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Mr W Noteman
Unity Housing Association Ltd
113-117 Chapeltown Road,
Leeds
LS7 3HY

BY E-MAIL

Our Ref: UHA/13/l1/AMJ

7th May 2024

Dear Wayne,

Plane Street, Huddersfield
Additional Intrusive Coal Mining Investigation

Various reports and works have been undertaken by a third party for this site historically. These are detailed below but comprise a Desk Study Report, a Site Investigation Report and Further Site Investigation Report. The coal mining risk was predominantly assessed within the Further Site Investigation Report (but was also reviewed within the initial Desk Study Report).

The Further Site Investigation Report included three rotary holes which were undertaken to assess the risk from potential historical coal workings beneath the site. The investigation found workings, but the report concluded that the workings identified did not pose a risk to the development but recommended that further rotary hole works were required in the west of the site to assess the worst case scenario (i.e. location of the shallowest coal/workings located beneath the site). In Condition 9 attached to the development, the Coal Authority also required further investigation (in the west of the site) to be undertaken to 'establish the exact situation in respect of coal mining legacy features' beneath the site.

Subsequent to the above and in accordance with our commission, the recommended additional rotary borehole investigation was carried out on 23rd and 24th April 2024. The locations of the rotary boreholes were agreed with The Coal Authority before the site works commenced. The findings of the investigation are reported below.

Background

As already mentioned above there are a number of relevant historical reports that exist for this proposed development. These are discussed below.

Solmek Phase 1 Desk Study – November 2019

This report includes a Coal Mining Report and acknowledges the potential for unrecorded shallow coal mining beneath the site. It recommends that three rotary boreholes are undertaken to identify any significant mine workings below the site. The report includes a drawing that shows the site to be in 'Development High Risk Area' but contradicts this finding in the main text and executive summary of the report.

Solmek Phase 2 Site Investigation – April 2020

This report does not include the three rotary boreholes recommended by the Desk Study Report and does not comment on the coal mining risk any further.

Solmek Further Site Investigation (Letter Report) – 5th May 2020

This report includes the three rotary boreholes that were recommended by the Desk Study Report. They were drilled to a maximum of 40m depth.

BH02 and BH03 intercepted a void and solid coal at depths of 12.2m and 14.1m respectively. BH01 did not encounter a coal seam within the 40m drill depth.

The coal seam encountered was assessed to be the Hard Bed coal seam with an identified thickness of 0.7m. The void that was identified was 0.9m thick. In both cases (for BH02 and BH03) the thickness ratio of intact rock cover is calculated to be over 10 (11.66 and 13.11 respectively).

The conclusion from the report is that the workings/void of the Hard Bed coal seam have adequate rock cover above and that there are no coal seams present within influencing distance below the Hard Bed seam. However, it does conclude that '*based on the borehole records it is likely that grouting is not required over much of the site area, however, the seam is shown to outcrop to the west of the site and dip below the site and therefore additional rotary boreholes may be required in the northwest of the site to confirm the depth to the coal seam (where it would be at its shallowest) and at the greatest risk posed by workings'*.

Planning Condition 9 and ARP Involvement

ARP were appointed to undertake the required additional rotary works in March 2024. It was agreed that five additional rotary boreholes would be drilled to identify the depth of the Hard Bed coal seam (and any associated workings) in the west and northwest of the site. It was not required to go deeper than the Hard Bed seam due to the significant depth of the underlying seams. The aim of the investigation was to ascertain the area of any required drill and grout works and to obtain additional information to allow for more accurate pricing of any works required (i.e. area/extent of site requiring drill and grout treatment, presence of significant voids or were workings backstowed reducing grout takes etc.).

The proposed works were agreed with The Coal Authority and the permit was issued on 19th April 2024.

The works were undertaken with the intention of discharging condition 9 attached to the development.

ARP Site Works

Six boreholes were drilled, using rotary openhole water flush techniques, by GSS on the 23rd and 24th April 2024. The boreholes were numbered BH1 to BH6 and were drilled to depths of between 12m and 18m, at the locations shown on the attached plan. The investigation was designed, organised and supervised (on a full-time basis) by ARP Geotechnical Ltd, and boreholes were logged by both the Engineer and the lead driller. An additional borehole was added (with six drilled in total) as it became evident during the site works that the Hard Bed coal seam (and associated workings) was significantly shallower than previously identified.

ARP Ground Conditions and Stability Assessment

The investigation revealed soils overburden (interpreted to be made ground and superficial deposits, and referred to only as "made ground" and “clay” on the logs) to depths of between 2.6m (BH3) and 3.6m (BH5). Trial pits and window sample boreholes excavated previously by Solmek in April 2020 and May 2022, were used to determine the approximate depths of made ground. The overburden was underlain by mudstone, to significant depth, in all six boreholes.

Five of the boreholes encountered either broken or soft strata or voids (representing underground workings), with associated loss of flush, from depths of between 6.3m and 12.3m. The broken/soft zone or void ranged in thickness between 2.3m (BH1) and 1.1m (BH2).

Intact coal was encountered in BH3 (9.7m to 10.5m) with a thickness of 0.8m.

It is a generally accepted rule of thumb that workings in a seam will require some form of treatment (usually drilling and grouting), unless there is at least 10 times the seam thickness of rock cover above the original seam roof (not above the top of any migrated workings). Working on an assumption of a 0.8m (extracted) seam thickness indicated by the maximum intact coal thickness encountered there needs to be 8m of rock cover above the original seam roof.

A summary table showing the rotary borehole investigation details and assessment of cover thickness is presented below.

BH	Depth to Rock (m)	Depth (m) to base of coal or wkgs	Depth to Original Roof (m)	Rock Cover to Original Seam Roof (m)	Comment on Rock Cover Thickness	Flush Returns
BH1	3.0	8.6 (BG)	7.8	4.8	Insufficient	LOF
BH2	2.9	9.7 (V)	8.9	6	Insufficient	LOF
BH3	2.6	10.5 (IC)	9.7	7.1	Insufficient	Full
BH4	3.1	11.2 (BG)	10.4	7.3	Insufficient	LOF
BH5	3.6	11.1 (BG)	10.3	6.7	Insufficient	LOF
BH6	3.4	12.3 (BG)	11.5	8.1	Sufficient	LOF

Wkgs = workings BG = Broken Ground S = Soft V = Void IC = Intact coal LOF= Loss of Flush

From the above, it can be seen that there is insufficient cover in all locations where a seam or workings were positively identified, except for BH6. BH6 was an addition to originally proposed drilling locations and was moved significantly towards the east, deliberately, to try to find a point on the site where adequate rock cover was present.

<u>Review and Further Assessment of the ARP Investigation Findings</u>

The original site investigation proposal, as stated previously, was to investigate the west and northwest of the site, subsequent to the findings of the Solmek Rotary drilling works.

Based on the ARP borehole findings however, it is evident a significant area of the site would not have sufficient cover (more than just the northwest and west of the site). Using the rotary borehole information (from the six ARP boreholes) and topographical survey information it is possible to calculate levels of the top of the Hard Bed coal seam and then infer levels in between the borehole locations. It is possible to draw contour levels of the top of the Hard Bed seam and understand and calculate the dip of

the seam. Geographically spaced points on the site were utilised to assess where sufficient and insufficient rock cover was present (a table with level data is included for all of the points presented on the plan).

The coal seam contour plan and plan showing sufficient and insufficient cover is included with this letter.

From the coal seam contour plan drawn, the Hard Bed coal seam was calculated to be dipping east-north-east at a shallow angle of just under 3 degrees (2.6 degrees).

When compared to the geological map which covers the site area (Sheet SE11NW 1:10,000 scale) the Hard Bed coal seam can be clearly seen outcropping to the west of the site (approximately 100m away but at a similar level to the central portion of the site) and a nearby dip angle records the strata (including the coal seam) to be dipping at 3 degrees to the east. This agrees/confirms the findings and assessment of the ARP site investigation.

Taking the geological map information and the level of the outcrop of the Hard Bed coal seam (to the west of the site) and extending the seam at 3 degrees below the site, gives very similar levels to the actual borehole information recorded and the calculated/inferred levels of the seam.

Using a 0.8m thick extraction for the coal seam leaves a relatively small area in the southeast of the site that does not require drill and grouting. If it considered that the extracted thickness was more than 0.8m (voids were found thicker than 0.8m) then the entire site will need drill and grouting. We do, however, consider that 0.8m is an acceptable thickness to use as this was the thickest intact seam identified and the voids cannot be as accurately recorded as the intact coal seam can be, and the voids could also represent the start of void migration. Therefore, it is considered excessive to use a void thickness to calculate the required rock cover, in this case.

It should be noted that BH01 of the Solmek investigation (which is located in the southeast corner of the site) did not identify the Hard Bed Coal at all. It is therefore possible that a fault is present somewhere across the site, but this is not identified on any of the geological plans. This will be resolved during the drilling and grouting works.

<u>Ruling Out of Coal Seams Below the Hard Bed Coal Seam</u>

The next coal seam below the Hard Bed Coal seam is the Middle Band Coal and this is recorded as thin and therefore will not have been worked. This seam is also not picked up the Solmek boreholes which were progressed to a depth of 40m below the site.

The coal seam below the Middle Band Coal is the Soft Bed Coal which is mentioned by the Coal Mining Reports as being worked. This seam has been calculated, based on the geological stratigraphical column and its position and level of outcrop (also west of the site), to be approximately 25m below the Hard Bed Coal. It is recorded as being 0.6m thick and therefore will have considerable rock cover above it and is not considered to represent a risk to the site.

Conclusion

In the light of the above, coal mine workings identified from the rotary investigation do not have sufficient rock cover for the proposed development, and it is recommended that stabilisation treatment by injection of grout into a grid of boreholes (known as drilling and grouting) is undertaken.

It is, therefore, recommended that treatment is required for roads and pertinent structures, and 3m beyond, for the proposed development.

The drilling and grouting works will need to be designed (and a Drilling and Grouting Specification produced) and carried out generally in accordance with CIRIA 758D "Abandoned Mine Workings Manual". The works will need to be monitored by a Geotechnical Engineer, and a Validation Report on the works issued following completion, to interested Stakeholders.

There is a small area in the southeast of the site that has been assessed to not require drilling and grouting works, if a 0.8m extracted coal seam thickness is used for sufficient rock cover thickness. It is recommended that during the proposed drill and grout works further investigation is undertaken at this location to confirm cover. The extracted thickness of 0.8m will need to be agreed to be the Coal Authority.

It is possible that roadways will exist within the workings below the site and these would be expected to be identified by the drilling and grouting works. It is also possible that unrecorded mining features (such as shafts and crown holes) could be identified on the site. Any suspicious looking features will require an inspection from a qualified geotechnical engineer.

Once the workings have been treated, foundations will need to be appropriately reinforced. For a strip foundation, this would comprise two layers of B503 mesh within a 300mm thick footing - one near the bottom of the footing and one near the top.

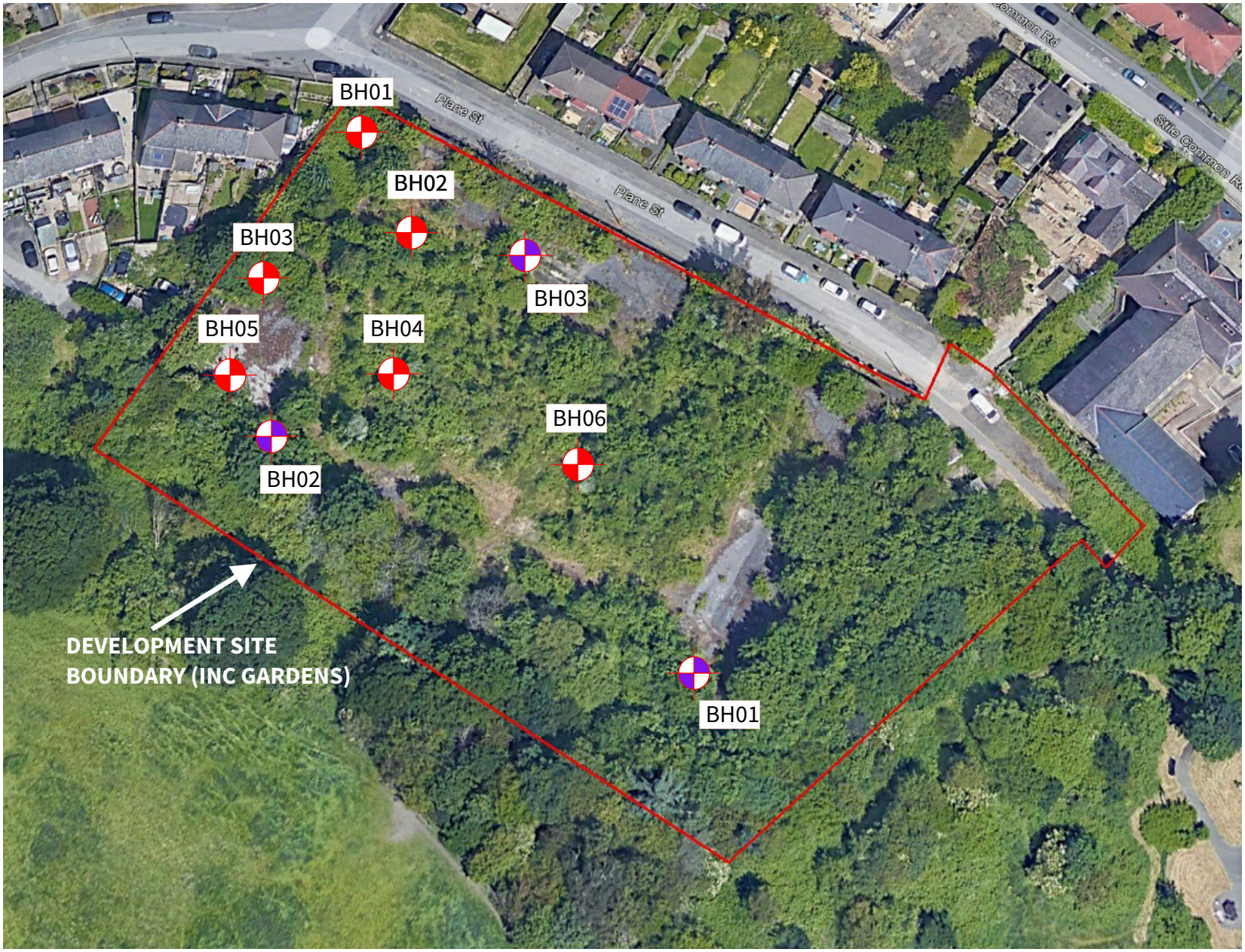
Regulatory agreement will be required for any proposed ground stabilisation programme and engineering designs which interact with mining features.

We trust the above information and enclosures meet your requirement. However, if you have any queries, please do not hesitate to contact us at your convenience.

Yours sincerely
for ARP GEOTECHNICAL LTD

A M Jones

Encs



0m 25m

Approximate Scale

KEY

ARP Rotary Borehole Location

Solmek Rotary Borehole Location

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Project	PLANE STREET, HUDDERSFIELD
Client	UNITY HOUSING ASSOCIATION
Title	SITE INVESTIGATION PLAN
Date	MAY 2024
Drawn	AMJ
Scale	AS SHOWN
Job No.	**UHA/13**

ARP GEOTECHNICAL LTD
CHARTERED CONSULTING ENGINEERS

Site	Borehole Number
Plane Street, Huddersfield	BH01

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Casagrande C6 XP2 Rotary Open Hole Drilling		114.61	Unity Housing Association	UHA/13
	Location	**Dates**	**Engineer**	**Sheet**
	414567 E 415449 N	23/04/2024	JP	1/1

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						114.21	(0.40) 0.40	MADE GROUND		
								CLAY		
							(2.60)			
						111.61	3.00	MUDSTONE		
							(3.30)			
						108.31	6.30	BROKEN GROUND		
							(2.30)			
						106.01	8.60	MUDSTONE		
							(9.40)			
						96.61	18.00	Complete at 18.00m		

Remarks
No groundwater strike recorded by the driller.
Water flush lost in broken ground.
Backfilled with arisings and bentonite upon completion.

Scale (approx)	Logged By
1:100	JP

Figure No.
UHA/13.BH01

ARP GEOTECHNICAL LTD
CHARTERED CONSULTING ENGINEERS

Site	Borehole Number
Plane Street, Huddersfield	BH02

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Casagrande C6 XP2 Rotary Open Hole Drilling		116.10	Unity Housing Association	UHA/13
	Location	**Dates**	**Engineer**	**Sheet**
	414576 E 415432 N	23/04/2024	JP	1/1

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						115.70	(0.40) 0.40	MADE GROUND		
								SILT AND CLAY		
							(2.50)			
						113.20	2.90	MUDSTONE		
							(5.70)			
						107.50	8.60	VOID		
							(1.10)			
						106.40	9.70	MUDSTONE		
							(8.30)			
						98.10	18.00	Complete at 18.00m		

Remarks
No groundwater strike recorded by the driller.
Water flush lost in broken ground.
Backfilled with arisings and bentonite upon completion.

Scale (approx)	Logged By
1:100	JP

Figure No.
UHA/13.BH02

ARP GEOTECHNICAL LTD
CHARTERED CONSULTING ENGINEERS

Site	Borehole Number
Plane Street, Huddersfield	BH03

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Casagrande C6 XP2 Rotary Open Hole Drilling		117.87	Unity Housing Association	UHA/13
	Location	**Dates**	**Engineer**	**Sheet**
	414553 E 415426 N	23/04/2024	JP	1/1

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						117.47	(0.40) 0.40	MADE GROUND		
								CLAY		
							(2.20)			
						115.27	2.60	MUDSTONE		
							(7.10)			
						108.17	9.70	COAL		
							(0.80)			
						107.37	10.50	MUDSTONE		
							(7.50)			
						99.87	18.00	Complete at 18.00m		

Remarks
No groundwater strike recorded by the driller.
Backfilled with arisings and bentonite upon completion.

Scale (approx)	Logged By
1:100	JP

Figure No.
UHA/13.BH03

ARP GEOTECHNICAL LTD
CHARTERED CONSULTING ENGINEERS

Site	Borehole Number
Plane Street, Huddersfield	BH04

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Casagrande C6 XP2 Rotary Open Hole Drilling		117.85	Unity Housing Association	UHA/13
	Location	**Dates**	**Engineer**	**Sheet**
	414578 E 415413 N	23/04/2024	JP	1/1

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						117.45	(0.40) 0.40	MADE GROUND		
								CLAY		
							(2.70)			
						114.75	3.10	MUDSTONE		
							(6.20)			
						108.55	9.30	BROKEN GROUND		
							(1.90)			
						106.65	11.20	MUDSTONE		
							(6.80)			
						99.85	18.00	Complete at 18.00m		

Remarks
No groundwater strike recorded by the driller.
Water flush lost in broken ground.
Backfilled with arisings and bentonite upon completion.

Scale (approx)	Logged By
1:100	JP

Figure No.
UHA/13.BH04

ARP GEOTECHNICAL LTD
CHARTERED CONSULTING ENGINEERS

Site	Borehole Number
Plane Street, Huddersfield	BH05

Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Casagrande C6 XP2 Rotary Open Hole Drilling		118.98	Unity Housing Association	UHA/13
	Location	**Dates**	**Engineer**	**Sheet**
	414550 E 415411 N	23/04/2024	JP	1/1

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						118.68	(0.30) 0.30	MADE GROUND		
								CLAY		
							(3.30)			
						115.38	3.60	MUDSTONE		
							(5.90)			
						109.48	9.50	BROKEN GROUND		
							(1.60)			
						107.88	11.10	MUDSTONE		
							(0.90)			
						106.98	12.00	Complete at 12.00m		

Remarks
No groundwater strike recorded by the driller.
Water flush lost in broken ground.
Backfilled with arisings and bentonite upon completion.

Scale (approx)	Logged By
1:100	JP

Figure No.
UHA/13.BH05

ARP GEOTECHNICAL LTD
CHARTERED CONSULTING ENGINEERS

Site	Borehole Number
Plane Street, Huddersfield	BH06

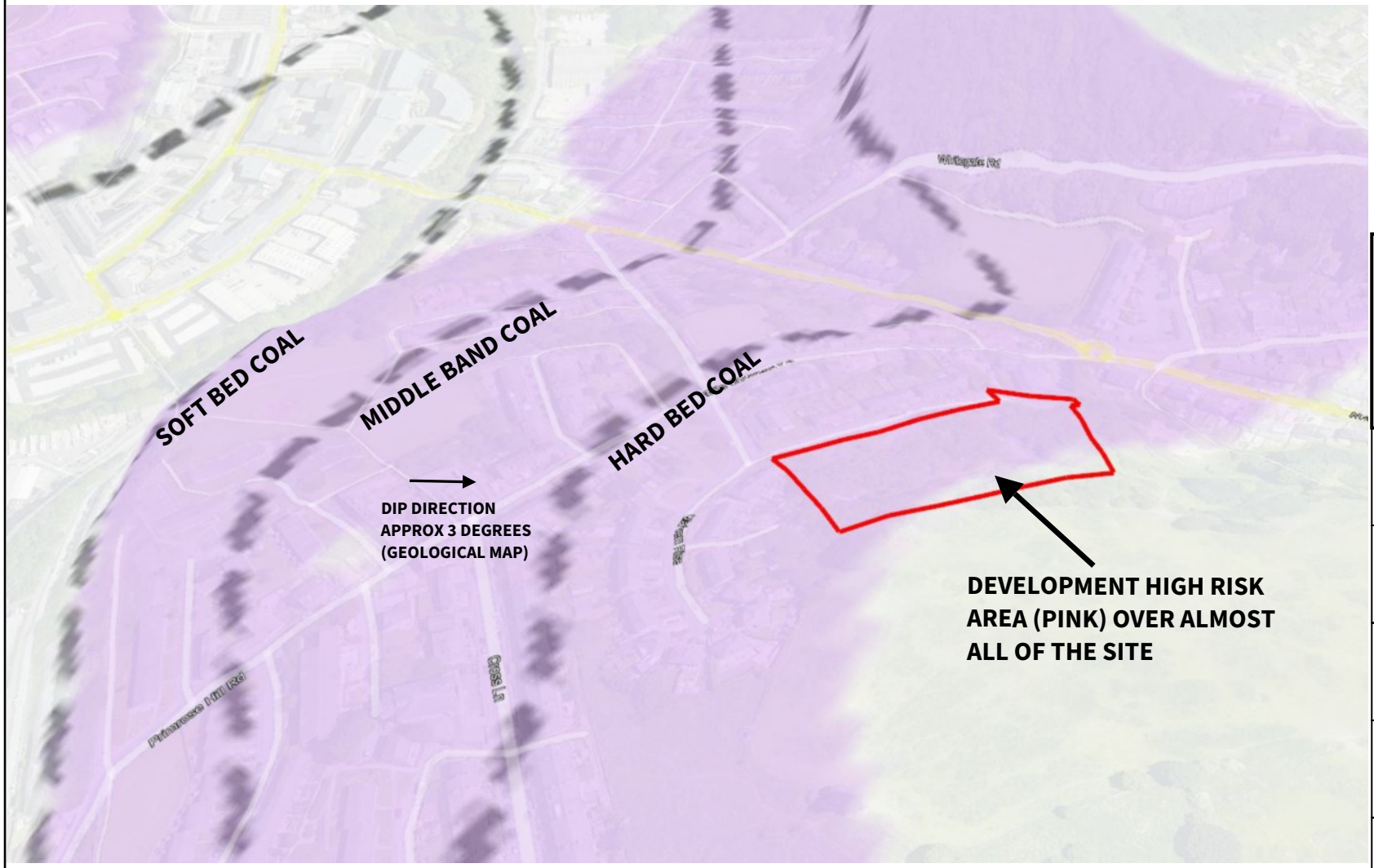
Boring Method	Casing Diameter	Ground Level (mOD)	Client	Job Number
Casagrande C6 XP2 Rotary Open Hole Drilling		117.64	Unity Housing Association	UHA/13
	Location	**Dates**	**Engineer**	**Sheet**
	414600 E 415400 N	23/04/2024	JP	1/1

Depth (m)	TCR (%)	SCR (%)	RQD (%)	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Description	Legend	Water
						117.24	(0.40) 0.40	MADE GROUND		
								CLAY		
							(3.00)			
						114.24	3.40	MUDSTONE		
							(7.60)			
						106.64	11.00	BROKEN GROUND		
							(1.30)			
						105.34	12.30	MUDSTONE		
							(1.70)			
						103.64	14.00	Complete at 14.00m		

Remarks
No groundwater strike recorded by the driller.
Water flush lost in broken ground.
Backfilled with arisings and bentonite upon completion.

Scale (approx)	Logged By
1:100	JP

Figure No.
UHA/13.BH06



0m 100m
Approximate Scale

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Project
PLANE STREET,
HUDDERSFIELD

Client
UNITY HOUSING
ASSOCIATION

Title
COAL SEAM OUTCROPS
AND DEVELOPMENT HIGH RISK
AREA PLAN

Date
MAY 2024

Drawn
AMJ

Scale
AS SHOWN

Job No.
UHA/13

0m 25m

Approximate Scale

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Project	PLANE STREET, HUDDERSFIELD
Client	UNITY HOUSING ASSOCIATION
Title	TOP OF HARD BED COAL CONTOUR LEVELS
Date	MAY 2024
Drawn	AMJ
Scale	AS SHOWN
Job No.	**UHA/13**

0m 25m

Approximate Scale

KEY

Sufficient Cover

Insufficient Cover

Area of Sufficient Cover

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Project
PLANE STREET, HUDDERSFIELD

Client
UNITY HOUSING ASSOCIATION

Title
POSITIONS SHOWING SUFFICIENT & INSUFFICIENT COVER (BASED ON 0.8M SEAM EXTRACTION)

Date
MAY 2024

Drawn
AMJ

Scale
AS SHOWN

Job No.
UHA/13

0m 25m

Approximate Scale

KEY

Sufficient Cover

Insufficient Cover

Area of Sufficient Cover

ARP GEOTECHNICAL LTD
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Project
PLANE STREET, HUDDERSFIELD

Client
UNITY HOUSING ASSOCIATION

Title
POSITIONS SHOWING SUFFICIENT & INSUFFICIENT COVER PROPOSED LAYOUT (BASED ON 0.8M SEAM EXTRACTION)

Date
MAY 2024

Drawn
AMJ

Scale
AS SHOWN

Job No.
UHA/13

Intact Rock Cover Calculations for Boreholes and Positions

Position	Ground Level (m AOD)	Bedrock Level (m AOD)*	Top of Hard Bed Coal Level (m AOD)	Rock Cover (m)	Sufficient/Insufficient**
BH1	114.61	111.61	106.81	4.8	Insufficient
BH2	116.1	113.2	107.2	6	Insufficient
BH3	117.87	115.27	108.17	7.1	Insufficient
BH4	117.85	114.75	107.45	7.3	Insufficient
BH5	118.98	115.38	108.68	6.7	Insufficient
BH6	117.64	114.24	106.14	8.1	Sufficient
A	118	114.6	106	8.6	Sufficient
B	116.75	113.35	105.5	7.85	Insufficient
C	118	114.6	106.5	8.1	Sufficient
D	115	111.6	106	5.6	Insufficient
E	114.4	111	105	6.8	Insufficient
F	115.9	112.5	105.5	7	Insufficient
G	114	110.6	104.5	6.1	Insufficient
H	115	111.6	105	6.6	Insufficient
I	110.7	107.3	104	3.3	Insufficient
J	110	106.6	103.5	3.1	Insufficient
K	117.25	113.855	105.5	8.35	Sufficient
L	117	113.6	106.5	7.1	Insufficient
M	118.1	114.7	107	7.7	Insufficient
N	118.1	114.7	107.5	7.2	Insufficient
O	117.5	114.1	105.75	8.35	Sufficient
P	117.4	114	105.75	8.25	Sufficient

* Assumed average worst case of 3.4m to intact bedrock from ground level (except BHs where levels are known)

** Based on a 0.8m extracted seam, 8m of intact rock cover is required