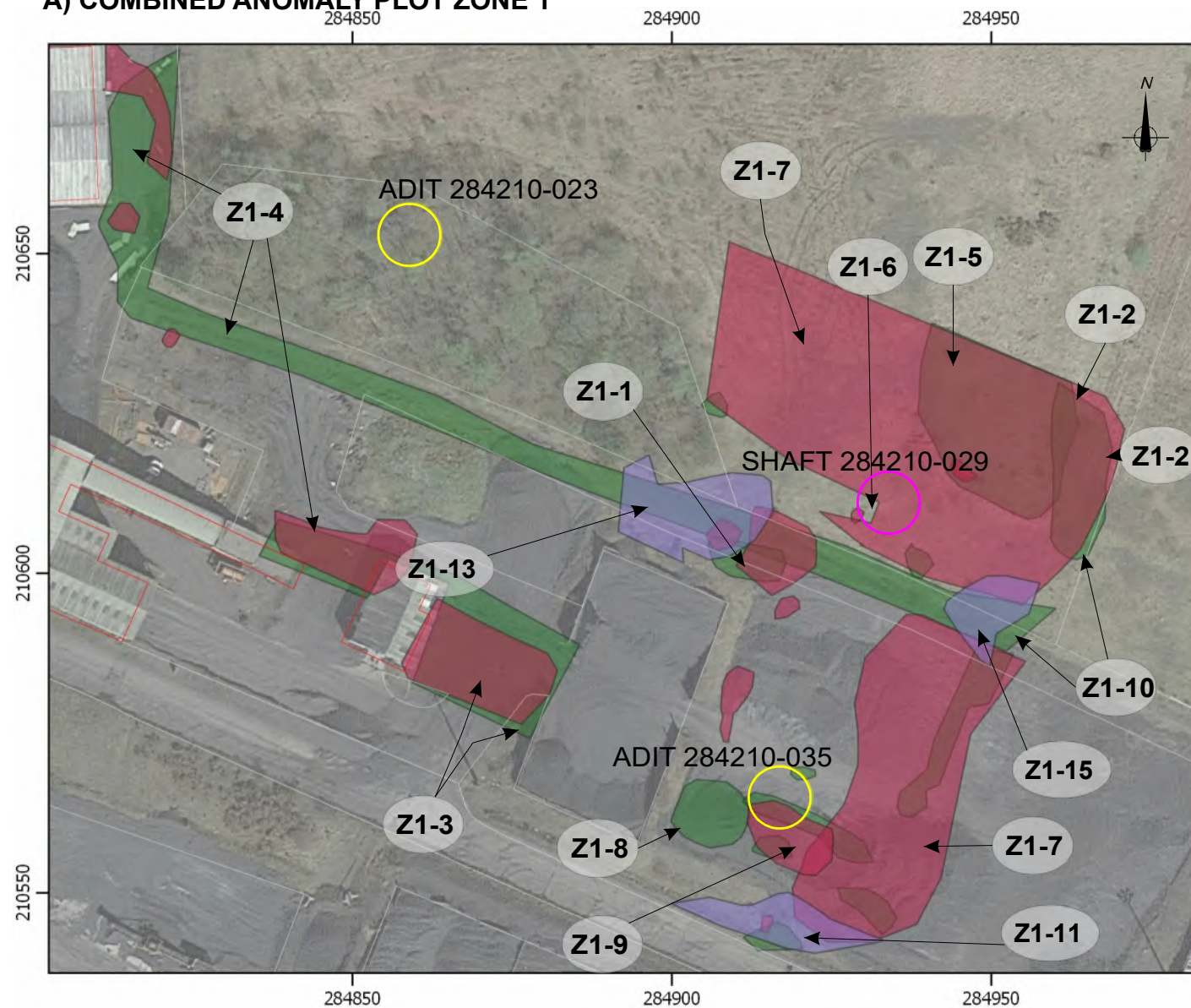
Scale: See individual plots
Drawn by/Ref: KZ&AL/7591/9
Date: December 2021

FIGURE 9

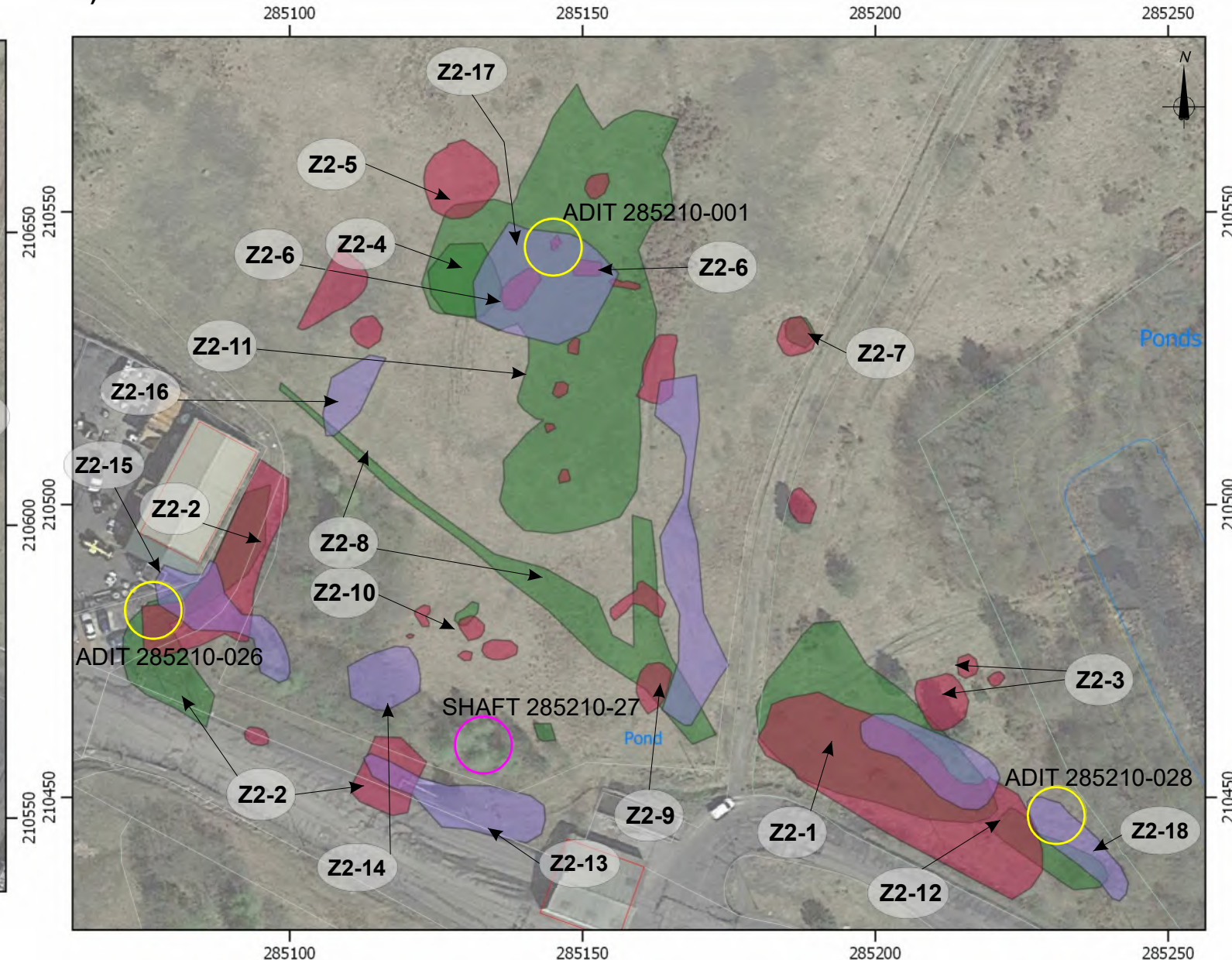
GRAVITY ID DESCRIPTION

Z4-5: Low gravity values close to the proposed adit location indicating less dense ground and correlating with a cluster of magnetic and EM anomalies. This area is recommended for intrusive investigation.
Z4-6: Low gravity zones likely indicates less dense areas of made-ground/colliery spoil.

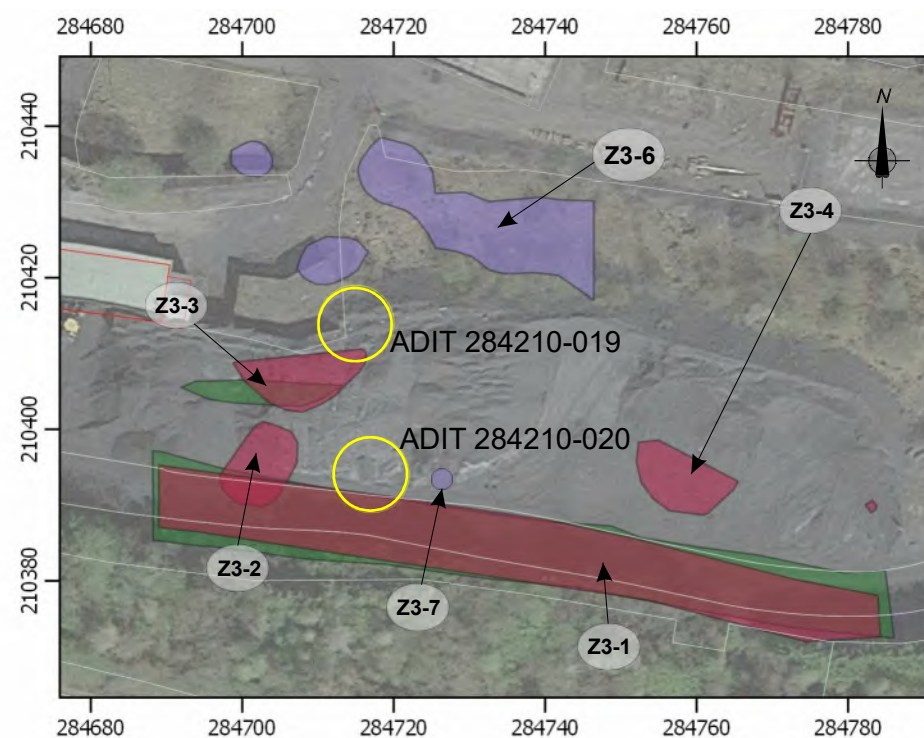
A) COMBINED ANOMALY PLOT ZONE 1



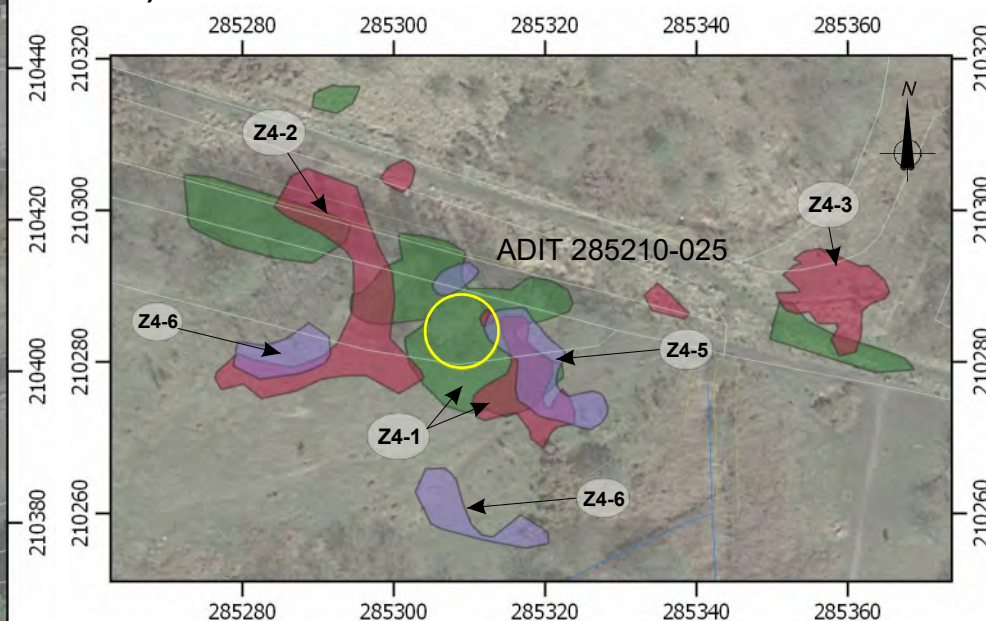
B) COMBINED ANOMALY PLOT ZONE 2



C) COMBINED ANOMALY PLOT ZONE 3



D) COMBINED ANOMALY PLOT ZONE 4



KEY

- Expected location of mineshaft
- Expected location of adit
- ID of detected feature
- Anomalous zone feature detected in magnetic survey
- Anomalous zone or feature detected in the EM survey
- Zone of mass decrease detected in the gravity survey

NOTES

Interpretive summary plots provide an overview of main features and anomalies detected in the surveys.

For detailed results and descriptions please refer to individual zones.

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SUMMARY SURVEY RESULTS

Project:
**ONLLWYN COAL WASHERY,
NEATH-PORT TALBOT**

Scale: 1:1000 @ A3
Drawn by/Ref: KZ&AL/7591/10
Date: December 2021

FIGURE 10

Appendix

Appendix - Magnetic Survey

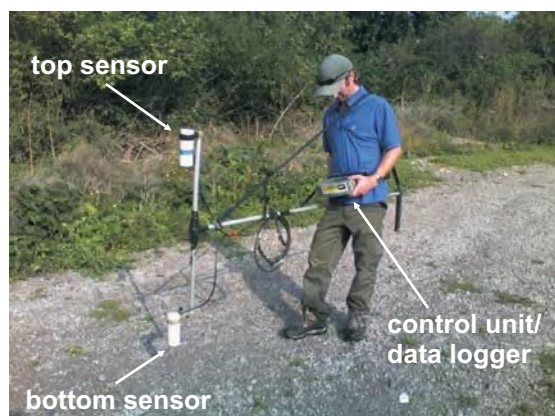
The magnetic survey technique is based on mapping localised variations in the Earth's magnetic field caused by sub-surface magnetic materials, which range from naturally occurring magnetic minerals to man-made ferrous objects. This leads to a wide range of applications from small-scale archaeology and engineering surveys to detect buried metallic objects, to large-scale surveys carried out to investigate regional geological trends or mineralisation.

Magnetic surveys are carried out using a man-portable instrument with readings taken on a regular grid or along selected traverse lines. The equipment functions by measuring the Earth's magnetic field to a very high precision at each survey station. Ferrous materials in the subsurface have an induced magnetic field that is superimposed on the Earth's field at that location creating a magnetic anomaly. The spacing of survey stations depends on the width of the expected anomaly, which broadens with the size, and depth of burial of the targeted feature. Continuous profiling methods may be used for a high-resolution dataset.

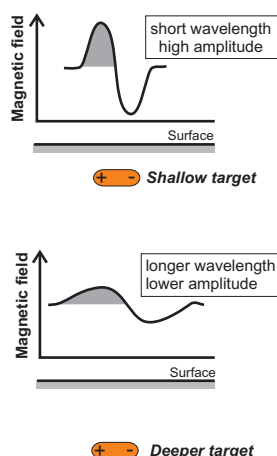
Magnetometer data are stored digitally by the survey instrument and downloaded to a field computer at the end of each day. The magnetic data are then processed to enhance any identifiable anomalies and presented on colour-contoured plots overlain with site maps (when available).

The results of the magnetic survey are usually presented as total field and analytical signal plots. The total field data may be used to observe the general character of the magnetic field across the survey area while the peak values (pink) displayed on the analytical signal plot indicate the source positions for dipole type magnetic anomalies. In general terms, the interpretation of a magnetic anomaly is based on observing the type (pole/dipole), amplitude and wavelength of the anomalous features.

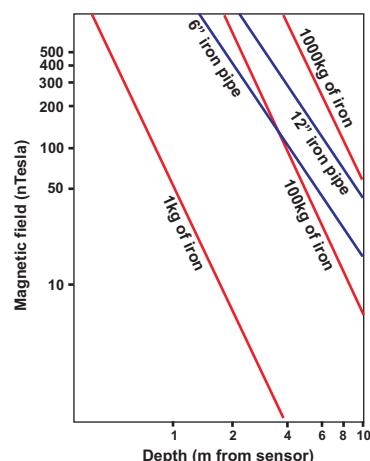
Gradiometer survey



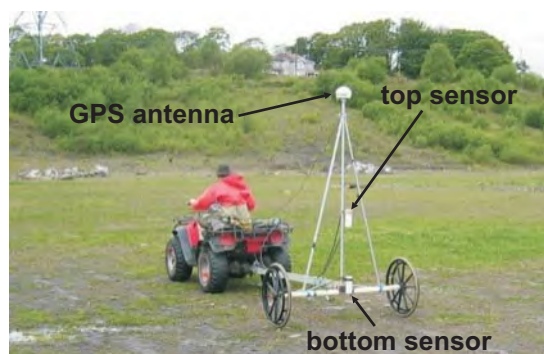
Magnetic anomalies



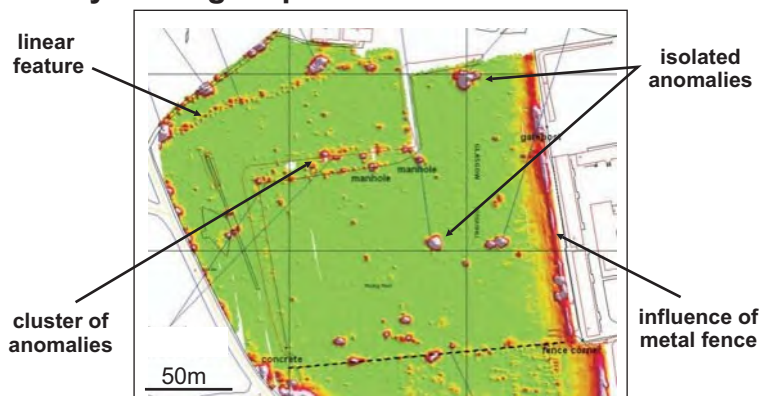
Guide to anomaly size



Towed gradiometer with dGPS



Analytical signal plot



Constraints

Metal objects or structures close to the survey area (fences, vehicles, debris etc.) produce a strong signal that can overshadow more subtle effects of sub-surface anomalies.

Appendix - Ground conductivity (EM) survey

A ground conductivity or electromagnetic (EM) survey involves the generation of an EM field at the surface and subsequent measuring of the response as it propagates through the subsurface. The main components of the instrument are a transmitter coil (to generate the primary EM field) and receiver coil (to measure the induced secondary EM field). The amplitude and phase-shift of the secondary field are recorded and are then converted into values for ground conductivity and in-phase component (metal indicator).

The ground conductivity (EM) instruments are either hand carried or mounted/towed behind a quad bike. Readings are usually taken on a regular grid or along selected traverse lines and positional control can be provided by dGPS if there is sufficient satellite coverage.

The selection of the particular EM instrument (EM-38/EM-31/GEM-2) is primarily based on the required penetration depth of the survey. However for most conductivity surveys the GEM-2 has replaced the more conventional EM-31 instrument due to its ability to simultaneously acquire data at different frequencies (i.e. different depth levels) and a greater depth of penetration. At the end of each survey, the survey data is downloaded to a field computer and corrected for instrument, diurnal and positional shifts. Additional editing may be carried out to remove any 'noisy' data values/positions.

The results from the EM survey can be presented as colour contoured plots of conductivity and inphase (metal response) data. In general terms, a relative increase in conductivity values usually indicates a local increase in clay content or water saturation. However, if there is a corresponding increase in the inphase response, the influence of some artificial source is likely (i.e. metal).



EM-38
Single frequency
Exploration depth ~1.5m

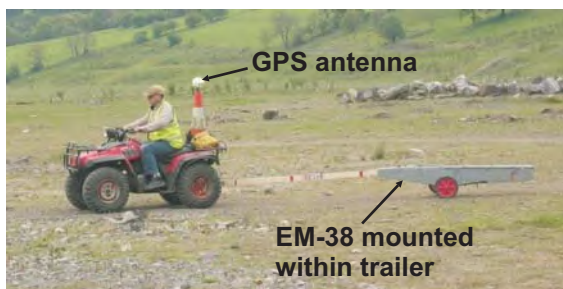


EM-31
Single frequency
Exploration depth ~3 to 5m

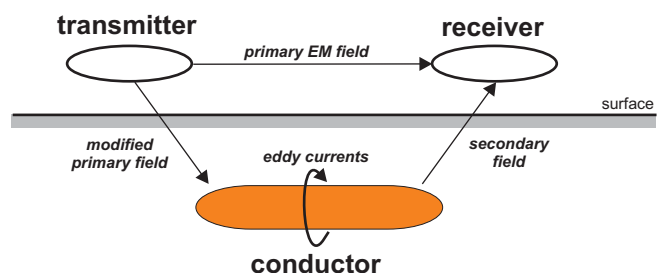


GEM-2
Multi-frequency
Exploration depth up to 10m

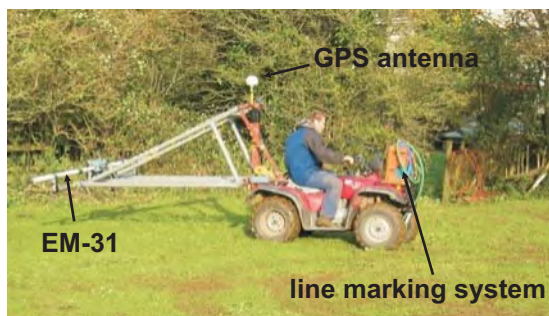
Towed EM-38 with dGPS



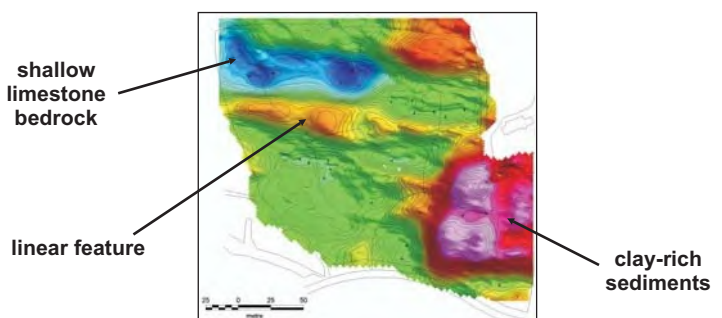
General principle of EM surveying



Mounted EM-31 with dGPS



Ground conductivity data plot



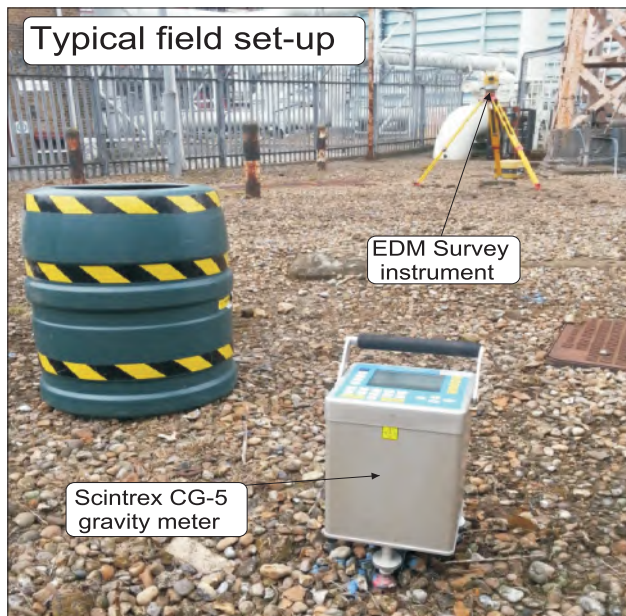
Constraints

Power lines, buildings, metal structures (fences, rebar, vehicles, debris etc.) and buried services can interfere with the electro-magnetic measurements.

Appendix - Gravity Survey

The gravity technique is based on measuring localised variations in the Earth's gravitational field which are caused by materials of different densities. The presence of an anomalously high (or low) density body in the subsurface causes a localised high (or low) anomaly in the measured gravitational field. The gravity effects described are extremely small, however, modern instrumentation and exhaustive data processing techniques enable detection of both geological and artificial structures or voids.

The CG-5 gravity meter is a semi-automated system that enables statistical averaging and filtering of readings taken every second over a fixed period of time (typically 2-3 minutes). The elevation of the gravity instrument was recorded to a 1mm precision ($<0.3\text{cm}$ error) at each survey station to facilitate accurate elevation correction. The results from the microgravity survey can be presented as a series of gravity profiles or colour contoured plot displaying the derived Bouguer Anomaly. Interpretation of the microgravity data is based on observing the shape, amplitude and wavelength of a particular anomaly and comparing it against the modelled gravity profile of a given target feature.



In order to remove (reduce) background gravitational effects i.e. those that do not originate from the target feature, the following processing steps were applied to the acquired dataset using a combination of internal CG-5 software and TerraDat proprietary software GRED.

Earth Tide, Temperature & Tilt Correction: Applied automatically by the gravity meter software.

Un-modelled Temporal Residual Correction: Obtained by least-squares fitting of a quadratic polynomial through the base station readings for each day. It is our normal practice to set the Bouguer anomaly at the base to zero so that the calculated values for the other stations are relative to a base station zero.

Latitude Correction: Calculated on the basis of the site latitude. Typically, due to the small latitude extent of the survey grid the correction is assumed to be linear per metre north.

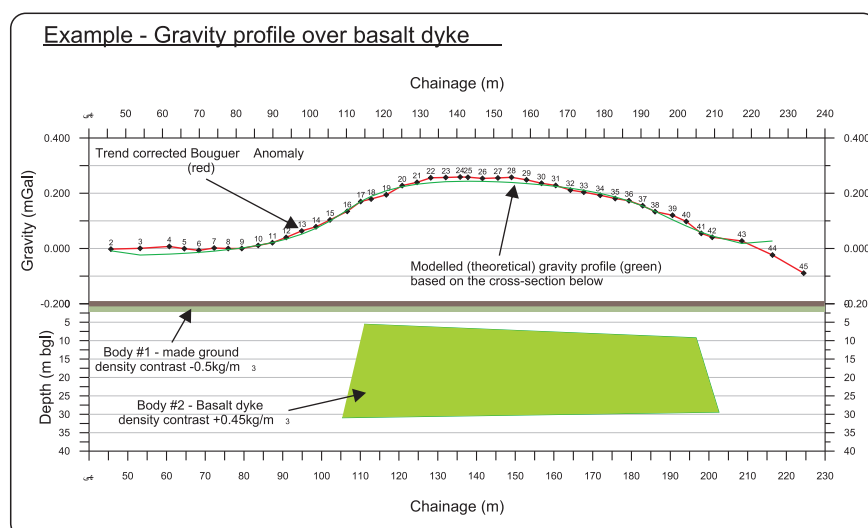
Free-air Correction: Applied to the dataset based on the instrument elevations, which were recorded to a 1mm precision ($<0.3\text{cm}$ error) using an EDM survey system.

Terrain Correction: Based on the measured ground level at each gravity reading station and selected points beyond the survey grid.

Bouguer Correction: The selection of the reduction density is based on both site and geological consideration plus Nettleton's method where appropriate.

Constraints

The principal limitation on the use of gravity is the time required for careful acquisition and data processing. The detectability of a feature using the gravity methods is proportional to its size/depth ratio and its density contrast with the host material. There is a decrease in spatial resolution with increased depth of burial. In terms of site considerations, it is best to avoid sites with severe terrain or are have excessive vibrational noise.



APPENDIX X – GROUND GAS & GROUNDWATER MONITORING RECORDS

Page 1 of 1

Project Name:	GCRE
Project No.:	Q0652
BH/TP No.:	BH07
Instruments Used:	Water Dip Meter Probe, GA2000 Gas Analyser

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
271.278	A	50mm	10.00	8.00-10.00

[illegible]

Page 1 of 1

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
236.953	A	50mm	5.00	1.00-5.00

[illegible]

Page 1 of 1

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
280.709	A	50mm	10.00	8.00-10.00

[illegible]

Page 1 of 1

Project Name:	GCRE
Project No.:	Q0652
BH/TP No.:	BH19A
Instruments Used:	Water Dip Meter Probe, GA2000 Gas Analyser

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
	A	50mm	28.20	25.20-28.20

[illegible]

Page 1 of 1

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
213.006	A	50mm	34.00	29.00-34.00

[illegible]

Page 1 of 1

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
257.707	A	50mm	49.20	39.20-49.20

[illegible]

Page 1 of 1

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
210977	A	50mm	49.20	39.20-49.20

[illegible]

Page 1 of 1

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
230.736	A	50mm	15.00	12.00-15.00

[illegible]

Page 1 of 1

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
230.738	A	50mm	4.00	3.00-4.00

[illegible]

Page 1 of 1

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
238.608	A	50mm	21.00	16.00-21.00
	B	19mm	5.00	1.00-5.00

[illegible]

Page 1 of 1

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
230.745	A	50mm	17.50	12.50-17.50

[illegible]

Page 1 of 1

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
230.736	A	50mm	20.00	15.00-20.00

[illegible]

Page 1 of 1

Installation Date:				
GL (mAOD)	Pipe	Type	Installation Depth (mbgl)	Response Zone (mbgl)
230.736	A	50mm	13.00	11.00-13.00
	B	50mm	3.30	1.00-3.30

[illegible]



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Appendix G.Factual Report Atkins Ground Investigation 2022/2023

Global Centre of Rail Excellence (GCRE)

Stage 1 Ground Investigation

Factual Report

G22069

January 2023

GCRE Limited

**Global Centre of Rail Excellence
Onllwyn
Neath Port Talbot
United Kingdom
SA10 9HN**

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Frams Enterprise Centre at Parc Busnes Edwards
Llantrisant
Pontyclun
CF72 8QZ

www.jacksonge.co.uk



Report Control Sheet**Report Number**

G22069

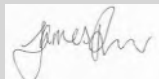
Date of Issue

January 2023

Site Address

Onllwyn Distribution Centre, Onllywn, Neath, SA10 9HN

Report Preparation

Revision	Writer	Approver
Rev 0	Adam Putt BSc (Hons) FGS CGeol CSci EurGeol MEnvSc Registered Ground Engineering Professional	James Power BSc (Hons) FGS
	Signature 	Signature 
Rev 1		
	Signature	Signature

Jackson Geo Services is a trading name of Jackson Drilling Holdings Limited – registered company number 06919550.

QMS ref: GEO-Q021

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1 Introduction

1.1 General

GCRE Limited entered into a contract with Jackson Geo Services (JGS) to complete a ground investigation at the Global Centre of Rail Excellence (GCRE) site (hereafter referred to as The Site). The contract was agreed during October 2022. As per the Construction Design and Management (CDM) Regulations (2015), parties were attributed the following responsibilities:

Table 1: Responsibility Under CDM

Client	GCRE Limited
Designer	Atkins (SNC-Lavalin)
Principal Contractor	Walters UK Limited
Sub-Contractor	Jackson Geo Services

1.2 Proposed Development

The site is proposed to be developed as a new rail testing and training centre, with the proposed development comprising a rail testing, storage and maintenance facility. The Phase 1 proposed works associated to this ground investigation comprise earthworks for the proposed rail depot and storage facility which will consist of the installation of multiple sidings for train stabling, inspection and maintenance sheds, fuelling roads and carriage wash facilities. In addition, to the track elements, it is also proposed to construct several buildings forming and Innovation Hub as well as further industrial/commercial developments.

1.3 Scope of Works

The scope of investigation was defined by Atkins and is detailed within specification document GCRE001-AWJV-EW-XX-SP-GE-00001 3.0 (dated November 2022) (hereafter referred to as The Specification). In summary, the scope of investigation comprised:

-  Dynamic Sampling with Rotary Follow-on Coring
-  Rotary open holing (probe holing) for mine workings
-  Machine Excavated Trial Pitting
-  In-situ Testing
-  Geotechnical Testing
-  Geoenvironmental Testing
-  Factual Reporting
-  Production of Digital Data in AGS4 format

1.4 Limitations

The project has been undertaken in accordance with The Specification and current standards and guidance as applicable (see References).

This report presents the observations made during desk based studies and the fieldwork period on a factual basis. Any observations within the report are limited to those which can be made based upon the information available at the time.

JGS consider the contents of the report have been produced accurately and the data presented is representative of the site conditions at the time. JGS assumes any third party data included in the report is accurate and correct. No responsibility is accepted by JGS for inaccuracies within third party data.

This report has been written to The Specification and is for use only in this context by the named Client and their advisers and is confidential to the named Client.

This report presents information on ground conditions, including groundwater, gas and contamination concentrations and soil properties, which are based upon the available dataset for the investigation. This dataset is considered representative of the site as whole, however is limited by the locations of investigation. Ground conditions, in particular Made Ground, can vary substantially and JGS do not accept responsibility for local unforeseen changes. Furthermore, groundwater, gas concentrations and chemical concentration can vary with time, atmospheric conditions and spatially dependent upon a variety of confining factors.

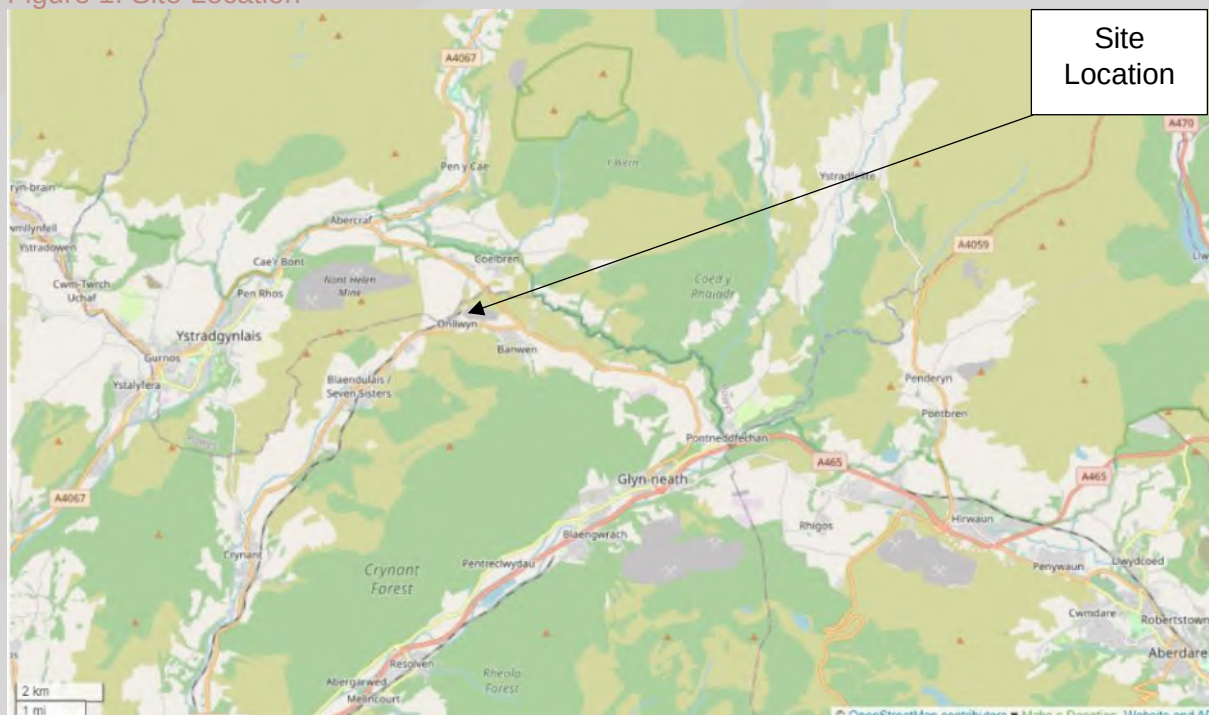
Consideration should be made as to the relevance of the information if the dataset is to be utilised after a significant period of time has elapsed from the date of investigation.

2 The Site

2.1 Site Location

The Site is situated at National Grid Reference (NGR) SN 844 104, and is approximately 200 m north of Onllwyn Welfare Hall. The location of The Site is shown in Figure 1:

Figure 1: Site Location



© OpenStreetMap contributors. <https://www.openstreetmap.org/copyright>

2.2 Current Use

The Site comprises part of the now defunct Onllwyn Washery and Distribution Centre. It is pseudo-triangular in shape and measures approximately 830 m (west to east) and 170 m (north to south) along its longest axes.

The Site was being decommissioned during the fieldwork period with many of the rail tracks, buildings, conveyors and related concrete slabs and basements in the process of being, or having already been, removed. There are several structures onsite relating to its previous use comprising a mixture of brick structures (substation and laboratory) and metal structures (fitting shops, stores, and associated buildings). Although The Site steps up in places (west to east) it is predominantly flat rising very gently from west to east. The exception to this is at the eastern most point of The Site where it rises moderately steeply from south to north. There are numerous drainage channels around the site that flow freely (east to west) during periods of rainfall. There are unnamed watercourse along the north and west of the site that feed in to (occasionally via settlement ponds) Avon Dulais. To the south of The Site are three brick buildings comprising a bath house, a main reception and a visitor's centre.

The northern boundary follows a railway track that was used to export the coal away from the site, beyond which is an area of grassy bog and grassland. The small settlement of Coelbren lies beyond the bog and grassland. The former Nant Helen Opencast Mine is to the north east. The west of the site is bound by Onllwyn Road, a highway. which also crosses the site via two bridges which are adjacent to each other. Beyond Onllwy Road lies open grassland and the A4109 highway to the south west which leads to Seven Sisters. Immediately to the south of the site are buildings and infrastructure associated with the washery, beyond which lie the settlements of Onllwyn and Banwen, plus land associated with Mesgwyn Wind Farm and Walter's Arena further to the south. To the west the site is bounded by land associated with the washery including a weighbridge and a small independent coal merchant, beyond which lies grassland and woodland leading to The Brecon Beacons.

2.3 Anticipated Ground Conditions

The anticipated ground conditions have been assessed using the data available on the British Geological Survey (BGS) GeoIndex (onshore) Map Viewer (2022) and the published BGS map (map no. 231, 1979), these are summarised within Table 2:

Table 2: Anticipated Ground Conditions

Artificial Ground	Made Ground	Artificial Deposit
Superficial Deposits	Peat in northern section of the site. None recorded in the remainder of the site.	Peat
Solid Geology	South Wales Middle Coal Measures Formation in the west of the site. South Wales Lower Coal Measure Formation in the east underlies the majority of the site.	Mudstone, Siltstone and Sandstone.

Areas of artificial ground, considered to be associated with the former washery and related mining activity are located to the south, south west and north east of the site only as isolated features.

There is an inferred fault of unknown displacement shown on the GeoIndex (onshore) Viewer. It trends south south-east to north north-west, through the site and also demarcates the geological boundary between the middle and lower South Wales Coal Measures.

It is known that mine workings associated with the South Wales Coal Measures are located beneath the site.

The Department for Environment, Food & Rural Affairs (DEFRA) MAGIC mapping system (2021) indicates The Site is located within an area where the bedrock is classified as a secondary A aquifer. The superficial (peat) deposits are not shown as being classified.

3 Fieldwork

3.1 General Information

The fieldwork was completed between 7 November and 23 December 2022. A second phase of works is proposed to complete some additional exploratory holes which will form part of the Stage 1 ground investigation. This will commence from 16 January 2023.

The ground investigation was undertaken in accordance with BS5930:2015+A1:2020. The works were supervised by a trained and competent JGS engineer.

The layout of the investigation locations and their unique identifiers were determined by Atkins and are listed within Schedule 2 of The Specification. This information was provided to JGS prior to works commencing onsite. Walters UK Limited set out the locations onsite using co-ordinates provided.

Service drawings were provided to JGS by Walters UK Limited prior to works commencing on site and the location of the proposed investigation locations was checked against the service drawings prior to excavation.

Prior to excavation, each exploratory hole location was scanned using a Cable Avoidance Tool (CAT) to confirm the absence of services beneath the proposed excavation.

All exploratory hole locations, with the exception of machine excavated trial pits and rotary open (probe holes), were excavated to a depth of 1.20 m by hand prior to using mechanical plant. As hand excavation progressed, the excavations were scanned using a Cable Avoidance Tool (CAT) to continue to confirm the absence of services.

Where rotary open (probe) holes were completed, a trench was excavated to a depth of 1.20 m depth by hand around each proposed batch of drill hole locations to confirm no services had been laid into the area of investigation.

Where exploratory holes were extended into the Coal Measures, 5 in 1 gas monitors measuring carbon monoxide (CO), methane (CH₄), Carbon dioxide (CO₂), Oxygen (O₂) and Hydrogen Sulphide (H₂S) were placed at the well head during drilling in order to confirm gas concentration's within the drilling operatives breathing zone.

Photographs of the materials encountered were taken in accordance with The Specification and are presented in Appendix II.

Following completion of the fieldwork, all investigation locations been surveyed to National Grid and Ordnance Datum. The location of the exploratory holes is shown on the drawing within Appendix I. The survey was completed by Walters UK Limited.

3.2 Exploratory Holes

The proposed numbers of exploratory holes, their unique identifiers, termination depths and installation requirements were provided to JGS within Schedule 2 of The Specification. The details of the as built exploratory holes, including the location ID, construction method, actual termination depth and installation detail, are listed within Table 3.

Table 3: Exploratory Hole Details

Exploratory Hole ID	Construction Method	Termination Depth (m)	Installation Details		
			Type	Diameter (mm)	Response Zone (m bgl)
S1-BH101	Dynamic Sampling with Rotary Coring	24.60	SP	50	11.00 – 14.00
S1-BH102		30.00	SP	50	6.00 – 9.00
S1-BH103		30.80	SP	50	2.00 – 5.50
S1-BH105		30.80	SP	50	11.00 – 15.00
S1-BH106		20.00	Backfilled with Bentonite		
S1-BH107		8.00	Backfilled with Bentonite Cement Grout		
S1-BH108		30.00	SP	50	13.00 – 15.50
S1-BH109		15.90	Backfilled with Bentonite		
S1-BH110		12.00	Backfilled with Bentonite		
S1-BH112		30.40	SP	50	1.00 – 2.50
			SP	50	8.00 – 15.00
S1-BH113		30.00	SP	50	3.00 – 5.50
S1-BH114		9.00	Backfilled with Bentonite		
S1-BH114B	Dynamic Sampling	4.00	Backfilled with Bentonite Cement Grout		
S1-BH116	Dynamic Sampling	17.40	Backfilled with Bentonite		
S1-BH121	Dynamic Sampling with Rotary Coring	10.50	SP	50	2.00 – 3.50
S1-BH122		10.50	SP	50	1.00 – 1.90
SOP001.1	Rotary Open Holing	25.00	Backfilled with Bentonite		
SOP001.2		15.00			
SOP001.3		15.00			
SOP001.4		15.00			
SOP001.5		15.00			
SOP001.6		15.00			
SOP001.7		15.00			
SOP001.8		15.00			
SOP001.9		15.00			
SOP001.10		15.00			
SOP001.11		15.00			
SOP001.12		15.00			
SOP001.13		15.00			
SOP001.14		15.00			
SOP001.15		15.00			
SOP001.16		15.00			
SOP001.17		15.00			

SOP001.18		15.00	Backfilled with Bentonite		
SOP001.19		15.00			
SOP001.20		15.00			
SOP002.1		20.00			
SOP002.2		11.50			
SOP002.3		11.50			
SOP002.4	Rotary Open Holing	11.50			
SOP002.5		11.50			
SOP002.6		11.50			
SOP002.8		11.50			
SOP002.9		11.50			
SOP002.10		11.50			
SOP002.11		11.50			
SOP002.12		11.50			
SOP002.13		11.50			
SOP002.14		11.50			
SOP002.15		11.50			
SOP002.16		11.50			
SOP002.17		11.50			
SOP002.18		11.50			
SOP002.19		11.50			
SOP002.20		11.50			
SOP002.21		11.50			
SOP002.22		11.50			
SOP002.23		11.50			
SOP002.24		11.50			
SOP002.25		11.50			
SOP003.1		14.00			
SOP003.2		12.50			
SOP003.3		15.00			
SOP003.4		15.00			
SOP003.5		15.00			
SOP003.6		13.00			
SOP003.7		15.00			
SOP003.8		13.00			
SOP003.9		15.00			
SOP003.10		15.00			
SOP003.11		15.00			
SOP003.12		15.00			
SOP003.13		15.00			
SOP003.14		15.00			
SOP003.15		25.00			
SOP003.16		23.00	SP	50	10.00 – 13.00
Emb 2 Soakaway	Machine Excavated Trial Pit	2.00	Backfilled with Arisings		
S1-TP101		2.40			
S1-TP102		3.90			
S1-TP103		4.00			
S1-TP104		4.00			
S1-TP105		0.80			
S1-TP106		4.00			
S1-TP109		4.00			
S1-TP110		3.50			
S1-TP111		3.50			
S1-TP112		1.70			
S1-TP113		4.00			
S1-TP114		2.40			
S1-TP115		0.70			
Trial Emb Cut		2.00			

Notes: SP – Standpipe piezometer; P – Piezometer

Exploratory hole S1-BH101 was extended beyond the proposed scheduled depth of 17.00 m as per Atkins instruction due to bedrock not being encountered within the borehole. The exploratory was extended to a maximum depth of 24.60 m.

Exploratory hole S1-BH107 was terminated at 8.00 m depth due to encountering artesian water.

Exploratory hole S1-BH114 was terminated at 9.00 m depth due to encountering artesian water. The location was relocated approximately 20 m east and renamed S1-BH114B. This exploratory was subsequently terminated at 4.00 m depth due to encountering artesian water.

The rotary open (probe) hole locations (designated SOP001, SOP002 and SOP003) were all terminated at depths as per Atkins onsite instructions.

Exploratory hole S1-TP101 was terminated at 2.40 m depth due to instability.

Exploratory hole S1-TP102 was terminated at 3.90 m depth due to hard ground preventing further excavation.

Exploratory hole S1-TP105 was terminated at 0.80 m depth due to water ingress.

Exploratory holes S1-TP107 and S1-TP108 were not excavated due to waterlogged ground preventing access.

Exploratory hole S1-TP110 was terminated at 3.50 m due to instability.

Exploratory hole S1-TP111 was terminated at 3.50 m depth on bedrock.

Exploratory hole S1-TP112 was terminated at 1.70 m depth due to water ingress and instability.

Exploratory hole S1-TP114 was terminated at 2.40 m due to water ingress and instability.

Exploratory hole S1-TP115 was terminated at 0.70 m due to water ingress.

Fair copy logs, which record the method, samples obtained, in-situ testing completed within the exploratory holes, backfill and descriptions of the material encountered, are presented within Appendix II.

3.3 Logging and Sampling

Samples of the materials encountered were obtained in accordance with The Specification for descriptive and geotechnical and geoenvironmental testing purposes.

The description of the materials encountered was completed in accordance with BS5930:2015+A1:2020, BS EN ISO 14688-1 (2018) and BS EN ISO 14689 (2018).

Geotechnical samples were stored at ambient temperature and protected from extremes of weather until lab testing commenced, either onsite or at the JGS Llantrisant sample storage facility. Once scheduled for testing, the samples were transported to Geo Site and Testing Services (GSTL).

Geoenvironmental samples were packaged appropriately and dispatched directly from site to Eurofins Chemtest ensuring compliance with the deviant sampling policy. The samples were subsequently stored under laboratory conditions until testing commenced.

3.4 In-situ Testing, Monitoring and Well Development during Fieldwork

In-situ testing was completed in accordance with The Specification and relevant associated technical standards. In summary, the in-situ testing comprised the following:

-  Standard Penetration testing
-  Headspace testing using a Photo Ionisation Detector
-  Soakaway Testing

The lateral and vertical spacing of the in-situ testing was determined by Atkins.

Soakaway testing was unable to be completed within exploratory hole locations; S1-TP112 and S1-TP114 due to water ingress and instability during excavation, S1-TP113 due to water ingress occurring into the pit overnight and S1-TP115 due to water ingress during excavation.

The in-situ testing results are presented within Appendix II. Where an in-situ test is not listed as separate item on the appendix cover page, the results of the in-situ testing are presented on the exploratory hole logs. Calibration certificates for the equipment used are presented within Appendix II as appropriate.

Monitoring of the groundwater was undertaken during fieldwork by JGS in accordance with The Specification and relevant technical standards. Monitoring undertaken during the fieldwork period is presented within Appendix III.

Each installation was developed during the fieldwork period. The well development was undertaken in accordance with The Specification and groundwater extracted using an in-situ impellor pump. Records of the well development are presented within Appendix III.

3.5 Post Fieldwork Monitoring and Sampling

Monitoring of the groundwater and ground gas was undertaken post fieldwork by JGS in accordance with The Specification and relevant technical standards. Three post fieldwork monitoring visits have been proposed, however at the time of issue of this report only the first round of monitoring has been completed. The monitoring was completed on 9 January 2023. Records of the groundwater and gas levels recorded during monitoring are presented within Appendix III along with associated calibration certificates for the equipment used.

Samples of the groundwater will be obtained from the installations post fieldwork in accordance with The Specification. The samples will be obtained using low flow techniques. Records of the in-situ parameters recorded during purging and sampling will be presented within Appendix III.

4 Laboratory Testing

4.1 Geotechnical Testing

Laboratory testing for geotechnical purposes was completed at Geo Site and Testing Services Limited, UKAS registration number 2788. The testing requirements were specified by Aktins and the testing has been completed in accordance with the requirements of The Specification and relevant technical standards. At the time of issue of this report the geotechnical testing is still ongoing. An interim set of data is presented in this report. The interim testing is summarised in Table 4 and the results are presented within Appendix IV.

Table 4: Geotechnical Testing Summary

Test Type	Number of Tests
Moisture Content	13
Atterberg Limits	11
Particle Size Distribution	24
Dry Density / Moisture Content Relationship	1
Point Load Index	3
Total Organic Carbon	6
BRE Suite D	23

4.2 Geoenvironmental and Geochemical Testing

Laboratory testing for geoenvironmental and geochemical purposes was completed at Eurofins Chemtest, UKAS registration number 2183. The testing requirements were specified by Atkins and the testing has been completed in accordance with The Specification and relevant technical standards. The geoenvironmental testing scheduled during the fieldwork period was completed on 16 January 2023, however further testing will be scheduled as part of the monitoring. The testing is summarised within Table 5 and the results are presented within Appendix V.

Table 5: Geoenvironmental Testing Summary

Test Type	Number of Tests
Suite E – Soil	80
Suite F – Leachate	29
Suite G – Waters	1
Suite H – Inert Waste WAC	33

5 References

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Appendix I

Drawings

Exploratory Hole Plan

Drawing Number: G22069-JGS-001