DYSE
STRUCTURAL ENGINEERS

Cherry Tree Surgery
Performance Specification for Grout Stabilisation of Coal Mine Workings

Ref: LM22220-DYSE-XX-ZZ-SP-C-0001

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Client: Dr Arif Shaikh

Document Control

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Date: 19/07/2023

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Date: 19/07/2023

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Date: 19/07/2023

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P01	First Issue	30/06/2023	JB	SF	JDY
P02	Second Issue	19/07/2023	JB	JDY	JDY

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Executive summary

Site address	Cherry Tree Surgery, 132 Upper Commercial Street, Batley, WF17 5DH
National Grid Reference	E 424077, N 424336
Background	DYSE have been instructed by A-Z Medical Instruments to prepare a Performance Specification for the Grout Stabilisation of Coal Mine Workings that will facilitate safe development by means of a single storey extension to an existing medical centre. The DYSE specification has been produced in due consideration of the geo-environmental site assessment and coal mining risk assessment undertaken by Groundtech Consulting. The subject site is currently occupied by a medical centre with associated hardstanding (car park etc). The existing medical centre was designed in May 2000 and assumed to have been constructed shortly after. No as-built information has been obtained, but it is assumed the existing building was appropriately remediated with drilling and grouting. Contractor is to seek verification prior to any works being carried out.
Coal mining	The subject site is located within a Coal Authority defined development high risk area. The underlying bedrock strata in the central and southern part of the site (Pennine Lower Coal Measures) is characteristically a coal bearing stratum. A coal seam is shown to outcrop in the extreme southern area of the site, inferred as the Flockton Thick. The seam is indicated to be between 0.3m and 1.5m in thickness and,the seam dips to the south away from the proposed development area. The Flockton Thin Coal seam is indicated to outcrop 155m north of the site and is likely to dip beneath the proposed development area. From available geological plans, the dip angle of the Flockton Thin in the surrounding area is indicated to be 3° suggesting the seam would be encountered at circa 8.1m BGL at the site, and is generally indicated to have a thickness of 0.3m to 1.4m. Ground investigations have indicated an intact seam between 5.0 - 6.4m, an intact seam between 12.5 – 14.5m and a worked seam between 16.0 – 18.5m. Thickness of workings is in the region of 1.5-2m. The worked seam is not deemed to have sufficient rock cover, and as such requires remediating.

Summary of consolidation and stabilisation works

Consolidation of shallow workings in coal seam	A design verification inclined borehole will be undertaken to confirm presence of existing remediation below the existing building. After which, a grout curtain will be installed to the perimeter of the proposed works, on a 1.5m grid. Boreholes will be drilled on a primary staggered 6 m × 6 m grid across the building footprint, with treatment extending up to 3 m beyond the plot line, with secondary boreholes to then be drilled at 3m infill centres across the area of stabilisation as required. The boreholes will serve as injection points where grout will be pumped under pressure into the workings to consolidate the voids in accordance with the specification herein. Where necessary, tertiary boreholes will be drilled on a 1.5 m grid where grout take is high and completion pressure cannot be achieved within a grout hole. It is recommended that an inclined borehole beneath the building prior to the main remedial works taking place. This will allow for confirmation of any existing grouting and allow for early re design of the grout pattern. Boreholes adjacent to the existing building will serve as design verification boreholes to confirm whether the existing building has been remediated. If it hasn't the extent of drilling and grouting should be extended to cover the entire building footprint, and utilise inclined boreholes as necessary to remediation under the existing building. Works will be considered to be completed when the required borehole grid and pressure grouting has achieved the performance specification. Validation test boreholes will be drilled to confirm consolidation at locations and centres to be dictated by the supervising engineer. No mine shafts are anticipated to be on the site. However, should a mine shaft be encountered during the drilling and grouting works, the mine shaft shall be suitably remediated by means of drilling, grouting and capping.

Contents

1 Introduction

1.1 Background

DYSE have been instructed by A-Z Medical Instruments to prepare a Performance Specification for the Grout Stabilisation of Coal Mine Workings that will facilitate safe and regulatory compliant stabilisation of the land forming the development.

1.2 Report objectives

The objectives of this report are to:

- Prepare an overview of identified issues with abandoned mine workings.
- Evaluate feasible consolidation and stabilisation options.
- Define the proposed scope of works for the stabilisation of abandoned mine working within the sectors of the site that have been determined to be at risk from a future subsidence evnbe.t
- Set out the validation criteria and protocols required to demonstrate the successful implementation of the mine stabilisation works with sufficient supporting information, test data and independent quality control to ensure successful implementation of the works.

1.3 Previous works

The following phases of geotechnical and geo-environmental investigations have been carried out:

J Roberts Design Ltd

Coal Mining Risk Assessment, December 2021

Groundtech Consulting

Geo-Environmental Appraisal, February 2023, GRO-22384-4134

Coal Mining Risk Assessment, June 2023, GRO-22384-4487

1.4 Redevelopment plan

We understand that it is proposed to construct a single storey side extension to the existing single storey building.

1.5 Summary of parties involved

Role	Party
Local planning authority	Kirklees Council
Client	A-Z Medical Instruments
Geoenvironmental consultant	Groundtech Consulting
Civil and structural engineer	DYSE
Main contractor	TBC
Grout stabilisation contractor	TBC
Regulator	The Coal Authority

1.6 Site details

Site address	Cherry Tree Surgery, 132 Upper Commercial Street, Batley, WF17 5DH
National Grid Reference	E 424077, N 424336

1.7 Site description

Occupancy/Use	Cherry Tree Surgery, 132 Upper Commercial Street, Batley, WF17 5DH
Structures	E 424077, N 424336

1.8 Summary of reported ground conditions

DYSE have reviewed the Groundtech Consulting investigations and reports and as summary of the reported ground conditions and presented here:

Made Ground

Made ground was encountered in all bore hole and trial pit locations to a maximum depth of 1.0m BGL and generally consisted of topsoil or gravel surfacing, overlaying gravelly sand with brick, plastic and sandstone.

Superficial Deposits

No superficial deposits were indicated as being present on the site.

Bedrock

The bedrock deposits are indicated to be the Emley rock formation comprising sandstone in the northern area and the Pennine Lower Coal Measures Formation (Secondary A Aquifer) which typically consists of mudstone, siltstone, sandstone and coal seams beneath the central and southern parts.

Groundwater

No ground water was encountered during the ground investigations.

2 Synopsis of coal mining issues

2.1 Background

The existing building is located within a development High Risk area for coal mining. The Coal Authority are familiar with the site as when it was first constructed, the site needed remedial ground treatment.

2.1 Desk study review

The proposed surgery extension is to occupy an approximate footprint of 11m x 11m and is to be of a single storey construction. The approximate grid reference for the proposed extension is E 424050 N 424380

2.2 Coal mining information

The coal mining report ref: 51002774172001 dated 08/12/2021 states the proposed site is located in an area where the Coal Authority believes there is coal at or close to the surface that may have been worked at some time in the past.

2.3 Coal mining risk assessment

A revised CMRA was produced by GroundTech ref: Gro-22384-4487 dated 01/06/2023 as the initial preliminary CMRA determined that there is a potential risk from unrecorded workings beneath the site from the Flockton Thin Coal Seam.

2.4 Intrusive coal mining investigation

GroundTech undertook ground investigations on the 7th and 8th June 2023. The purpose of the investigations were to undertake a revised coal mining risk assessment for the site. These comprised of 3No. rotary open boreholes to a maximum depth of 25m BGL using flush water.

2.5 Summary of ground investigations

The table below summarises the findings regarding the coal seams.

Location	Depth coal Encountered (m BGL)	Thickness of coal (m)	Seam Condition
R01	5.60-6.40	0.8	Intact
R01	12.5-13.2	0.7	Intact
R01	16.0-18.0	2.0	Void encountered, rods dropped and loss of flush (Workings)
R02	5.40-6.30	0.9	Intact
R02	13.5-14.1	0.6	Intact
R02	16.7-18.0	1.3	Void encountered, rods dropped and loss of flush (Workings)
R03	5.00-5.60	0.6	Intact
R03	13.8-14.5	0.7	Intact
R03	17.2-18.5	1.3	Intact

2.6 Summary of coal mining issues

A risk from historical coal mining has been identified by the ground investigation.

Due to insufficient competent rock cover over the worked Flockton Thin Coal, a programme of drilling and grouting will be required for this seam as a minimum in accordance with an approved Drill and Grout Specification.

3 Preliminaries

3.1 In this specification the term ‘Engineer’ shall refer to the authorised representative from DYSE. The term ‘Contractor’ shall refer to the specialist Contractor tendering for the location and treatment of shallow workings and/or disused mine shaft(s) and/or adit(s).

3.2 All work shall be carried out strictly in accordance with CIRIA C758D ‘Abandoned Mine Workings Manual’.

3.3 Before submitting their tender the Contractor shall visit the site. The tender shall include any costs likely to be incurred in gaining access to the site with plant and materials including removing fencing and reinstating same at the completion of work.

3.4 The contractor shall note in his tender the necessity for removal of overhead wires or any other items likely to increase the cost of the work. Any points not so noted and itemised, or cost details not included shall be deemed to be covered in the tender figure.

3.5 The contractor shall comply in all respects with local bye-laws with particular regard to noise, smoke and parking for off-loading, etc.

3.6 The contractor shall state in his tender the type and number of machines and drilling rigs he intends to use on site and their method of operation. The conditions likely to be met on site shall be determined by the Contractor and it shall be his responsibility to provide suitable plant to cope with the ground conditions and any changes in level. The cost of standing time caused by failure or inadequacy of plant shall not be recoverable under the contract.

3.7 At the time of the tendering the Contractor shall clearly state in detail, including size and amounts, the working or storage areas, water, power, access, labour or any other items he will require to be provided. Any item not so noted shall be assumed to be covered in the tender figure.

3.8 The contractor shall state in his tender the amount of notice he requires before beginning work. Any costs incurred by delays in beginning operations shall be borne by the Contractor.

3.9 Sufficient insurance cover against damage to persons or property shall be arranged by the Contractor and dated prior to the commencement on site by the Contractor and shall be maintained to cover the full period of the Contractor’s legal liability.

3.10 The contractor shall provide and erect adequate fencing around all excavations and shafts once they have been located. If deemed necessary by the Engineer the Contractor shall provide a watchman together with all necessary equipment and accommodation on site.

3.11 The contractor shall carry out the works in a safe and competent manner and shall comply with the appropriate safety regulations applicable to the site and nature of the ground encountered. All safety procedures relevant to mine workings are to be adhered to.

3.12 If unrecorded mine shafts are encountered, the Contractor shall be responsible for arranging, where necessary, for a Coal Authority Surveyor to visit the site to determine that a disused mine shaft has been located and this has been securely fenced and to make the necessary tests for noxious gases.

3.13 The contractor must allow a sum in his tender to cover the full cost of any standing involved while waiting for The Coal Authority to visit the site to determine that a mine shaft has been found at and to test for noxious gases.

3.14 The Contractor shall include for the provision of noxious gas detection equipment and equipment required on site to comply with the Coal Authority safety requirements for the duration of the contract.

3.15 The contractor will be provided with all information available concerning services under the site. In some cases it may be necessary, at the discretion of the Contractor, to begin boring or excavations with a hand excavation to a depth of 1.2m to avoid service or drainage runs. Any damage to such services or drains under the site shall be the responsibility of the Contractor and he shall ensure at the timer of tendering that, should precautions be necessary, they are included in the tender.

3.16 The Contractor shall provide the Engineering with electronic copies of the boring record detailing items required by the Engineer for every hole bored as the works proceed. He shall also give the Engineer sufficient notice to enable them to check and agree the length of penetration of each hole bored.

3.17 No conditions requested by the Contractor with his tender shall override any clause in this Specification. Should a Contractor require modification to any clause he shall apply in writing to the Engineer before submitting his tender.

3.18 On completion of the work the Contractor shall remove from site all unwanted materials and plant.

3.19 The Contractor shall dispose of all excavated material to the satisfaction of the Engineer and to a suitably licensed disposal facility. The Contractor shall be responsible for backfilling boreholes and excavations on completion of work. The site when vacated shall be in a similar condition to its condition before commencement of work.

3.20 The contractor shall be responsible for removing from site all effluent, unused or waste material arising from grouting operations to a suitably licensed disposal facility.

3.21 Nothing in this specification should be taken as an instruction to adopt working methods which contravene the CDM Regulations, and all contractor/sub-contractors etc are responsible for ensuring safe procedures which comply with regulations.

4 Materials

4.1 Test certificates for materials showing compliance with the British Standard along with source of manufacture should be forwarded to the Engineer for record purposes before orders are placed.

4.2 The use of materials or techniques not covered by the British Standard or excluded from the specification clauses will not be permitted unless by prior written agreement with the Engineer.

4.3 Water shall be from the mains supply or other source approved by the Engineer.

4.4 Sand shall generally comply with BS EN 12620:2013 and be of a grading suitable for use in the Contractor’s plant and approved by the Engineer.

4.5 Pea gravel shall comply with BS EN 16260:2013, grading approved by the Engineer.

4.6 Bulk material, excluding mixing water, shall be paid for by weight, except that there shall be no payment for the excess weight if the moisture content exceeds 10% by weight of the dried material as determined in accordance with BS 1881.

4.7 Pulverised Fuel Ash (PFA) for use in grouts shall comply with BS EN 450-1:2005 (+A1:2007). Its source of supply shall be to the approval of the Engineer, and certificates of compliance with BS EN 450-1:2005 (+A1L2007) shall be provided by the Contractor to the Engineer for all the material used.

4.8 Portland cement / PFA grout shall comply with the requirements of BS EN 197—1: 2011.

4.9 Proprietary grouts shall be of a type approved for the purpose by the Manufacturers and the Engineer and used strictly in accordance with the Manufacturer’s instructions. The constituent materials including catalysts, additives and admixtures shall be notified to the Engineer immediately upon requires.

4.10 Cement for sand and cement grouts shall be Sulphate Resisting Portland Cement to BS EN 197-4:2011; cement for use with PFA shall be Ordinary Portland Cement (OPC) to BS EN 197-1:2011.

4.11 Sand and cement grouts shall be made with an approved super-plasticiser, Sand grading shall be determined by the Contractor to achieve the required performance.

4.12 Materials shall be stored so as to prevent contamination and deterioration. Cement shall be kept in a dry location and the delivery sequence recorded to ensure that cement is used in rotation. If and where end tipping is deemed available and safe methodology for the filling of open voids e.g. mine shafts, the selection and use of granular bulk filling materials shall be subject to the approval of the Engineer.

5 Grouting plant

5.1 The Contractor shall submit to the Engineer, for comment, details of his proposed method of mixing, batching and pumping of grout of the injection points, together with the means of monitoring grouting pressures and the quantities injected. The materials shall be introduced into the mixer via., approved weight batching equipment. The grout mixer shall be capable of producing a homogeneous mix, all particles being thoroughly wetted without segregation occurring.

5.2 Any grout which has started to gel shall be discarded; the addition of extra water or the ‘working up’ of gelled grout shall not be permitted.

6 Grout mixes

6.1 Before any work commences, the Contractor shall confirm to the Engineer a selection of grout mixes likely to prove satisfactory for the conditions. The Contractor shall prepare cubes, of an agreed size, representative of the mixes agreed, and he shall arrange for them to be tested by crushing at 14 and 28 days in accordance with BS 1881. The testing shall be carried out by an independent laboratory if directed by the Engineer. Where time permits, the results of the tests shall be furnished to the Engineer prior to commencement of grouting operations.

6.2 The following mixes (proportions by weight) are listed for general guidance:

Primary grouting positions; or perimeter curtain grouting: <u>cavities less than 500mm high</u>

- Cement: PFA = 1:12
- Cement: PFA: Sand = 1:10:2 (sand can be added where grout consumption or spread should be limited).
- The cement content should not be less than 75kg/m^3 in dry or unsaturated conditions. In waterlogged workings, the minimum cement content may be raised to 100kg/m^3

Primary grouting positions; or perimeter curtain grouting; or mine entry grouting: <u>for large or interconnecting cavities exceeding 500mm high (a pea gravel infilling is recommended to limit grout travel within the area of consolidation)</u>

- Cement: PFA: Sand = 1:6:1
- The cement content should not be less than 100kg/m^3 in dry or unsaturated conditions. In waterlogged workings, the minimum cement content may be raised to 125kg/m^3. (Admixtures, such as bentonite, may be incorporated to limit the spread of the grouting during injection).
- The grout is injected while pea gravel is fed simultaneously through a hopper, to form a cone of side slope greater than 35 degrees.

Secondary grouting positions; or infill grouting

- Cement: PFA = 1:12 – 1:20
- The cement content should not be less than 50kg/m^3 in dry or unsaturated conditions. In waterlogged workings, the minimum cement content may be raised to 75kg/m^3.

Shaft Plug (a pea gravel infilling is recommended to limit grout travel within the area of consolidation)

- Cement: PFA: Sand = 1:8:1 to 1:10:1
- The cement content should not be less than 100kg/m^3 in dry or unsaturated conditions. In waterlogged workings, the minimum cement content may be raised to 125kg/m^3. (Admixtures, such as bentonite, may be incorporated to limit the spread of the grouting during injection).

- The grout is injected while pea gravel is fed simultaneously through a hopper, to form a cone of side slope greater than 35 degrees

6.3 The design, adjustment and installation of grouts shall be the sole responsibility of the Contractor who shall nevertheless satisfy the Engineer that the mix proportions are in accordance with this Specification, or with the approved variations, and meet the minimum strength and flow requirements of this specification.

7 Grout properties and testing

7.1 Water to cement and PFA ratios shall generally be in the range of 0.4 – 0.45 (including the moisture in the aggregates), the mixes envisaged should produce pumpable grout with lucidity readings of 300 to 600mm when measure in a meter of the 'Concrete' type.

7.2 High bleed grouts shall be avoided and the bleed capacity shall be limited to 5% maximum.

7.3 Bleed capacity shall be measured in a clear plastic or glass graduated cylinder which has an internal diameter not less than 50mm, with a volume of approximately 1000ml. After placing the grout, a cover shall be placed over the cylinder to avoid evaporation. Bleed capacity shall be read at hourly intervals. For a neat cement grout, readings shall continue for not less than 3 hours, and for not less than 6 hours for fly/ash cement grouts.

7.4 The mixes shall produce cubes with crushing strengths of not less than 1.0N/mm^2 (1MPa) at 28 days.

7.5 The actual proportions to be used initially for the various grouts shall be determined by the Engineer, according to the conditions met in drilling and the results of any cube testing or trial grouting carried out before work commences.

7.6 Grout viscosity at the time of injection shall be such as to achieve full penetration of all voids encountered, subject to achieve a satisfactory gel with minimum bleeding and shrinkage within three hours of injection.

7.7 The Contractor shall check the lucidity of the grout on site during operations by means of a flow meter. Bleed capacity after 2h hours shall be monitored by means of a graduated beaker. For strength testing, the Contractor shall make sets of six test cubes of an agreed sizes and taken from the grouting, at surface positions, when directed by the Engineer. The cubes shall be marked, handled, stored and tested in accordance with BS 1881 to confirm the projected 14 and 28 day strengths of the gout.

7.8 If the Engineer considers the results of the tests indicate that a change of mix proportions is required, the Contractor shall make such modifications as the Engineer may direct. If required by the Engineer, the testing shall be carried out by an independent laboratory which shall provide certified records of the results. The contract shall specify the extent of testing and allow a provisional sum for such.

8 Drilling and grouting procedures

8.1 Drill procedures

8.2 All holes including any which strike mineral pillars, to be used for the injection grout, shall be drilled by rotary or rotary percussive techniques down to the pavement of the old workings. The drilling system and water flushing to be used shall be approved by the Engineer. The minimum diameter of holes shall be 50mm unless otherwise specified by the Engineer. When it is impracticable to drill at the minimum diameter for the full depth, the diameter of the holes shall be increased in the upper lengths.

8.3 The holes shall be cased through made ground and superficial deposits down to the rock-head, and if directed by the Engineer, down through the rock strata. The holes shall be kept open until grout injection into the workings and rock is complete.

8.4 Where a hole proves abortive because it becomes obstructed, or because of the Contractor’s failure to progress the hole, it shall be re-drilled at a larger diameter and re-cased, or a new hole drilled and cased at the Contractor’s expense.

8.5 Grouting procedures

8.6 The Contractor shall stabilise by grouting all worked seams, voids and cavities as shown on the drawings or as directed by the Engineer. The maximum drill depth anticipated is 20m with a review during the works to reduce the depth as the data set is enhanced and made clearer. The Contractor shall be responsible for ensuring that the grouting has completely stabilised all voids, cavities, worked seams, adits or shafts encountered in the boreholes.

8.7 Immediately prior to grouting each hole, the Contractor shall check that it is unobstructed to the required depth to receive the tubing or pipes for gout. Obstructions shall be dealt with as described above.

8.8 Grout shall be tremied into position down each hole via. an approved T-connection and flexible tubing, or series of steel tubes, placed to the base of the hole or to such other depth as specified by the Engineer. Provision shall be made for monitoring the pressure of the grout and the quantity being delivered in the line. The grout shall be injected at the approved rates until either a limiting pressure of 10kN/m2 per m overburden or a maximum of 200kN/m,2 is reached, or grout appears near the point of injection when the hole shall be deemed complete. If one of these criteria is reached quickly, the grout tubes or pipes shall be lifted to check that a local obstruction is not preventing the flow of the grout into the strata.

8.9 Grout shall be injected using a grout tube carried below rock head level. The Contractor shall seal the tube against the surrounding ground as necessary to develop the required pressures with a bentonite slurry.

8.10 If pressure is not achieved or grout has not appeared at the point of injection after 15 tonnes of grout materials have been placed, the grout tube or pipe shall be removed from the hole and the injection suspended. After a period of a least 12 hours, up to a further 10 tonnes of materials shall be injected. If there is still no result, injection shall again be suspended for at least 12 hours and the process shall be repeated with further quantities of 5 tonnes. If the hole is still accepting grout after a total of 50 tonnes of material have been injected without any sign of the hole being completed, the Contractor shall consult the Engineer to determine whether the injection is to be continued or other measures such as secondar y or test holes are required.

8.11 When holes have been cased through rock, grout injection shall continue at gauge pressures to be approved by the Engineer, subject to the maximum of $10kN/m^2$ per me of overburden with an upper limit of $200kN/m^2$ whatever the depth, as the casing is withdrawn.

8.12 Care shall be taken to ensure that uplift pressures are not allowed to develop under any adjacent building or structure, including services, during grout injections. Where nearby buildings or structures might be affected by the grouting operations, the Contractor shall employ special supervision, and unless otherwise specified by the Engineer, shall monitor ground levels by precise levelling at intervals, both prior to and during operations

8.13 Reporting and Certification

8.14 The contractors shall issue a Certificate and Warranty (exact requirements to be confirmed to successful Contractor) upon completion of the treatment work itemising:

8.15 The depth and position of each hole drilled;

8.16 The condition of seams, shafts or cavities encountered;

8.17 The quantity and type of grout injected, measured as tonnes of dry materials;

8.18 The quantity and type of other filling material used;

8.19 Any information related to underground workings bearing on future building development on the site, and stating the site is stabilised and for the proposed development subject to suitable foundation design;

8.20 Completion report in addition to Factual Remedial Works Report.

9 Gas monitoring during works

9.1 The contractor shall provide a strategy and method such that all boreholes and excavations are regularly tested for carbon dioxide, carbon monoxide, methane, oxygen and hydrogen sulphide gases.

9.2 Pressures should be monitored during boreholes, and where falling barometric pressure is recoded, the frequency of testing should be increased.

9.3 Monitoring and alarms are to be installed into the active surgery to monitor for gas sources intersected by the works from shallow workings, outcrops, faults or fissures.

9.4 The contractor shall provide a strategy and method for monitoring by means of regulated gas alarms.

9.5 Alarms shall be up to date with relevant safety checks and certification available upon request.

10 In-situ testing

10.1 The contractor should consider the need to test the consolidated ground for permeability and strength.

10.2 Permeability by grout acceptance testing should be checked by drilling test holes and injecting grout at pressures appropriate to the depth, all in accordance with the requirements for infill grouting. The engineer will advise upon test positions. If the quantities of grout accepted are excessive further holes should be drilled and grouted.

10.3 After testing, holes shall be completed in accordance with the requirements for grouting infill holes.

10.4 Where deemed appropriate, the strength of consolidated ground shall be tested by taking sample cores either in newly drilled and cased holes or in re-drilled existing holes. When the samples have been taken, the hole shall be fille dup with grout injected in accordance with the requirements for infill grouting.

11 Records

11.1 The Contractor should prepare and keep available for inspection, site plans showing the position and surface levels of all holes, and sections through the rows of holes to show the results of the Works, inclusive of the Daily Drilling Records (see below) together with the total amounts of grout injected. All levels should be given with reference to a datum to be determined.

11.2 Daily drilling records should be provided for each hole and should preferably contain the following information:

11.2.1. Job title and location
11.2.2. Hole reference number
11.2.3. Date
11.2.4. Contractor's name
11.2.5. Plant in use, crew members and hours worked
11.2.6. Method of boring or drilling, flushing medium and type of drill bit used
11.2.7. Type, diameter and depth of casing used
11.2.8. Diameter and depth of hole at the beginning and end of each working day or shift
11.2.9. Loss of any flushing medium during drilling
11.2.10. Standing time, with reason, or lost overcoming obstructions
11.2.11. Details of underground services located
11.2.12. Details of any settlement or ground heave
11.2.13. Daily and cumulative length drilled
11.2.14. Depth to each major change of stratum
11.2.15. Description, with identification of the stratum and whether it is intact or broken
11.2.16. Depths at which groundwater is encountered
11.2.17. Depths at which any samples are taken
11.2.18. Details of any voids or suspended workings
11.2.19. Details of any emissions of gas, water etc
11.2.20. Depth of completed hole
11.2.21. Daily grouting records should be provided for each hole and should preferably contain the following information:
11.2.22. Job title and location
11.2.23. Hole reference number
11.2.24. Date
11.2.25. Contractor's name
11.2.26. Plant in use, crew members and hours worked
11.2.27. Detail of type of injection and grout-line dimensions (e.g. tremie injection through 25mm diameter line)
11.2.28. Type of grout mix and volumetric quantity injected
11.2.29. Grout pressures recorded with the corresponding depths
11.2.30. Detail of casing abandoned

11.3 The contractor will be required to provide a Warranty for the remedial works undertaken. The exact warranty terms and requirements will be confirmed with the successful Contractor prior to commencement of the works

Appendix A - Drawings

James Totty Partnership, Architects

15/1297 16 B Site Plan

DYSE, Civil and Structural Engineers

LM22220-DYSE-XX-ZZ-DR-C-1001 P01 Coal Mining Remediation – Drilling and Grouting

Appendix B - Documents

J Roberts Design Ltd

Coal Mining Risk Assessment, December 2021

Groundtech Consulting

Geo-Environmental Appraisal, February 2023, GRO-22384-4134

Coal Mining Risk Assessment, June 2023, GRO-22384-4487