

LAND OFF UPPER COLLIERS' ROW
HEOLGERRIG, MERTHYR TYDFIL
SOUTH WALES

Completion Report

Consolidation of Potential Abandoned Ironstone
Workings by Drilling and Grouting



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Contents

Control Sheet	3
Introduction	5
Site Location And Description	6
Ground Conditions & Geology	6
Methodology	7
Ground Stability Assessment	10
Conclusion.....	11

Appendices

Appendix A	Figures
Appendix B	Coal Authority Permit
Appendix C	Drilling and Grouting Details
Appendix D	Cube Test Certificates

Control Sheet

This report has been prepared for the sole benefit, use and information of Maxiom Developments Ltd for the purposes set out in the instructions commissioning it. The liability of Van Elle Ltd in respect of the information contained in the report will not extend to any third party. It is now the client's responsibility to fulfil the Coal Authorities requirements with regards to the Coal Authority Permit.

SUMMARY TABLE: COMPLETION REPORT FOR THE DRILLING AND GROUTING TREATMENT OF POTENTIAL MINEWORKINGS	
SITE:	Upper Colliers' Row, Heolgerrig, Merthyr Tydfil, South Wales
CLIENT:	Maxiom Developments Ltd
DATE:	17 March 2022
REFERENCE:	VE 214320 – PS3328 V1
DEVELOPMENT PROPOSAL:	The proposed development comprises the clearance and regrading off a parcel of vacant land and the construction of 8 no. detached two-storey dwellings along with gardens and hardstandings.
MINING GEOLOGY:	South Wales Lower Coal Measures Formation, which is overlain by glacial till and Made Ground. The general strata dip is towards the west at about 1 in 12 towards the south. The Coal Authority describe the site as being <u>not</u> within a designated Development High Risk Area and that abandoned coal workings at shallow depth (less than 30m bgl) are not expected. However, it is known that coal and ironstone seams have been worked in the general area both from adits and shafts. This drilling and grouting programme has therefore been undertaken as a precaution, particularly against the risk from unrecorded abandoned ironstone workings. The geological records show the outcrop of the GARW coal seam close to the south-western corner of the site. Ironstone seams are known to be present above and below the GARW seam. There are no recorded mine entries within or within influencing distance of the site.
RESULTS OF PREVIOUS PROBE DRILLING:	A Phase 2 ground investigation (including rotary probe drilling) has been undertaken by Blandford Consulting (Ref: BC/MB/11.20.04, dated February 2021). The boreholes encountered old workings in two ironstone veins and in the GARW Coal seam. Blandford concluded that: - the old workings in the ironstone veins are at depths where they pose a risk of collapsing up to rockhead; - the old workings in the GARW Coal seam pose a negligible risk of collapsing to rockhead.

SCOPE OF DRILLING AND GROUTING WORKS:		A total of 53no. production grout take holes (1,589 lin.m) were drilled as part of the shallow mine workings consolidation scheme, along with 3no. test holes. Grout take holes were drilled on a 6m x 6m grid, with infill holes as required by drilling and grouting results. Grout holes were drilled to an average completion depth of 30.0m bg. Grouting was undertaken using a 6tonne air driven mixer and pumped until boreholes were deemed full. The grout for this project comprised a 12:1 PFA:OPC mix. A total of 20.0 tonnes of grout mixture was injected beneath the area. Of the 8 no. proposed residential plots, only 6 no plots were treated. It is understood that ground beneath Plot 4 was treated by Apex Drilling during February 2021 as an extension of site investigation works. During the current phase of stabilisation works, the final position of Plot 8 was uncertain; as a result this was not treated.
CONCLUSION:		Soft ground was only encountered in 10 no. injection holes. Overburden was found to be between about 10.80m and 12.50m thick. All but 1 no. grout injection hole took just 0.26 tonnes of grout at 1:12 OPC:PFA. It is considered that no further ground stabilisation works are required at Plots 1 to 7 inclusive, but that treatment will be required beneath Plot 8 during a future phase of the site development.
RECOMMENDATIONS:		Following the mine working consolidation programme, it is considered that no further stabilisation works are required at Plots 1 to 7 inclusive. Notwithstanding this, it is recommended that vigilance is maintained, particularly during earthworks phases of future work, for possible coal related features including unrecorded mine entries.
Author:		Phil Shelton BSc PhD CEng MIMMM FGS <i>Associate</i>
Date:	March 2022	
Version:	1.0	

Introduction

Maxiom Developments Ltd (Maxiom) is in the process of overseeing the construction of a residential complex at a site off Upper Colliers' Row, Heolgerrig, Merthyr Tydfil, South Wales.

Site Location and layout Plans (**Figures 1 and 2**) are included in **Appendix A**.

A Phase 2 ground investigation (including rotary probe drilling) has been undertaken by Blandford Consulting (Ref: BC/MB/11.20.04, dated February 2021). This report, along with reference to the Coal Authority Interactive Map Viewer and BGS sources indicate that while the site is not within a CA designated Development High Risk Area, there is potential for there being unrecorded ironstone workings at shallow depth, which would require a formal programme of consolidation to enable the above ground re-development to progress.

It is understood that there are no recorded coal/ironstone mine entries within or within 20m of the site boundary.

Maxiom propose to construct 8 no. new detached residential properties within the site along with gardens and hardstandings. The development layout is shown in **Figure 3** in **Appendix A**.

This report relates to a programme of pre-construction consolidation treatment works of potential abandoned shallow ironstone mine workings.

The scope of works for the mine workings consolidation has been developed by others. The site works were overseen by an engineer appointed by the client.

The works have included the drilling of 53 no. production rotary boreholes (1,589 lin.m), along with 3no. test holes and controlled backfilling with a 12:1 PFA:OPC cement-based grout. The drilling was undertaken on an *ad hoc* plot by plot spacing, depending on local drilling and grouting results - see **Appendix B**.

The works were undertaken between 28th February and 9th March 2022.

Of the 8 no. proposed residential plots, only 6 no plots were treated. It is understood that ground beneath Plot 4 was treated by Apex Drilling during February 2021 as an extension of site investigation works. During the current phase of stabilisation works, the final position of Plot 8 was uncertain; as a result this was not treated.

It is understood that Van Elle will be remobilised at some time in the future to undertake a second stage of works. treatment of Plot 8 will be undertaken at this time.

Data References

- Proposed development plan – **Appendix A**;
- Site Investigation Report – February 2021, Blandford Consulting;
- CIRIA Pub 32 1984 – 2002 Construction over abandoned mine workings;
- CIRIA RP940/C758 Feb 2018 Abandoned Mine Workings;

- CIRIA C758D Nov 2019 Abandoned Mine Workings Manual.

Site Location and Description

The Site is located approximately 700m west of Merthyr Tydfil town centre at approximate national Grid Reference 304060 206025. The closest postcode is CF48 1UN. It is irregular in outline and occupies an area of approximately 0.82 hectares at an average elevation of about 200m aOD. The ground slopes downwards towards the west and south.

At the time of the stabilisation works, the site had been cleared and levelled. It is located in what is now a mainly residential area on the fringes of the town and is bounded on its western side by residential dwellings and a lane; to the north is Aberdare Road and beyond it the Trago Mills retail site; to the east is the public highway serving Colliers' Row, beyond which is the A 470 (T), and to the south there are a mixture of rough ground, agricultural enclosures and open countryside. An areal view of the site is shown in **Figure 2** in **Appendix A**.

A site walkover was undertaken of the areas for development prior to undertaking the works.

It is known that this area, along with most of the South Wales 'Valleys', has a long history of coal and ironstone mining, much of which dates from before it was a requirement to maintain accurate mining records.

Ground Conditions & Geology¹

Local geological information has been obtained from the British Geological Survey (BGS) published mapping and other sources as detailed below:

- BGS 1:50,000 scale Sheet 231 Merthyr Tydfil;
- BGS 1:10,560 scale Sheet SO 00 NW;
- BGS 3D Interactive mapping;
- on-line digital mapping (GeoIndex);
- Blandford Consulting Site Investigation Report, February 2021.

These sources indicate that Made Ground should be expected to depths of between 5.50m and 8.0m bgl, typically comprising black sandy gravelly CLAY, with the gravel mainly comprising crushed brick and coal. Geological mapping shows the majority of the valley below Merthyr being covered with Made Ground being derived from its past industrial history.

Beneath the Made Ground, superficial strata between 3.5m and 7.0m thick is expected to comprise glacial till (also known as diamicton). This comprises mainly unsorted mixtures of sand, gravel, cobbles and boulders set in a CLAY matrix. Glacial till in South Wales also commonly contains bands and lenses of uniformly graded SAND.

¹ Details of ground conditions are not definitive representations, they are intended as a summary only

Solid strata is expected to comprise South Wales Lower Coal Measures Formation, which is of Carboniferous age. These generally comprise regular sequences of mudstone, siltstone and sandstone with frequent thin coal and ironstone layers. Geological mapping (BGS 1:50,000 Sheet 231) - see **Figure 4** in **Appendix A** – shows The GARW coal seam to outcrop close to the south-west corner of the site. However, an analysis of geological data by Blandford Consultancy (beyond the scope of this report) places Five Feet/Gellideg Seam at this position.

Strata are expected to dip at a gradient of about 1 in 12 towards the south.

Faulting is common in the South Wales Coalfield with many normal faults having a north-west to south-east trend. A significant, named, fault (Merthyr Hurch Fault) passes a few tens of metres to the north-east of the site, with a downthrow to the south-west.

Methodology

The mine workings consolidation works for the area covered by this report were undertaken during February and March 2022. The works were undertaken in general accordance with the Code of Practice for Site Investigations BS5930: 2015 and CIRIA guidances on the treatment of shallow mineworkings.

The mine workings consolidation treatment incorporated the following:

The advancing of a total of 53no. (1,589 lin.m) production rotary grout injection holes and 3no. test hole.

Grout injection boreholes were drilled to completion depths of between 28.0m and 31.0m bgl (average 30.0m). The final borehole depth was varied to ensure completion in solid strata beneath the lowest significant coal/ironstone seam.

Stabilisation of the abandoned workings was completed by the injection of a total of about 20.0tonnes of grout.

The rotary injection borehole details and grout takes are tabulated and represented spatially in **Appendix B**.

Grout injection works were not undertaken at Plot 4 because this plot was grouted by Apex Drilling Co. Ltd under instruction from Blandford Consulting during the site investigation works reported in February 2021. In addition, grout injection works were not undertaken at Plot 8 because the final position of this plot was not available at the time. It is understood that the ground beneath Plot 8 will be treated during a later phase of stabilisation works.

Drilling

The drill and grout works were designed to consolidate voids and disturbed ground resulting from the long-term collapse of potential abandoned mine workings at shallow depth beneath the proposed development.

The treatment has also been designed in consideration of the existing site layout, the development proposal and health and safety issues. Drilling was undertaken by open hole methods using a Casagrande C6 XP 1439 track-mounted rig. Each grout injection hole was drilled with steel casing to about rockhead at a consistent depth of 12m bgl. All boreholes were drilled with water flush, as is usually required by the Coal Authority to minimise the risk of spontaneous combustion if coal is encountered.

The drilling pattern was developed on a plot-by-plot basis starting with a basic pattern on a nominal 6m x 6m spacing, with additional intermediate grout injection holes being drilled depending on the interpretation of drill chipping return descriptions, water flush returns and grout takes. Grout injection holes were all given a unique reference based on proposed residence Plot number - see **Appendix B**. All injection holes were drilled vertical.

Unconsolidated 'soil' deposits, mainly Made Ground and glacial till, with some sand layers and completely weathered Coal Measures were encountered to depths of between 10.8m and 12.5m (average 12.05m) bgl.

Most boreholes recorded solid strata as comprising a mixture of intact interbedded mudstone, sandstone and coal, but with no distinguishable thick coal seam. In these cases, 100% flush returns were maintained throughout.

Layers of soft ground were recorded at 10 no. injection holes at depths of between 18.5m and 27.5m bgl; with the shallowest occurring at Plot 5, in the south and the deepest at Plot 1, in the north. However only at one injection hole (2H at Plot 2) was flush returns completely lost.

Throughout the works monitoring for the presence of harmful gases was maintained at the drill rig. Gases included: carbon monoxide (CO), carbon dioxide (CO₂) hydrogen sulphide (H₂S) and methane (CH₄) along with levels of airborne oxygen (O₂). The drilling crew also carried personal gas alarms, which activate visible and audible alarms should concentrations of any of these gases reach pre-determined trigger levels. No harmful levels of gases were recorded during the works.

A summary of grout hole drilling records is included in **Appendix B**.

Grouting

Each borehole was filled with a cementitious grout with a composition of 12:1 PFA: Ordinary Portland Cement (OPC) under hydrostatic pressure. Flow tests and bleed tests

were undertaken during the grouting period. The results of bleed and flow tests are shown below.

Date	Flow (mm)	Bleed (ml/l)
3 March 2022	440mm	980/1000
7 March 2022	420mm	980/1000
9 March 2022	440mm	980/1000

Sets of 4 no. cubes were taken on 3rd March and 7th March 2022. Cube testing was scheduled for 7day, 14day and 28day compressive strength. The 4th cube was taken as a spare.

Acceptable bleed and flow thresholds are usually taken as:

flow: between 300mm and 600mm;
bleed: less than 2% (>980/1000) after 3 hours;

Cube test results are included in **Appendix C**. Results obtained following the issue of this report will be sent under a separate cover.

Grout was batched on site using an agitator mixer powered by an air compressor. Constituent materials were introduced by a loading shovel, and pumped to each treatment borehole using a sand pump. All plant was certified safe and maintained properly throughout the operation.

A summary of grouting records is included in **Appendix B**.

Test Boreholes

Three non-production test grout boreholes were drilled at the positions shown below and in **Appendix B**.

TH1 Plot 2
TH2 Plot 6
TH3 Plot 5

The positions of the test holes were selected by Van Elle and were placed close to locations where production borehole drilling had shown the greatest degree of disturbance at the 'soft ground' level. The test holes were subsequently subjected to sustained pressure grouting. The results confirmed that when a grout pressure of 2 bars was sustained for 3 minutes, only minimal grout takes were recorded. A summary of test grout hole details is included in **Appendix B**.

Ground Stability Assessment

This Ground Stability Assessment considers the proposed development following drill and grouting works designed to consolidate potential abandoned ironstone workings.

Risk Assessment

Borehole drilling associated with the abandoned mine stabilisation works identified occasional horizons of soft ground at depths of between 18.5m and 27.5m bgl (although 100% flush loss only occurred at injection hole 2H at Plot 2). It is by no means certain that these 'soft' horizons represent abandoned ironstone workings.

Driller's records give a qualitative description of the condition of coal and/or mine workings as encountered using rotary drilling methods. These are based on chipping returns and borehole penetration rate and can be summarised as follows:

Intact Solid Strata	-	Interpreted as intact Coal Measures strata only with no intact coal, soft ground, or broken ground
Intact Coal	-	Interpreted as intact, unworked, coal
Soft Ground	-	Interpreted as rapid penetration through potential old mine workings
Broken Ground	-	Interpreted as ground, including small voids disturbed by potential old mine workings
Void	-	Empty space, with drill rods falling with no resistance

Appendix B shows the positions of the grout injection holes along with a visual representation of the conditions encountered at the level of the soft ground horizon. These results can be summarised as follows:

Intact Solid Strata (non-coal)	-	Recorded at 43 no. boreholes (81%)
Intact Coal	-	Not encountered
Soft Ground	-	Recorded at 10 no. boreholes (19%)
Broken Ground	-	Not encountered
Void	-	Not encountered

Appendix B tabulates the quantities of grout injected into each stabilisation borehole. For the most part, very small grout takes were recorded. In general, just 0.26tonnes of grout was accepted by injection holes drilled through intact Coal Measures Strata, which is just enough to fill the drill hole annulus. However, even where the drilled injection hole intercepted soft ground, the grout take only rose above 0.26tonnes at one location, injection hole 2H at Plot 2 (6.5tonnes). This was also the only injection hole to sustain a complete loss of flush return.

Three locations were selected to undertake post treatment test drilling and grouting at positions where production drilling showed the greatest degree of disturbance. These were drilled to similar completion depths and grouted under a sustained pressure of 2bars for 3 minutes. Only a minimal quantity of grout was accepted at each test hole.

Having undergone the mine workings consolidation treatment undertaken by Van Elle during February and March 2022, it is considered that no further works will be necessary

within the footprints of six of the plots at the proposed development in respect of mining legacy.

Of the 8 no. proposed residential plots, only 6 no plots were treated. It is understood that ground beneath Plot 4 was treated by Apex Drilling during February 2021 as an extension of site investigation works. During the current phase of stabilisation works, the final position of Plot 8 was uncertain; as a result, this was not treated.

It is considered that no further ground stabilisation works are required at Plots 1 to 7 inclusive, but that treatment will be required beneath Plot 8 during a future phase of the site development.

There are no recorded mine entries at the site. However, there is always a risk of encountering an unrecorded mine entry in development risk areas. It is not considered appropriate to make a specific search, but earthworks contractors and ground workers should be informed of the need to be vigilant during site clearance and construction works.

Conclusion

In order to prepare for the proposed development at the site known as Land Off Colliers' Row, Heolgerrig, Merthyr Tydfil, South Wales, a mine working consolidation programme has been undertaken by drilling and grouting.

Grout injection boreholes were set out and drilled on a surveyed grid beneath the footprint of the proposed development and cementitious grout was pumped into each borehole.

A total of 53no. production grout holes (1,589 lin.m) were drilled on an *ad hoc* grid based on adjacent drilling and grouting results. Grout holes were drilled vertical to an average depth of about 30.0m bgl utilising water flush. No positive evidence of abandoned coal or ironstone mine workings was encountered.

Grouting was undertaken via a 6tonne air driven mixer then pumped out via a 3" electric Matt pump down each borehole under static head pressure until the borehole was deemed full. The grout mix for this project comprised a 12:1 PFA:OPC mixture. A total of approximately 20tonnes of grout was injected.

It is considered that no further stabilisation works are required at this site in respect of abandoned shallow mine workings beneath Plots 1 to 7 inclusive.

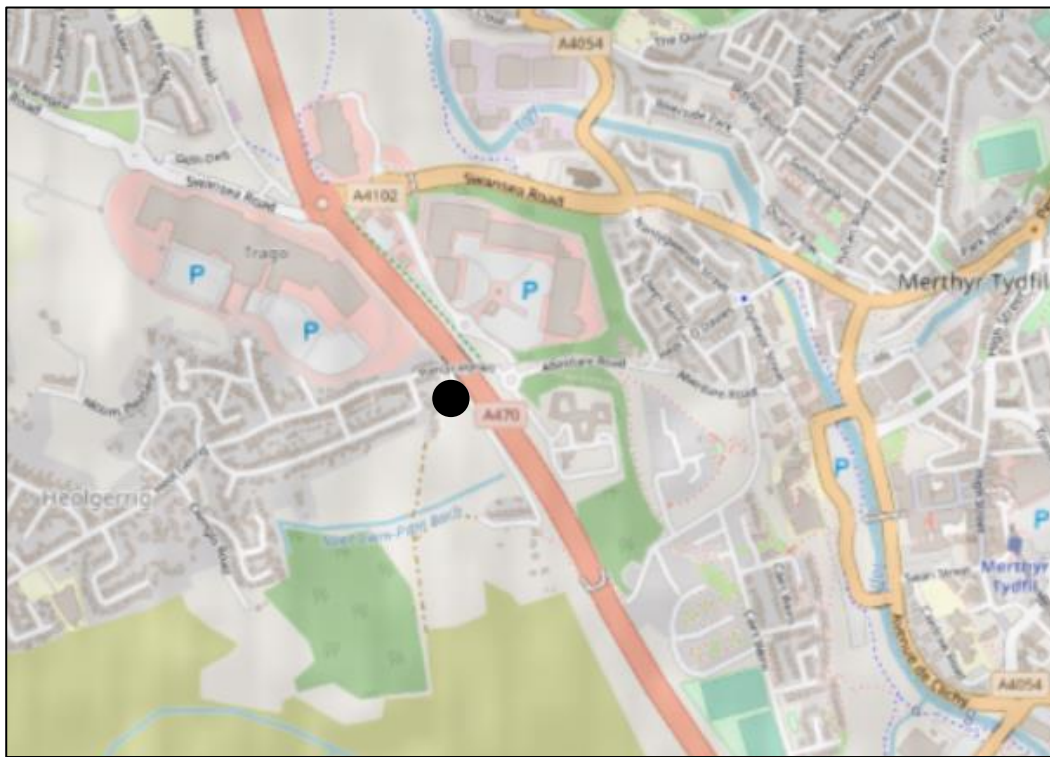
Appendix A

Site Plans



Van Elle Limited
Kirkby Lane, Pinxton
Nottinghamshire
NG16 6JA

Tel: 01773 580580
Fax: 01773 862100



KEY:



Site Location



Approximate Site
Boundary

DO NOT SCALE



Van Elle Limited
Kirkby Lane, Pinxton
Nottinghamshire
NG16 6JA

Tel: 01773 580580
Fax: 01773 862100

TITLE:

Site Location Plan

PROJECT:

Upper Colliers' Row, Merthyr Tydfil

PROJECT No:

214320 PS3328

DATE:

March 2022

SCALE:

NTS

DRAWN:

PS

DWG No:

Figure 1



KEY:



Site Boundary



Van Elle Limited
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Nottinghamshire
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Fax: 01773 862100

TITLE:

Aerial View

PROJECT:

Upper Colliers' Row, Merthyr Tydfil

PROJECT No:

214320 PS3328

DATE:

March 2022

SCALE:

NTS

DRAWN:

PS

DWG No:

Figure 2

DO NOT SCALE



KEY:

DO NOT SCALE



Van Elle Limited
Kirkby Lane, Pinxton
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Fax: 01773 862100

TITLE:

Proposed Development

PROJECT:

Upper Colliers' Row, Merthyr Tydfil

PROJECT No:

214320 PS3328

DATE:

March 2022

SCALE:

NTS

DRAWN:

PS

DWG No:

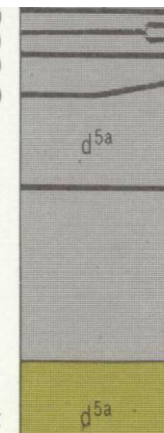
Figure 3



No.2 YARD (No.2 fd)
SEVEN-FEET (7-FT)
FIVE-FEET (5-FT)
GELLIDEG (Ge)

GARW

Farewell Rock



Site
Zone

KEY:



Approximate Site Location



Van Elle Limited
Kirkby Lane, Pinxton
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TITLE:

Extract From BGS Sheet 231

PROJECT:

Upper Colliers' Row, Merthyr Tydfil

PROJECT No:

214320 PS3328

DATE:

March 2022

SCALE:

NTS

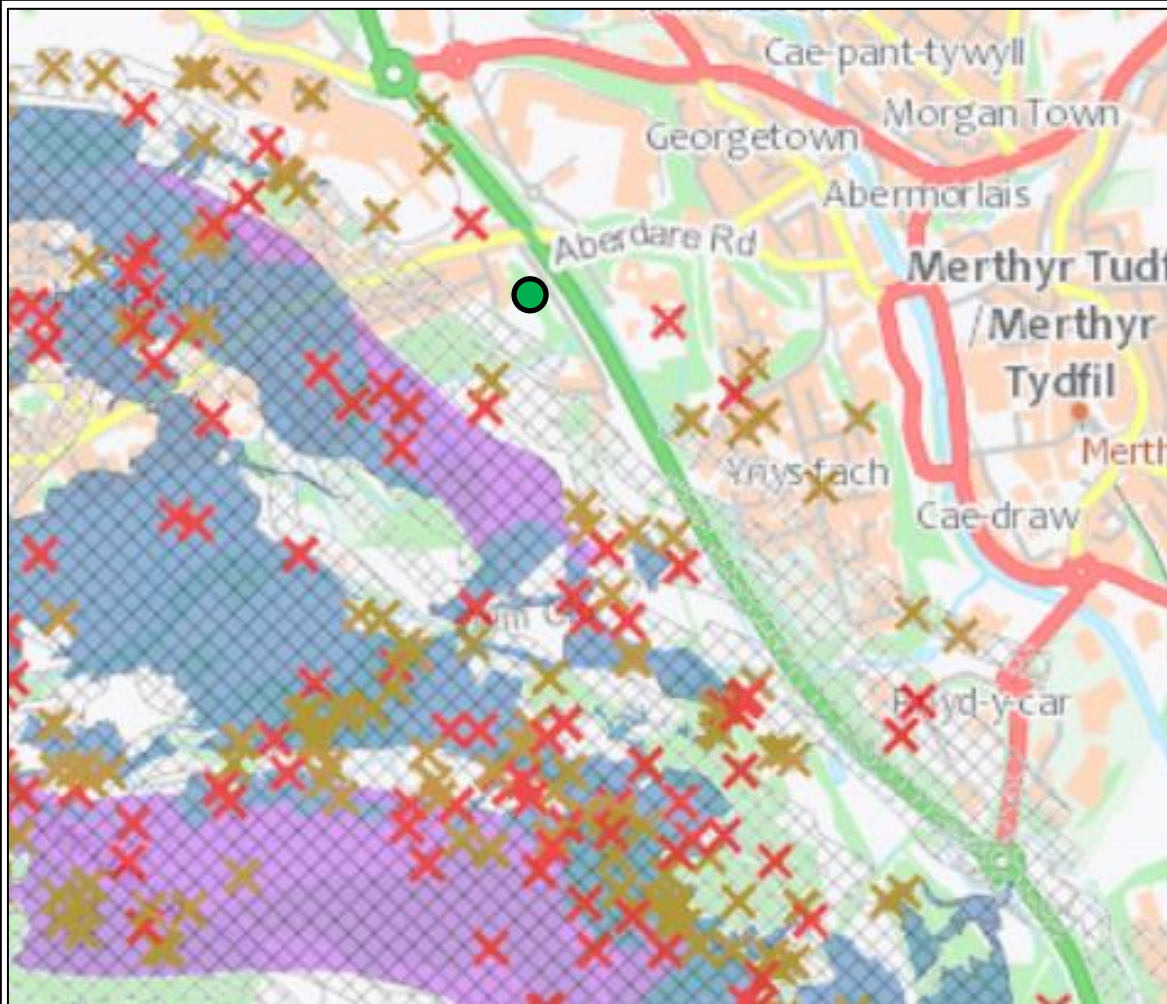
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PS

DWG No:

Figure 4

DO NOT SCALE



-  Development High Risk and Probable Shallow Workings
-  Development High Risk and Recorded Shallow Workings
-  Recorded Coal Mine Entry

KEY:



Approximate Site Location



Total Foundation Solutions

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TITLE:

Coal Mining Context

PROJECT:

Upper Colliers' Row, Merthyr Tydfil

PROJECT No:

214320 PS3328

DATE:

March 2022

SCALE:

NTS

DRAWN:

PS

DWG No:

Figure 5

DO NOT SCALE

APPENDIX B

Drilling and Grouting Data



PS3323 - Stephenson Square, Walsall																	
VE220309																	
Drilling and Grouting Data																	
					Overburden	Mst + SSt + Coal		Soft Ground							Grouting		
Reference	Date	Angle °	Comp Depth m	To m	From m	To m	From m	To m	Comments			Steel Casing		OPC	PFA	TOTAL	
1 A	28-Feb-22	90	30.0	11.00	11.00	30.00						12.0		0.020	0.24	0.26	
1 B	28-Feb-22	90	30.0	11.20	11.20	30.00						12.0		0.020	0.24	0.26	
1 C	28-Feb-22	90	30.0	10.80	10.80	27.50	27.50	29.50				12.0		0.020	0.24	0.26	
1 D	01-Mar-22	90	30.0	11.40	11.40	30.00						12.0		0.020	0.24	0.26	
2 A	01-Mar-22	90	30.0	12.00	12.00	30.00						12.0		0.020	0.24	0.26	
2 B	01-Mar-22	90	30.0	12.00	12.00	30.00						12.0		0.020	0.24	0.26	
2 C	01-Mar-22	90	30.0	11.50	11.50	30.00						12.0		0.020	0.24	0.26	
2 D	01-Mar-22	90	30.0	11.70	11.70	30.00						12.0		0.020	0.24	0.26	
2 E	01-Mar-22	90	31.0	11.80	11.80	30.00						12.0		0.020	0.24	0.26	
2 F	01-Mar-22	90	30.0	11.90	11.90	30.00						12.0		0.020	0.24	0.26	
2 G	02-Mar-22	90	30.0	12.20	12.20	30.00						12.0		0.020	0.24	0.26	
2 H	02-Mar-22	90	28.0	12.00	12.00	25.00	25.00	26.50				12.0		0.500	6.00	6.50	
2 I	02-Mar-22	90	30.0	11.80	11.80	30.00						12.0		0.020	0.24	0.26	
2 J	02-Mar-22	90	30.0	12.10	12.10	30.00						12.0		0.020	0.24	0.26	
2 K	02-Mar-22	90	30.0	12.20	12.20	30.00						12.0		0.020	0.24	0.26	
2 L	02-Mar-22	90	30.0	12.10	12.10	30.00						12.0		0.020	0.24	0.26	
2 M	02-Mar-22	90	30.0	12.40	12.40	30.00						12.0		0.020	0.24	0.26	
2 N	04-Mar-22	90	30.0	12.00	12.00	25.00	25.00	26.50				12.0		0.020	0.24	0.26	
2 O	04-Mar-22	90	30.0	12.00	12.00	30.00						12.0		0.020	0.24	0.26	
2 P	04-Mar-22	90	30.0	12.10	12.10	30.00						12.0		0.020	0.24	0.26	
2 Q	04-Mar-22	90	30.0	11.80	11.80	25.20	25.20	26.20				12.0		0.020	0.24	0.26	
3 A	09-Mar-22	90	30.0	11.70	11.70	30.00						12.0		0.020	0.24	0.26	
3 B	09-Mar-22	90	30.0	11.80	11.80	30.00						12.0		0.020	0.24	0.26	
3 C	09-Mar-22	90	30.0	11.70	11.70	30.00						12.0		0.020	0.24	0.26	
3 D	09-Mar-22	90	30.0	11.80	11.80	30.00						12.0		0.020	0.24	0.26	
5 A	07-Mar-22	90	30.0	12.20	12.20	19.00	19.00	21.50				12.0		0.020	0.24	0.26	
5 B	07-Mar-22	90	30.0	12.20	12.20	30.00						12.0		0.020	0.24	0.26	

5	C	07-Mar-22	90	30.0	12.20	12.20	30.00					12.0		0.020	0.24	0.26
5	D	07-Mar-22	90	30.0	12.10	12.10	30.00					12.0		0.020	0.24	0.26
5	E	07-Mar-22	90	30.0	12.30	12.30	30.00					12.0		0.020	0.24	0.26
5	F	08-Mar-22	90	30.0	12.50	12.50	30.00					12.0		0.020	0.24	0.26
5	G	08-Mar-22	90	30.0	12.40	12.40	30.00					12.0		0.020	0.24	0.26
5	H	08-Mar-22	90	30.0	12.40	12.40	30.00					12.0		0.020	0.24	0.26
5	I	08-Mar-22	90	30.0	12.50	12.50	30.00					12.0		0.020	0.24	0.26
5	J	08-Mar-22	90	30.0	12.50	12.50	30.00					12.0		0.020	0.24	0.26
5	K	08-Mar-22	90	30.0	12.50	12.50	30.00					12.0		0.020	0.24	0.26
5	L	08-Mar-22	90	30.0	12.50	12.50	30.00					12.0		0.020	0.24	0.26
5	M	08-Mar-22	90	30.0	12.40	12.40	30.00					12.0		0.020	0.24	0.26
5	N	08-Mar-22	90	30.0	12.40	12.40	18.50	18.50	21.00			12.0		0.020	0.24	0.26
5	O	09-Mar-22	90	30.0	12.40	12.40	18.50	18.50	21.00			12.0		0.020	0.24	0.26
6	A	03-Mar-22	90	30.0	12.50	12.50	30.00					12.0		0.020	0.24	0.26
6	B	03-Mar-22	90	30.0	12.40	12.40	30.00					12.0		0.020	0.24	0.26
6	C	03-Mar-22	90	30.0	12.20	12.20	24.00	24.00	25.00			12.0		0.020	0.24	0.26
6	D	03-Mar-22	90	30.0	12.20	12.20	23.80	23.80	24.80			12.0		0.020	0.24	0.26
6	E	03-Mar-22	90	30.0	12.40	12.40	30.00					12.0		0.020	0.24	0.26
6	F	03-Mar-22	90	30.0	12.50	12.50	30.00					12.0		0.020	0.24	0.26
6	G	03-Mar-22	90	30.0	12.50	12.50	30.00					12.0		0.020	0.24	0.26
6	H	03-Mar-22	90	30.0	12.50	12.50	23.80	23.80	25.00			12.0		0.020	0.24	0.26
6	I	04-Mar-22	90	30.0	12.30	12.30	30.00					12.0		0.020	0.24	0.26
7	A	04-Mar-22	90	30.0	11.50	11.50	30.00					12.0		0.020	0.24	0.26
7	B	04-Mar-22	90	30.0	11.40	11.40	30.00					12.0		0.020	0.24	0.26
7	C	07-Mar-22	90	30.0	11.80	11.80	30.00					12.0		0.020	0.24	0.26
7	D	07-Mar-22	90	30.0	11.90	11.90	30.00					12.0		0.020	0.24	0.26
		Count		53	53	53	53	10	10			53		53	53	53
		Sum		1589.0	638.6	638.6	1520.3	230.3	247.0			636.0		1.5	18.5	20.0
		Maximum		31.0	12.50	12.50	30.00	27.50	29.50			12.00		0.50	6.00	6.50
		Minimum		28.0	10.80	10.80	18.50	18.50	21.00			12.00		0.02	0.24	0.26
		Average		30.0	12.05	12.05	28.68	23.03	24.70			12.00		0.03	0.35	0.38
TH	1	09-Mar-22	90	30.0	12.0	12.0	30.00			Plot 2		12.0		0.013	0.15	0.16
TH	2	09-Mar-22	90	30.0	12.5	12.5	30.00			Plot 6		12.0		0.013	0.15	0.16
TH	3	09-Mar-22	90	30.0	12.4	12.4	30.00			Plot 5		12.0		0.013	0.15	0.16

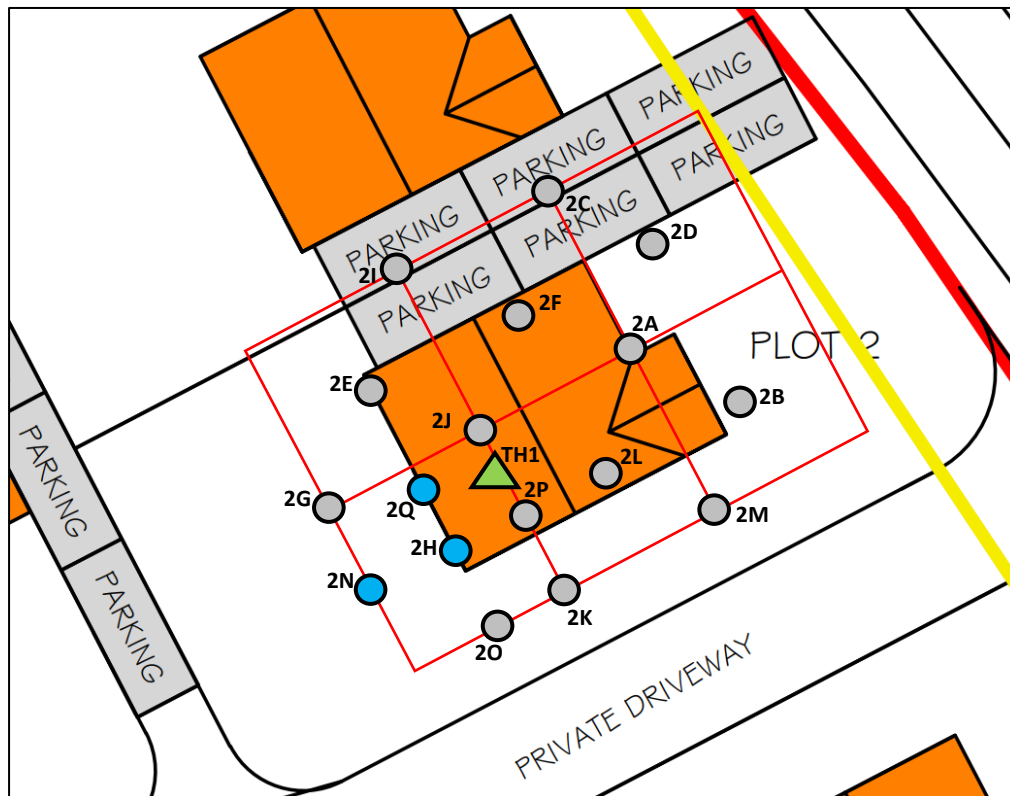
Drilling Summary



PS3328 VE214320 – Upper Colliers' Row

Drilling Summary

Plot 2



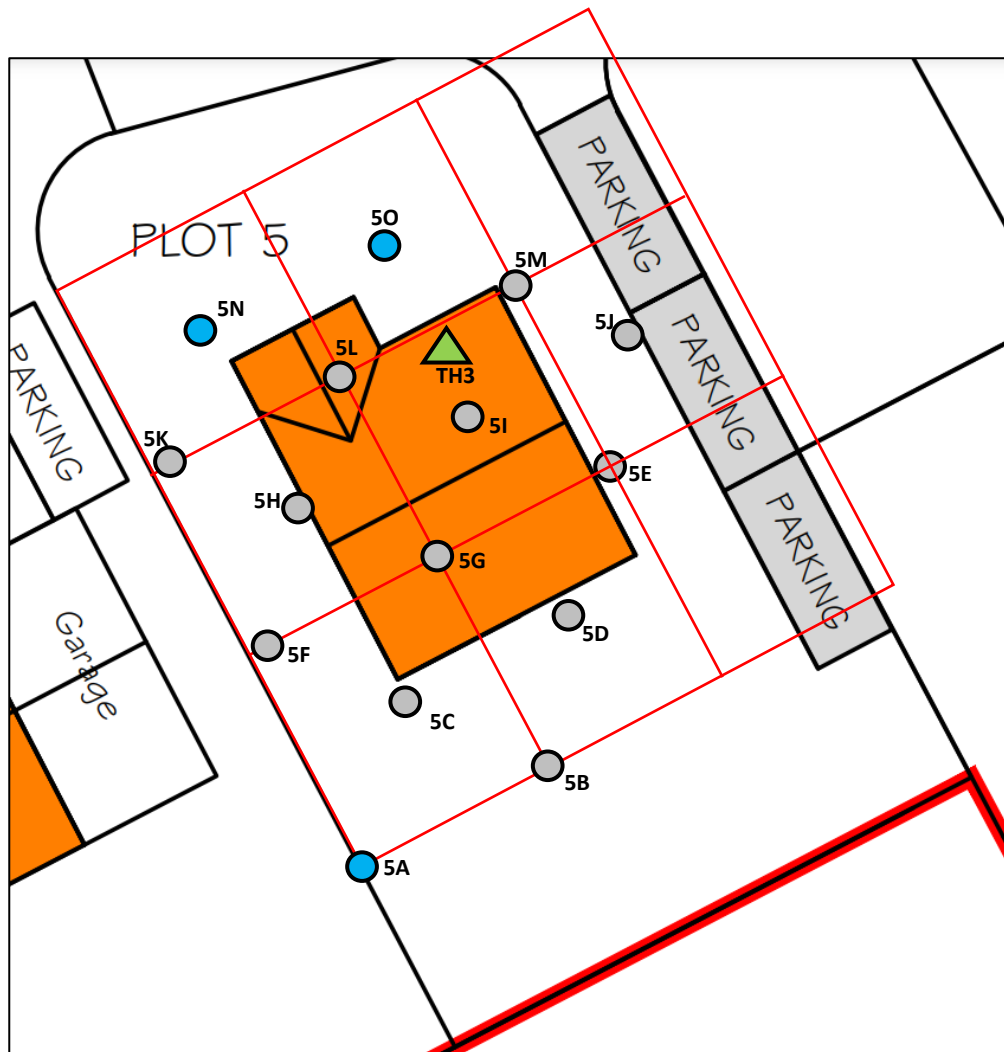
Key

-  Intact Mudstone Sandstone and Coal
-  Soft Ground
-  Test Injection Hole

PS3328 VE214320 – Upper Colliers' Row

Drilling Summary

Plot 5



Key

-  Intact Mudstone Sandstone and Coal
-  Soft Ground
-  Test Injection Hole

Grouting Summary



Grouting Summary

Plot 2



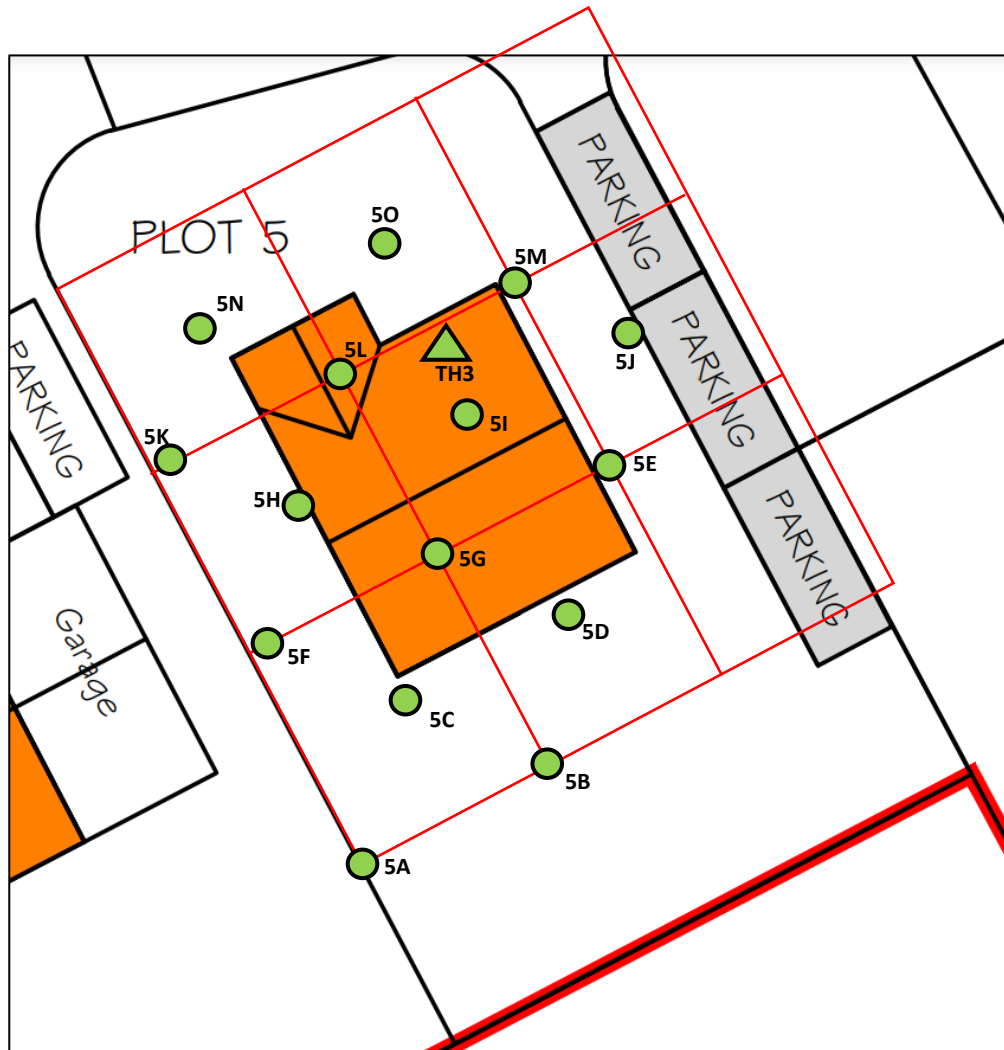
Key

- Less than 0.3tonnes
- 0.3tonnes to 3.0tonnes
- More than 3tonnes
- ▲ Test Injection Hole

PS3328 VE214320 – Upper Colliers' Row

Grouting Summary

Plot 5



Key

-  Less than 0.3tonnes
-  0.3tonnes to 3.0tonnes
-  More than 3tonnes
-  Test Injection Hole

APPENDIX C

Grout Cube Test Results

