REPORT SDS2544
June 2014

COMPLETION REPORT FOR THE DRILLING AND GROUTING TREATMENT OF MINEWORKINGS

at land off
BARNBURGH LANE, GOLDTHORPE (PHASE 1)

prepared for
GLEESON HOMES AND REGENERATION

REPORT NUMBER:	SDS2544	**REPORT STATUS:**	FINAL
REPORT TYPE:	COMPLETION REPORT FOR THE DRILLING AND GROUTING TREATMENT OF MINEWORKINGS		
REPORT DATE:	June 2014		
SITE:	BARNBURGH LANE, GOLDTHORPE (PHASE 1)		
PREPARED FOR:	GLEESON HOMES AND REGENERATION		
PREPARED BY:	Sirius Geotechnical & Environmental Ltd 4245 Park Approach Thorpe Park Leeds LS15 8GB	Tel: 01132 649 960 Fax: 01132 649 962	

COMPLETION REPORT FOR THE DRILLING AND GROUTING TREATMENT OF MINEWORKINGS at land off BARNBURGH LANE, GOLDTHORPE (PHASE 1)

Prepared for

GLEESON HOMES AND REGENERATION

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1. INTRODUCTION

Gleeson Homes and Regeneration (Gleeson) are in the process of developing land off Barnburgh Lane, Goldthorpe for residential housing with private gardens and associated infrastructure. A proposed layout plan is presented within Appendix A as Drawing No. SDS2544/CS/02.

Evidence of shallow mineworkings was encountered within the Shafton Seam during the intrusive site investigation works which included rotary probing.

Sirius Remediation Ltd (SRL) was commissioned by Gleeson to stabilise the identified workings across areas exhibiting less than ten times the worked seam thickness of competent rock cover and to probe and treat a mineshaft located on the southeast of the site. Sirius Geotechnical and Environmental Ltd (SGE) were then subsequently commissioned to prepare a specification, supervise and validate the drilling and grouting works on the site. Prior to starting works the specification was approved by the relevant regulatory bodies and Eastwood & Partners Ltd (Eastwood), who are Gleeson's consulting engineers on this project. A copy of the specification for the pressure grout treatment of the mineworkings is presented within Appendix B of this report. A licence to undertake the pressure grouting of the shallow mine workings within the treatment area was obtained from the Coal Authority (CA) by Eastwood.

This Completion Report includes the following information:

- A summary of the works undertaken and presentation of the findings.
- Confirmation that the works have been carried out in accordance with the current guidelines and specification.

The principal parties to the contract are:

- Gleeson Homes and Regeneration – Developer.
- Sirius Geotechnical and Environmental Ltd – Supervising Engineer for the works.
- Sirius Drilling Services (SDS) – Principal Contractor for the drilling and grouting.
- Eastwood and Partners – Designer of drill and grouting of shallow mine workings.
- Barnsley MBC – Planning Authority.

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2. SITE DETAILS AND DESCRIPTION

2.1 Site Location

The site is located off Barnburgh Lane, Goldthorpe, 15.3km east of Barnsley Town Centre at an approximate National Grid Reference of SK 467 038.

A site location plan is included as Drawing No. SDS2544/CS/01 within Appendix A.

2.2 Site Description

The Phase 1 site occupies a roughly rectangular plot of land covering approximately 3.8 hectares, bound to the north by Gleeson's residential development works and to the east, south and west by open fields. The site comprises an open field that generally slopes downward to the south.

2.3 Geology

A summary of available published geological information is provided in Table 2.1.

Table 2.1 Geological Summary

Sources of Information	BGS 1:10,000 scale (Sheet SE 40 SE) Eastwood Preliminary Site Summary Report
Made Ground	No made ground is recorded on the BGS map.
Drift Geology	No drift geology is recorded on the BGS map.
Solid Geology	Middle Coal Measures strata comprising undifferentiated sandstones, siltstones, mudstones and coals. Two coal seams are shown to be present at the site – Shafton Coal and Highgate Coal. The shallowest of being the Shafton Coal, which lies at approximately 15m to 40m below the site, deepening from south to north. No faults are recorded within the site boundary.

Mining and Quarrying	No extraction features are recorded on the geological plan within the site, however a shaft has been proven by Eastwoods in the South East corner of Phase 1. Goldthorpe Colliery was located some 230m north of Barnburgh Lane.

2.4 Previous Investigations

The site has been subject to a desk top review and a preliminary intrusive investigation prepared for Gleeson by Eastwood.

In September 2012 SGE produced a document summarising the previous investigations and detailing the extent of the drilling and grouting required across the site. This document was supplemented with additional requirements following discussions with Barnsley MBC. This completion report should be read in conjunction with following documents:

- *Desk Study Report. Land off Barnburgh Lane Goldthorpe.* Report Ref: 34041-001. Dated August 2011. Prepared by Eastwood and Partners.
- *Preliminary Site Summary. Land off Barnburgh Lane Goldthorpe.* Report Ref: 34041-004. Dated September 2011. Prepared by Eastwood and Partners.
- *Strategy for the Treatment of Shallow Mineworkings Phase 1 Works Barnburgh Lane, Goldthorpe.* Report Ref: C5971. Dated September 2012. Prepared by Sirius Geotechnical and Environmental Ltd.
- *Letter to Mr I Wilson at Barnsley MBC.* Letter Ref: JMW/KE/34041-017. Dated 29th July 2013. Prepared by Eastwood and Partners.

A summary of the salient information from the above documents is included below.

2.4.1 Introduction

With relation to ground stabilisation the investigation was designed to assess the extent of the drilling and grouting requirements and involved a review of desk study information.

2.4.2 Geological Assessment

The report reviewed previously obtained information in light of the workings encountered on the site. This information is summarised below:

- Information from the Coal Authority (CA) indicated that 'the site lies within the likely zone of surface influence from workings in five coal seams at shallow to 670m depth, the latest date of working being 1982'. Goldthorpe Colliery, located ~230m to the north of the site, sunk shafts to the Shafton Coal seam (the shallowest significant seam beneath the site). It is therefore considered likely that the Shafton Coal has been worked below the site. One former mineshaft is shown to be present in the southeast corner of the Phase 1 site. It has been filled to an unknown specification.

2.4.3 Fieldwork

In total twenty three boreholes were drilled across the site by Sirius and Eastwood during previous intrusive investigation. These boreholes were drilled to depths ranging from 3m bgl to 25m bgl.

2.4.4 Findings of Ground Investigation

The investigation identified a worked coal seam, likely to be Shafton Coal, at depths ranging from 11.7m to 19m below ground level, typified by coal, soft push and broken ground. The seam thickness was recorded to vary between 0.8m and 1.8m. A second seam, the Highgate Coal, was found to be shallow and intact in the north of the site. Issues pertaining to Highgate Coal are not considered within the strategy or within this report.

Drill and grout treatment will be required on all plots and roads where less than 18m of competent strata above the Shafton Seam is evident. The approximate 10 times seam thickness line is shown on the drawings SDS2544/CS/03 and SDS2544/CS/04 within Appendix A. Drill and grout treatment is required to the south of this line.

The shaft in the southeast corner of the site was located by the investigation.

2.5 Drilling and Grouting Specification

The specification for the pressure grout treatment of mineworkings (Report ref. C5971, dated September 2012) was prepared by SGE and is included within Appendix B. SGE provided part-time supervision on site to ensure that the works were carried out in accordance with the specification.

3. DRILLING AND GROUTING WORKS

3.1 The Works

The previous site investigation works formed the basis of the works undertaken at the site.

Within the areas of the site affected by shallow workings, the intention of the works was to stabilise the floor plan of residential plots extending up to 3m beyond the footprint of the buildings. The adoptable highways affected by the shallow workings would also be stabilised. Treatment boreholes were to be drilled on a nominal 3m x 3m grid beneath plot and highway.

The stabilisation works were undertaken by injecting a PFA / cement grout into the boreholes.

Prior to the works commencing a single shaft was known in the southeast of the site. This was located, drilled and grouted. Capping of the shaft remains to be carried out following completion of cap design by Eastwood.

3.2 Programme

The programme of treatment work was carried out as a continuous operation from the 2nd April 2014 to the 27th May 2014

3.3 Drilling Procedure

Boreholes were drilled using open hole rotary percussive drilling rigs with either water flush or air\ mist flush depending of the proximity of potential receptor properties. Each hole was extended to base of the coal seam or the base of the workings if apparent. A further minimum 1.0m thickness of solid strata was then penetrated in order to prove competent rock. Sacrificial plastic casing was used at the top of each borehole to maintain integrity prior to grouting.

Throughout the treatment area, boreholes/ grout injection points were drilled in accordance with the layout as shown on Drawing No SDS2544/CS/03 within Appendix A.

The ground conditions encountered in each borehole are tabulated in a summary table and detailed within daily drill log sheets, included within Appendix C of this report.

3.4 Ground Conditions Encountered

Plots

A total of 1194 boreholes were drilled amounting to a total of 20441m of drilling.

The rotary probe holes typically encountered intact coal or evidence of workings at depths of between 9.20m and 21.00m bgl, ranging in thickness from 0.50m and 4.5m, average thickness 1.89m.

- Solid Coal (incl. weak coal) was encountered in 499 holes (approx. 42%) ranging in thickness from 0.50m to 2.5m with average thickness 1.55m.
- Broken Ground was encountered in 140 holes (approx. 12%) ranging in thickness from 1.50m to 4.50m, average thickness 2.46m
- Soft Push (incl. soft coal) was encountered in 550 holes (approx. 46%) ranging in thickness from 0.90m to 3.70m, average thickness 1.98m. Two boreholes (AI23 and AW35) recorded soft push from either ground surface or beneath superficial deposits to depths of 9m and 16.5m respectively. Further drilling at 1m distance around these boreholes (borehole refs. AI23A to AI23D and AW35A to AW35C) recorded soft push to a similar depth.

Road

A total of 368 boreholes were drilled amounting to a total of 6135m of drilling.

The rotary probe holes typically encountered intact coal or evidence of workings at depths of between 9.80m and 20.30m bgl, ranging in thickness from 1.00m and 3.7m, average thickness 1.78m.

- Solid Coal was encountered in 151 holes (approx. 43%) ranging in thickness from 1.00m to 1.90m, average thickness 1.60m.
- Broken Ground was encountered in 52 holes (approx. 15%) ranging in thickness from 1.40m to 3.70m, average thickness 2.27m.
- Soft Push was encountered in 149 holes (approx. 42%) ranging in thickness from 1.00m to 3.00m, average thickness 2.1m. Four boreholes (AD9, AT39, AM23 and AS38) recorded soft push from either ground surface or beneath superficial deposits to depths of between 10m and 13.5m bgl. Further drilling at 1m distance around boreholes AM23, AS38 and AT39 (AM23A to AM23D etc.) did not record similar soft push ground. Further drilling around borehole AD9 (AD9A to AD9D) recorded soft push to the same depth.

Further investigation of the soft push features beneath both plots and roads was supervised by Eastwood, and was carried out using a JCB 3CX excavator. It is our understanding that Eastwood are to provide information on their investigation into these features under separate cover.

The depth at which the coal or worked ground was encountered generally corresponded to the depths anticipated within the previous reports for the site. Borehole records indicate localised thinning and thickening of the seam across the site.

The layout of boreholes / grout injection points, together with the extent of soft or broken ground subject to grout injection is shown on Drawing No. SDS2544/CS/03 presented within Appendix A.

3.5 Grouting Procedure

Boreholes were injected with grout comprising a 12:1 ratio mixture of Pulverised Fuel Ash (PFA) and Ordinary Portland Cement (OPC) respectively with 40 to 45% water.

Grout was injected under hydrostatic head into all boreholes using a tremie pipe, placed to the base of each hole and a diaphragm pump operating at around 100psi (6.9 bar) until grout appeared at the surface. Grout takes for plot and road boreholes are tabulated within Appendix C and are summarised below. Grout takes of between 2 and 5 tonnes and greater than 5 tonnes are highlighted on the tabulated information with grout takes exceeding 5 tonnes indicated on Drawing No. SDS2544/CS/04.

Plot

A total of 1258 tonnes of grout was injected into plot boreholes. Grout acceptance varied between 0.11 tonnes to 16.9 tonnes with an arithmetical average of 1.05 tonnes per hole.

Road

A total of 406 tonnes of grout was injected into boreholes beneath the highway with the grout acceptance varying between 0.13 tonnes to 10.01 tonnes with an arithmetical average of 1.10 tonnes per hole.

4. SHAFT TREATMENT

4.1 Treatment Procedure

Site investigation works undertaken on the Phase 1 area had identified a mineshaft (Coal Authority Shaft Ref. 446403-021) in the southeast of Phase 1 area. This shaft is shown on Drawing No SDS2544/CS/03 within Appendix A, and on the Coal Authority Mining Report within Appendix E. Shallow, localised excavations were carried out at this location prior to stabilisation, to accurately determine the depth and position of this feature. A probe hole was initially sunk, to ascertain the shaft depth and the nature of shaft infill material.

Once the shaft had been investigated, the borehole was then cased along its length and grout injected in ascending stages to the surface. Subject to treatment in accordance with CIRIA SP32 utilising reverse stage pressure grouting techniques with a 12:1 PFA to OPC grout mix.

Following a period of at least 24 hours, a test \ treatment borehole was drilled and grouted.

Six areas characterised by ‘soft push’ ground from near surface were also highlighted by the drilling works, as detailed within section 3.4. Further trial pit investigation works were undertaken in these areas by Eastwood in order to better understand the ground conditions at the location of these areas of ‘soft push’ ground. We understand that Eastwood can provide this information on request.

A potentially significant feature comprising a possible unrecorded mine entry was identified by these trial pitting works in the vicinity of borehole AW35. Rotary drilling works were not undertaken within this area owing to soft ground. It is understood that Eastwood are in the process of providing recommendations for further investigation and potential treatment works in respect to this feature, which will be subject to validation under separate cover. Trial pits excavated at the location of the remaining five areas of shallow ‘soft push’ ground from near surface identified undisturbed natural ground at shallow depth.

4.2 Conditions Encountered

Shaft

An identified mine shaft present in the vicinity of grid BE43, as shown on drawing No SDS2544/CS/03, was probed and found to extend to a depth of 16.00m. The diameter of the shaft was recorded as being approximately 2.3m with shaft backfill material being generally soft. However, as drilling flush was lost it was not possible to record the constituents of the backfill. Notwithstanding this, following treatment, the shaft accepted 5.1 tonnes of grout.

4.3 Shaft Cap Design

The shaft has not been capped by Sirius. It is understood that the design of a suitable shaft cap is to be undertaken by Eastwood and the installation and validation of such a shaft cap will be reported under separate cover.

5. VALIDATION

In order to assess the standard of the stabilisation works undertaken, a total of 16 test boreholes were drilled in selected locations within the treatment area. Five of these were located beneath adoptable highway as agreed with Barnsley MBC. The locations of the test boreholes are shown on Drawing No. SDS2544/CS/03 within Appendix A.

The locations of the test boreholes were selected by the supervising engineer with the emphasis on localised high grout takes, areas of unexpected low grout takes as well as to provide general coverage of the treated area, including the proven mineshaft.

The test boreholes encountered solid strata with either grout returns or grout and coal. The efficiency of the treatment works was assessed using grout injection tests in each of the test holes under a constant pressure of up to a maximum of 200kN/m^2. This pressure was maintained for a period of 5 minutes, after which the recorded drop in pressure was found to be less than 10%. On this basis the treatment was considered satisfactory, with substantial filling of workings.

Bleed tests and flow tests on the grout were carried out regularly during the grouting works. Bleed tests were undertaken over a 6 hour test period with bleed capacities recorded as being below the maximum 5%, as detailed within the specification. Flow tests, carried out at a minimum frequency of two per week, recorded grout flowability readings between 360mm and 580mm, using a 'Colcrete' meter, in accordance with guidance contained within the specification. The results of these tests are presented within Appendix D of this report.

In order to determine the compressive strength of infill grout, test cubes were formed on site at a frequency of two sets of test cubes of grout from 1 batch of grout per week, and subject to testing by Environmental Scientifics Group Ltd, based in Warrington, a UKAS accredited laboratory. In addition test cubes were taken from grout batches used for treatment of the shaft.

Grout cubes were scheduled to be crushed at 7 and 28 day intervals in accordance with BS 1881. The results of testing are presented within Appendix D of this report. After 28 days the results range from 2.7 to 12.2 MN/m^2, significantly above the 0.7MN/m^2 specified for general treatment boreholes and 0.9MN/m^2 specified for shaft treatment boreholes.

6. CONCLUSIONS

The site observations, drilling and grouting records, and test boreholes, indicate that the drilling and grouting works have been carried out to a satisfactory standard in accordance with the agreed specification and the established methodologies set out within CIRIA SP 32.

The identified mine shaft present in the vicinity of grid BE43 (Coal Authority Shaft Ref. 446403-021), has not been capped by Sirius. It is understood that the design of a suitable shaft cap is to be undertaken by Eastwood and the installation and validation of such a shaft cap will be reported under separate cover.

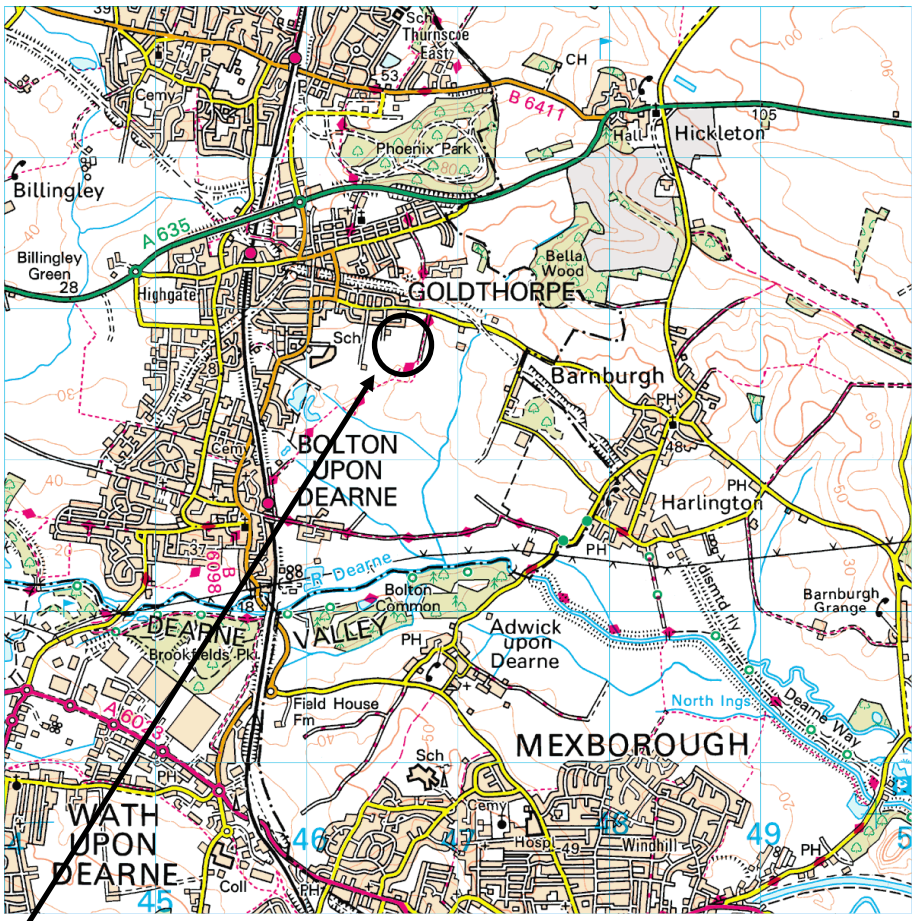
Six areas characterised by ‘soft push’ ground from near surface were also highlighted by the drilling works. Further trial pit investigation works undertaken in these areas by Eastwood identified a potentially significant feature comprising a possible unrecorded mine entry in the vicinity of borehole AW35. Rotary drilling works were not undertaken within this area owing to soft ground. It is understood that Eastwood are in the process of providing recommendations for further investigation and potential treatment works in respect to this feature, which will be subject to validation under separate cover.

APPENDIX A

FIGURES AND DRAWINGS

Site Location Plan

Contract Number	SDS2544
Contract	Barnburgh Lane, Goldthorpe
Client	Gleeson Homes and Regeneration



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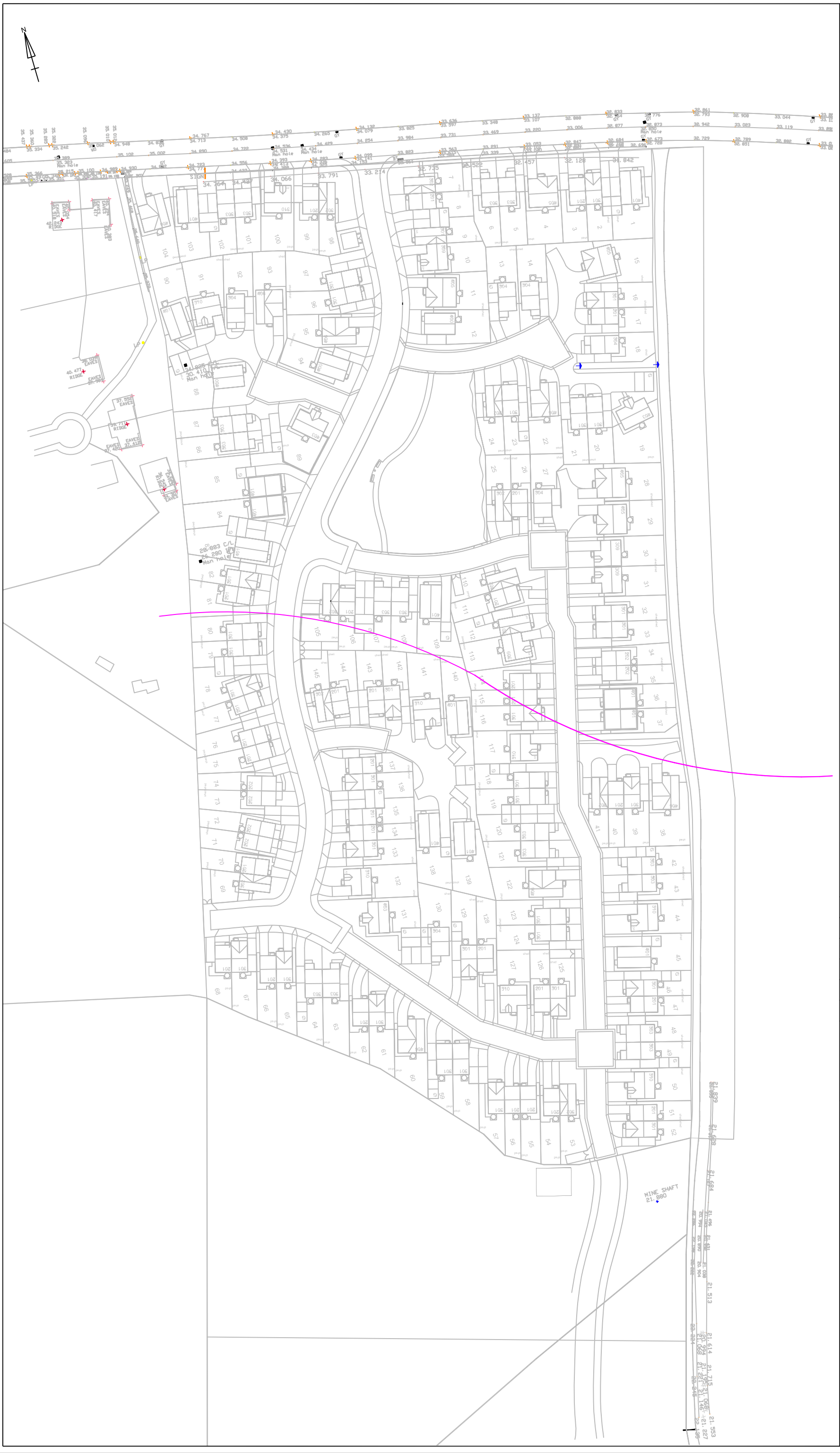
Licence No. 100042005

Scale	1:50,000		
Drawn by	MB	Approved	JCC
Drawing Number	SDS2544/CS/01		



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SIRIUS
REMEDIATION LTD
4245 Park Approach,
Thorpe Park,
Leeds
LS15 8GB
www.theslriusgroup.com
TEL: 0113 264 9960
FAX: 0113 264 9962

CLIENT

Gleeson Homes and Regeneration

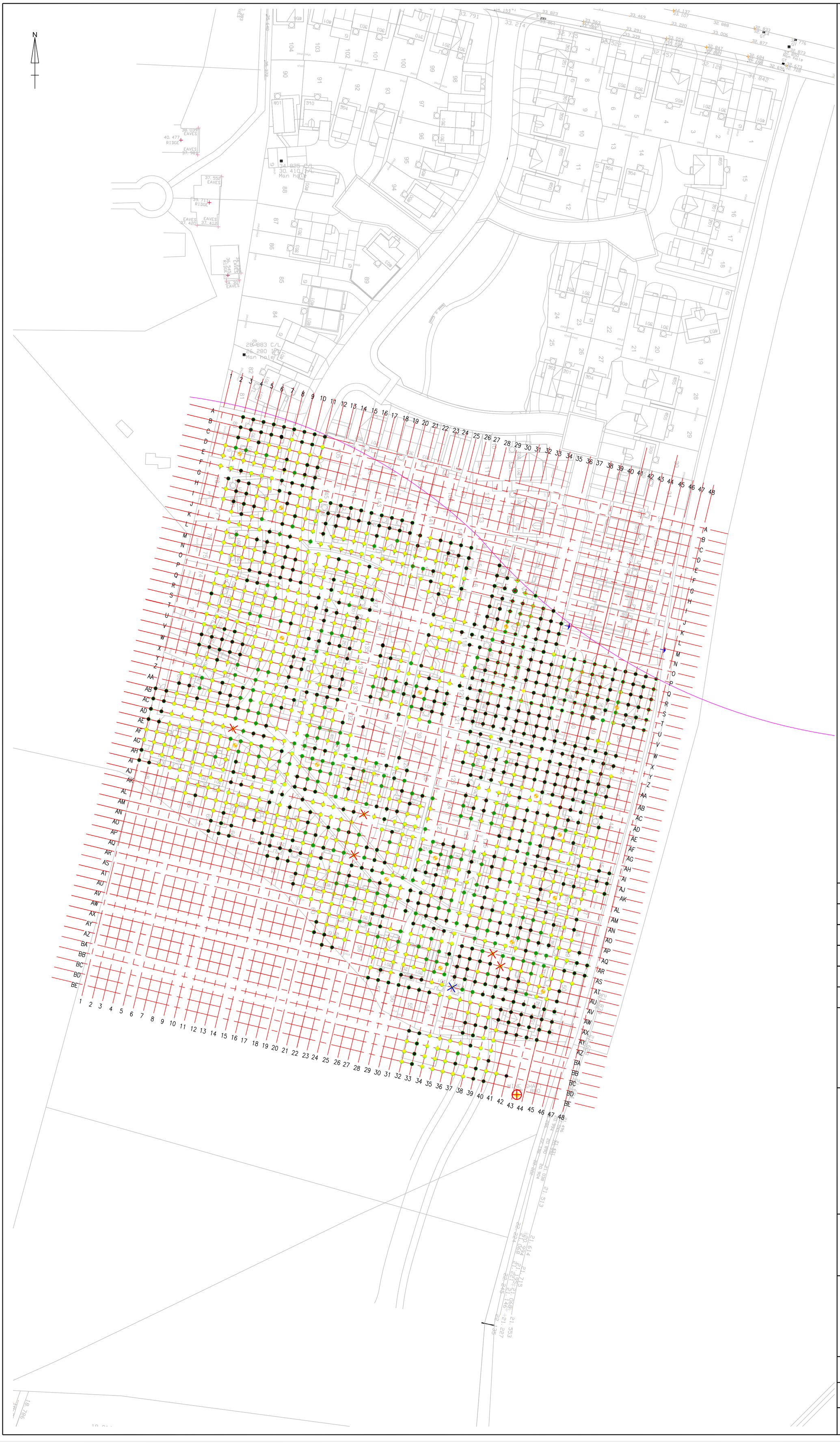
SITE

Barnburgh Lane, Goldthorpe

DRAWING TITLE

Development Layout

DRAWING NO.	REVISION NO.
SDS2544/CS/02	0
DRAWN BY	APPROVED BY
MB	JCC
DATE	SCALE	PAPER SIZE
June 2014	1:1000	A3



NOTES

- Coal
- Soft
- Broken Ground
- Soft push from surface or base of superficials
- Soft push feature (AW35). Further investigation and potential tratement works required
- Test Hole Location
- Mineshaft 446403-021 (Subject to treatment by Sirius under supervision by Eastwood)

Grid references and grouting locations are taken from Eastwood and Partners drawing 34041/012 RevD, dated 29/7/13

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SIRIUS
REMEDIATION LTD
4245 Park Approach,
Thorpe Park,
Leeds
LS15 8GB
www.thesiriusgroup.com
TEL: 0113 264 9960
FAX: 0113 264 9962

CLIENT

Gleeson Homes and Regeneration

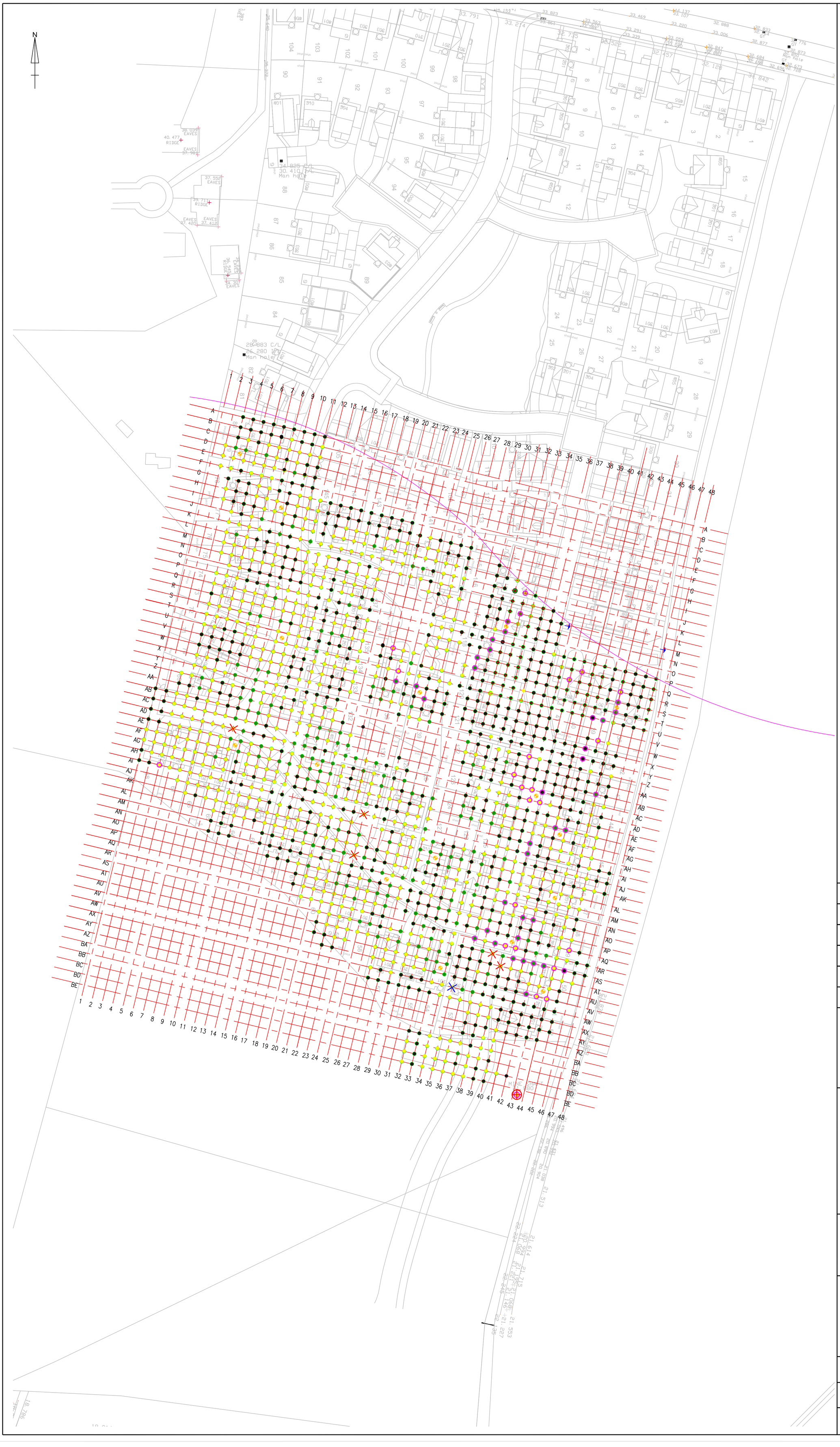
SITE

Barnburgh Lane, Goldthorpe

DRAWING TITLE

As-Built Drilling Plan

DRAWING NO.	REVISION NO.
SDS2544/CS/03	0
DRAWN BY: MB	APPROVED BY: JCC
DATE: June 2014	SCALE: 1:500
PAPER SIZE: A1	



NOTES

- Coal
- Soft
- Broken Ground
- Soft push from surface or base of superficials
- Soft push feature (AW35). Further investigation and potential tratement works required
- Grout Take > 5 tonnes
- Test Hole Location
- Mineshaft 446403-021 (Subject to treatment by Sirius under supervision by Eastwood)

Grid references and grouting locations are taken from Eastwood and Partners drawing 34041/012 RevD, dated 29/7/13

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SIRIUS
REMEDIATION LTD
4245 Park Approach,
Thorpe Park,
Leeds
LS15 8GB
www.thesiriusgroup.com
TEL: 0113 264 9960
FAX: 0113 264 9962

CLIENT

Gleeson Homes and Regeneration

SITE

Barnburgh Lane, Goldthorpe

DRAWING TITLE

As-Built Grouting Plan

DRAWING NO.	REVISION NO.
SDS2544/CS/04	0
DRAWN BY: MB	APPROVED BY: JCC
DATE: June 2014	SCALE: 1:500
PAPER SIZE: A1	

APPENDIX A

FIGURES AND DRAWINGS

APPENDIX B

DRILL & GROUT STRATEGY

APPENDIX C

DRILL & GROUT RECORDS

APPENDIX D

CUBE RESULTS, BLEED AND FLOW TEST RESULTS

APPENDIX E

COAL AUTHORITY PERMIT AND MINING REPORT

STRATEGY FOR THE TREATMENT OF SHALLOW MINEWORKINGS

PHASE 1 WORKS BARNBURGH LANE

GOLDTHORPE

Prepared for

GLEESON HOMES & REGENERATION

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APPENDICES

APPENDIX A FIGURES AND DRAWINGS

Drawing No.	Title	Scale
34041/012	Grouting Hole Position Plan	1 : 500

1. INTRODUCTION

Sirius Remediation Ltd (Sirius) were commissioned by Gleeson Homes & Regeneration Ltd (Gleeson) to prepare a Drilling and Grouting Strategy for the treatment of shallow mineworkings at their Barnburgh Lane site, Goldthorpe.

This strategy covers only the southern half of the Phase 1 Works at the site and does not consider the Phase 2 works immediately south of the current development

It is understood that Gleeson intend to develop the site with residential properties and associated carriageways and landscaped areas.

A geoenvironmental investigation prepared for the site, by Eastwood and Partners (Consulting Engineers) Ltd (Eastwood), has identified the presence of a single seam of coal in the area requiring treatment. This is considered to be the Shafton Seam and workings have been encountered within the unit which will affect surface stability where inadequate competent rock cover is present.

Sirius Remediation Ltd's Drilling Services Division (SDS) have been commissioned to undertake the stabilisation of shallow mineworkings beneath the defined area of the site, by means of drilling and grouting methods. This work will be carried out under the supervision of a competent engineer and will be in general accordance with CIRIA SP32.

Within the areas of the site affected by shallow workings, it is intended to stabilise the floor plan of residential plots with the zone of treatment extending up to 3m beyond the perimeter of residential properties. All adoptable highways exhibiting inadequate rock cover above the worked seam will also be treated across their width.

Treatment will be undertaken across areas exhibiting less than ten times the worked seam thickness of competent rock cover.

Boreholes will be drilled on a nominal 3m x 3m grid across the building footprints with treatment extending up to 3m beyond the plot line, boreholes will also be drilled on a 3m x 3m grid below the adoptable highways.

The stabilisation works will be undertaken by injecting under static head of pressure, a PFA / cement grout into the workings via the boreholes.

The contractor will be supplied with details of all known underground services at the commencement of the contract, but it shall be his responsibility to confirm that each borehole is clear of all underground services, above ground services, equipment, property etc. prior to commencing operations.

All works shall be carried out in accordance with the Construction Design Management (CDM) Regulations and the Construction Phase Health and Safety Plan.

This strategy has been prepared for the sole use of Gleeson and their appointed agents. No other third party may rely upon or reproduce the contents of this report without the written approval of Sirius. If any unauthorised third party comes into possession of this report, they rely on it entirely at their own risk and the authors do not owe them any Duty of Care or Skill.

2. SITE DETAILS AND DESCRIPTION

Table 2.1 Site Location

Location	The site is located off Barnburgh Road, Goldthorpe, and in total occupies an area of approximately 5.7 hectares. The area of this first phase covers approximately 3.8 hectares.
National Grid Reference	NGR SK 467, 038
Current Site Description	Arable cropped farmland which slopes towards the south .
Site Boundaries	North - Barnburgh Lane East – Engine Lane North West - Residential South West - Farmland

3. GEOLOGICAL SETTING

A summary of available published geological information is provided in Table 3.1 below.

Table 3.1 Geological Summary

Sources of Information	BGS 1:10,000 scale geological map (Sheet SE40SE) Eastwood Preliminary Investigation Report
Made Ground	No made ground is recorded on the BGS map within the site.
Drift Geology	No Superficial soils recorded on the BGS map within the site. .
Solid Geology	Middle Coal Measures strata comprising undifferentiated sandstones, siltstones, mudstones and coals Two coal seams are shown to be present at the site – Shafton Coal and Highgate Coal. Faulting – No faults are recorded within the site boundary
Mining and Quarrying	No extraction features are recorded on the geological plan within the site however a shaft has been proven by Eastwoods in the South East corner of the current phase of works. Goldthorpe Colliery was located some 230m north of Barnburgh Lane

4. PREVIOUS INVESTIGATIONS

4.1. Introduction

The site has been the subject to a desk top review and a preliminary intrusive investigation prepared previously for Gleeson by Eastwoods.

Summary of Relevant Findings

With specific regard to the issue of shallow coal mining in the site area, the findings from the previous investigations are summarised below.

A rotary probing has been undertaken across the site area by both Eastwoods and Sirius. The investigations identified coal, broken ground and voiding within the Shafton Seam (1.8m max thickness). A second seam - the Highgate Coal was found to be shallow and intact in the north of the site and any issues pertaining to this seam fall outside this document.

It is anticipated that mineworkings within the Shafton Seam extend beneath the whole of the development area; however surface stability will only be an issue where inadequate competent rock cover is present.

The shaft in the south east corner of the site has been located and will require probing and treatment.

Unrecorded shafts may be present on site and due regard to any such features needs to be maintained during any soil stripping operations.

5.0 GENERAL SPECIFICATION

5.1 Constituent Materials for Grouting

Water shall be from the mains supply or other source approved by the RE, supplied by the Main Contractor.

Cement shall be Ordinary Portland cement complying with BS12.

PFA shall be conditioned hopper ash, or dry powder ash, or a type suitable as a constituent for grout and obtained from an approved supplier.

Sand shall generally comply with BS882 and be of a grading suitable for use in the Contractor's plant.

Pea gravel shall comply with BS882, and be of a suitable grading.

Thixotropic admixtures shall be bentonite or another suitable admixture.

5.2. Storage and Use of Materials

Storage of materials shall be such as to prevent contamination and deterioration. Cement shall be kept in a dry location, and the sequence of deliveries recorded so that cement can be used in rotation.

PFA shall be delivered to site and stockpiled, If required it may be stored under impermeable covers which shall be weighted down to prevent dust nuisance and to retain moisture.

5.3. Grouting Mixing

Grout will be mixed by loading hopper conditioned PFA and bagged OPC directly into the rotary paddle mixer. Water supplied from a nearby source will be then be added to the mix to produce grout of the correct consistency.

The grout will be mixed and injected under hydrostatic head using a 50mm diaphragm pump operating at around 100 psi (6.9 bar) and will be pumped via 50mm reinforced grout hoses into the boreholes.

The grout mixer will be capable of producing a homogenous mix, with all particles being thoroughly wetted and without segregation occurring.

5.4. Grout Mixes

With consideration to the future use of the area, the filing material shall generally consist of a PFA:cement grout which should be mixed in the proportions of up to 12:1 where water is present, but which may range up to 20:1 in dry conditions.

It is anticipated that an 12:1 mix will be utilised at this site although the exact proportion of the mix to be used at any one time shall be as instructed by the RE.

Where excessive lateral flow of grout is anticipated or when voids greater than 500mm are encountered, the addition of sand or pea gravel to the mix in accordance with CIRIA SP32 may be utilised. The specified grout mix shall have the minimum water content consistent with effective pumping.

5.5. Grout Properties and Testing

With water / (cement and PFA) ratios generally in the range of 0.4 to 0.45, (including the moisture in the aggregates), the mixes proposed should produce pumpable grout with flowability readings of between 300 to 600mm, when measured in a meter of the “Colcrete” type.

The sample for the flowability test shall be obtained by the grouting Contractor at the point of injection i.e. from the end of the tremie pipe.

A minimum of two flowability tests per week shall be performed by the Contractor.

High-bleed grouts shall be avoided. Bleed capacity should be limited to 5% maximum unless agreed otherwise.

A minimum of two bleed capacity tests shall be performed by the Contractor per shift. The sample of grout for the test shall be taken from the point of injection i.e. the end of the tremie pipe.

Bleed capacity shall be measured in a clear plastic or glass graduated cylinder which has an internal diameter not less than 50mm and 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 neat cement grout, and readings should continue for not less than 3 hours. For PFA:cement grouts readings should continue for not less than 6 hours.

The Contractor shall prepare two sets of test cubes of grout from one batch of grout per week.

Each cube shall be of 100mm side, and shall be taken from the grout at the point of injection i.e. the end of the tremie pipe.

At the instruction of the RE, the Contractor shall arrange for them to be tested by crushing at 7 and 28 days in accordance with BS1881.

The testing shall be carried out by an independent laboratory.

The mixes shall produce cubes with crushing strengths of not less than 0.7MN/m^2 at 28 days (Note: the 7 day test is performed to indicate that the 28 day strength is achievable i.e. a 7 day value of about 0.4MN/m^2 would probably be considered on target.

If the RE considers the results of the test indicate that a change of mix proportions is required, the Contractor shall make such modifications as the RE may direct.

5.6. Drilling Procedures for Treatment of Shallow Mineworkings

All boreholes to be used for the injection of grout, including those which strike coal pillars, shall be drilled by rotary or rotary percussive techniques down to between 0.5m and 1.0m beyond the base of the old workings in the seams to be treated. The drilling system and flushing medium to be used shall be as instructed on the Coal Authority licence.

The minimum diameter of the holes shall be 50mm. When it is impracticable to drill at the minimum diameter for the full depth, the diameter of the boreholes shall be increased in the upper lengths.

The boreholes shall be kept open until grout injection into the workings and rock is complete.

Where a borehole proves abortive because it becomes obstructed, it shall be re-drilled in a suitable position.

Boreholes shall be formed in general accordance with the locations shown on the plan in Appendix A. Any deviation from this proposed layout including the drilling of additional secondary and

tertiary holes shall be recorded by the contractor and a revised borehole location plan provided to the client.

During the course of the works, an on-going review of the data generated will be undertaken to assess the potential for the treatment zone extending beyond the considered areas.

5.7. Grouting Procedures for Shallow Mineworkings

The Contractor shall fill all abandoned mineworkings and voids encountered in the boreholes in the manner specified.

Grout shall be introduced into all boreholes drilled.

Perimeter grout walls, if required, shall be formed by filling boreholes with a viscous grout composed of appropriate proportions of cement, PFA, sand or pea gravel and water.

Unless specified otherwise, the section of the perimeter wall at the deepest part of the seam shall be constructed first.

Immediately prior to grouting each borehole, the Contractor shall check that it is unobstructed to the required depth to receive the tubing or tremie pipes for grout injection. Obstructions shall be dealt with as described in 'drilling procedures' above.

Grout shall be injected into position down each hole via an approved flexible grouting tube, placed to the base of the hole or to such other depth to receive the tubing or pipes for grout.

Grouting shall proceed upwards from the base of each borehole to the base of the surface deposits. It is not intended that, as a general rule, significant quantities of grout shall be injected into the surface deposits unless specified otherwise.

The grout shall be injected at the approved rates until grout appears near the point of injection, when the borehole shall be deemed complete. If this criteria is reached quickly, the grout tubes shall be lifted to check that a local obstruction is not preventing flow of the grout into the strata.

Hydrostatic pressure shall be applied to the grout in every borehole. If grout has not appeared at the point of injection after 5 tonnes of grouting materials have been introduced then sand and/or pea gravel (gravel which passes through a 6.33mm sieve and is retained on a 2.36mm sieve) may be added to the mix or placed down the borehole.

5.8. Stabilisation Procedures for the Treatment of Mine Shafts

The former mine shafts on site shall be stabilised in accordance with the recommendations given in the NCB handbook 'The Treatment of Disused Mine Shafts and Adits.' and CIRIA SP32.

All work on or about old mine shafts must be carried out from a safety platform of adequate dimensions that will span the potential collapse zone and support the crew and equipment should a catastrophic failure of the shaft occur.

Prior to work commencing the area will be inspected to ensure that the safe movement of heavy equipment can proceed. This will be carried out by a competent, experienced person who will be securely fastened to the surface by means of a full body harness anchored some 5.0 metres away from the shaft perimeter.

If the shaft is found to be open from the surface, then it shall be backfilled with graded material. Any such material will be introduced directly into the shaft from the surface utilising equipment such as a 360 excavator or conveyor.

If the shaft is backfilled then reversed stage pressure grouting of the infill material will be undertaken. Such treatment is achieved by a combination of permeation grouting and low pressure compaction grouting of the infill material which forms a enhanced bond between the infill and the shaft lining \ country rock.

Treatment will therefore be undertaken in the following manner.

A rigid steel and wooden shaft frame will be then mounted over the shaft mouth to ensure that any slumping of the shaft infill will not jeopardise the stability of the drilling rig and the safety of the crew.

Once the safety frame is in place, the drill rig will be positioned over the shaft to allow the sinking of a centrally located borehole through fill material.

Treatment will involve the drilling of a single borehole **to the base of the shaft and at least three metres in to natural strata,**. This is to ensure that no "staging" is present within the shaft and that the actual shaft base has been reached. Shaft staging would typically be encountered within the first 50m below ground within shafts although no hard or fast rules can be applied to this. Staging can be a problem if, over time, it deteriorates to such an extent that catastrophic failure of the infill material occurs

On completion of the first borehole temporary steel casing will then be inserted into the borehole. This casing forms the basis of the reversed stage pressure grouting technique.

The grouting operation will commence on completion of the borehole and will involve direct injection down the borehole under pressure through the drill rods or casing in ascending 3m stages.

The grout will possess water: solids ratio **of no more than 40 % giving an** approximate compressive strength of 0.9N/mm2 @ 28 days.

Grout will be mixed by loading hopper conditioned PFA and bagged OPC directly into the mixer as per the grouting procedure above.

The grout will be mixed and injected using a 50mm diaphragm pump operating at around 100 psi and will be pumped via 50mm reinforced grout hoses into borehole. This will continue until either a maximum pressure is reached or refusal of grout occurs. A length of casing will then be extracted, and the process repeated until the complete length of the shaft has been treated.

Should any significant thickness of permeable / granular fill be present on site, grouting may need to be terminated at the level of the base of such material.

If any significant voids are encountered during the operation, a grout \ pea gravel mix will be introduced into the borehole to restri**ct excessive movement of grout.** However should any major mining feature such as roadways running off the shaft are suspected these will require investigation and treating separately from the shaft.

5.9. Services and Roads

The grouting Contractor shall take all necessary precautions, including making all reasonable liaison with the Client (Gleeson), to ascertain the positions and depths of underground services and drains passing through the site, making full allowance for working around and protecting live services and drains.

The Contractor shall be responsible for maintaining close liaison with the Local Authority and the Public Utility Authorities so as to avoid any disruption of the existing services.

The Contractor shall keep the public and private roads clear from all obstructions other than those permitted by the police and highway authority or the owners, and shall abide by all other police regulations.

When introducing grout into any borehole the Contractor shall ensure by regular inspections throughout the day that the grout is not entering adjacent drains, services, culverts and ducts. In the event that any such leakage is detected the Contractor shall immediately suspend the grouting operations and commence to remove any accumulated grout.

5.10. *In Situ* Testing

On completion of the works, the Contractor shall test the efficacy of the consolidation work.

Permeability by grout acceptance testing shall be checked by drilling test holes in positions to be selected by the engineer and injecting grout at pressures appropriate to the depth, all in accordance with the requirements for infilling grouting. If it is considered that the quantities of grout accepted are excessive, further holes shall be drilled and grouted at the rates and prices agreed.

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

5.11. Records

The Contractor shall prepare and keep available for inspection on site, plans showing the positions of all boreholes, daily drilling records (see below), together with the total amounts of grout injected.

As works proceed, the Contractor shall maintain separate daily records for drilling, for grouting and for materials and plant received. The daily records signed by the Contractor's agent shall be submitted each day to the engineer.

Daily drilling records shall be provided for each borehole and contain the following information:

1. Job title and location
2. Borehole reference number
3. Date
4. Contractor's name
5. Plant in use, crew members and hours worked
6. Method of boring or drilling

7. Type, diameter and depth of casing used
8. Diameter and depth of hole at the beginning and end of each working day or shift
9. Loss of any flushing medium during drilling
10. Standing time, with reason, or time lost overcoming obstructions
11. Details of underground services located
12. Details of any settlement or ground heave
13. Daily and cumulative length drilled
14. Depth to each major change of stratum
15. Description , with identification, of the stratum and whether it is intact or broken
16. Each depth at which groundwater is encountered (if apparent), the depth to which it rose and any steps taken to stop the flow
17. Depths at which any samples are taken
18. Details and results of any permeability tests instructed by the RE
19. Details of any voids or suspected workings
20. Details of any emissions of gas, water, etc.
21. Depth of completed borehole

Daily grouting records shall be provided for each borehole and contain the following information:

1. Job title and location
2. Borehole reference number
3. Date
4. Contractor's name
5. Plant in use, crew members and hours worked

6. Details of type of injection grout-line dimensions and length of standpipes inserted

7. Type of grout mix and volumetric quantity injected including total quantity by weight by each type of grouting material introduced

8. Grout pressures recorded, with the corresponding depths

9. The results of all flow and bleed tests

10. Details of casing abandoned

11. Details of grouting materials delivered to the site and a running total of each of the materials delivered

12. The nature, frequency and results of all inspections of services to check for grout penetration

13. Details of all stoppages or delays and any other relevant information

The daily records of materials and plant received shall show in particular that day's quantities by weight of each type of material and cumulative quantities

On completion of the drill and grout programme, the contractor shall prepare a completion report containing copies of borehole records, a borehole location plan, procedures followed during the works, the results of validation boreholes and pressure tests, and a record of any deviation from this specification.

APPENDIX C

DRILL & GROUT RECORDS

SDS2544 - Land off Barnburgh Lane, Goldthorpe (Phase 1)

Plot Boreholes

Borehole ID	Date Drillled	Drilled By	Superficials	Strata	From (m bgl)	To (m bgl)	Thickness	BH Depth (m bgl)	Grout Take (Tonnes)	Comment
A3	06/05/2014	DG	1.4	C	18.5	20	1.5	21	0.13	
A4	06/05/2014	DG	1.4	C	18.6	20.2	1.6	21.2	0.13	
A5	06/05/2014	DG	1.4	C	18.6	20.1	1.5	21.1	0.13	
A6	06/05/2014	DG	1.4	C	18.5	20	1.5	21	0.13	
A7	12/05/2014	DG	1.4	C	18	19.5	1.5	20.5	0.13	
B3	06/05/2014	DG	1.4	C	18.3	19.8	1.5	20.8	0.13	
B4	06/05/2014	DG	1.4	C	18.3	19.9	1.6	21	0.13	
B5	06/05/2014	DG	1.4	C	18.4	20	1.6	21	0.13	
B6	06/05/2014	DG	1.4	C	18.4	20	1.6	21	0.13	
B7	12/05/2014	DG	1.4	C	18.1	19.6	1.5	20.6	0.13	
C3	06/05/2014	DG	1.4	C	18	19.5	1.5	20.5	0.13	
C4	06/05/2014	DG	1.4	S	17.9	19.8	1.9	20.8	0.65	
C5	06/05/2014	DG	1.4	C	18.1	19.7	1.6	20.7	0.13	
C6	06/05/2014	DG	1.4	S	18	20	2	21	0.91	
C7	09/05/2014	DG	1.5	S	18.1	20	1.9	21	0.91	
D2	02/05/2014	DG	1.4	S	17.8	20	2.2	21	0.65	
D3	02/05/2014	DG	1.4	BG	17.7	20.4	2.7	21.4	1.43	
D4	02/05/2014	DG	1.4	BG	18	20.3	2.3	21.3	0.65	
D5	06/05/2014	DG	1.4	S	17.8	20.2	2.4	21.2	0.65	
D6	06/05/2014	DG	1.4	BG	18	20.3	2.3	21.3	1.3	
D7	09/05/2014	DG	1.5	S	18	20	2	21	1.43	
E2	02/05/2014	DG	1.4	S	17.6	19.8	2.2	20.8	0.65	
E3	02/05/2014	DG	1.4	S	17.6	19.7	2.1	20.7	0.78	
E4	02/05/2014	DG	1.4	S	17.6	19.6	2	20.6	1.04	
E5	02/05/2014	DG	1.4	S	17.6	19.9	2.3	21	0.91	
E6	02/05/2014	DG	1.4	S	17.7	19.8	2.1	20.8	0.52	
E7	09/05/2014	DG	1.5	S	17.8	19.7	1.9	20.7	0.65	
F2	02/05/2014	DG	1.4	S	17.3	19	1.7	20	1.04	
F3	02/05/2014	DG	1.4	S	17.4	19.3	1.9	20.3	1.3	
F4	02/05/2014	DG	1.4	C	17.5	19	1.5	20	0.13	
F5	02/05/2014	DG	1.4	S	17.3	19.3	2	20.3	1.04	

SDS2544 - Land off Barnburgh Lane, Goldthorpe (Phase 1)

Plot Boreholes

Borehole ID	Date Drillled	Drilled By	Superficials	Strata	From (m bgl)	To (m bgl)	Thickness	BH Depth (m bgl)	Grout Take (Tonnes)	Comment
F6	02/05/2014	DG	1.4	S	17.6	19.6	2	20.6	1.17	
F7	09/05/2014	DG	1.5	S	17.8	19.8	2	20.8	4.42	
G3	02/05/2014	DG	1.4	C	17	18.6	1.6	19.6	0.13	
G4	02/05/2014	DG	1.4	C	17.1	18.7	1.6	19.7	0.13	
G5	02/05/2014	DG	1.4	C	17.2	18.8	1.6	19.8	0.13	
G6	02/05/2014	DG	1.4	S	17	19	2	20	1.3	
G7	09/05/2014	DG	1.5	S	17.9	19.9	2	21	3.38	
G12	24/04/2014	DG	1.5	S	17.3	19.9	2.6	21	1.56	
G13	24/04/2014	DG	1.5	C	18.3	19.9	1.6	21	0.13	
G14	24/04/2014	DG	1.5	C	18.4	20	1.6	21	0.13	
G15	24/04/2014	DG	1.5	C	18.5	20.1	1.6	21.1	0.13	
G16	24/04/2014	DG	1.5	C	18.7	20.3	1.6	21.3	0.13	
G17	24/04/2014	DG	1.5	C	18.6	20.2	1.6	21.2	0.13	
G18	24/04/2014	DG	1.5	C	18.4	20	1.6	21	0.13	
G19	23/04/2014	DG	1.5	C	18.5	20.1	1.6	21.1	0.13	
G20	23/04/2014	DG	1.5	C	18.5	20.1	1.6	21.1	0.13	
G21	23/04/2014	DG	1.5	C	18.3	19.8	1.5	20.8	0.13	
H3	01/05/2014	DG	1.5	S	16.7	18.7	2	19.7	0.65	
H4	01/05/2014	DG	1.5	C	16.8	18.4	1.6	19.4	0.13	
H5	02/05/2014	DG	1.5	C	17	18.6	1.6	19.6	0.13	
H6	09/05/2014	DG	1.5	S	17.5	19.4	1.9	20.4	0.65	
H7	09/05/2014	DG	1.5	S	17.7	19.6	1.9	20.6	4.16	
H12	24/04/2014	DG	1.5	S	16.8	19.5	2.7	20.5	1.17	
H13	24/04/2014	DG	1.5	C	18	19.6	1.6	20.6	0.13	
H14	24/04/2014	DG	1.5	C	18.1	19.7	1.6	20.7	0.13	
H15	24/04/2014	DG	1.5	C	18	19.6	1.6	20.6	0.13	
H16	24/04/2014	DG	1.5	C	18	19.6	1.6	20.6	0.13	
H17	24/04/2014	DG	1.5	C	18	19.6	1.6	20.6	0.13	
H18	24/04/2014	DG	1.5	C	18.2	19.8	1.6	20.8	0.13	
H19	23/04/2014	DG	1.5	C	18.3	19.9	1.6	21	0.13	
H20	23/04/2014	DG	1.5	C	18.2	19.8	1.6	20.8	0.13	

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Plot Boreholes

Borehole ID	Date Drillled	Drilled By	Superficials	Strata	From (m bgl)	To (m bgl)	Thickness	BH Depth (m bgl)	Grout Take (Tonnes)	Comment
H21	17/04/2014	DG	1.5	C	17.7	19.3	1.6	20.3	0.13	
H22	17/04/2014	DG	1.5	C	17.7	19.3	1.6	20.3	0.13	
H23	17/04/2014	DG	1.5	S	17.3	19.7	2.4	20.7	0.65	
H24	17/04/2014	DG	1.5	C	17.6	19.2	1.6	20.2	0.13	
H25	17/04/2014	DG	1.5	C	17.5	19.1	1.6	20.1	0.13	
H26	17/04/2014	DG	1.5	C	17.6	19.2	1.6	20.2	0.13	
H27	16/04/2014	DG	1.5	C	17.6	19.2	1.6	20.2	0.13	
I3	01/05/2014	DG	1.5	S	16.5	18.5	2	19.5	1.56	
I4	01/05/2014	DG	1.5	C	16.8	18.4	1.6	19.4	0.13	
I5	01/05/2014	DG	1.4	C	16.8	18.4	1.6	19.4	0.13	
I6	08/05/2014	DG	1.5	C	17.6	19.1	1.5	20.1	0.13	
I7	09/05/2014	DG	1.5	S	17.6	19.4	1.8	20.4	4.55	
I8	09/05/2014	DG	1.5	S	17.7	19.5	1.8	20.5	3.9	
I12	28/04/2014	DG	1.6	S	16.9	19.3	2.4	20.3	0.91	
I13	25/04/2014	DG	1.5	C	17.5	19	1.5	20	0.13	
I14	25/04/2014	DG	1.5	C	17.4	19	1.6	20	0.65	
I15	25/04/2014	DG	1.5	S	17.1	19.5	2.4	20.5	0.91	
I16	25/04/2014	DG	1.5	S	17.2	19.6	2.4	20.6	0.65	
I17	25/04/2014	DG	1.5	S	17	19.5	2.5	20.5	1.04	
I18	25/04/2014	DG	1.5	C	17.9	19.5	1.6	20.5	1.3	
I19	23/04/2014	DG	1.5	S	17.7	20.2	2.5	21.2	0.78	
I20	23/04/2014	DG	1.5	BG	17	20	3	21	0.39	
I21	16/04/2014	DG	1.5	S	17.2	20	2.8	21	1.04	
I22	16/04/2014	DG	1.5	C	17.5	19.1	1.6	20.1	0.13	
I23	16/04/2014	DG	1.5	S	17.3	19.8	2.5	20.8	1.95	
I24	16/04/2014	DG	1.5	S	17.2	19.7	2.5	20.7	0.78	
I25	16/04/2014	DG	1.5	C	17.5	19.1	1.6	20.1	0.13	
I26	16/04/2014	DG	1.5	C	17.4	19	1.6	20	0.13	
I27	16/04/2014	DG	1.5	C	17.5	19.1	1.6	20.1	0.13	
I30	14/04/2014	DG	1.5	C	17	18.6	1.6	19.6	0.13	
J4	01/05/2014	DG	1.5	S	16.4	18.3	1.9	19.3	1.17	

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Plot Boreholes

Borehole ID	Date Drillled	Drilled By	Superficials	Strata	From (m bgl)	To (m bgl)	Thickness	BH Depth (m bgl)	Grout Take (Tonnes)	Comment
J5	01/05/2014	DG	1.4	C	16.6	18.2	1.6	19.2	0.13	
J6	08/05/2014	DG	1.5	S	17.3	19.1	1.8	20.1	1.56	
J7	08/05/2014	DG	1.5	BG	17.5	19.3	1.8	20.3	2.6	
J12	28/04/2014	DG	1.6	S	16.5	18.9	2.4	20	1.3	
J13	28/04/2014	DG	1.6	C	17.2	19	1.8	20	0.13	
J14	28/04/2014	DG	1.5	S	16.7	19	2.3	20	1.56	
J15	28/04/2014	DG	1.6	S	17	19	2	20	1.3	
J16	28/04/2014	DG	1.7	S	16.8	19	2.2	20	1.04	
J17	28/04/2014	DG	1.7	S	17	19.3	2.3	20.3	1.95	
J18	28/04/2014	DG	1.7	BG	17	19.1	2.1	20.1	1.3	
J19	23/04/2014	DG	1.5	S	17.2	20	2.8	21	0.65	
J20	23/04/2014	DG	1.5	S	17	19.6	2.6	20.6	1.3	
J21	16/04/2014	DG	1.5	S	17.4	19.8	2.4	20.8	1.95	
J22	15/04/2014	DG	1.5	S	17.4	20	2.6	21	0.78	
J23	15/04/2014	DG	1.5	S	17.3	19.8	2.5	20.8	0.91	
J24	15/04/2014	DG	1.5	S	17.1	19.7	2.6	20.7	1.82	
J25	15/04/2014	DG	1.5	S	17.3	20	2.7	21	1.04	
J26	15/04/2014	DG	1.5	S	17.2	19.7	2.5	20.7	1.56	
J27	15/04/2014	DG	1.5	C	17	18.6	1.6	19.6	0.13	
J30	14/04/2014	DG	1.5	C	17.2	18.8	1.6	19.8	0.13	
J31	10/04/2014	DG	1.5	C	17.7	19.3	1.6	20.3	0.13	
J32	03/04/2014	RYE	1.5	S	17.5	18.7	1.2	19.7	1.3	
K4	01/05/2014	DG	1.5	S	16.3	18.3	2	19.3	0.65	
K5	01/05/2014	DG	1.5	S	16.3	18.4	2.1	19.4	0.91	
K6	08/05/2014	DG	1.5	S	17	18.9	1.9	20	1.3	
K7	08/05/2014	DG	1.5	S	17.2	19	1.8	20	1.3	
K8	02/05/2014	RWE	1.5	C	17.5	19	1.5	20	0.13	
K12	28/04/2014	DG	1.7	BG	15.5	18	2.5	19	1.43	
K13	28/04/2014	DG	1.6	S	15.8	18.2	2.4	19.2	0.78	
K14	28/04/2014	DG	1.6	S	16.1	18.3	2.2	19.3	1.56	
K15	28/04/2014	DG	1.6	S	16.4	18.5	2.1	19.5	1.3	

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Plot Boreholes

Borehole ID	Date Drillled	Drilled By	Superficials	Strata	From (m bgl)	To (m bgl)	Thickness	BH Depth (m bgl)	Grout Take (Tonnes)	Comment
K16	29/04/2014	DG	1.6	S	16.6	18.7	2.1	19.7	1.95	
K17	29/04/2014	DG	1.7	S	16.6	18.4	1.8	19.4	1.56	
K18	29/04/2014	DG	1.6	S	16.5	18.3	1.8	19.3	0.78	
K19	23/04/2014	DG	1.5	S	16.7	19.4	2.7	20.4	1.04	
K20	23/04/2014	DG	1.5	S	17.2	20	2.8	21	1.3	
K21	16/04/2014	DG	1.6	S	17.1	19.6	2.5	20.6	1.3	
K22	14/04/2014	DG	1.6	BG	16.6	19.2	2.6	20.2	3.9	
K23	14/04/2014	DG	1.6	BG	16.8	19.6	2.8	20.6	1.95	
K24	14/04/2014	DG	1.5	C	17.5	19.1	1.6	20.1	1.04	
K25	14/04/2014	DG	1.5	S	17	19.3	2.3	20.3	1.04	
K26	14/04/2014	DG	1.6	S	17	19.5	2.5	20.5	0.65	
K27	14/04/2014	DG	1.6	S	16.8	19.4	2.6	20.4	1.69	
K30	14/04/2014	DG	1.5	C	17.2	18.8	1.6	19.8	0.13	
K31	10/04/2014	DG	1.5	C	17.6	19.2	1.6	20.2	0.13	
K32	02/04/2014	RYE	1.5	C	17	18.6	1.6	19.6	0.13	
K33	07/04/2014	DG	1.5	S	17.5	20	2.5	21	10.14	
K34	07/04/2014	DG	1.5	C	17.8	19.4	1.6	20.4	0.13	
L4	01/05/2014	DG	1.5	S	16.2	18.2	2	19.2	1.3	
L5	01/05/2014	DG	1.5	BG	16	18.2	2.2	19.2	1.3	
L6	08/05/2014	DG	1.5	S	16.7	18.6	1.9	19.6	1.3	
L7	08/05/2014	DG	1.5	C	17.1	18.6	1.5	19.6	0.13	
L8	02/05/2014	RWE	1.5	C	17.6	19	1.4	20	0.13	
L21	14/04/2014	DG	1.7	S	16.5	19	2.5	20	1.3	
L22	14/04/2014	DG	1.7	S	16.3	19	2.7	20	1.95	
L23	14/04/2014	DG	1.7	S	16.3	18.9	2.6	20	2.21	
L24	14/04/2014	DG	1.6	C	16.4	18	1.6	19	0.13	
L25	14/04/2014	DG	1.7	S	16.2	18.7	2.5	19.7	1.3	
L26	14/04/2014	DG	1.8	S	16.3	18.8	2.5	19.8	2.6	
L27	14/04/2014	DG	1.8	C	16.6	18.2	1.6	19.2	0.13	
L30	11/04/2014	DG	1.5	C	17.6	19.2	1.6	20.2	0.13	
L31	10/04/2014	DG	1.5	C	17.7	19.3	1.6	20.3	0.13	

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Plot Boreholes

Borehole ID	Date Drillled	Drilled By	Superficials	Strata	From (m bgl)	To (m bgl)	Thickness	BH Depth (m bgl)	Grout Take (Tonnes)	Comment
L32	02/04/2014	RYE	1.5	C	17.2	18.7	1.5	19.7	0.13	
L33	04/04/2014	DG	1.5	C	17.4	18.6	1.2	19.6	0.13	
L34	07/04/2014	DG	1.5	S	17.5	20	2.5	21	0.65	
M4	08/05/2014	DG	1.5	S	16	18	2	19	0.91	
M5	08/05/2014	DG	1.5	S	16.1	18	1.9	19	0.78	
M6	08/05/2014	DG	1.5	S	16.2	18.1	1.9	19.1	1.56	
M7	08/05/2014	DG	1.5	S	16.6	18.6	2	19.6	2.34	
M8	02/05/2014	RWE	1.5	C	17.4	18.8	1.4	19.8	0.13	
M9	02/05/2014	RWE	1.5	S	15.5	17	1.5	18	2.73	
M24	15/04/2014	DG	1.7	S	16	18.5	2.5	19.5	1.56	
M25	15/04/2014	DG	1.6	C	16	17.8	1.8	18.8	0.13	
M26	15/04/2014	DG	1.6	S	16.1	18.6	2.5	19.6	1.17	
M27	15/04/2014	DG	1.7	S	16.3	18.7	2.4	19.7	1.82	
M30	11/04/2014	DG	1.5	C	17.4	19	1.6	20	0.13	
M31	09/04/2014	DG	1.5	C	18	19.7	1.7	20.7	0.13	
M32	02/04/2014	RYE	1.5	C	17.1	18.7	1.6	19.7	0.13	
M33	07/04/2014	DG	1.5	BG	17.4	20	2.6	21	16.9	
M34	07/04/2014	DG	1.5	S	17.5	19.8	2.3	20.8	0.52	
N4	08/05/2014	DG	1.5	S	15.9	17.8	1.9	18.8	1.17	
N5	08/05/2014	DG	1.5	S	15.8	17.8	2	18.8	1.04	
N6	08/05/2014	DG	1.5	S	16	18	2	19	0.91	
N7	08/05/2014	DG	1.5	S	16	18	2	19	4.55	
N8	02/05/2014	RWE	1.5	S	16	18	2	19	3.25	
N9	02/05/2014	RWE	1.5	S	16.2	17.8	1.6	18.8	3.9	
N13	30/04/2014	DG	1	S	15.4	17.5	2.1	18.5	1.17	
N14	30/04/2014	DG	1.7	S	15.2	17.2	2	18.2	0.65	
N15	30/04/2014	DG	1.6	C	16	17.6	1.6	18.6	1.3	
N16	30/04/2014	DG	1.6	S	15.4	17.8	2.4	18.8	0.13	
N17	30/04/2014	DG	1.6	S	15.5	17.9	2.4	19	0.78	
N18	30/04/2014	DG	1.6	S	15.6	18	2.4	19	1.04	
N19	23/04/2014	DG	1.5	S	16.3	19.1	2.8	20.1	0.78	

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Plot Boreholes

Borehole ID	Date Drillled	Drilled By	Superficials	Strata	From (m bgl)	To (m bgl)	Thickness	BH Depth (m bgl)	Grout Take (Tonnes)	Comment
N30	11/04/2014	DG	1.5	C	17.2	18.8	1.6	19.8	0.13	
N31	10/04/2014	DG	1.5	C	18	19.6	1.6	20.6	0.13	
N32	02/04/2014	RYE	1.5	BG	17.5	20.5	3	21.5	14.95	
N33	07/04/2014	DG	1.5	S	17.8	19.4	1.6	20.4	0.91	
N34	07/04/2014	DG	1.5	C	17.8	19.4	1.6	20.4	0.13	
O5	08/05/2014	DG	1.5	S	15.5	17.4	1.9	8.4	1.3	
O6	08/05/2014	DG	1.5	S	15.7	17.7	2	18.7	1.56	
O7	08/05/2014	DG	1.5	C	16	17.5	1.5	18.5	0.13	
O8	02/05/2014	RWE	1.5	C	16.4	17.8	1.4	18.8	0.13	
O9	02/05/2014	RWE	1.5	C	16.6	19.1	2.5	20.1	0.13	
O13	01/05/2014	DG	1.6	S	15.2	17.1	1.9	18.1	0.52	
O14	01/05/2014	DG	1.6	S	15	17	2	18	0.13	
O15	01/05/2014	DG	1.6	C	15.5	17.1	1.6	18.1	0.65	
O16	01/05/2014	DG	1.6	S	15.2	17.2	2	18.2	1.04	
O17	01/05/2014	DG	1.5	S	15.5	17.5	2	18.5	0.91	
O18	30/04/2014	DG	1.5	C	15.3	16.9	1.6	18	0.13	
O19	23/04/2014	DG	1.5	C	16.2	17.8	1.6	18.8	0.13	
O25	22/04/2014	DG	1.6	C	16	17.6	1.6	18.6	0.13	
O26	22/04/2014	DG	1.5	S	15.5	18.2	2.7	19.2	1.3	
O27	17/04/2014	DG	1.5	S	16	18.6	2.6	19.6	0.39	
O28	17/04/2014	DG	1.6	S	16.3	19	2.7	20	0.26	
O29	17/04/2014	DG	1.6	C	16	17.6	1.6	18	0.13	
O30	11/04/2014	DG	1.5	C	16.8	18.4	1.6	19.4	0.13	
O31	10/04/2014	DG	1.5	S	18	19.6	1.6	20.6	0.13	
O32	02/04/2014	RYE	1.5	BG	18	21	3	22	9.75	
O33	07/04/2014	DG	1.5	C	18	19.6	1.6	20.6	0.13	
O34	07/04/2014	DG	1.5	C	18	19.6	1.6	20.6	0.13	
P4	08/05/2014	DG	1.5	S	15	17	2	18	0.65	
P5	07/05/2014	DG	1.5	S	15.2	17.1	1.9	18.1	0.39	
P6	07/05/2014	DG	1.5	S	15.3	17.3	2	18.3	0.39	
P7	02/05/2014	RWE	1.5	C	16.2	17.7	1.5	18.7	0.13	

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Plot Boreholes

Borehole ID	Date Drillled	Drilled By	Superficials	Strata	From (m bgl)	To (m bgl)	Thickness	BH Depth (m bgl)	Grout Take (Tonnes)	Comment
P8	02/05/2014	RWE	1.5	C	16.3	17.8	1.5	18.8	0.13	
P9	02/05/2014	RWE	1.5	BG	15	17.3	2.3	18.3	1.3	
P10	01/05/2014	JL	1.6	S	15	16.7	1.7	17.7	0.65	
P14	02/05/2014	JL	1.6	C	15	16.5	1.5	17.5	0.13	
P15	06/05/2014	JL	1.7	S	14.8	16.8	2	17.8	0.26	
P16	06/05/2014	JL	1.6	C	15.2	16.6	1.4	17.6	0.13	
P17	07/05/2014	JL	1.7	BG	14	16.7	2.7	17.7	1.43	
P18	08/05/2014	JL	1.7	S	14.3	16.3	2	17.3	0.78	
P19	23/04/2014	DG	1.5	C	15.9	17.5	1.6	18.5	0.13	
P25	22/04/2014	DG	1.6	S	15.5	18.3	2.8	19.3	1.56	
P26	22/04/2014	DG	1.6	S	15.6	18.5	2.9	19.5	1.17	
P27	17/04/2014	DG	1.6	S	15.7	18.5	2.8	19.5	0.65	
P28	17/04/2014	DG	1.7	C	16.2	17.8	1.6	18.8	0.13	
P29	17/04/2014	DG	1.7	C	15.8	17.4	1.6	18.4	0.13	
P30	11/04/2014	DG	1.5	C	16.5	18.1	1.6	19.1	0.13	
P31	10/04/2014	DG	1.5	BG	16.6	19.6	3	20.6	10.4	
P32	02/04/2014	RYE	1.5	C	16.8	18.4	1.6	19.4	0.13	
P33	07/04/2014	DG	1.5	C	18	19.5	1.5	20.5	0.13	
P34	07/04/2014	DG	1.5	C	18	19.7	1.7	20.7	0.13	
P38	07/04/2014	RYE	1.5	C	17.2	18.8	1.6	19.8	0.13	
P39	04/04/2014	RYE	1.5	C	17.2	18.7	1.5	19.7	0.13	
P40	04/04/2014	RYE	1.5	C	17.2	18.8	1.6	19.8	0.13	
P41	04/04/2014	RYE	1.5	C	17.1	18.7	1.6	19.7	0.13	
P42	03/04/2014	RYE	1.5	C	16.9	18.5	1.6	19.5	0.13	
P43	07/04/2014	RYE	1.5	C	17.4	19	1.6	20	0.13	
P44	08/04/2014	RYE	1.5	C	17.6	19.3	1.7	20.3	0.13	
P45	08/04/2014	RYE	1.5	C	17.7	19.4	1.7	20.4	0.13	
P46	09/04/2014	RYE	1.5	C	17.8	19.6	1.8	20.6	0.13	
P47	04/04/2014	DG	1.5	C	17.3	18.9	1.6	20	0.13	
Q4	07/05/2014	DG	1.5	S	14.7	16.7	2	17.7	0.65	
Q5	07/05/2014	DG	1.5	S	14.8	16.7	1.9	17.7	1.3	

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Plot Boreholes

Borehole ID	Date Drillled	Drilled By	Superficials	Strata	From (m bgl)	To (m bgl)	Thickness	BH Depth (m bgl)	Grout Take (Tonnes)	Comment
Q6	07/05/2014	DG	1.5	S	14.9	16.8	1.9	17.8	1.04	
Q7	06/05/2014	RWE	1.5	S	15	17.1	2.1	18.1	0.91	
Q8	06/05/2014	RWE	1.5	S	14.8	17	2.2	18	1.95	
Q9	02/05/2014	RWE	1.5	S	15	17	2	18	1.04	
Q10	01/05/2014	JL	1.6	BG	13.5	16.3	2.8	17.3	0.78	
Q14	02/05/2014	JL	1.6	C	15	16.5	1.5	17.5	0.13	
Q15	06/05/2014	JL	1.7	C	15	16.6	1.6	17.6	2.34	
Q16	06/05/2014	JL	1.6	C	15	16.5	1.5	17.5	0.13	
Q17	07/05/2014	JL	1.7	S	15	17	2	18	1.43	
Q18	08/05/2014	JL	1.6	C	14.5	16	1.5	17	0.13	
Q19	23/04/2014	DG	1.5	S	15.5	18	2.5	19	0.65	
Q25	22/04/2014	DG	1.6	C	16.2	17.8	1.6	18.8	0.13	
Q26	22/04/2014	DG	1.6	S	15.4	18.1	2.7	19.1	1.04	
Q27	17/04/2014	DG	1.6	S	15.4	18	2.6	19	0.65	
Q28	17/04/2014	DG	1.6	S	15.5	18	2.5	19	0.39	
Q29	17/04/2014	DG	1.6	C	15.5	17.1	1.6	18.1	0.13	
Q30	11/04/2014	DG	1.5	C	16.4	18	1.6	19	0.13	
Q31	10/04/2014	DG	1.5	BG	16.1	19	2.9	20	8.45	
Q32	02/04/2014	RYE	1.5	C	16.9	18.6	1.7	19.6	0.13	
Q33	07/04/2014	DG	1.5	C	17.9	19.6	1.7	20.6	0.13	
Q34	08/04/2014	DG	1.5	C	18	19.6	1.6	20.6	0.13	
Q38	07/04/2014	RYE	1.5	S	17	18	1	19	4.81	
Q39	04/04/2014	RYE	1.5	C	17.3	19	1.7	20	0.13	
Q40	04/04/2014	RYE	1.5	S	17	18.3	1.3	19.3	5.85	
Q41	04/04/2014	RYE	1.5	C	17	18.6	1.6	19.6	0.13	
Q42	03/04/2014	RYE	1.5	C	16.9	18.6	1.7	19.6	0.13	
Q43	07/04/2014	RYE	1.5	C	17.3	18.8	1.5	19.8	0.13	
Q44	07/04/2014	RYE	1.5	C	17.6	19.2	1.6	20.2	0.13	
Q45	08/04/2014	RYE	1.5	C	17.5	19	1.5	20	0.13	
Q46	08/04/2014	RYE	1.5	C	17.6	19.2	1.6	20.2	0.13	
Q47	04/04/2014	DG	1.5	C	17.3	19	1.7	20	0.13	

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Plot Boreholes

Borehole ID	Date Drillled	Drilled By	Superficials	Strata	From (m bgl)	To (m bgl)	Thickness	BH Depth (m bgl)	Grout Take (Tonnes)	Comment
R4	07/05/2014	DG	1.5	C	14.4	16	1.6	17	0.13	
R5	07/05/2014	DG	1.5	S	14.6	16.4	1.8	17.4	1.3	
R6	07/05/2014	DG	1.5	S	14.7	16.3	1.6	17.3	1.95	
R7	06/05/2014	RWE	1.5	S	14.8	16.3	1.5	17.3	0.91	
R8	06/05/2014	RWE	1.5	S	15	17.2	2.2	18.2	2.6	
R9	06/05/2014	RWE	1.5	S	14.7	16.2	1.5	17.2	0.52	
R10	02/05/2014	JL	1.6	S	13.8	15.8	2	16.8	1.95	
R14	02/05/2014	JL	1.6	S	14.7	16.5	1.8	17.5	1.69	
R15	06/05/2014	JL	1.6	C	15	16.5	1.5	17.5	0.13	
R16	06/05/2014	JL	1.5	S	14.7	16.7	2	17.7	0.91	
R17	07/05/2014	JL	1.6	S	14.9	16.8	1.9	17.8	1.3	
R18	08/05/2014	JL	1.6	C	14.6	16.2	1.6	17.2	0.13	
R19	23/04/2014	DG	1.5	S	14.8	17	2.2	18	1.3	
R25	22/04/2014	DG	1.6	S	15.5	18.5	3	19.5	1.95	
R26	22/04/2014	DG	1.6	S	15.3	18	2.7	19	0.78	
R27	17/04/2014	DG	1.5	S	15.1	18	2.9	19	1.17	
R30	11/04/2014	DG	1.5	BG	16.2	19	2.8	20	10.4	
R31	10/04/2014	DG	1.5	C	17	18.6	1.6	19.6	0.13	
R32	02/04/2014	RYE	1.5	C	16.7	18.2	1.5	19.2	0.13	
R33	07/04/2014	DG	1.5	C	18	19.6	1.6	20.6	0.13	
R34	08/04/2014	DG	1.5	C	17.9	19.5	1.6	20.5	0.13	
R38	07/04/2014	RYE	1.5	C	17	18.6	1.6	19.6	0.13	
R39	04/04/2014	RYE	1.5	S	17.2	18.4	1.2	19.4	5.85	
R40	04/04/2014	RYE	1.5	C	17	18.6	1.6	19.6	0.13	
R41	04/04/2014	RYE	1.5	C	16.9	18.5	1.6	19.5	0.13	
R42	03/04/2014	RYE	1.5	C	17.1	18.7	1.6	19.7	0.13	
R43	07/04/2014	RYE	1.5	C	17.3	19	1.7	20	0.13	
R44	07/04/2014	RYE	1.5	S	18	19.2	1.2	20.2	5.2	
R45	08/04/2014	RYE	1.5	C	17.6	19.2	1.6	20.2	0.13	
R46	09/04/2014	RYE	1.5	C	17.5	19.2	1.7	20.2	0.13	
R47	04/04/2014	DG	1.5	C	17.3	18.9	1.6	19.9	0.13	