REPORT SDL4050
MAY 2022

SPECIFICATION FOR THE DRILLING AND GROUTING OF SHALLOW MINE WORKINGS

for
CENTRE 27, BANKWOOD WAY
BIRSTALL

Prepared for
LIDL GB LIMITED

REPORT NUMBER:	SDL4050	**REPORT STATUS:**	FINAL
REPORT TYPE:	SPECIFICATION FOR THE DRILLING AND GROUTING OF SHALLOW MINE WORKINGS		
REPORT DATE:	MAY 2022		
SITE:	CENTRE 27 BANKWOOD WAY, BIRSTALL		
PREPARED FOR:	LIDL GB LIMITED		
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SPECIFICATION FOR THE DRILLING AND GROUTING OF SHALLOW MINE WORKINGS of land at CENTRE 27, BANKWOOD WAY, BIRSTALL Prepared for LIDL GB LIMITED

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SDL4050/SP/01	Site Location Plan	1:25,000
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1. INTRODUCTION

Sirius Drilling Ltd (Sirius) have been commissioned by Lidl GB Limited (Lidl), the Client, to prepare a specification for the stabilisation of shallow mine workings below at proposed retail development at Centre 27, Birstall, West Yorkshire.

It is understood that Lidl intend to develop the site with two retail units, car parking areas and associated carriageways.

A combined Phase 1 and Phase 2 Ground Investigation Report was prepared for the site by Curtins Consulting Limited (Curtins) in 2020, which identified the presence of shallow coal and suspected shallow mineworkings below the site. The shallow seam is considered to be the Flockton Thin Coal, with evidence of workings within influencing distance encountered across the western and north-eastern site areas.

A Detailed Coal Mining Risk Assessment and Supplementary Coal Mining Investigation were prepared for the site by Sirius Geotechnical Limited (SGL) in 2021 and 2022 respectively.

A plan showing the required treatment areas, together with the development proposals, is enclosed in Appendix A.

Boreholes will be drilled on a nominal 3m x 3m grid across the building footprints and below retaining walls greater than 1.5m in height, with the nominal zone of consolidation extending up to 3m beyond the plot line.

Boreholes will also be drilled on a on a nominal 3m x 3m grid across the adoptable access road. Below the access road, should mine workings be encountered within 5m of the surface, the grid will be reduced further to form a 3m grid with central borehole.

Across the car parking areas boreholes will also be drilled on a nominal 6m x 6m grid.

The stabilisation works will be undertaken by injecting a PFA / cement grout into the workings via the boreholes with the aim of substantially filling any mining related voiding.

The Client will supply the contractor with details of all known underground and 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 specification is divided into two sections; the general site details including information on the site, previous investigations and their findings; the second part of this report is a general specification for the works to be undertaken.

On completion of the drill and grout programme, a validation 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 will be produced and issued to the client and all other relevant parties.

This specification has been prepared for the sole use of Lidl 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 to the south of Bankwood Way, within the wider Birstall Retail Park area, approximately 5km south-west of Leeds city centre.
National Grid Reference	NGR 423694, 427432
Current Site Description	The site occupies and area of approximately 1.5 hectares and comprises an irregular shaped parcel of land covered by demolition rumble stockpiles following clearance of the previous development.
Site Boundaries	**West** – Existing retail properties **East** – Bankwood Way and undeveloped area **South** – Bankwood Way, existing commercial buildings and undeveloped areas. **North** – Existing retail properties

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 maps (Sheet SE22NW).
Made Ground	Made ground is recorded across the site, associated with quarry or colliery spoil.
Drift Geology	No superficial soils recorded on the BGS map.
Solid Geology	Solid strata underlying the site comprise Pennine Lower Coal Measures strata, which typically consists of undifferentiated sandstones, siltstones, mudstones and coals with the Emley Rock sandstone formation is indicted to underlie the western and northern areas.

Mining and Quarrying	**Coal Seams:** The Flockton Thin Coal seam outcrops within the site, across the central area and close to the north eastern boundary, underlying the western and north eastern site areas. The First Brown Metal Coal seam underlies the Flockton Thin Coal with a parting of around 20m, outcropping beyond the south eastern boundary and underlying the entire site. **Coal Mining:** The site is noted to be in a Development High Risk Area due to the presence of probable unrecorded shallow mine workings in the Flockton Thin Coal and First Brown Metal Coal seams. **Mine Entries:** A recorded adit (CA Ref. 423427-054) is present within the site boundary, located in the north east of the site with a north-north easterly heading. **Opencast Coal & Quarries:** Former quarry highwalls are indicated to be present across the site associated with historic quarrying activity.

4. PREVIOUS INVESTIGATIONS

The site has been the subject of a Combined Phase 1 and Phase 2 Ground Investigation Report prepared by Curtins Consulting Limited in 2020. The report includes a desk study followed by an intrusive investigation and geoenvironmental assessment.

A Detailed Coal Mining Risk Assessment and subsequent Supplementary Coal Mining Investigation were prepared for the site by Sirius Geotechnical Limited (SGL) on behalf of Lidl GB Limited, in 2021 and 2022 respectively. The Detailed Coal Mining Risk Assessment comprised a desk based assessment of the published information and previous intrusive investigations. The Supplementary Coal Mining Investigation principally comprised of an intrusive investigation of the recorded adit as well as further confirmatory intrusive investigations.

Summary of Relevant Findings

Within their report, Curtins state that….

"The site is located within a Coal Mining Development High Risk Area.

The Flockton Thin and Top Fenton (also referred to as High Fenton or the First and Second Brown Metal coal seam) coal seams underlying the site were last worked in 1877 and 1911 respectively. The Flockton Thin coal seam (0.91m thick) is indicated to be present at a depth of 10mbgl and the Top Fenton (0.6m thick) is shown at a depth of 30mbgl.

The shallow coal encountered across the site is considered to be attributed to the Flockton Thin coal seam based on thickness and depths. It should be noted that recent changes to site levels resulting from demolition works may result in increased depth ranges when compared to previous site investigations. Given the thicknesses and depths of the Flockton Thin coal seam, this coal seam is considered to pose a risk to future developments based on CIRIA's SP32 10:1 criterion, which considers the potential collapse of historical mine workings propagating to the surface.

Exploratory holes (RH201 to RH203, TT201A and TT201e) completed in the northeast corner of the site did not identify any evidence of collapsed mine workings. The loss of flush identified at 4.6mbgl in RH202 is at a similar depth to the coal seam identified in RH201 and

therefore is considered to be broken ground attributed to the coal seam. Similarly, the thickness of loose coal tailings identified in TT201e, together with the identification of overlying reworked natural clay strata suggests disturbed ground and/or fill arisings rather than potential mine workings.

Intact coal (0.6m thick) was encountered within the PLCM in TT201A at 3.4mbgl which provides further evidence to suggest the lack of collapsed mine workings. The collapsed workings (described as loose fill) identified in the rotary probe borehole (RT101) completed by Delta-Simons in 2018 are confined to the extreme northeast boundary, trending offsite to the northeast. It should be noted the location of exploratory hole locations were restricted by the presence of the deep culverted watercourse (approximately 8mbgl) which runs parallel with the eastern boundary. Therefore, if present further to the east, the construction of the culvert may have disturbed the mine adit.

Rotary open-holed borehole RH204 drilled in the southwest of the site encountered a sequence of broken ground, potential backfilled arisings and soft ground and/or a void from 2.1mbgl to 3.5mbgl. This also coincided with a partial loss of flush followed by a complete loss of flush. These ground conditions are similar to those encountered in RT107 completed by Delta-Simons in 2018, which identified a loss of flush and no recovery which was deemed to be a potential void.

TT204B completed approximately 15m to the northeast of RH204 encountered a large void between 1.5mbgl and >3.0mbgl in the northern face of the pit. The base of the void was not proven due to collapse and rapid water ingress.

The nature, size and structure (i.e. overlying sandstone strata provides support as a roof) suggests potential bell pitting coal mining techniques within the west of the site. The depth at which the void was encountered is also similar to the depths recorded for the coal in TT204C (2.8mbgl to >3.2mbgl), located approximately 5m to the west.

The evidence of potential mine workings identified between 1.8mbgl and 4.5mbgl in RH205 affirms the findings encountered within RT108 completed by Delta-Simons in 2018. Similar mining techniques (i.e. bell pitting) identified in TT204B might have been employed in this area.

Mine legacy features comprising potential worked seam and bell pits will require treatment prior to development. The advice of a specialist contractor should be sought however consideration should be given to bulk excavation and filling of bell pit features in association with drilling and grouting of worked seams."

Within their reports, SGL state that….

"Based on the results of the ground investigation works, recorded mine workings within the Flockton Thin coal seam were recorded at depths of between 3.5m and 8.0m bgl. Where intact, the Flockton Thin coal seam was encountered at a thickness of up to 0.60m. Where encountered, suspected workings were identified due to/as 'loss of flush', 'loose fill: collapsed workings', 'possible voids', 'possible void / soft ground' and 'possible broken ground', at thicknesses of between 0.60m and 2.80m.

Evidence of seat earth was recorded underlying made ground soils within Curtins trial hole TT204A. It is unclear if the seatearth has been subject to extraction below the site, although a 0.3m thick band of 'spavin' is shown underlying the Flockton Thin seam on the relevant abandonment plan. The seam is recorded to have been worked in approximately 1877, indicating that a pillar and stall method is likely to have been used. Due to the age of the workings, the findings of the site investigation are consistent with collapsed workings. The presence of intact coal may represent areas of 'pillars', left in-situ as support for the workings.

The coal appears to have been locally extracted by opencast methods, as identified by areas of earthworks and highwalls on historic OS maps, with resultant excavations backfilled with made ground soils. These areas should be evident by associated deep made ground where the coal seam would be anticipated.

The CIRIA Abandoned Mine Workings Manual notes that instability in bedrock resulting from collapse of pillar and stall mine workings might, exceptionally, extend to 10 times the height of the original extraction. All boreholes where evidence of mine workings were encountered within the Flockton Thin seam were found with insufficient cover assuming 10 times the height of extraction (recorded as 0.91m in thickness by the CA).

Sufficient competent cover has been identified above the deeper Top Fenton / First Brown Metal seam (with a recorded extraction thickness of 0.60m), to mitigate any risk from

surface stability within any mine workings present below the site. In addition, no definitive evidence of mine workings within the seam are shown underlying the site on the relevant mine abandonment plan.

In view of this, it is recommended that areas of the site underlain by the Flockton Thin and / or associated coal / seatearth workings be stabilised by drilling and pressure grouting to mitigate the risk of surface instability. At this stage it is considered that remedial works are likely to comprise drill and grout stabilisation boreholes on a staggered preliminary 6m probing grid beneath the footprint of the proposed stores, reducing to a 3m grid where workings are encountered. Within adoptable highway and the service yard/car parking, consideration could be given to the treatment boreholes being drilled on a 3m and 6m grid, respectively. Confirmatory probe holes should be drilled within the areas of former opencast (to the north of the conjectured Flockton Thin outcrop) to prove the absence of the coal seam.

The stabilisation works are proposed to allow historic workings within the Flockton Thin coal seam (and any underlying seat earth) to be substantially filled, in addition to any voids or broken ground found within the overlying strata in order to prevent the development of crown holes at the surface / foundation level.

The possibility of encountering unrecorded mine entries on site cannot be discounted. It is therefore recommended that the areas beneath proposed buildings have overlying made ground removed (where feasible, and in particular where within the conjectured sub-crop of the underlying Flockton Thin coal seam), in order to expose the natural ground. This action, would enable the inspection for any disturbed ground, associated with possible historic bell pits/mine entries/ crop workings of the shallow coal. If any disturbed ground is suspected, advice regarding treatment should be sought from a suitably qualified engineer."

Based on the findings of this supplementary phase of investigation, no evidence of the adit has been identified to a maximum depth of 25m bgl, along its conjectured length (allowing for an up to 8m departure from its recorded location).

Abandonment plans obtained for the site indicate the conjectured adit to be present leading to off-site workings within the First Brown Metal coal, at a recorded depth of c.12m. On this basis, it is anticipated that the adit, if currently present, is anticipated to have been present at a depth of less than c.10m bgl within the site area, and likely to have been intersected by the rotary transects. The adit may have been removed as part of historical earthworks

within the northeastern site area and on this basis is considered to pose a low risk to surface stability.

Although considered an unlikely possibility, should the adit exist at a depth greater than 25m bgl within the site area, sufficient competent cover is considered to exist within the eastern part of the site to mitigate any risk from surface stability of the adit which has a conjectured height of 2m."

5. GENERAL SPECIFICATION

5.1. Constituent Materials for Grouting

Water shall be from the mains supply or other source approved by the Resident Engineer (RE) and supplied by the Client.

Cement shall be CEM II 32.5 conforming to BS EN 197-1:2011

Pulverised Fuel Ash (PFA) complying with BS EN 12715: 2000 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 and approved by the RE.

Pea gravel shall comply with BS882, and be of grading approved by the RE.

Thixotropic admixtures shall be bentonite or another admixture approved by the RE.

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 stored within a pre-defined area and will be kept dampened to mitigate against fugitive dust.

5.3. Grouting Plant

The Contractor shall submit to the RE, for approval, details of the proposed method of mixing, and pumping of grout to 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 volumetric methods.

The grout mixer shall be capable of producing a homogenous mix, all particles being thoroughly wetted without segregation.

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 generally mixed in the proportions of to 12:1.

The mixes shall produce cubes with crushing strengths of not less than 1.0 MN/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.

Where excessive lateral flow of grout is anticipated or when voids greater than 500mm are encountered, sand or pea gravel may be introduced in to the workings in accordance with CIRIA C758D. The specified grout mix shall have the minimum water content consistent with effective pumping.

The actual proportions to be used initially for the various grouts shall be agreed with the RE paying due regard of the conditions met in drilling and the results of any trial grouting carried out before work commences.

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 as directed by the RE.

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

A minimum of two bleed capacity tests shall be performed by the Contractor per shift or as directed the RE. 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 per week, or as directed by the RE. Each cube shall be of 100mm side, or as agreed with the RE, 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 or as agreed with the RE.

As stated previously mixes shall produce cubes with crushing strengths of not less than 1.0 MN/m^2 at 28 days

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 Mine Workings

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 a minimum of 0.5m beyond the base of the old workings in the seam or the floor of the seam itself whichever is greater.

The drilling system and flushing medium to be used shall be as instructed on the Coal Authority licence, and approved by the RE. The Contractor shall allow for the provision of appropriate dust suppression for those holes that are to be drilled near sensitive receptors (e.g. nearby houses, highways, active commercial properties, car parks and public footpaths).

Treatment of the access road will be undertaken utilising a nominal 3m x 3m grid across the highway footprint, where mine workings are encountered at a depth less than 5m from the surface the grid will be reduced to form a 3m grid with central borehole.

Treatment of the retail unit footprint and below retaining walls greater than 1.5m in height will be undertaken utilising a 3m x 3m grid, with the zone of consolidation extending up to 3m beyond the building footprint.

Treatment of the car park areas will be undertaken utilising a 6m x 6m grid.

The minimum diameter of the holes shall be 75mm unless otherwise specified by the RE. 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.

Boreholes shall be temporarily cased through superficial deposits down to the rockhead and if directed by the RE, down through the rock strata. 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 location as directed by the RE, at a large diameter and re-cased.

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

During the course of the works, the RE will review the borehole records generated, and will review the potential for the presence of workings at shallow depth below rockhead elsewhere on the site. If so required, the RE shall instruct the Contractor to undertake supplemental investigation boreholes in areas outwith the proposed drill and grout programme, to confirm the presence or otherwise of workings at shallow depth. If such

workings are suspected or identified, the drill and grout programme shall be extended to treat such areas.

5.7. Grouting Procedures for Shallow Mine Workings

The aim of the stabilisation work is to substantially fill any old workings within the identified seam as well as any voids or broken ground found within the overlying strata in order to mitigate the development of crown holes at the surface \ foundation level.

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. The mix, proportions and method must be agreed with the RE.

Pressure need not be applied to the grout in affected boreholes unless required by the RE.

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 each hole via an approved flexible tube with grout placed to the base of the hole.

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. This requirement will be subject to RE review.

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 the is 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.

Should a borehole within the adoptable highway accept more than 6 tonnes of grout, treatment within the hole will be suspended for 12 hours. Thereafter further grout will be injected in 2 tonne batches. If pressure has not been achieved or grout appeared after a total of 10 tonnes of grout has been placed then a review of the borehole grid spacing, grout mix and materials used will be undertaken.

5.8. Stabilisation Procedures for the Treatment of Mine Shafts

Any former mine shafts encountered 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 C758D.

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 at an appropriate safe distance away from the potential shaft collapse zone.

If any 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 may 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 1.5m stages.

The grout will possess water: solids ratio of no more than 0.4 giving an approximate compressive strength of 1.00 MN/m^2 @ 28 days.

Grout will be mixed by loading hopper conditioned PFA and bagged OPC directly into the mixer via a front loading shovel and by hand. Water supplied from the approved water source will be then be added to the mix to produce grout of the correct consistency.

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

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 restrict 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.

Depending on the location of the shaft, a capping solution may be required such as a reinforced concrete cap.

Any cap will be designed by a competent structural engineer with its orientation founding depth and ultimate design agreed by the Coal Authority prior to construction. As a minimum any reinforced cap will be typically twice the shaft diameter,

5.9. Services and Roads

The grouting Contractor shall take all necessary precautions, including making all reasonable liaison with the Client, 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.

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

When directed by the RE, the Contractor shall test the consolidated ground for permeability and strength.

Permeability by grout acceptance testing shall be checked by drilling test holes in positions to be selected by the RE and injecting grout at pressures appropriate to the depth, all in

accordance with the requirements for infilling grouting. If the RE considers 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.

In general, test holes will be undertaken along the adoptable highways adjacent to boreholes exhibiting grout taken in excess of 6 tonnes.

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. Levels shall be given with reference to a datum to be confirmed by the RE.

The plans shall be updated daily in conformity with the Records noted below. On completion of the works, the Contractor shall give fair copies of the plans and sections to the RE within one week of completion of the programme of grouting.

As works proceed, the Contractor shall maintain separate daily records for drilling, for grouting and for materials and plant received in a form to be approved by the RE. The daily records signed by the Contractor's agent shall be submitted each day to the RE for his agreement. The Contractor shall provide one copy of the agreed record for the RE's retention and keep a further copy available for inspection on site.

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

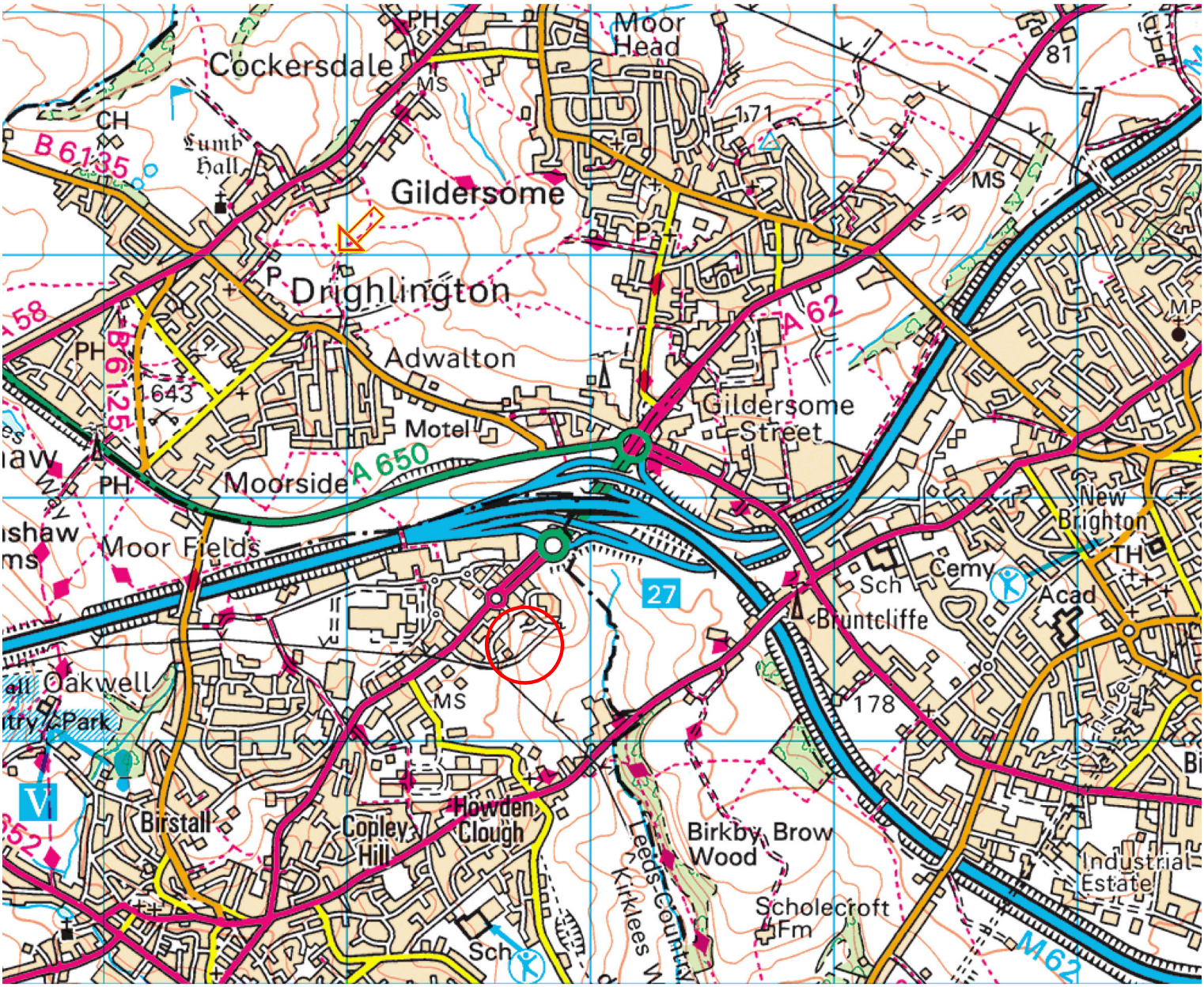
The daily records of materials and plant received shall show in particular that day's quantities by weight of each type of material and cumulative quantities. With the daily records, the Contractor shall submit to the RE copies of receipts or invoices for all materials delivered and he shall keep them on site until the Works are complete.

Notwithstanding the information listed above, the Contractor shall provide any other information required by the RE.

On completion of the drill and grout programme, the RE shall prepare a validation 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 A

FIGURES, DRAWINGS AND PLATES



NOTES

Site Location

REVISION	
0	For Information
A	>>
B	>>
C	>>
D	>>

SIRIUS DRILLING LTD
4245 Park Approach
Thorpe Park
Leeds
LS15 8GB
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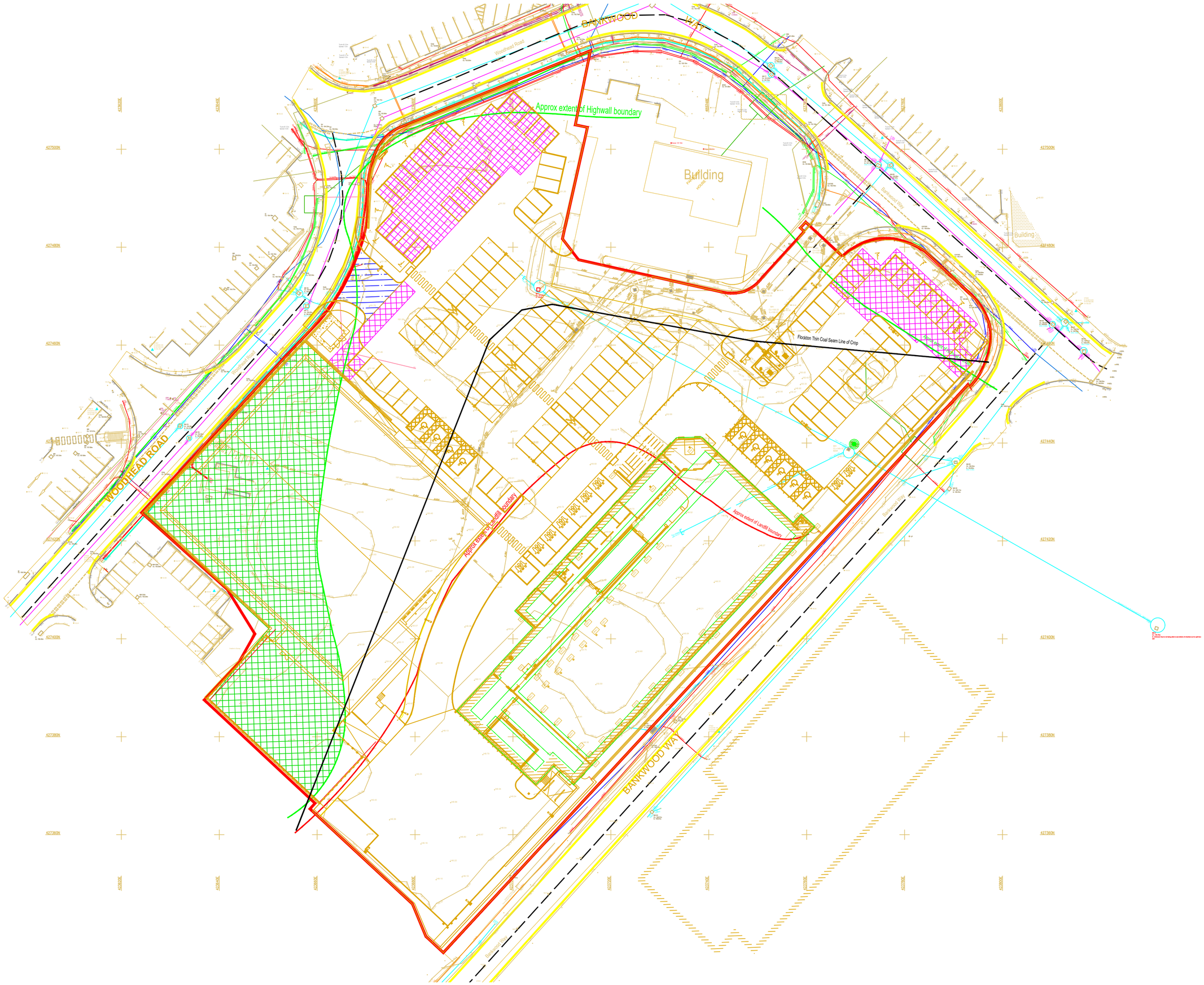
CLIENT	DRAWING NO.	REVISION NO.
LIDL GB LIMITED	SDL4050/CS/01	0
SITE: CENTRE 27 BANKWOOD WAY BIRSTALL	DRAWN BY: NJI	APPROVED BY: JCC
DRAWING TITLE: SITE LOCATION PLAN	DATE: MAY 2022	SCALE: 1:25,000 — A4



NOTES

- Buildings & Retaining Walls Over 1.5m - CMC Ground Improvement + Drilling & grouting of shallow mine workings at 3.0m c/c
- Car Park - BMC Ground Improvement + Drilling & grouting of shallow mine workings at 6.0m c/c
- Car Park - BMC Ground Improvement + Drilling & grouting of shallow mine workings at 1.5m c/c

REVISION		BY	DATE
0	>>	>>	>>
A	>>	>>	>>
B	>>	>>	>>
C	>>	>>	>>
D	>>	>>	>>

SIRIUS
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CLIENT

LIDL GB LIMITED

SITE

CENTRE 27
BANKWOOD WAY
BIRSTALL

DRAWING TITLE

PROPOSED SHALLOW MINE WORKINGS TREATMENT AREAS

DRAWING NO.	REVISION NO.
SDL4050/SP/02	0
DRAWN BY	APPROVED BY
NJI	JCC
DATE	SCALE	PAPER SIZE
MAY 2022	1:500	A2