ARP GEOTECHNICAL LTD
CHARTERED CONSULTING ENGINEERS

UHA/13

UNITY HOUSING ASSOCIATION

PLANE STREET, HUDDERSFIELD

GROUND STABILISATION TREATMENT METHOD SPECIFICATION

JULY 2024

1.0 BACKGROUND

1.1 ARP Geotechnical Ltd (ARP) has been commissioned by Unity Housing Association (the Client) to prepare a method specification for the ground stabilisation treatment of mine workings, for a proposed residential development.

1.2 In May 2022, Solmek issued a letter report on a Further Site Investigation, referenced S220220, dated 5th May 2022. The report included three rotary boreholes to 40m depth.

1.3 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).

1.4 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’.

1.5 ARP were appointed to undertake the recommended additional rotary works in March 2024. In May 2024, ARP issued a letter report on an Additional Intrusive Coal Mining Investigation, referenced UHA/13/l1/AMJ, dated 7th May 2024.

1.6 The ARP 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.

1.7 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).

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

1.9 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.

1.10 Based on the ARP borehole findings, it is evident a significant area of the site would not have sufficient cover (more than just the northwest and west of the site). However, 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.

1.11 In the light of the above, it was recommended that stabilisation treatment by injection of grout into a grid of boreholes (drilling and grouting) should be undertaken beneath the proposed building footprints, roads, and 3m beyond.

1.12 A preliminary grout treatment plan for the site is attached.

1.13 The Coal Authority's records do not show any mine shafts on site. If any mine shafts are identified during the site strip the requirements for any capping or grout treatment will be identified by the Consultant in conjunction with the regulators, where necessary, as these will depend on the particular circumstances of the mine entry, for example requirements will vary depending on whether they are located within gardens or public open space, within influence of proposed buildings, or within influence of an adoptable road. The Contractor will be advised in advance of any additions to the works outlined in this Specification.

2.0 GENERAL

CDM and Health and Safety

2.1 The Contract shall be undertaken in accordance with the Construction Design and Management (CDM) Regulations 2015. Risk assessments and method statements shall be provided by the Contractor for inclusion in the Health and Safety file.

2.2 The works will need to be undertaken in accordance with the terms of the pending Coal Authority Permit to Treat. To comply with the permit, water flush will probably be required on the site. The Contractor will be responsible for carrying out, and recording, continuous borehole/on-rig gas monitoring in accordance with the Permit. Boreholes/treatment holes should be sealed/treated appropriately, as soon as practically possible.

Environmental Management

2.3 Site specific measures should include a risk assessment of pollution prevention controls required. Where possible, drill flush returns should be collected, to prevent air and watercourse pollution, or impact on any adjacent sites. Water flush systems should, ideally, recycle cleaned flush returns water into the drilling or (grout mixing process).

Services

2.4 Plans of all known services will be provided to the Contractor by the Client, but it will be a requirement to provide an appropriate services detector on site for areas to be checked prior to drilling and grouting.

2.5 The Contractor shall indemnify the Client against all claims in respect of any damage to services.

Drainage

2.6 The Contractor shall take all steps to ensure that grout or drilling water does not enter any adopted or private sewers or watercourses and appropriate plans will be provided prior to commencement of the works. The Contractor shall indemnify the Client against all claims in respect of any damage/pollution to drainage systems or watercourses.

Noise and Dust

2.7 The Contractor shall take all reasonable steps to ensure that noise emissions are kept within acceptable levels and control dust arising from the works.

Protection of Adjacent Property

2.8 The works shall be carried out in a competent manner to ensure minimum disruption and no damage to any adjacent buildings, boundary fences or other property.

Contract - Basis of Works

2.9 ARP is not party to the tendering process. However, the basis of the works shall be to drill and grout the required treatment area on a 3m grid. The Contractor will drill and grout the boreholes at the locations indicated on Drawing No. UHA/13/SI.01 (dated July 2024) or any subsequently agreed revisions. Perimeter holes may be spaced 3m generally but, if necessary, may be reduced to 1.5m centres to prevent grout flowing beyond the treatment area. The infill holes will be at 3m centres.

2.10 Validation boreholes will be required, in accordance with Section 5.0. If the tenderer is providing a fixed price, these shall be inclusive within the fixed price. Any additional drilling required as a result of failure of the proof holes shall also be included within the fixed price.

Setting Out

2.11 The Client shall be responsible for setting out of corners of the buildings, or of suitable key positions to establish the grid.

2.12 The Contractor shall be responsible for setting out of the boreholes. The Contractor shall obtain sufficient setting out stations from the Client, to enable the grid of boreholes to be determined to within a horizontal accuracy of 0.3m. The borehole locations are indicated on the drawing, and it will be necessary to use the borehole numbering system shown on the grid.

3.0 DRILLING

3.1 If any unexpected mine entries or surface-reaching void migrations are encountered which have not been identified and advised to the Contractor prior to mobilisation, these shall be treated based on a Schedule of Rates to be provided by the Contractor.

3.2 Holes shall be drilled by rotary or rotary percussion techniques using water flush.

3.3 A 3m x 3m grid will be set out across the areas of the site judged to be requiring treatment (shown on drawing numbers UHA/13/SI.01, and the seam will be treated by injection of grout. The drilling pattern shown shall be followed. If necessary to prevent grout flowing beyond the treatment area, holes around the perimeter of any grout area shall be reduced from a 3m spacing to 1.5m spacing. Each borehole shall have an individual borehole reference number defined by the grid shown on the drawing, so that any borehole can be clearly distinguished from any other borehole.

3.4 A 6m x 6m investigation grid is proposed in the southeast to confirm if sufficient rock cover is present. If the rock cover in this location is found to be insufficient, then the grid will need to be tightened to a 3m grid spacing.

3.5 No mine shafts are indicated to be present on site. However, in the event that a mine shaft is encountered within influencing distance of an adoptable road, the shaft would need to be drilled to the base with a central hole, and then reverse staged pressure grouted from the base to the surface. Up to 3 no. treatment holes may be required depending on the diameter of the shaft. The shafts should then be capped at bedrock with a reinforced concrete slab, to be designed by the Engineer.

3.6 Validation boreholes will be required, in accordance with Section 5.0, and testing should be inclusive within any fixed price. Any additional drilling required as a result of failure of the proof holes will also be included within any fixed price.

3.7 A systematic and accurate record shall be made of all the boreholes. Driller's logs shall be prepared and copied for the Engineer on a daily basis.

3.8 Holes shall be drilled vertically unless otherwise agreed. However, holes along the proposed boundary retaining walls may need to be angled.

3.9 Holes shall be a minimum 50mm diameter, to a depth of 1m below any workings or coal seam. Where it is impractical to drill at the minimum diameter for the full depth, or for operational

reasons such as hole blockage concerns, the diameter of the hole shall be increased, as appropriate. Holes drilled for a perimeter curtain wall shall be a minimum 75mm diameter.

3.10 The boreholes should be provided with temporary casing, if ground conditions or flush loss require it, which if used, will have been completely removed from the borehole on completion of the grouting.

3.11 The Contractor shall provide an as-built plan referencing positions of all boreholes drilled on the site to the agreed layout.

4.0 GROUTING

4.1 Immediately prior to grouting any borehole, the Contractor shall check that the borehole is open and unobstructed throughout its depth.

4.2 Grouting works shall be carried out with grout introduced under pressure in all but perimeter holes and solid coal holes, to ensure that workings will fully receive grout to all interstices. The gauge reading pressure shall not exceed 20kN/m^2 (3 PSI or 0.2 bar) to avoid ground heave. Where significant water is present within any borehole at the time of grout injection, the grout shall be introduced from the base of the hole using a tremie pipe.

4.3 In any infill borehole, if grout has not emerged at the surface after approximately 15 tonnes has been injected, the grout hole shall be left for between 12 and 24 hours before being retreated with reduced quantities of grout. This process shall be repeated until the grout is confirmed to be at the surface and holding the required pressure.

4.4 Grout shall be mixed to a ratio of 1: 10 cement: pulverised fuel ash (PFA).

4.5 Cement shall be Ordinary Portland Cement (OPC) complying with BS EN 197-1 or sulphate resisting Portland Cement complying with BS 407.

4.6 PFA shall be conditioned hopper ash, or dry powder ash of a type suitable as a constituent for grout and obtained from an approved supplier and conform to the requirements of BS 3892.

4.7 Sands shall comply with BS EN 12620 and be of a grading suitable for use within the works.

4.8 Where it is considered that grout may be being lost beyond the treatment area, consideration shall be given to drilling intermediate holes to form a perimeter and introducing pea gravel. Pea gravel may also be introduced to infill holes where voids in excess of 1.5m high are encountered. Holes into which pea gravel are introduced must be at least 75mm in diameter.

4.9 Pea gravel shall comply with BS EN 12620 and be of a grading which would be satisfactory for use in the works.

4.10 Cement shall be stored in a dry location and the sequence of deliveries recorded so that the cement can be used in rotation. Different brands of cement shall not be mixed together. PFA shall be kept covered and slightly damp to minimise nuisance of dust, but without affecting its performance.

4.11 Grouting logs shall be prepared and copied for the Engineer on a daily basis.

4.12 Tickets or records of all materials delivered to site shall be copied for the Engineer for validation purposes.

5.0 GROUT PROPERTIES AND TESTING

5.1 The Contractor shall check the flowability of the grout on site at regular intervals during the grouting works by means of a "Colcrete" type flow meter, and readings between 300mm and 600mm shall be obtained. If required, the mix shall be adjusted immediately, and the test repeated. All tests must be recorded on the grouting logs.

5.2 The bleed capacity of the grout shall also be checked each morning of grouting using a graduated beaker. Once in the beaker, the grout shall be covered to avoid evaporation, and bleed capacity measured at hourly intervals for six hours. Bleed capacity results shall be maintained below 5%. All tests must be recorded on the grouting logs.

5.3 A set of six grout cubes shall be taken at random times (of the Engineer's choosing) once each week during the grouting works and tested by a UKAS accredited laboratory to confirm the 14- and 28-day strengths of the grout. The strength shall be at least 1.0MN/m^2 after 28 days. Any individual cube set shall be tested at both 14 and 28 days.

5.4 On completion of the works, validation holes shall be drilled at locations selected by the Engineer, to prove that the grout has filled interstices within the specified grid, to ensure that the works have been implemented to a satisfactory standard, and that stabilisation of the voided or broken ground has been achieved. An allowance of one testing borehole every other plot (Up to 15 tests) shall be made, together with testing boreholes at an approximate 25m spacing on adoptable roads. If any shafts are identified within influencing distance of the proposed road, up to 3 no. treatment holes may be required, depending on the diameter of the shaft.

5.5 The validation holes shall consist of drilling to below the level of the workings, recording the integrity of the ground through the borehole during drilling, and then grouting at a pressure appropriate to the depth, using a packer. The pressure shall be maintained for a period of not less than three minutes. The grout takes, pressure, and borehole logs, shall be recorded in conjunction with the Engineer. Where the Engineer considers that grout take is excessive, the pressure has not held, or there is evidence of untreated workings, then further holes shall be drilled and grouted in the surrounding area, as necessary.

N O T E S

1. The proposed development layout included as base is Watson Batty Architects Drawing Number: PLNST-WBA-XX-Z-DR-A-TD02
2. If proposed layout is updated then this will require updating to reflect the changes.
3. The grout treatment proposed in this drawing is subject to regulatory approval.
4. Do not scale off this map.
5. Angled drilling may be required for for boreholes positioned along boundary retaining walls.
6. The Coal Authority's records do not show any mine shafts on site. However, if mine shafts are encountered within influencing distance of adoptable roads the shafts would need to be drilled to the base with a central hole and reverse stoged pressure grouted from the base to the surface. Up to 3 no. treatment holes may be required depending on the diameter of the shaft. The shafts should then be capped at bedrock with a reinforced concrete slab.

K E Y

- Borehole (Total No. of boreholes = 675)
- Investigation boreholes (Total No. of boreholes = 20) If insufficient rock cover is identified the treatment grid will be tightened to a 3m grid
- Area of further investigation

Rev	By	Date	Revision	Chk	Apvd
/	JC	03.07.24	Issued for Approval	OG	JR

ARP ASSOCIATES
Chartered Consulting Engineers
Northwest House ● 5 & 6 Northwest Business Park ● Servia Hill, Leeds ● LS6 2QH
☎ 0113 245 8498 🖷 0113 244 3864 ✉ leeds@arpassociates.co.uk 🌐 www.arpassociates.co.uk
ARP Associates is a trading division of ARP Geotechnical Ltd, a company registered in England and Wales with company number 3771811, whose registered office is at 5/6 Northwest Business Park, Servia Hill, Leeds LS6 2QH

TITLE
PROPOSED DRILLING & GROUTING BOREHOLE PLAN

PROJECT
PLANE STREET, HUDDERSFIELD

CLIENT
UNITY HOUSING ASSOCIATION LTD

DRAWING STATUS
APPROVAL

Scale	Date	Drawn	Chk.
1:250 @ A1	JUL 24	JC	OG

Drg. No. UHA/13/SI.01 Rev /