



# GEOENVIRO

SOLUTIONS LIMITED

**SPECIFICATION FOR THE  
STABILISATION OF SHALLOW MINE  
WORKINGS**

**AT**

**FLOCKTON GREEN WMC, BARNSELY  
ROAD, WAKEFIELD**

**FOR**

**FLOCKTON GREEN LTD**

Report Reference: 4678-24

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|                     | Name             | Position                  | Date          |
|---------------------|------------------|---------------------------|---------------|
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| <b>Approved by:</b> | Andrew Dickinson | Associate Director        | February      |

## ISSUE STATUS

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## LIST OF ACRONYMS

| Acronym | Meaning  |
|---------|--|
| BGS     | British Geological Survey                            |
| BH      | Borehole   |
| CDM     | Construction Design and Management                   |
| CL:AIRE | Contaminated Land: Applications In Real Environments |
| CLR     | Contaminated Land Report                             |
| COSHH   | Control Of Substances Hazardous to Health            |
| CSM     | Conceptual Site Model                                |
| DCP     | Dynamic Cone Penetrometer                            |
| DEFRA   | Department for Environment Foods and Rural Affairs   |
| DoE     | Department of Environment                            |
| DP      | Dynamic Probe  |
| DWS     | Drinking Water Standard                              |
| EA      | Environment Agency                                   |
| EQS     | Environmental Quality Standard                       |
| GAC     | Generic Acceptance Criteria                          |
| HA      | Hand Auger   |
| HP      | Hand Pit   |
| LPA     | Local Planning Authority                             |
| LQM     | Land Quality Management                              |
| mbgl    | Metres Below Ground Level                            |
| MP      | Mackintosh Probe                                     |
| NGR     | National Grid Reference                              |
| NPPF    | National Planning Policy Framework                   |
| OS      | Ordnance Survey                                      |
| SGV     | Soil Guideline Value                                 |
| SPOSH   | Significant Possibility of Significant Harm          |
| SPT     | Standard Penetration Test                            |
| SPZ     | Source Protection Zone                               |
| SSSI    | Site of Special Scientific Interest                  |
| SSV     | Soil Screening Value                                 |
| TP      | Trial Pit  |
| TT      | Trial Trench   |
| WS      | Windowless Sample / Window Sample                    |
| WSV     | Water Screening Value                                |

# 1. INTRODUCTION

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## 1.1. BACKGROUND AND INSTRUCTION

GeoEnviro Solutions Ltd (GES) have been commissioned by Flockton Green Ltd (the Client) to prepare a Specification for the stabilisation of shallow mine workings at the Flockton Green Working Mens Club, Barnsley Road, Flockton, Wakefield, WF4 4AA.

## 1.2. PROPOSED DEVELOPMENT

It is understood that the Client intends to refurbish and extend the currently existing buildings.

## 1.3. OBJECTIVES

GES have been contracted to provide a specification for the potential stabilisation of shallow mine workings identified beneath the property.

## 1.4. SCOPE

The proposed scope of the works to be undertaken is as follows:

Initial Site investigation drilling to investigate the presence of mine workings in the extension area.

Should mine workings be revealed. boreholes drilled on a nominal 3 m x 3 m grid across the proposed building footprints and adoptable highways with the nominal zone of consolidation extending an appropriate distance beyond the plot line.

Stabilisation of identified mine works and voids, undertaken by injecting a PFA / cement grout into the workings via the boreholes.

A plan showing the development proposals is enclosed as in [Appendix 1](#).

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

## 1.5. PREVIOUS INVESTIGATIONS

GES have previously undertaken a Coal Mining Risk Assessment Report at the site (Report ref 4678-24 CMRA) which this report should be read in conjunction with.

In summary, the report identified a high risk from worked seams of the Flockton Thin Coal Seam underlying the site at shallow depth, along with mine entry shafts within 100 m of the site boundary and a moderate risk from historical opencast and possible unrecorded shallow works. In addition, the development surrounding the site has been drilled and grouted and subsequently approved for development, including the remediation of multiple mining features.

In consultee responses the Coal Authority has objected to the redevelopment of the existing building and requested clarification of why the development cannot be moved to avoid the ZOI's from shafts adjacent. However, given the development is an extension, the encroachment is considered minimal and would be difficult to avoid, given it is indeed an extension not a new development.

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The CA further commented “*Our concern relates particularly to shaft 424415-070 which was grouted but not capped, possibly due to the depth of superficial materials*”. However, a validation report was produced by Sirius, Ref: SR3096/6854/CL/CL with the area grouted and presumably signed off by consultees as part of the surrounding development, with the area of this shaft forming car parking so should have been considered safe for the final use by consultees after treatment.

## 2. PHYSICAL SETTING

### 2.1. SITE INFORMATION

#### Location

The site is located at Flockton Green Working Men's Club, Barnsley Road, Flockton WF4 4AA, at approximate National Grid Reference NGR: 424188:415009 (centre of the site).

#### Site Description

At this stage, a site reconnaissance has not been carried out; the site description has been taken in part from Google Earth and Google Street View imagery.

A site walkover may be carried out either prior to or during any intrusive investigation and will be reported accordingly.

The site comprises a roughly rectangular shaped piece of land with an approximate area of 0.1 Ha.

The topography of the site is generally flat with a slope heading upwards to the north from Barnsley Road to the main building, whilst Barnsley Road itself slopes downhill to the west.

The site is currently occupied by the existing two-storey working men's club building, with associated landscaping and parking infrastructure.

An approximate distribution of the surface covering is given below in Table 2.1.

Table 2.1: Distribution of surface area types

| Type of Surface Cover                      | Distribution (%) |
|--|------------------|
| Soft Ground (grassed and landscaped areas) | 20               |
| Hardstanding                               | 10               |
| Roadways                                   | 40               |
| Buildings                                  | 30               |
| Water (ponds, streams)                     | 0                |

### 2.2. GEOLOGY

The British Geological Survey shows the site to be underlain by the geological succession outlined below in Table 2.2.

Table 2.2: Published Geology

| Geology     | Description /strata         |
|-------------|-----------------------------|
| Artificial  | None Recorded               |
| Superficial | None Recorded               |
| Bedrock     | Pennine Lower Coal Measures |

There are no known artificial deposits recorded underlying the site.

There are no known superficial deposits recorded underlying the site.

The bedrock geology beneath the site is shown to be the Pennine Lower Coal Measures Formation which is generally described as *'interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part'* (BGS Lexicon description).

## **3. GENERAL SPECIFICATION**

### **3.1. 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.

### **3.2. 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.

### **3.3. 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.

### **3.4. GROUT MIXES**

With consideration to the future use of the area, the filling material shall generally consist of a PFA: cement grout which should be generally mixed in the proportions of 12:1.

The mixes shall produce cubes with crushing strengths of not less than 0.7 MN/m<sup>2</sup> 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 0.4 MN/m<sup>2</sup> would probably be considered on target).

Where excessive lateral flow of grout is anticipated or when voids greater than 500 mm are encountered, sand or pea gravel may be introduced into the workings in accordance with CIRIA SP32. 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 to the conditions met in drilling and the results of any trial grouting carried out before work commences.

### 3.5. 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 600 mm, when measured in a metre 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 50 mm and with a volume of approximately 1000 ml. 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 100 mm 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 0.75 MN/m<sup>2</sup> 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.

### 3.6. 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 a minimum of 0.5 m beyond the base of the old workings in the seam or the floor of the seam 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).

Boreholes drilled for the treatment of the plots will ensure the zone of consolidation extends beyond the building footprint, based upon anticipated grout flows and may include private driveways.

The minimum diameter of the holes shall be 75 mm 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 the 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 agreed post site investigation. 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 out with 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.

### **3.7. GROUTING PROCEDURES FOR SHALLOW MINeworkINGS**

The aim of the stabilisation work is to substantially fill any old workings within the Flockton Thin seam as well as any voids or broken ground and legacy shafts found within the overlying strata in order to prevent the development of crown holes at the surface or 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 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 2.36 mm sieve) may be added to the mix or placed down the borehole.

Treatment of any adoptable highways and public parking areas will generally be undertaken as per the plots although should a borehole within the 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.

### **3.8. 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 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 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 an 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 into 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 50 m 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 3 m stages.

The grout will possess water: solids ratio of no more than 40 % giving an approximate compressive strength of 0.70 MN/m<sup>2</sup> @ 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 50 mm diaphragm pump operating at around 100 psi and will be pumped via 50 mm 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.

### **3.9. 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.

### **3.10. 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.

### 3.11. 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:

- Job title and location
- Borehole reference number
- Date
- Contractor's name
- Plant in use, crew members and hours worked
- Method of boring or drilling
- Type, diameter and depth of casing used
- Diameter and depth of hole at the beginning and end of each working day or shift.
- Loss of any flushing medium during drilling
- Standing time, with reason, or time lost overcoming obstructions
- Details of underground services located
- Details of any settlement or ground heave
- Daily and cumulative length drilled
- Depth to each major change of stratum
- Description, with identification, of the stratum and whether it is intact or broken
- Each depth at which groundwater is encountered (if apparent), the depth to which it arose, and any steps taken to stop the flow
- Depths at which any samples are taken
- Details and results of any permeability tests instructed by the RE
- Details of any voids or suspected workings
- Details of any emissions of gas, water, etc.
- Depth of completed borehole
- Daily grouting records shall be provided for each borehole and contain the following information:
  - Job title and location

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- Borehole reference number
- Date
- Contractor's name
- Plant in use, crew members and hours worked
- Details of type of injection grout-line dimensions and length of standpipes inserted
- Type of grout mix and volumetric quantity injected including total quantity by weight by each type of grouting material introduced
- Grout pressures recorded, with the corresponding depths
- The results of all flow and bleed tests
- Details of casing abandoned
- Details of grouting materials delivered to the site and a running total of each of the materials delivered
- The nature, frequency and results of all inspections of services to check for grout penetration
- 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.

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

## 4. RELIANCE AND LIMITATIONS

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This report has been prepared using published information and information provided by the Client and their professional advisers which has been made available to GES at the time of writing only. GES accepts no liability for any changes resulting from new information which has become available since this time.

This report is provided for the sole use of the client and their professional advisors and is confidential to them unless agreed otherwise in writing. This report may only be used and relied on once the work has been paid for in full. GES owes no duty of care and has no liability to any third party who is not authorised by GES to use this report. Any unauthorised third parties using information contained in this report do so at their own risk.

We are content that as a result of the ground investigation works and subsequent soil testing undertaken, as outlined within this report, we have characterised the ground conditions and consequently the potential for contamination to exist on site. These works and ensuing assessment have been detailed in this report.

This assessment has been carried out to determine the potential risks posed to future end users, along with other key receptors, resulting from potential contamination at the site, based on the proposed development. Should any revisions in the development proposals result in a change any assessment parameters detailed in this report, a re-assessment of the risk should be carried out.

Whilst this report may reference observations made regarding the presence of features/ issues such as invasive species, ACM, site drainage and evidence of structural abnormalities, this report does not constitute specialist surveys on these matters. Should further specialist surveys be carried out in this regard, the findings of these should be reported to GES so that we may determine if this has any impact on the findings of this report.

This report is written in the context of an agreed scope of works and should not be used in a different context.

Ground conditions can be variable and change rapidly, especially in areas of Made Ground, however it is assumed that the ground conditions encountered and observed are typical and representative of the site as a whole. Most specifically with regard to this limited investigation, the ground conditions have been determined from a limited number of exploratory holes formed across the site, therefore only a small percentage of the total area of the site has been investigated. Interpolation between exploratory holes has enabled a general picture of the subsurface conditions to be produced. Conclusions drawn from the ground investigation should be read in this context. GES cannot accept responsibility for any situations resulting from locally unforeseen ground conditions occurring between exploratory holes.

In addition, subsurface conditions including contaminant concentrations and groundwater levels may vary spatially with time. This factor should be given due consideration in the event that the information contained within this report is used after any significant period of time has elapsed.

**APPENDIX 1**  
**DRAWINGS AND PLANS**



General  
Site  
Location



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|                       |                          |
|-----------------------|--------------------------|
| <b>PROJECT NAME</b>   | Barnsley Road, Wakefield |
| <b>PROJECT NUMBER</b> | 4678-24                  |
| <b>TITLE</b>          | Site Location Plan       |

|                    |            |
|--------------------|------------|
| <b>DRAWING NO.</b> | 4678-24/01 |
|--------------------|------------|

|              |       |
|--------------|-------|
| <b>SCALE</b> | N.T.S |
|--------------|-------|

|             |               |
|-------------|---------------|
| <b>DATE</b> | February 2024 |
|-------------|---------------|

|                 |    |
|-----------------|----|
| <b>DRAWN BY</b> | JF |
|-----------------|----|

