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Client

**JC Brennan Developments Ltd
9 Bluestone Drive
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Stockport
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Site Address

**Land off Church Avenue
Middleton
Manchester
M24 2UA**

Document Title

Drainage Condition Report

Contents

1.0	Introduction	4
1.1	General	4
1.2	Planning Conditions	4
2.0	Existing Site	5
2.1	Site Location	5
2.2	Existing Site Description	5
2.3	Topography	6
2.4	Hydrological Assessment	6
2.5	Existing Public Sewers	6
2.6	Existing Surface Water Runoff	7
2.7	Geology	7
2.8	Proposed Development	7
3.0	Proposed Surface Water Strategy.....	8
3.1	Sustainable Drainage Systems (SuDS) Assessment.....	8
3.2	Overall Strategy.....	11
3.3	Proposed Surface Water Flow Rate	12
3.4	Climate Change	12
3.5	Surface Water Treatment	13
4.0	Foul Water Strategy	14
4.1	Overall Strategy.....	14
4.2	Proposed Flow Rate	14
5.0	Management & Maintenance Plan	15
6.0	Drainage Related Planning Condition and Responses	20
6.1	Planning Conditions	20
	Appendix A – Brennan Consult Drawing	
	Appendix B – Site Investigation Report	

Project Title Land off Church Avenue, Middleton, Manchester, M24 2UA
Project No 3058-BCL-00-XX-RP-D-0001
Date 21.04.26



Revision History

Issue	Date	Status	Prepared By	Signature
P01	21.04.26	First Issue	Matthew McGowan BEng (Hons)	

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1.0 Introduction

1.1 General

- 1.1.1 This report has been prepared to address a drainage related condition within Planning Approval 25/00681/TDC1, the specific condition is number 4.

1.2 Planning Conditions

- 1.2.1 This report has been prepared to remove the drainage related planning conditions relevant to the application.

- 1.2.2 Condition 4 from Discharge of Conditions application 25/00681/TDC1 is detailed below in *italics*:

Prior to the commencement of development, details of a sustainable surface water drainage scheme and a foul water drainage scheme shall be submitted to and approved in writing by the Local Planning Authority. The drainage schemes must include:

- (i) An investigation of the hierarchy of drainage options in the National Standards for Sustainable Drainage Systems (or any subsequent amendment thereof). This investigation shall include evidence of an assessment of ground conditions and the potential for infiltration of surface water;*
- (ii) A restricted rate of discharge of surface water agreed with the local planning authority (if it is agreed that infiltration is discounted by the investigations);*
- (iii) Levels of the proposed drainage systems including proposed ground and finished floor levels in AOD;*
- (iv) Incorporate mitigation measures to manage the risk of sewer surcharge where applicable; and*
- (v) Foul and surface water shall drain on separate systems.*

2.0 Existing Site

2.1 Site Location

2.1.1 The site is referenced in Figure 1.

Item	Brief Description
Project name	Church Avenue, Middleton
Site address and location	Church Avenue, Middleton, Manchester, M24 2UA
Council Area	Rochdale Borough Council (RBC)
Approximate Grid Reference	OS: 388574, 408812
General Locality	The site is located approximately 3 km to the northeast of Middleton Town Centre.

Figure 1 - Site Referencing Information

2.2 Existing Site Description

- 2.1.1 The development site is irregular in plan shape and currently encompasses an undeveloped parcel of land located to the south of Church Avenue. To the north are existing dwellings, to the west is a colony of garages and to the east is currently open land. The closest postcode to the site is M24 2UA.
- 2.1.2 Currently, there is no vehicular access to the site. However, the northern boundary runs parallel to Church Avenue and provides an obvious point of entrance.
- 2.1.3 From review of the site topographical survey, the existing site has an area of approximately 0.153ha.
- 2.1.4 Figure 3 identifies the overall site location details.



Figure 2 Site Location plan

2.3 Topography

- 2.1.5 A full topographical survey has been undertaken at the site. This has identified the site as falling from north to south with an approximate maximum level of 134.49m AOD in the northeast and an approximate low level of 131.59m AOD in the southeast.

2.4 Hydrological Assessment

- 2.1.6 The closest identified watercourse is an Unnamed Brook that runs along the eastern boundary of the site. The brook flows in a southerly direction where it eventually connects into Whit Brook approximately 1.2km south of the site. Whit Brook ultimately discharges into to the River Irk.

2.5 Existing Public Sewers

2.5.1 United Utilities

The United Utilities sewer records identify a 300mm diameter public gravity combined sewer located to the north of the site within Church Avenue, flowing in a westerly direction.

2.5.2 Private Drainage

There is no existing private drainage within the site boundary. However, the site does have an existing connection into the Unnamed Brook that runs parallel to the eastern boundary of the site.

2.6 Existing Surface Water Runoff

- 2.6.1 The current site can be classed as Greenfield. Figure 5 below defines that the greenfield runoff rate for an area of 0.153 ha is calculated as 1.1 l/s.

Existing Site Area (ha)	QBAR (l/s)
0.153	1.1 l/s

Figure 3 Greenfield Runoff Rates

2.7 Geology

- 4.2.1 A Geotechnical Site Investigation prepared by GeoAssist Limited has confirmed the ground conditions to be predominately soft clays to depth, therefore infiltration is not a feasible solution. A full copy of the report can be found in Appendix B.

2.8 Proposed Development

- 2.8.1 The construction of five dwellings with landscaping, car parking and a private access road at Church Avenue, Middleton, Manchester, M24 2UA.
- 2.8.2 From review of the proposed site plan, approximately 0.085 ha of the site is hardstanding in the form of a drive, footpaths, and the building. The remaining 0.068 ha of the development is to be soft landscaping in the form of shrubbery and grasslands.
- 2.8.3 The proposed site layout can be found within Appendix A.

3.0 Proposed Surface Water Strategy

3.1 Sustainable Drainage Systems (SuDS) Assessment

3.1.1 SuDS Objectives

Sustainable drainage developed in line with the ideals of sustainable development is collectively referred to as Sustainable Drainage Systems (SuDS). At a particular site, these systems are designed both to manage the environmental risks resulting from the urban runoff and to contribute wherever possible to environmental enhancement. SuDS objectives are therefore to minimise the impacts from the development on the quantity and quality of the runoff and maximise amenity and biodiversity opportunities (CIRIA C753, 2015).

3.1.2 SuDS Design Themes

The 'Management Train Approach' should be central to the surface water drainage strategy of the proposed site. The main objective is treatment and control of runoff as near to the source as possible protecting downstream habitats and further enhancing the amenity value of the site. This concept uses a hierarchy of drainage techniques to incrementally reduce pollution, flow rates and volumes of storm water discharge from the site, and is as follows:

- i. **Prevention** – The use of good site design and housekeeping measures to prevent runoff and pollution and includes the use of rainwater reuse / harvesting.
- ii. **Source Controls** – Control of runoff at source or as close to source as possible (e.g. soak-aways, green roofs, pervious pavements).
- iii. **Site Control** – Management of water in a local area and can include below ground storage / attenuation, detention basins, large infiltration devices.
- iv. **Regional Control** – Management of water from a site or various sites and can include wetlands and balancing ponds.

3.1.3 SuDS Site Constraints

SuDS techniques are suitable for all sites; therefore, an assessment of the existing site is required so that SuDS limitations can be determined.

- *Land Use Characteristics:* The size and type of development provides the opportunity to include site control SuDS devices only.
- *Site Characteristics:* Based on the BGS mapping, infiltration is unlikely to be suitable but will be confirmed following future infiltration testing.
- *Catchment Characteristics:* The current site is greenfield but has an existing connection to an Unnamed Brook that will be retained.
- *Environmental and Amenity Performance:* The inclusion of SuDS within the overall development is a key driver in providing both amenity and habitat creation. SuDS will be considered where feasible. Safety to all future users is paramount and so best practice guidance will be incorporated so that these devices blend into the surrounding without the

need for significant safety precautions. Maintenance plans will be prepared for all SuDS devices that are included.

3.1.4 SuDS Methods

Figures 4 and 5 on the following pages provide an assessment of various above and below ground SuDS methods that can provide water quality treatment and management of flows to reduce runoff rates and volumes and whether they can be suitably incorporated at this development site. The purpose of this assessment is to set out options to be considered at the planning stage with consideration to time constraints, viability and lifetime maintenance of the residential development.

Method	Comment	Suitability for Development
Green Roofs	Can be used on suitable low-rise buildings to provide retention, attenuation and treatment of rainwater, and promotes evaporation and local biodiversity.	<u>Not suitable:</u> Architectural proposals for the development and maintenance issues deem this unsuitable.
Water Butts	Plastic tanks placed at the base of rainwater down pipes to collect rainwater runoff from the roof areas.	<u>Suitable:</u> Water butts have the potential to be located at the base of the rear RWP and used by the owner, subject to client approval.
Rainwater Harvesting	Rainwater harvesting reduces the total runoff volume from the developed site and reduces treated water consumption.	<u>Not Suitable:</u> - Additional costs of installation would have severe effect on viability of the development. - Running and maintenance costs would not be acceptable to our client and future occupiers. - The ability to restrict peak flow rates and short-term peak volumes is non-existent where a critical storm event occurs.
Infiltration Options	Reduces total run off volume from the development.	<u>Not Suitable:</u> The site investigation confirms that the underlying ground is not suitable for infiltration.
Permeable Surfacing (Infiltration)	- Reduces total run off volume from the development. - Can be used to enhance water quality.	<u>Not Suitable:</u> The site investigation confirms that the underlying ground is not suitable for infiltration.
Permeable Surfacing (Standard)	Can be used to enhance quality of runoff water.	<u>Suitable:</u> Private parking bays have the potential to attenuate and filter surface water flows through

	Sub-base provides 'source' storage and reduces the volume of storage downstream.	the use of permeable surfacing (subject to confirmation of surface finishes).
Swales, basins and ponds	- Provide areas for above ground surface runoff storage. - Swales also allow filtering of particulate matter, improving water quality	<u>Not suitable:</u> No available area for attenuation pond to be allocated in a domestic setting.
Bio-Retention	Collect and retain run-off to help improve water quality, prior to discharge in piped system on infiltration.	<u>Not suitable:</u> Space constraints on site do not permit above ground areas for flood storage.

Figure 4 Surface SuDS Methods

Method	Comment	Suitability for Development
Geocellular Storage	- Suitable for sites with insufficient space for basins etc. - Suitable for sites where topography prevents the use of open basins etc. - Can be very effective infiltration devices subject to ground conditions.	<u>Suitable:</u> To be incorporated as part of the attenuation measures beneath the front parking and rear soft landscaping areas.
Large Diameter Pipes, Culverts or Tanks	- Suitable for sites with insufficient space for basins etc. - Provide a volume of below ground storage with a high void ratio and good man entry provision to allow for future maintenance and cleaning. - Generally, be suitable for adoption by the statutory water company (e.g. Severn Trent Water).	<u>Not suitable:</u> Oversized pipes more suitable to larger developments where the drainage is adopted.

Figure 5 Sub-Surface SuDS Methods

3.2 Overall Strategy

- 3.2.1 All proposed drainage systems should give preference to the SuDS hierarchy which sets out that schemes should aim to mimic natural drainage as closely as possible, and that discharge of surface runoff should be dealt with in the following ways (in order of preference) (Department for Communities and Local Government, 2014):

Method	Suitability	Suitability for Development
Infiltration to Ground	No	The site investigation has determined that the underlying ground would not be suitable for infiltration-based options.
Connection to Watercourse	Yes	Reuse and improvement of existing connection to the Unnamed Brook that runs parallel to the eastern boundary of the site.
Connection to Surface Water Sewer	No	No surface water sewer within close proximity to the site.
Connection to a Combined Sewer	No	The United Utilities sewer records identify a 300mm diameter public gravity combined sewer located to the north of the site within Church Avenue, flowing in a westerly direction. However, higher priority options are available.

Figure 6 SuDS Hierarchal Approach

- 3.2.2 Greenfield surface water runoff rates have been determined for the existing development site (refer to section 4.3 for details).
- 3.2.3 The general principal of the surface water drainage strategy is to collect the runoff from the new residential properties and direct it to a below ground surface water drainage network. The network would flow around the properties and then following attenuation and a flow control would discharge into the unnamed Brook via the existing connection. The peak flow rate aims to mimic the greenfield runoff rate for the existing site. This was calculated as 1.1 l/s. To minimise the risk of blockages occurring, it is therefore proposed to discharge surface water from the site at a maximum rate of 5 l/s. Geocellular attenuation crates will act as the means of retaining the flow rates more than this.
- 3.2.4 The proposed private drainage layout for the new development site will be designed in accordance with BS EN 752: 2008 and Building Regulations Part H guidance. This is to provide no flooding up to the 30-year storm return period criterion.
- 3.2.5 Flooding can occur on a local scale beyond the 30 year criterion due to runoff exceeding the capacity of the minor system during extreme events and it can only be addressed on a site-specific basis. In the case of this development, exceedance flows will be all those over and above the 30-year design criterion. Using storage within the external hardstanding and soft landscaping areas

would be achievable and would direct flood water away from the new property with flows directed back into the surface water drainage network as the water levels in the drainage network recede.

- 3.2.6 Although it is envisaged that prevention and source controls measures could be included in the final scheme, this strategy will assume for outline calculations purposes that only site control methods are incorporated. Outline attenuation volumes have been determined (Figure 7 below) using the Micro Drainage design software. This considers the peak discharge rate of 5l/s and assumes no prevention and source control measures are incorporated and no infiltration to ground is possible. It is noted that these rates and volume are preliminary for this outline assessment and are likely to alter at detailed design stage when more site-specific information it made available.

New Impermeable Area	Attenuation Volume for 30yr + 45% CC Event	Outline Attenuation Volume for 100yr + 45% CC Event
0.095ha	11.4m ³	21.3m ³

Figure 7 Outline Attenuation Volumes

- 3.2.7 Any future drainage calculations carried out as part of a site wide drainage strategy or for the development layouts themselves must include the appropriate increase in rainfall to satisfy the future climate change allowances.
- 3.2.8 SuDS will be incorporated in the form of water butts, SuDSPods, geocellular attenuation tank, and permeable surfacing with a diffuser will be incorporated to the driveway.
- 3.2.9 A copy of the proposed drainage layout is enclosed in Appendix B.

3.3 Proposed Surface Water Flow Rate

- 3.3.1 The greenfield runoff rate for the site is calculated as 1.1 l/s.
- 3.3.2 To reduce the risk of blockages, it is proposed to discharge surface water from the site at a maximum rate of 1.0 l/s from each plot, a total of 5 l/s.

3.4 Climate Change

- 3.4.1 In line with the NPPF and local planning guidance, climate change should be considered for all developments. In accordance with the local planning guidance, a climate change allowance of 40% will be included for the 1 in 30-year storm events and 40% for the 1 in 100-year storm events for the proposed surface water drainage system.

3.5 Surface Water Treatment

- 3.5.1 Silt is to be prevented from entering the drainage system by the use of trapped gullies, channels with silt traps or by the use of Sustainable Drainage techniques. Runoff from the private driveways will be directed through the permeable paving; this will help to remove pollutants prior to connection to the drainage network. Silt and debris will also be prevented from entering the drainage system by the use of trapped gullies and silt boxes. Being a residential led scheme, the pollution risk is considered to be very low.

4.0 Foul Water Strategy

4.1 Overall Strategy

- 4.1.1 The proposed private drainage layout for the new development site will be designed in accordance with BS EN 752: 2017 and Building Regulations Part H guidance.
- 4.1.2 The foul flows will be collected in a separate gravity foul water drainage systems The pipework will be 100mm diameter and laid at falls to suit self-cleansing velocities.
- 4.1.3 It is proposed to discharge foul water into the existing combined manhole within the site which will continue to discharge into the existing UU sewer located within Pinfold Lane. It is recommended that a CCTV survey is undertaken to confirm the condition of the existing sewer connection.
- 4.1.4 The proposed drainage layout can be found within Appendix B.

4.2 Proposed Flow Rate

- 4.2.1 Using Flows and Loads 4 Table of Loadings, we get an average rate of 150 litres per person per day for dwellings. A single house with more than 3 bedrooms shall be designed by adding 1 P for each additional bedroom to the minimum single house value of 5 P.

- House with 4 bedrooms = minimum 6 P system.

If we assume that a maximum of 6 people live in the plot, then this gives the following flows per day:

- 1 plot x 6 People x 150 = 900

Assuming the majority of flow occurs over a 12-hour period, this produces an average flow rate of 0.021 l/s and a peak flow rate (6 x average) of 0.125 l/s.

5.0 Management & Maintenance Plan

- 5.1.1 The drainage network encompasses standard pipework, manholes and a flow control. As long as the gullies at the base of the rainwater pipes are kept clear of leaves and detritus by regular inspection by the property owners then this should negate it passing into the network.
- 5.1.2 All management and maintenance of the drainage will be with the property owners. This will involve general maintenance of the drainage network in accordance with best practice. All drainage will remain private and not be adopted by the local sewerage authority.
- 5.1.3 This section is intended to give an overview of the operation and maintenance for the drainage features included with the drainage strategy and in relation to typical details. Where proprietary products are specified, the manufacturer's instructions and recommendations should be followed in priority to this document unless specifically noted otherwise due to project constraints. The recommended operations and frequencies are typical only and should be more frequent initially to ensure that there are no unforeseen issues with the operation and then adjusted to suit the site requirements.
- 5.1.4 There are three types of maintenance activities associated with surface water drainage systems. The SuDS Manual, CIRIA C753, defines these as:
- Regular Maintenance – 'basic tasks undertaken on a frequent and predictable schedule' including vegetation management, litter and debris removal, and inspections.'
 - Occasional Maintenance – 'tasks that are likely to be required periodically, but on a much less frequent and predictable basis than the routine tasks (sediment removal is an example.'
 - Remedial Maintenance – 'intermittent tasks that may be required to rectify faults associated with the system, although the likelihood of faults can be minimised by good design. Where remedial work is found to be necessary, it is likely to be due to site-specific characteristics or unforeseen events, and as such timings are difficult to predict.'
- 5.1.5 Specific maintenance needs should be monitored and maintenance schedules adjusted to suit the location and condition of the drainage feature in question.

Piped Networks, Inspection, Manhole and Catchpit Chambers

- 5.1.6 The appropriate health and safety equipment must be used when accessing manholes. Confined space certificates must be held by any personnel entering a manhole and the appropriate permits should be obtained from the Maintenance Manager prior to any access.
- 5.1.7 Pipes are proprietary products, and the materials can vary across the site and as such where used the manufacture's recommendations should be followed.

- 5.1.8 Pipes are intended to be the main conveyance across the development and where oversized they form the attenuation volume required by the limitation of the discharge rate. They are intended to be dry except for during rainfall events. These have been designed to be self-cleaning where possible for smaller diameter pipes, and for larger diameters the risk is reduced due to the overall pipe size.
- 5.1.9 Access for maintenance is provided through access chambers and manholes.
- 5.1.10 Regular inspection and maintenance are important to identify areas which may have been obstructed /clogged and may not be drainage correctly thus exposing the site to a greater level of flood risk.

Maintenance Schedule	Required Action	Typical Frequency
Regular Maintenance	Inspect and identify any features that are not operating correctly. If required, take remedial action	Monthly for three months, then six monthly
	Debris removal from catchment surface / gratings (where may cause risks to performance)	Monthly (and after large storms)
	Remove sediment from trapped sumps, manholes and catchpits.	Annually or as required
Remedial Maintenance	Repair / rehabilitation of gratings, inlets and outlets	As required
Monitoring	Inspect / check all gratings, trapped sumps, manholes and catchpits to ensure that they are in good condition and operating as designed	Annually and after large storm events
Structure Rehabilitation / Repair	Regular Maintenance and Monitoring to identify if repair and / or replacement of features or pipework is required.	As required

Figure 7 Operation and Maintenance Requirements of Piped Networks and Inspection Chambers

Flow Control Units

- 5.1.11 The flow control units are intended for flood control and flow restriction.
- 5.1.12 The flow control is specified as an orifice plate and is a proprietary product; therefore, manufacturer's recommendations should also be taken into consideration.
- 5.1.13 Access for maintenance has been provided by locating within manhole chambers.

Maintenance Schedule	Required Action	Frequency
Monitoring (to be undertaken more regularly within the first year of operation and adjusted as required).	Inspect inlets for blockages, and clear if required. If faults persist jetting and CCTV survey may be required.	Monthly and after large storms.
Regular maintenance	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly.
	Debris removal from catchment surface (where may cause risks to performance).	Monthly
	Remove sediment from pre- treatment structures and flow control chambers.	Annually (or as required after heavy rainfall events)
Remedial Actions	Repair/rehabilitation of inlets.	As required.

Figure 8: Operation and Maintenance Requirements for Flow Controls

Permeable Paving

- 5.1.14 Permeable paving provides a surface suitable for vehicular traffic, while allowing rainwater to infiltrate through the surface and into the underlying structural layers. The surface itself is impervious to water, but the blocks are laid to provide void space through the surface to the sub-base. The water is temporarily stored within this sub-base before controlled discharge downstream.
- 5.1.15 Permeable surfaces, together with their associated substructures, are an efficient means of managing surface water runoff close to its source – intercepting runoff, reducing the volume and frequency of runoff, and providing a treatment medium. Treatment processes that occur within the surface structure, sub-base and geotextile layers include filtration, absorption, biodegradation and sedimentation.
- 5.1.16 Permeable paving should be inspected regularly, preferably during and after heavy rainfall to check effective operation and identify areas of ponding. Permeable paving needs to be regularly cleaned of silt and other sediments to preserve their infiltration capacity. Evidence suggests that sweeping once per year should be sufficient to maintain an acceptable infiltration rate on most developments.

Maintenance Schedule	Required Action	Frequency
Regular Maintenance	Brushing and vacuuming (standard cosmetic sweep over whole surface)	Once a year, or when required during autumn leaf fall
	Inspect infiltration surfaces for ponding, compaction, silt accumulation, record areas where water is ponding for > 48hours	Every 3 months, 48 hours after large storms.
Occasional Maintenance	Stabilise and mow contributing and adjacent areas	As required
	Manage other weeds and vegetation and remove nuisance plants	Once a year, or when required
Remedial Actions	Repair erosion of any adjacent soft landscaping adjacent to the paving	As required
	Remedial work to any depressions, rutting and cracked or broken blocks.	As required
	Rehabilitation of surface and upper sub-structure by remedial sweeping	As required
	Remove and dispose of oils or petrol residues using safe standard practices	As required

Figure 9: Operation and Maintenance Requirements for Permeable Paving

Attenuation Tank

- 5.1.17 The geocellular attenuation tank is wrapped on the outside in an impermeable membrane and infilled with geocellular crates. This allows the water to pass into the tank and be retained during peak storm conditions.
- 5.1.18 Access for maintenance should be provided by an access chamber constructed as a catchpit, located at the main entry. Regular inspection and maintenance are important for the effective operation of attenuation tanks as designed. As the feature is buried, a regular inspection regime is very important to ensure the correction functionality of the surface water drainage network.

Maintenance Schedule	Required Action	Frequency
Monitoring	Inspect inlets, outlets and overflows for blockages, and clear if required. If faults persist jetting and CCTV survey may be required.	Monthly and after large storms.
Regular Maintenance \ Inspection	Inspect and identify any areas that are not operating correctly. If required, take remedial action.	Monthly for 3 months, then six monthly.
	Debris removal from catchment surface (where may cause risks to performance).	Monthly
	Remove sediment from pre- treatment structures.	Annually (or as required after heavy rainfall events)
Remedial Actions	Repair/rehabilitation of inlets, outlets and overflows.	As required.

Figure 10: Operation and Maintenance Requirements of Geocellular Attenuation Tanks

6.0 Drainage Related Planning Condition and Responses

6.1 Planning Conditions

Each point of conditions are listed below in italics with the Brennan Consult response beneath in Blue.

6.1.1 Condition 4 from planning application 25/00681/TDC1 is detailed below in *italics*:

Prior to the commencement of development, details of a sustainable surface water drainage scheme and a foul water drainage scheme shall be submitted to and approved in writing by the Local Planning Authority. The drainage schemes must include:

- (i) *An investigation of the hierarchy of drainage options in the National Standards for Sustainable Drainage Systems (or any subsequent amendment thereof). This investigation shall include evidence of an assessment of ground conditions and the potential for infiltration of surface water;*

A site investigation has confirmed the site to be underlain by clay strata therefore infiltration is not feasible. Section 3.2 refers to the overall surface water strategy for the site. It discusses how the hierarchy of drainage options have been used to determine that a connection to the existing adjacent watercourse is the most appropriate solution.

- (ii) *A restricted rate of discharge of surface water agreed with the local planning authority (if it is agreed that infiltration is discounted by the investigations);*

We have adopted the discharge rate proposed in our Drainage Strategy Report which was issued as part of the planning submission therefore is deemed to be acceptable in the absence of any comments.

- (iii) *Levels of the proposed drainage systems including proposed ground and finished floor levels in AOD;*

The drawings included in Appendix B confirms the FFL and proposed drainage levels.

- (iv) *Incorporate mitigation measures to manage the risk of sewer surcharge where applicable; and*

Section 5.0 goes into detail of the ongoing maintenance and management plan, to mitigate flooding risk.

- (v) *Foul and surface water shall drain on separate systems.*

The proposed drainage layout is shown within Appendix B, demonstrates the foul and surface water systems are on separate systems.

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Appendix A – Brennan Consult Drawing

Project Title Land off Church Avenue, Middleton, Manchester, M24 2UA
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Appendix B – Site Investigation Report



Client:

JC Brennan Developments Limited
74 Dickenson Road
Rusholme
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M14 5HF.

Ground Investigation - Geotechnical

Church Avenue, Middleton

July 2025

Site Ref: 6192/VCA-G

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Ground Investigation - Geotechnical

1. Introduction	4
2. Description of the Site	4
2.1 Present	4
2.2 Proposed	4
3. Geology	5
4. Mineworkings and Mineral Extraction	5
5. Intrusive Investigation	5
5.1 Exploratory Hole Programme	5
5.2 Field Sampling and Testing	5
5.3 Field Results	5
6. Laboratory Investigation	6
6.1 Geotechnical Testing	6
6.2 Test Results	6
7. Subsurface Stratigraphy	6
8. Groundwater	7
9. Geotechnical Properties	7
9.1 Upper Clay	7
9.2 Lower Clay	7
10. Geotechnical Assessment	8
10.1 Design Criteria	8
10.2 Foundation Design Considerations	8
10.3 Excavations	8
10.4 Pile Foundations	8
10.6 Ground Shrinkage and Heave	8
10.7 Subsurface Concrete Attack	8

Appendices

- A1. Site Plan with Exploratory Hole Locations
- A2. Proposed Site Plan
- B1. Terminology used in Soil Descriptions
- B2. List of Abbreviations
- B3. Concrete in Aggressive Ground
- B4. Standard Penetration Test
- C1. Exploratory Hole Logs WS1 to WS6
- D1. Laboratory Test Summary Sheets
- D2. Classification Test Summary Sheet
- D3. Sulphate and pH Test Summary
- D4. Particle Size Distribution Graphs

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Ground Investigation - Geotechnical

1. Introduction

This report is an account of an intrusive Geotechnical Ground Investigation carried out by GeoAssist Limited at the request of the Client JC Brennan Developments Limited as the potential owner and developer of the site at Church Avenue, Middleton.

The object of this geotechnical investigation was to obtain information on the nature, depth and extent of the superficial deposits and bedrock if encountered beneath the site to facilitate a Residential development.

Geotechnical parameters and groundwater regime were to be obtained.

The work was commissioned following acceptance of the quotation and an instruction to proceed issued by the Client JC Brennan Developments Limited on 30th June 2025.

It is understood that the proposed development for this site involves the construction of low-rise residential housing.

The approximate grid reference for the centre of the site is 388570E, 408810N.

The exploratory hole locations are indicated on the site plan in Appendix A1.

2. Description of the Site

2.1 Present

The site is located within a residential area on the southern side of Church Lane, Middleton approximately 2.5km to the northeast of Middleton town centre. The site forms a roughly rectangular parcel of land, and the levels gently falls away from Church Lane to the south. The site is comprised of a parcel of grass and scrubland with mature trees to the northeast corner, southeast and west, three small timber outbuildings (sheds) with felt roofs to the east and an area of paving at the northwest. It is understood that the site was formerly used as allotment gardens.

Residential property forms the site boundary to the west and south. Church Avenue forms the site boundary to the north over which is situated more residential property. Open land meets the eastern boundary of the site.

2.2 Proposed

It is understood that the proposed development incorporates the erection of five detached residential dwelling houses with associated private gardens, off road parking and a shared access road.

The proposed residential development is shown on the plan in Appendix A2.

3. Geology

The BGS online GeoIndex facility shows superficial drift deposits of Glacial Till are present on the site.

The solid geology is shown as being Interbedded mudstone, siltstone and sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part of the Pennine Lower Coal Measures Formation.

No faults are shown as passing directly beneath the site

4. Mineworkings and Mineral Extraction

The site is situated within a Coal Mining Reporting Area.

The site is not within a Development High Risk Mining Area.

Whilst the Phase 1 undertaken by others indicates that the Site is situated within the Lancashire Coal Mining Reporting Area, however, there is no evidence of any past or current coal mining activity within 500m of the site, it is recommended that a preliminary COM 29M search with the Coal Authority is undertaken to confirm the status of the site in the respect of any impact there might be from past, present or future mine workings on this development site.

5. Intrusive Investigation

5.1 Exploratory Hole Programme

Six geotechnical exploratory holes referenced WS1 to WS6 were undertaken by GeoAssist using windowless sampling and dynamic probing techniques at the location as shown on the site plan in Appendix A1.

On completion of exploratory holes WS1 to WS3 gas/groundwater monitoring standpipes were installed.

Exploratory holes WS4 to WS6 were backfilled and reinstated on completion.

The details of the strata in the exploratory holes were recorded by a suitably qualified Professional Engineer.

All intrusive work was carried out in accordance with British standard 5930: 1999/2015 Code of Practice for Site Investigations and British Standard 10175: 2011 where applicable.

The fieldwork was completed on 7th July 2025 in dry weather conditions.

5.2 Field Sampling and Testing

Representative samples were taken of all the strata encountered in the exploratory holes.

In Situ Dynamic Penetration tests using the Standard SPT drop weight and drop height were carried out in the exploratory holes.

All samples were stored in airtight containers and returned to the laboratory for subsequent examination and testing.

Observations of groundwater conditions were made throughout the fieldwork operations.

5.3 Field Results

Full details of the subsoil conditions in the exploratory holes are given in the exploratory hole log sheets, which form Appendix C1 to this report.

6. Laboratory Investigation

6.1 Geotechnical Testing

The following geotechnical tests were performed in GeoAssist's laboratory on samples recovered from the exploratory holes.

Table 6.1 Geotechnical Testing

TEST	PURPOSE
Shear Strength from Hand Vane/Hand Penetrometer test	Assessment of in-situ shear strength of cohesive deposits
Natural Moisture Content and Classification test	Assessment of in-situ subsoil conditions and compressibility/shrinkage of cohesive deposits
Sulphate and pH test	Assessment of potential aggressive ground conditions with respect to subsurface concrete
Particle size distribution Test	Determination of grading characteristics of granular deposits.

6.2 Test Results

The results of the Hand Vane/Hand Penetrometer shear strength tests are given on the exploratory hole logs.

The geotechnical tests are given in the laboratory test results summary sheets, which form Appendices D1 to D4 to this report.

7. Subsurface Stratigraphy

The subsoil profile obtained from the exploratory holes WS1 to WS6 indicates the presence of variable grass/inferior vegetation over topsoil overlying gravelly sandy silty clay with sand and silt inclusions and partings. The clay at depth generally varies from firm to stiff becoming very stiff with depth.

Exploratory hole WS1 penetrated very stiff desiccated clays with evidence of fine rootlets present to 2.80m indicating the impact of the trees present in this area.

WS2 penetrated very soft organic silty clay to 2.00m interbedded with sand and very soft to firm clay beneath and present to 4.00m.

WS3 penetrated soft to firm clay to 3.00m depth with sand inclusions.

All of the exploratory holes were terminated in stiff to very stiff gravelly sandy silty clay present typically from around 3.00m to 4.00m depth.

Further details of the subsurface stratigraphy can be found in the exploratory hole log sheets which form Appendix C1 to this report.

Table 7.0 Subsoil Profile Summary

Strata	Depth of Strata (m) below ground level	
	Top	Base
Variable inferior grass/TOPSOIL	Ground Level	0.20
Very soft silty Clay with silt inclusions and sand horizons (organics present in WS2)	0.20	3.20 to 4.00 In WS2 and WS3
Firm to stiff to very stiff gravelly sandy silty Clay	3.20 to 4.00	Not proven

8. Groundwater

Seepage groundwater was recorded in exploratory holes WS2 and WS3 at 2.00m depth during the course of the fieldwork. The groundwater conditions entered on the exploratory hole logs are those observed at the time of the investigation and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. The groundwater monitoring undertaken in the standpipes installed in WS1 to WS3 recorded highest groundwater depths varying from dry in WS1, to 0.60m and 1.45m in WS2 and WS3 respectively. Groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

9. Geotechnical Properties

The following sections summarise the geotechnical properties for the main strata encountered on this site and are based on physical description, measured and empirical values.

9.1 Upper Clay

Very Silty Clay with organic inclusions and sand horizons.

Table 9.1 Summary of Geotechnical Properties – Upper Clay

Property	Number of Tests	Range of Results	Weighted Mean
Sulphate 2:1 Water:Soil Extract	4	400 to 580 mg/l	580 mg/l
pH	4	6.9 to 7.0	NA
Shear Strength From Hand Vane Test	5	17 to 47kN/m ²	Unsuitable Highly compressible
Equivalent N value Uncorrected from SPT tests	6	0 to 5	Unsuitable Highly compressible

9.2 Lower Clay

Gravelly sandy silty Clay

Table 9.2 Summary of Geotechnical Properties – Lower Clay

Property	Number of Tests	Range of Results	Weighted Mean
Shear Strength From Hand Vane Test	9	71 to >250kN/m ²	150
Equivalent N value Uncorrected from SPT tests	18	5 to 60	N= 20 Assessed Cu = 100kN/m ²

10. Geotechnical Assessment

10.1 Design Criteria

The following design criteria would normally be assumed for this proposed development.

1. Structural loads of up to 50kN/m on strip foundations/trench fill foundations at shallow to moderate depth.
2. Allowable foundation settlement of less than 25mm and differential settlement of less than 10mm.

10.2 Foundation Design Considerations

The presence of very soft and soft silty clay with sand horizons to depths of 3.20m and 4.00m in WS2 and WS3 together with the organic inclusions precludes the use of traditional shallow depth strip foundations and the use of ground bearing slabs on this site. Groundwater is likely to be present at the partially infilled adjacent water course level and will impact on the stability of the silty sands for trench fill foundations.

The preferred option would be for piled foundations penetrating into the lower stiff to very stiff gravelly sandy silty Clay present at variable depth across the site.

10.3 Excavations

Shallow to moderate depth excavations to be left open for any period of time will require full support for vertical faces to prevent instability of the excavation sides in the very soft deposits.

10.4 Pile Foundations

The use of pile foundations penetrating into the more competent clay deposits present at variable depth across the should be considered for the proposed foundations solution.

The magnitude of the loads to be taken by pile foundations can only be determined by consultation with the relevant piling contractor.

The piling contractor/warranty provider may require that the conformity of the lower clays beneath the deepest pile tip be proved for a depth of at least 5.00m below designed pile tip depth which on this site would require LCP boring techniques.

10.6 Ground Shrinkage and Heave

The exploratory holes encountered cohesive deposits within influencing depth of foundations including pile foundations with low to intermediate modified plasticity index up to 20% and low to medium volume change potential. The NHBC Standards Section 4.2 Building near trees must be followed for foundation design and any mitigating measures that might be required including for piled foundations. The desiccated and dry nature of the upper clay penetrated in WS1 along with fine rootlets evident to 2.80m depth indicates the potential for tree roots to penetrate to at least this depth.

10.7 Subsurface Concrete Attack

The results of the soluble sulphate and pH tests carried out on samples of made ground and clay obtained from this site in general indicate that according to Building Research Establishments Special Digest 1 (2005) particular precautions for concrete foundations will be required.

Generally, the use of concrete mix design sulphate class DS-2 and according to ACEC Class AC-2 of Table C1 conditions can be used for subsurface concrete mix design.



Matthew Benson MSc GMSCE
Geotechnical/Environmental Engineer



Mark Richardson MSc CEng MICE
Technical Director

Field investigations have been restricted to a level of detail required to achieve the stated objectives of the work. Ground conditions are, and can be, variable and have only been tested at isolated locations across the site. Therefore, the potential exists for ground conditions to be encountered which are different to those considered in this report.

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Appendix A

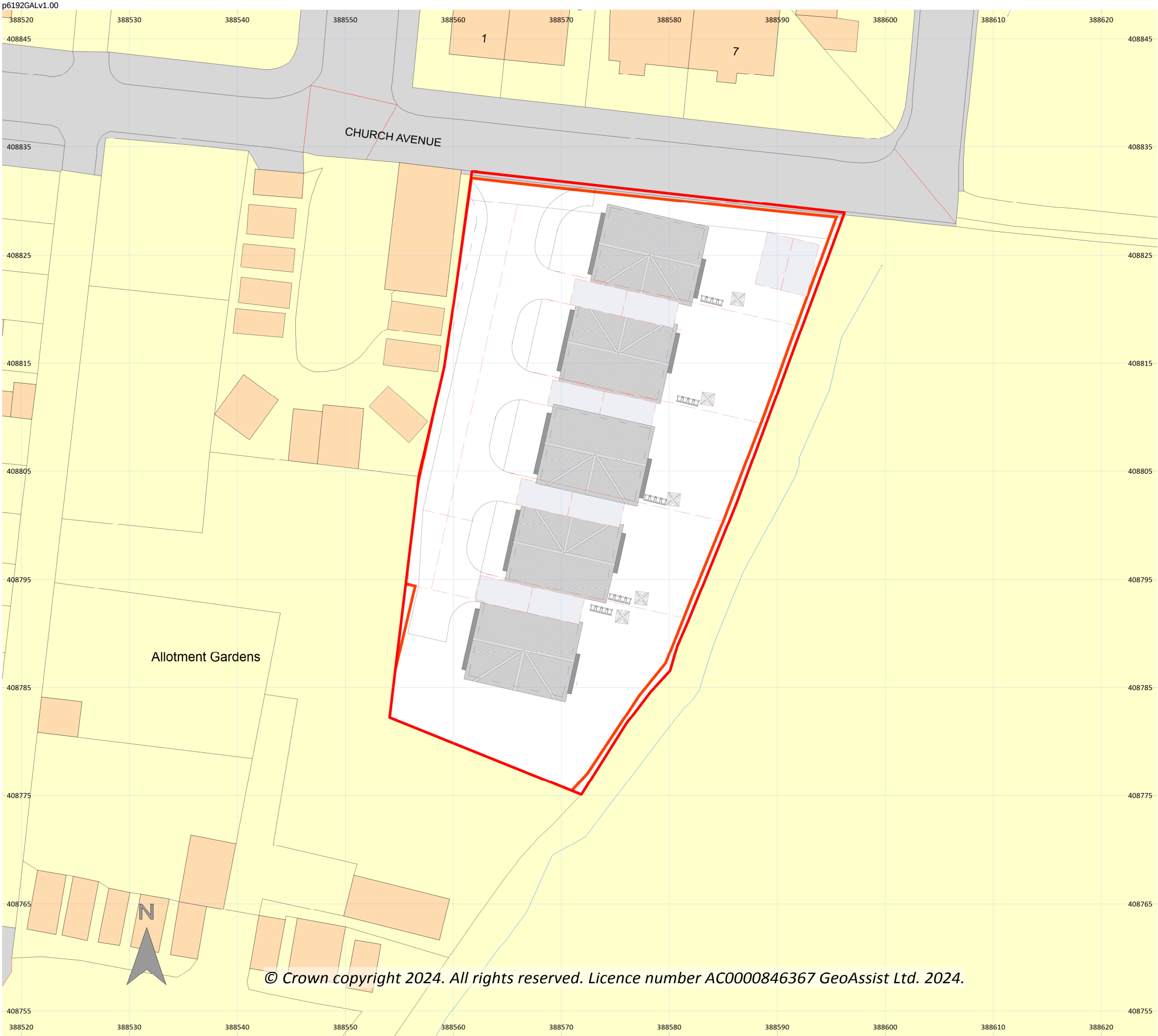
- A1 Site Plan with Exploratory Hole Locations
- A2 Proposed Site Plan



A1 Site Plan

Site Name	Church Avenue
Location	Middleton
GeoAssist Ref	6192VCA
Client	JC Brennan Developments Limited
	74 Dickenson Road Rusholme Manchester M14 5HF.
Planning Consultant	
NGR (centre of site)	388570,408810
Production Date	September 2025
Survey Method	
Surveyor	Others
Status	Final v1.00
Base Survey	OSGB36

Do Not Scale



A2 Proposed Plan

Site Name	Church Avenue
Location	Middleton
GeoAssist Ref	6192VCA
Client	JC Brennan Developments Limited
	74 Dickenson Road Rusholme Manchester M14 5HF.
Planning Consultant	
NGR (centre of site)	388570,408810
Production Date	September 2025
Survey Method	
Surveyor	Others
Status	Final v1.00
Base Survey	OSGB36

Do Not Scale

Appendix B

- B1 Terminology used in Soil Descriptions
- B2 List of Abbreviations
- B3 Concrete in Aggressive Ground
- B4 Standard Penetration Test

Terminology used in Soil Descriptions

The procedure and principles given in BS EN ISO 14688-1:2002 Part 1: 'Identification and description' have been adopted in producing the soil descriptions contained within this report.

The general identification and description of soils is based on a flexible system for immediate (field) use by experienced persons, covering both material and mass characteristics by visual and manual techniques.

Details are given of the individual characteristics for identifying soils and the descriptive terms in regular use, including those related to the results of tests from the field.

This part of ISO 14688 is applicable to natural soils *in situ*, similar man-made materials *in situ* and soils redeposited by man.

Particular sections of BS EN ISO 14688-1:2002 Part 1 are reproduced here in order to clarify the production of the soil descriptions contained within this report.

Identification of soil

General

Soil characteristics that generally permit soil to be identified with adequate accuracy for general (or preliminary) characterization are outlined below. A more accurate identification and classification based on grading, plasticity or organic content can be achieved by laboratory tests. In addition to identifying soils, the condition in which a soil is encountered, any particular secondary constituents, other features of a soil, such as carbonate content, particle shape, surface roughness of particles, odour, any common names and the geological classification are indicated.

The identification and description of soils generally follows the flow chart in Figure B1.1 attached.

Particle size

Particle size is the fundamental basis for designating mineral soils using particle fractions to distinguish the soil mechanical behaviour.

Table B1 shows the terms to be used for each soil fraction and its sub-fractions, together with the corresponding chosen range of particle sizes.

Basic soils are soils with uniform grading (i.e. they consist of particles of only one size range as specified in Table B1.1

Table B1.1 Particle Size Fractions

Soil fractions	Sub-fractions	Symbols	Particle sizes mm
Very coarse soil	Large boulder	LBo	> 630
	Boulder	Bo	> 200 to 630
	Cobble	Co	> 63 to 200
Coarse soil	Gravel	Gr	> 2,0 to 63
	Coarse gravel	CGr	> 20 to 63
	Medium gravel	MGr	> 6,3 to 20
	Fine gravel	FGr	> 2,0 to 6,3
	Sand	Sa	> 0,063 to 2,0
	Coarse sand	CSa	> 0,63 to 2,0
	Medium sand	MSa	> 0,2 to 0,63
	Fine sand	FSa	> 0,063 to 0,2
Fine soil	Silt	Si	> 0,002 to 0,063
	Coarse silt	CSi	> 0,02 to 0,063
	Medium silt	MSi	> 0,006 3 to 0,02
	Fine silt	FSi	> 0,002 to 0,006 3
	Clay	Cl	≤ 0,002

APPENDIX B1

Form No.: QF029AEN

Composite soils

General

Most soils are composite and consist of principal and secondary fractions. They are designated by a noun (main term) describing the principal fraction and by one or more adjectives (qualifying terms) describing the secondary fractions (e.g. sandy gravel saGr, gravelly clay grCl).

Principal fraction

The principal fraction in terms of mass determines the engineering properties of the soil and is given in capital letters for clarity.

In the case of very coarse soils, the principal fraction is the relevant very coarse soil fraction predominating in terms of mass. The very coarse fraction should be separated from the sample before identifying the fine and coarse fractions.

In the case of coarse soils, the principal fraction is the relevant coarse soil fraction predominating in terms of mass.

Composite coarse soils include a fines fraction (silt and/or clay) that does not determine the engineering properties of the soil.

In the case of fine soils, the principal fraction is the relevant fine soil type determining the engineering properties of the soil.

In the case of composite fine soils, the fines fraction determines the engineering properties of the soil. The fines fraction is regarded as determining the characteristics of a composite soil if this is of at least medium dry strength or exhibits a certain degree of plasticity.

In both cases, the soil is termed either "clay" or "silt", depending on the plasticity of the fines fraction and not on the grading.

Secondary fractions

Secondary and further fractions do not determine but will affect the engineering properties of the soil. The secondary fractions as adjectives are placed with the term describing the principal fraction in the order of their relevance.

If coarse secondary fractions are present in a particularly small or particularly large proportion, the term "slightly" or "very" shall precede the qualifying term.

If it is a fine soil, the properties of which are determined by fines fractions, a soil can be identified as "silt" or "clay" by checking for the presence of fine secondary constituents on the basis of its plasticity properties.

If, in the case of coarse soils, two soil fractions are present in approximately equal proportions, an oblique shall be placed between the relevant terms, e.g. gravel/sand (Gr/Sa) or fine/medium sand (FSa/MSa).

Plasticity

Assessment of the plasticity and identification of a soil as either silt or clay permits the soil to be qualified as being of low plasticity or high plasticity.

An exact determination can only be made by establishing the liquid limit and the plastic limit in laboratory tests.

Organic content

Small quantities of dispersed organic matter in a soil can produce a distinctive odour and colour. The intensity of odour and colour indicates the proportion of organic matter and should be described.

Determination of consistency

The consistency of a cohesive soil shall be determined in a manual test, permitting the following identification and description:

- a) a soil is to be identified as **very soft** if it exudes between the fingers when squeezed in the hand;
- b) a soil is to be identified as **soft** if it can be moulded by light finger pressure;
- c) a soil is to be identified as **firm** if it cannot be moulded by the fingers, but rolled in the hand to thick threads without breaking or crumbling;
- d) a soil is to be identified as **stiff** if it crumbles and breaks when rolled to thick threads but is still sufficiently moist to be moulded to a lump again;
- e) a soil is to be identified as **very stiff** if it has dried out and is mostly light coloured. It can no longer be moulded but crumbles under pressure. It can be indented by the thumbnail.

Preliminary descriptions are based on visual and manual identification only.

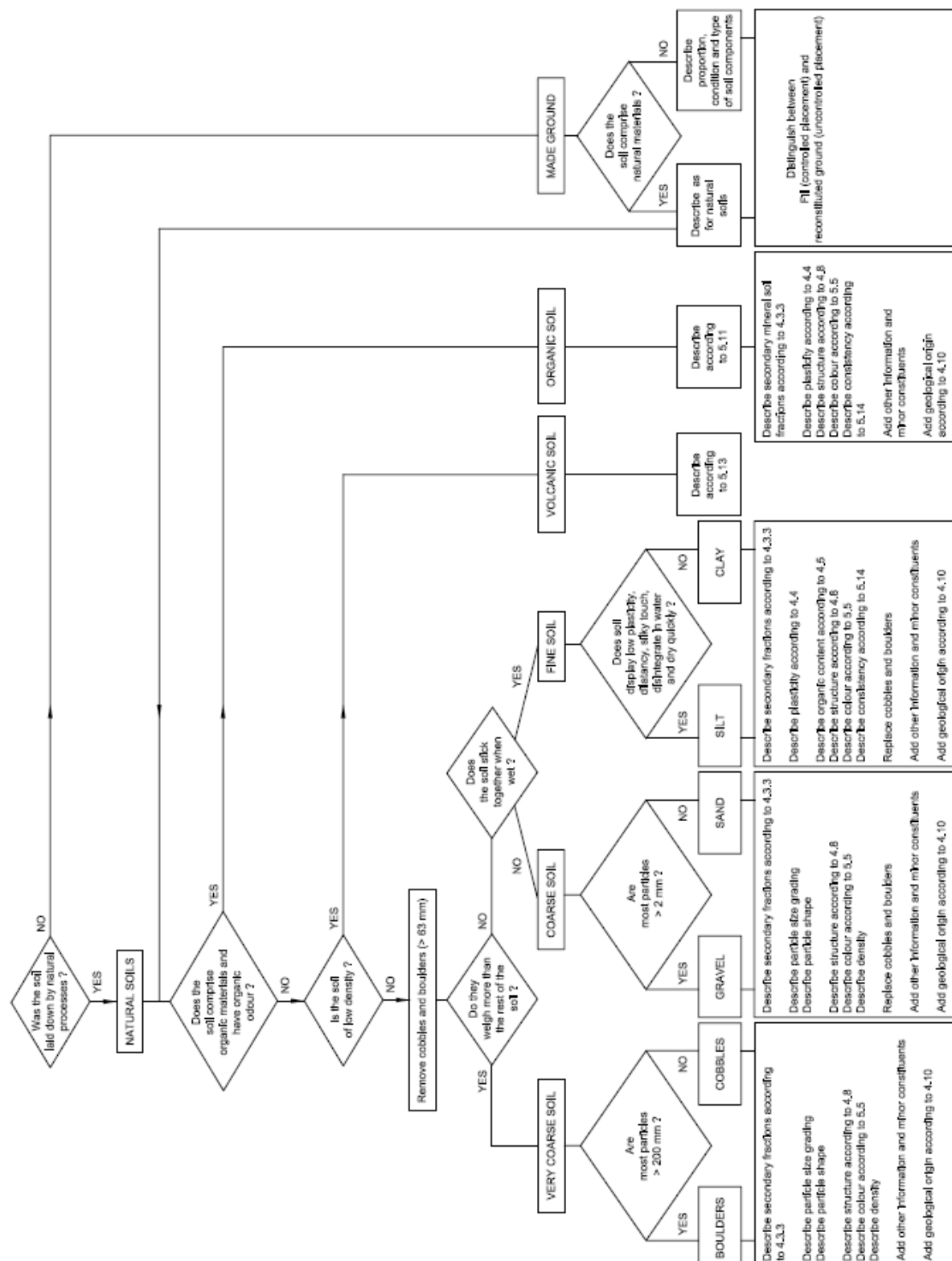


Figure B1.1 Flow chart for the identification and description of soils

Terminology used in Soil Classification

The procedure and principles given in BS EN ISO 14688-2:2004 Part 2: 'Principles for a classification' have been adopted in producing the soil descriptions contained within this report where laboratory or in situ field tests have been carried out.

The classification principles established in this part of ISO 14688 permit soils to be grouped into classes of similar composition and geotechnical properties and, with respect to their suitability for geotechnical engineering purposes.

This part of ISO 14688 is applicable to natural soil and similar man-made material *in situ* and redeposited, but it is not a classification of soil by itself.

Particular sections of BS EN ISO 14688-1:2002 Part 2 are reproduced here in order to clarify the production of the soil descriptions contained within this report.

Principles of soil classifications
General

Soils shall be classified into soil groups on the basis of their nature, which is the composition only, irrespective of their water content or compactness, taking into account the particle size distribution (grading), plasticity, organic content, genesis as appropriate.

The most common approach to classification is to divide the soils on the basis of particle size grading and plasticity. The division is made on the relative size fractions present for the coarser soil fractions, determined on the whole sample, and on the plasticity of the finer fractions (Table B1.2).

Table B1.2 Principles of a classification of soils

Criterion	Soil group	Quantification	Denomination into groups of similiar properties			Further subdivision as appropriate by
Wet soil does not stick together	very coarse	most particles > 200 mm	Bo	xBo		Requires special consideration
				boCo	coBo	
	most particles > 63 mm	Co	saCo, grCo	sagrCo		
	coarse	most particles > 2 mm	Gr	coGr	cosaGr	Particle size (grading) Shape of grading curve Relative density Permeability
			saGr, grSa	sasiGr, grsiSa		
		most particles > 0,063 mm	Sa	siGr, clGr orSa	siSa, clSa, sacIGr	(Mineralogy) (Particle shape)
Wet soils sticks together	fine	low plasticity dilatant	Si	saSi	sagrSi sacI Si	Plasticity Water content Strength, sensitivity Compressibility, stiffness (Clay mineralogy)
				clSi, siCl		
		plastic non-dilatant	Cl	orSi, orCl	sagrCl	
Dark colour, low density	organic		Or	saOr, siOr	clOr	Requires special consideration
Not naturally	Made ground	deposited	Mg	xMg	Man-made material	Requires special consideration
					Relaid natural materials	As for natural soils
Key to symbols						Cases requiring special consideration should be classified according to national or project requirements
Soil	Principal	Secondary or tertiary component				
Boulders	Bo	bo				
Cobbles	Co	co				
Gravel	Gr	gr	Gr(gr) and Sa(sa) can be subdivided into fine F(f), medium M(m) or coarse C(c)			
Sand	Sa	sa				
Silt	Si	si				
Clay	Cl	cl				
Organic	Or	or				
Made ground	Mg	—				
		x	any combination of components			

APPENDIX B1

Form No.: QF029AEN

Fractions

Soil is a mixture of materials of different particle size, which are grouped into fractions as specified in BS EN ISO 14688-1.

Classification of coarse and very coarse soils is to be based on the particle size distribution alone (see Table B1.3)

Table B1.3 Classification of very coarse soils

Fraction	Percent by mass	Term
Boulders	< 5	low boulder content
	5 to 20	medium boulder content
	> 20	high boulder content
Cobbles	< 10	low cobble content
	10 to 20	medium cobble content
	> 20	high cobble content

In the case of soils composed of both fine and coarse material, classification is to be based on both plasticity and particle size distribution.

Particle size distribution (grading)

The particle sizes and their distribution in a soil are determined by mechanical analysis carried out by the separation of the coarser fractions by sieving on a series of standard sieves and the determination of the finer fractions by sedimentation.

The results of the sieving and sedimentation process are plotted as a grading curve.

Plasticity

The fine fractions of soil, represented by clay and silt and containing clay minerals (see also BS EN ISO 14688-1), both alone or in mixtures with coarser material, are usually classified according to their plasticity characteristics. This is carried out on the basis of laboratory tests to determine the liquid limit w_L and plastic limit w_P .

Organic content

When soils with organic constituents are classified according to their organic content (Table B1.4), a distinction is to be made between organic soils and mineral soils with an organic content.

Table B1.4 Classification of soils with organic constituents

Soil	Organic content (≤ 2 mm) % of dry mass
Low-organic	2 to 6
Medium-organic	6 to 20
High-organic	> 20

Classification of coarse and composite organic soils accumulated *in situ* is based on the type of organic matter and that of organic soils, on the genetic origin and the degree of decomposition of the organic constituents.

APPENDIX B1

Form No.: QF029AEN

Undrained shear strength of fine soils

The terms to be used for the designation of the undrained shear strength according to the results of laboratory and field tests are given in Table B1.5.

Table B1.5 Undrained shear strength of fine soils

Undrained shear strength of clays	Undrained shear strength c_u kPa
Extremely low	< 10
Very low	10 to 20
Low	20 to 40
Medium	40 to 75
High	75 to 150
Very high	150 to 300
Extremely high ^a	> 300
^a Materials with shear strength greater than 300 kPa may behave as weak rocks and should be described as rocks according to ISO 14689-1.	

Table B1.6 Guiding values for the division of mineral soils on a basis of the contents of various fractions

Fraction	Content of fraction in wt % of material ≤ 63 mm	Content of fraction in wt % of material ≤ 0,063 mm	Name of soil	
			Modifying term	Main term
Gravel	20 to 40 > 40		gravelly	gravel
Sand	20 to 40 > 40		sandy	sand
Silt + clay (fine soil)	5 to 15	< 20	slightly silty	silt silt clay clay
		≥ 20	slightly clayey	
	15 to 40	< 20	silty	
		≥ 20	clayey	
	> 40	< 10		
		10 to 20	clayey	
		20 to 40	silty	
		> 40		

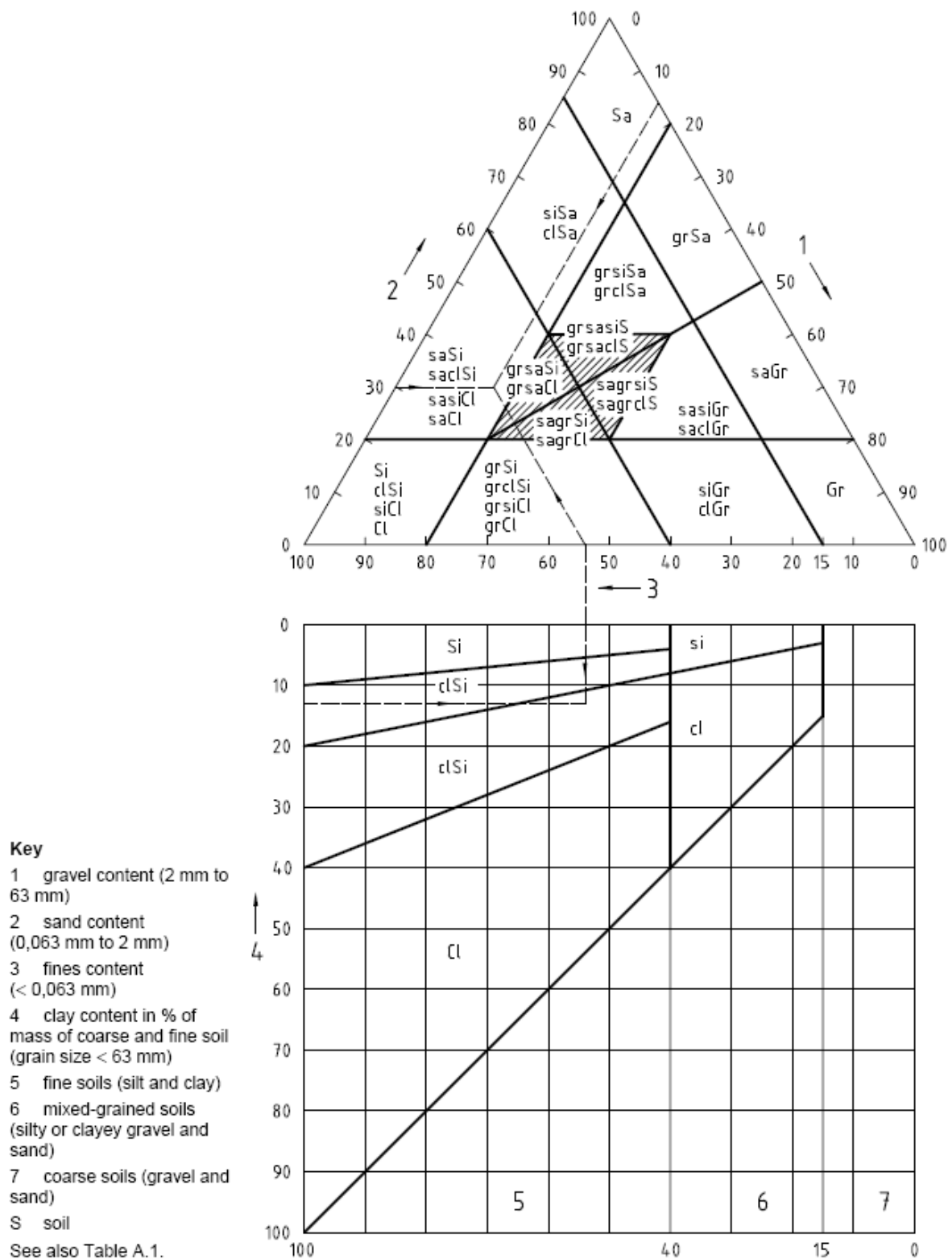


Figure B1.2 Classification of soils, based on grading alone

References

BS EN ISO 14688-1: 2002

Geotechnical investigation and testing — Identification and classification of soil — Part 1: Identification and description

BS EN ISO 14688-2: 2004

Geotechnical investigation and testing — Identification and classification of soil — Part 2: Principles for a classification

Abbreviations

Exploratory Hole log

Sample Type

AGS Code	Sample Type	AGS Code	Sample Type
B	Bulk Disturbed sample	SPT	Penetration Test – split spoon
CBR	CBR sample	U	Undisturbed sample – open drive
CPT	Penetration Test – cone	UF	Undisturbed sample failed recovery
D	Small disturbed sample	W	Water sample
PU	Piston sample	C - ES	Environmental sample

SPT and CPT – Standard Penetration Test

Blow Count (N) – If full penetration of 450mm then the total number of blows for the last 300mm is given.

If limited penetration following 150mm seating blows then the number of blows for the stated penetration is given.

If limited penetration then the total number of blows for the stated penetration is given.

The N values are actual blows recorded and uncorrected.

U - Undisturbed Sample

Blow Count – total number of blows for recovered length

Legend – As per British Standard – if blank then CAVITY/OPEN HOLE

Core Rec.:

T - Total Core Recovery as a percentage of the cored run

S – Solid Core Recovery as a percentage of the cored run

RQD – Rock Quality Designation as a percentage of the cored run

FI – Fracture index as number of fractures per metre

l_f – Fracture spacing as the average length of solid core pieces between natural fractures over core length of reasonable uniform characteristics

APPENDIX B2

Form No.: QF033AEN

Laboratory Test Summary Sheet

Tests on Soils

AGS Code	Test Name	AGS Code	Test Name
ASB	Asbestos	IDEN	In Situ Density
BDEN	Bulk Density	IGNIS	Loss on Ignition
CBR	California Bearing Ratio	IVAN	In Situ Vane
CD	Consolidated drained (single stage)	LS	Linear shrinkage
CDM	Consolidated drained (multi stage)	MCVG	Moisture Condition Value
CLSS	Atterberg Limits	NMC	Natural Moisture content
CMPG	Compaction	OMS	Organic Matter
CNMT	Contaminant and Chemical	PD	Particle density
CONG	Consolidation	PHS	pH
CU	Consolidated undrained with pwp measurement (single stage)	PTST	Laboratory permeability
CUM	Consolidated undrained with pwp measurement (multi stage)	RELD	Relative Density
DDEN	Dry Density	SHBG	Shear box
FRST	Frost Susceptibility	SLIM	Shrinkage Limit
GRAD HY	Particle Size (Hydrometer)	SULWS	Sulphate on 2:1 Water:Soil Extract
GRAD WS	Particle size (wet Sieve)	TNPC	Ten Per Cent Fines
HVP	Hand vane – peak	UU	Unconsolidated quick undrained (single stage)
ICBR	In situ CBR	UUM	Unconsolidated quick undrained (multi stage)

Tests on rocks and Aggregates

AGS Code	Test Name	AGS Code	Test Name
ACV	Aggregate crushing value	SHOR	Shore hardness
BRAZ	Tensile Strength by Brazilian method	SOUN	Aggregate Soundness Test
LOSA	Aggregate Los Angeles Abrasion	UCS	Uniaxial Compressive Strength
PLSI	Point Load Index – size corrected	WTAB	Aggregate Water Absorption

4. Reference AGS Format Edition 3

Concrete in Aggressive Ground

1. Assessing the Aggressive Chemical Environment

In order to assess the levels of sulphate in the ground or groundwater, which may have a deleterious effect on concrete, the sulphate content of soil and groundwater may be determined in accordance with BS 1377 (2001) Test 3:5. The sulphate contents determined are grouped into Aggressive Chemical Environment for Concrete (ACEC) site classifications in Building Research Establishment Special Digest 1 – Part 1 (2005) Tables C1 and C2 as reproduced below.

Based on this classification BRE Special Digest 1 gives recommendations for the design of suitable concrete mixes to resist chemical attack for each ACEC classification. Care should be taken in the interpretation of results over the site area, if classification is based solely on groundwater analysis, it should be based on the highest sulphate concentration recorded. Where a large number of results from soil analysis are available it should be based on the average of the highest 20 per cent of the results. If a varied set of results are recorded from a limited sampling programme it is important to carry out further analyses before a detailed classification is given.

2. References

BS 1377: 2001: 'Methods of Test for Soils for Civil Engineering Purposes': British Standards Institution.

BRE Special Digest 1: 2005: 'Concrete in Aggressive Ground': Building Research Establishment.

Table C1 Aggressive Chemical Environment for Concrete (ACEC) classification for natural ground locations ^a						
Sulfate Design Sulfate Class for location	2:1 water/soil extract ^b	Groundwater	Total potential sulfate ^c	Groundwater Static water	Mobile water	ACEC Class for location
1	2 (SO ₄ mg/l)	3 (SO ₄ mg/l)	4 (SO ₄ %)	5 (pH)	6 (pH)	7
DS-1	< 500	< 400	< 0.24	≥ 2.5	> 5.5 ^d 2.5–5.5	AC-1s AC-1 ^d AC-2z
DS-2	500–1500	400–1400	0.24–0.6	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-1s AC-2 AC-2s AC-3z
DS-3	1600–3000	1500–3000	0.7–1.2	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-2s AC-3 AC-3s AC-4
DS-4	3100–6000	3100–6000	1.3–2.4	> 3.5 2.5–3.5	> 5.5 2.5–5.5	AC-3s AC-4 AC-4s AC-5
DS-5	> 6000	> 6000	> 2.4	> 3.5 2.5–3.5	≥ 2.5	AC-4s AC-5

Notes

- ^a Applies to locations on sites that comprise either undisturbed ground that is in its natural state (ie is not brownfield – Table C2) or clean fill derived from such ground.
- ^b The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered relative to previous Digests (Box C7).
- ^c Applies only to locations where concrete will be exposed to sulfate ions (SO₄) which may result from the oxidation of sulfides (eg pyrite) following ground disturbance (Appendix A1 and Box C8).
- ^d For flowing water that is potentially aggressive to concrete owing to high purity or an aggressive carbon dioxide level greater than 15 mg/l (Section C2.2.3), increase the ACEC Class to AC-2z.

Appendix B3

Page 1 of 2

GeoAssist Limited

Table C2 Aggressive Chemical Environment for Concrete (ACEC) classification for brownfield locations ^a

Sulfate and magnesium						Groundwater		ACEC Class for location
Design Sulfate Class for location	2:1 water/soil extract ^b		Groundwater		Total potential sulfate ^c	Static water	Mobile water	
1	2 (SO ₄ mg/l)	3 (Mg mg/l)	4 (SO ₄ mg/l)	5 (Mg mg/l)	6 (SO ₄ %)	7 (pH) ^d	8 (pH) ^d	9
DS-1	< 500		< 400		< 0.24	≥ 2.5		AC-1s
							> 6.5 ^d	AC-1
							5.5–6.5	AC-2z
							4.5–5.5	AC-3z
							2.5–4.5	AC-4z
DS-2	500–1500		400–1400		0.24–0.6	> 5.5		AC-1s
							> 6.5	AC-2
							2.5–5.5	AC-2s
							5.5–6.5	AC-3z
							4.5–5.5	AC-4z
							2.5–5.5	AC-5z
DS-3	1600–3000		1500–3000		0.7–1.2	> 5.5		AC-2s
							> 6.5	AC-3
							2.5–5.5	AC-3s
							5.5–6.5	AC-4
							2.5–5.5	AC-5
DS-4	3100–6000	≤ 1200	3100–6000	≤ 1000	1.3–2.4	> 5.5		AC-3s
							> 6.5	AC-4
							2.5–5.5	AC-4s
							2.5–6.5	AC-5
DS-4m	3100–6000	> 1200 ^e	3100–6000	> 1000 ^e	1.3–2.4	> 5.5		AC-3s
							> 6.5	AC-4m
							2.5–5.5	AC-4ms
							2.5–6.5	AC-5m
DS-5	> 6000	≤ 1200	> 6000	≤ 1000	> 2.4	> 5.5		AC-4s
							2.5–5.5	AC-5
							≥ 2.5	
DS-5m	> 6000	> 1200 ^e	> 6000	> 1000 ^e	> 2.4	> 5.5		AC-4ms
							2.5–5.5	AC-5m
							≥ 2.5	

Notes

- ^a Brownfield locations are those sites, or parts of sites, that might contain chemical residues produced by or associated with industrial production (Section C5.1.3).
- ^b The limits of Design Sulfate Classes based on 2:1 water/soil extracts have been lowered from previous Digests (Box C7).
- ^c Applies only to locations where concrete will be exposed to sulfate ions (SO₄), which may result from the oxidation of sulfides such as pyrite, following ground disturbance (Appendix A1 and Box C8).
- ^d An additional account is taken of hydrochloric and nitric acids by adjustment to sulfate content (Section C5.1.3).
- ^e The limit on water-soluble magnesium does not apply to brackish groundwater (chloride content between 12 000 mg/l and 17 000 mg/l). This allows 'm' to be omitted from the relevant ACEC classification. Seawater (chloride content about 18 000 mg/l) and stronger brines are not covered by this table.

Standard Penetration Test

The full procedure for carrying out the Standard Penetration Test (SPT) is given in EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing - Field testing - Part 3: Standard penetration test.

The Energy ratio for the hammer used on this site is 72% as given in the test certificate attached.

The blow counts N noted on the borehole logs are the uncorrected field blows counts as recorded.

Essentially the test consists of driving a 50mm external diameter split barrel sampler into the soil using a 63.5kg hammer dropping 760mm. The penetration resistance is expressed as the number of blows required to obtain 300mm penetration below an initial seating drive of 150mm through any disturbed ground at the bottom of the borehole. The number of blows for the 300mm test drive penetration is recorded on the borehole log as the N-value.

The test is normally performed on sands, but may also be used in gravels, weak rocks and glacial tills in which case the driving shoe may be replaced by a cone. When attempting the standard penetration test in very dense materials or weathered bedrock it may be necessary to terminate the test before completion to prevent damage to the equipment. In these circumstances it is important to distinguish how the blow count relates to the penetration of the sampler. This may be achieved in the following manner.

- (a) Where the 150mm seating drive is complete and where the test drive is terminated at 50 blows the number of blows for the partial test drive (usually 50) and the penetration of the sampler within the test drive are recorded. An approximate N-value may be obtained by linear extrapolation of the number of blows recorded for the partial test drive.
- (b) If the total penetration is equal to or less than the 150mm seating drive then the number of blows (usually 50) and the depth of penetration within the initial seating penetration are recorded on the borehole logs.

The N-value obtained from the Standard Penetration Test may be used to assess the terms for classification of relative density of sands and gravels only in accordance with Table 10 of BS 5930: 2015+A1:2020, Code of Practice for Site Investigations, as follows:

Term	Classification based on uncorrected SPT N-values for use of borehole logs Blows/300mm Penetration
Very loose	0-4
Loose	4-10
Medium dense	10 - 30
Dense	30 - 50
Very dense	over 50

The blow counts N noted on the borehole logs are the uncorrected field blows counts as recorded.

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

ARCHWAY ENGINEERING (UK) LTD
AINLEYS INDUSTRIAL ESTATE
ELLAND
WEST YORKSHIRE
HX5 9JP

SPT Hammer Ref: DART314
Test Date: 04/03/2025
Report Date: 04/03/2025
File Name: DART314.spt
Test Operator: TW

Instrumented Rod Data

Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.4
Assumed Modulus E_a (GPa): 208
Accelerometer No.1: 72572
Accelerometer No.2: 72572

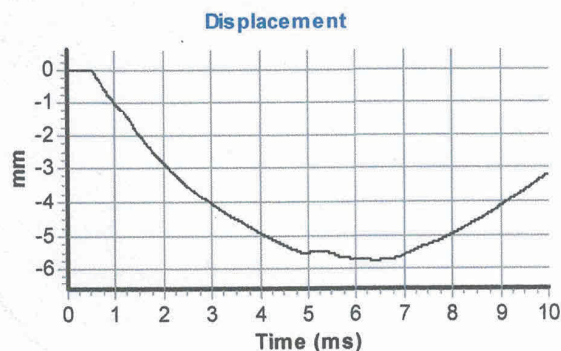
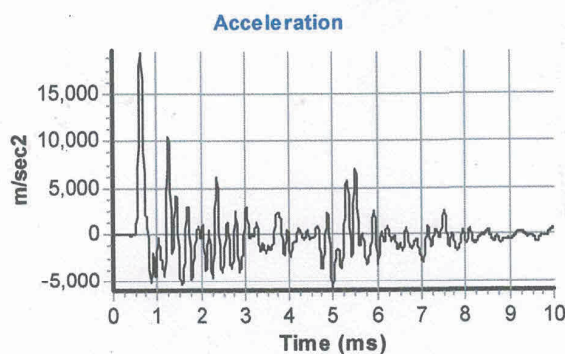
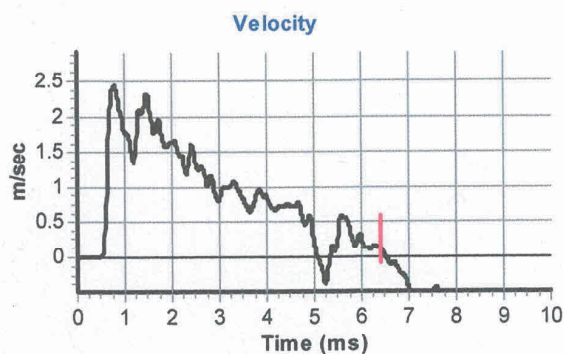
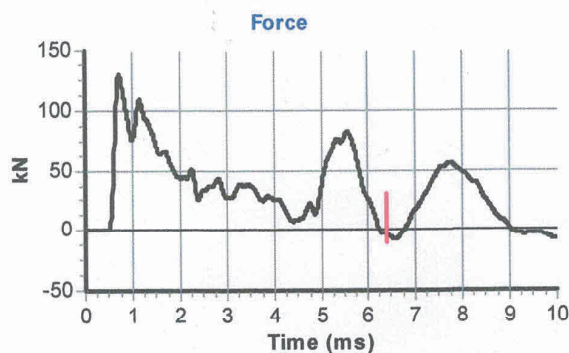
SPT Hammer Information

Hammer Mass m (kg): 63.5
Falling Height h (mm): 760
SPT String Length L (m): 10.0

Comments / Location

GEO ASSIST LTD

93226



Calculations

Area of Rod A (mm^2): 957
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 342

Energy Ratio E_r (%):

72

Signed: T WILKINSON
Title: FITTER

The recommended calibration interval is 12 months

Appendix C

C1 Exploratory Hole Logs WS1 to WS6

Remarks:	Logged: M Benson Date: 08/07/2025 Checked: M Richardson Date: 10/09/2025 Site Ref: 6192/VCA Scale 1:50 approx
The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.	

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS2		
Consultant: 0		Project: Church Avenue Location: Middleton					Sheet: 1		
Client: JC Brennan Developments Limited		Equipment: Archway Dart Rig with DCP Probe					Ground Level: 131.91 m.AOD Co-ordinates: Easting: 388572.5(m) Northing: 408786.9(m) Dates: 07/07/2025 to 07/07/2025		
Drilling Foreman: M Walton		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests			Field Records	
STRATUM DESCRIPTION Engineer/Geologist: M Benson					Depth (m) from to	Sample Type/No	Blow Count N/(U)		
0 Vegetation over soft brown very silty CLAY with roots		0.20	131.71						
Very soft to soft brown/grey organic silty CLAY with sand inclusions					0.30 0.40	C1			
					0.40 0.50	D1			
1		(1.80)			1.00	CP1	0		
					1.50 1.60	D2		Hand vane at 1.50m - 19kPa	
2 Grey/brown SILT/CLAY		2.00	129.91		2.00	CP2	0	Wet at 2.00m depth	
		2.30	129.61		2.50 2.60	D3			
3 Brown silty fine to medium SAND with silty clay inclusions		(0.70)			3.00	CP3	0		
Very soft to firm brown slightly gravelly very silty CLAY		(1.00)			3.70 3.80	D4		Hand vane at 3.30m - 17kPa	
		4.00	127.91		4.00	CP4	9	Hand vane at 3.70m - 34kPa	
4 Firm to stiff brown slightly gravelly very silty CLAY with silty sand inclusions		(1.50)			4.50	CP5	15		
					4.80 4.90	D5		Hand vane at 4.80m - 71kPa	
5		5.50	126.41		5.00	CP6	14		
					5.40 5.50	D6		Hand penetrometer at 5.50m - 134kPa	
6 Stiff to very stiff brown gravelly sandy to very sandy silty CLAY		(0.50)			5.90 6.00	D7			
Dynamic Probe only from 6.00m depth		6.00	125.91		6.00	CP7	28		
7 Stiff to very stiff gravelly sandy silty CLAY - Interpreted Stratum		(2.00)			7.00	CP8	39		
		8.00	123.91		7.90	CP9	60		
8 Exploratory Hole complete at 8.00m								07/07/2025: On completion of exploratory hole at 8.00m. Casing at 4.00m. Standing water level Nil with casing. On withdrawal of casing groundwater monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m	
9									
10									

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson
Date: 08/07/2025
Checked: M Richardson
Date: 10/09/2025
Site Ref: 6192/VCA
Scale 1:50 approx

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS3		
Consultant: 0		Project: Church Avenue Location: Middleton					Sheet: 1		
Client: JC Brennan Developments Limited		Equipment: Archway Dart Rig with DCP Probe					Ground Level: 132.74 m.AOD Co-ordinates: Easting: 388558.5(m) Northing: 408806.2(m) Dates: 07/07/2025 to 07/07/2025		
Drilling Foreman: M Walton		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests			Field Records	
STRATUM DESCRIPTION Engineer/Geologist: M Benson					Depth (m) from to	Sample Type/No	Blow Count N/(U)		
0 Vegetation over dark grey clayey TOPSOIL		0.20	132.54						
Orange/brown with light brown and grey very sandy silty CLAY with sand inclusions		(0.80)			0.30 0.40 0.40 0.50	C1 D1			
1 Firm brown/grey silty CLAY with brown sand inclusions		1.00 (1.00)	131.74		1.00 1.20 1.20 1.30	CP1 D2	5		Hand vane at 1.20m - 42kPa
2 Soft to firm brown slightly gravelly very silty CLAY		2.00 (1.00)	130.74		2.00 2.50 2.50 2.60	CP2 D3	5		Wet at 2.00m depth Hand vane at 2.50m - 47kPa
3 Loose brown silty fine to medium SAND		3.00 3.20	129.74 129.54		3.00 3.10 3.00 3.00	D4 CP3	8		
Stiff brown gravelly sandy silty CLAY					3.50 3.60	D5			Hand penetrometer at 3.50m - 130kPa
4		(1.80)			4.00 4.50 4.50 4.60	CP4 D6	11		Hand penetrometer at 4.50m - 107kPa
Dynamic Probe only from 5.00m depth		5.00	127.74		5.00	CP5	16		
5 Stiff gravelly sandy silty CLAY - Interpreted Stratum									
6		(3.00)			6.00	CP6	17		
7					7.00	CP7	23		
8 Exploratory Hole complete at 8.00m		8.00	124.74		7.90	CP8	39		07/07/2025: On completion of exploratory hole at 8.00m. Casing at 3.00m. Standing water level at 4.70m with casing. On withdrawal of casing groundwater monitoring standpipe installed to 5.00m with response zone from 1.00m to 5.00m
9									
10									
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 08/07/2025 Checked: M Richardson Date: 10/09/2025 Site Ref: 6192/VCA Scale 1:50 approx		

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS4	
Consultant: 0		Project: Church Avenue Location: Middleton					Sheet: 1	
Client: JC Brennan Developments Limited		Equipment: Archway Dart Rig with DCP Probe					Ground Level: 132.94 m.AOD Co-ordinates: Easting: 388581.6(m) Northing: 408804.2(m) Dates: 07/07/2025 to 07/07/2025	
Drilling Foreman: M Walton		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests			Field Records
STRATUM DESCRIPTION					Depth (m) from to		Sample Type/No	
Engineer/Geologist: M Benson								
0 Grass over brown clayey TOPSOIL with roots		0.20	132.74					
Dark brown sandy silty CLAY with fine rootlets		0.40	132.54		0.30 0.40	C1		
Stiff orange/brown and grey slightly gravelly sandy silty CLAY		(0.60)			0.50 0.60	D1		
1 Exploratory Hole complete at 1.00m		1.00	131.94					
2								
3								
4								
5								
6								
7								
8								
9								
10								

Remarks:

The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken.
Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.

Logged: M Benson
Date: 08/07/2025
Checked: M Richardson
Date: 10/09/2025
Site Ref: 6192/VCA
Scale 1:50 approx

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS5	
Consultant: 0		Project: Church Avenue Location: Middleton					Sheet: 1	
Client: JC Brennan Developments Limited		Equipment: Archway Dart Rig with DCP Probe					Ground Level: 132.03 m.AOD Co-ordinates: Easting: 388558.73(m) Northing: 408791.9(m) Dates: 07/07/2025 to 07/07/2025	
Drilling Foreman: M Walton		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests			Field Records
STRATUM DESCRIPTION Engineer/Geologist: M Benson					Depth (m) from to	Sample Type/No	Blow Count N/(U)	
0 Vegetation over dark grey clayey sand and gravel - MADE GROUND		0.10	131.93		0.30 0.40 0.50 0.60	C1 D1	07/07/2025: On completion of exploratory hole at 1.00m. Standing water level Nil. Exploratory hole backfilled and reinstated.	
Grey/brown organic silty CLAY		(0.80)						
1 Grey/brown gravelly sandy silty CLAY		0.90 1.00	131.13 131.03					
Exploratory Hole complete at 1.00m								
-2								
-3								
-4								
-5								
-6								
-7								
-8								
-9								
-10								
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.						Logged: M Benson Date: 08/07/2025 Checked: M Richardson Date: 10/09/2025 Site Ref: 6192/VCA Scale 1:50 approx		

GeoAssist Limited		Exploratory Hole Record Sheet					Ref: WS6	
Consultant: 0		Project: Church Avenue Location: Middleton					Sheet: 1	
Client: JC Brennan Developments Limited		Equipment: Archway Dart Rig with DCP Probe					Ground Level: 133.7 m.AOD Co-ordinates: Easting: 388563.5(m) Northing: 408829.5(m) Dates: 07/07/2025 to 07/07/2025	
Drilling Foreman: M Walton		Depth (Thick) (m)	Reduced Level (mAOD)	Strata Legend/ Standpipe Backfill	Samples/Tests			Field Records
STRATUM DESCRIPTION					Depth (m) from to		Sample Type/No	
Engineer/Geologist: M Benson								
0 Grass over orange/brown and grey brick rubble - MADE GROUND		0.20	133.50					
Grey silty sand with gravel - MADE GROUND		0.40	133.30		0.30 0.40	C1		
Very stiff orange/brown with light grey gravelly very sandy silty CLAY		(0.60)						
		1.00	132.70		0.80 0.90	D1		
1 Exploratory Hole complete at 1.00m								
2								
3								
4								
5								
6								
7								
8								
9								
10								
Remarks: The groundwater conditions entered on the exploratory hole logs are those observed at the time of the drilling operations and the water level may not have reached equilibrium with the surrounding water level prior to the record being taken. Standing groundwater levels will be subject to seasonal variation or changes in local drainage conditions and could be higher at certain times of the year particularly after periods of heavy rainfall.							Logged: M Benson Date: 08/07/2025 Checked: M Richardson Date: 10/09/2025 Site Ref: 6192/VCA Scale 1:50 approx	

Appendix D

D1	Laboratory Summary Sheet
D2	Classification Test Summary
D3	Sulphate and pH Summary
D4	Particle Size Distribution Graphs

GeoAssist Limited SOIL LABORATORY SUMMARY SHEET	Project: Church Avenue Location: Middleton Client: JC Brennan Developments Limited Consultant :	Site Ref: 6192/VCA Project Code :
		Hole Ref WS1 to WS6

Sample Ref.	Depth m	Sample Description	Classification					Triaxial Compression					Chemical		Test Code
			LL %	PL %	PI %	% passing 425 m	Moist Cont. %	Bulk Density Mg/m³	Sample Size mm	Confining Pressure kN/m²	Deviator /Shear Stress kN/m²	Shear Cohesion kN/m² /Friction angle degrees	So4 2:1 extract Soil:Water mg/l	pH	
WS1 D1	0.40	Orange/brown with light grey gravelly sandy silty CLAY with silt inclusions					-						400	7.0	SULWS PH
WS1 D2	0.70	Orange/brown with light grey gravelly sandy silty CLAY with silt inclusions	38	17	21	96	17								NMC CLSS
WS1 D3	2.50	Brown gravelly sandy silty CLAY with occasional sand inclusions	35	16	19	87	16								NMC CLSS
WS1 D4	3.50	Brown slightly gravelly sandy silty CLAY with fine rootlets to 2.80m depth					16								NMC
WS1 D5	4.50	Brown slightly gravelly sandy silty CLAY with fine rootlets to 2.80m depth					19								NMC
WS2 D1	0.40	Brown/grey organic silty CLAY with sand inclusions					-						580	6.9	SULWS PH
WS2 D2	1.50	Brown/grey organic silty CLAY with sand inclusions					66								NMC
WS2 D3	2.50	Brown silty fine to medium SAND with silty clay inclusions					-								GRAD WS
WS2 D4	3.70	Brown slightly gravelly very silty CLAY	31	13	18	98	20								NMC CLSS
WS2 D5	4.80	Brown slightly gravel very silty CLAY with silty sand inclusions					16								NMC
WS2 D6	5.40	Brown slightly gravel very silty CLAY with silty sand inclusions					16								NMC
WS2 D7	5.90	Brown gravelly sandy silty CLAY	18	11	7	62	9.5								NMC CLSS

GeoAssist Limited SOIL LABORATORY SUMMARY SHEET	Project: Church Avenue Location: Middleton Client: JC Brennan Developments Limited Consultant :	Site Ref: 6192/VCA Project Code :
		Hole Ref WS1 to WS6

Sample Ref.	Depth m	Sample Description	Classification					Triaxial Compression					Chemical		Test Code
			LL %	PL %	PI %	% passing 425 m	Moist Cont. %	Bulk Density Mg/m³	Sample Size mm	Confining Pressure kN/m²	Deviator /Shear Stress kN/m²	Shear Cohesion kN/m² /Friction angle degrees	So4 2:1 extract Soil:Water mg/l	pH	
WS3 D1	0.40	Orange/brown with light brown and grey very sandy silty CLAY with sand inclusions					-						400	7.0	SULWS PH
WS3 D2	1.20	Orange/brown with light brown and grey very sandy silty CLAY with sand inclusions	24	14	10	100	21								NMC CLSS
WS3 D3	2.50	Brown slightly gravelly very silty CLAY					16								NMC CLSS
WS3 D4	3.00	Brown silty fine to medium SAND					-								GRAD WS
WS3 D5	3.50	Brown gravelly sandy silty CLAY	21	11	10	97	14								NMC CLSS
WS3 D6	4.50	Brown gravelly sandy silty CLAY					13								NMC
WS4 D1	0.50	Orange/brown and grey slightly gravelly sandy silty CLAY					23								NMC
WS5 D1	0.50	Grey/brown organic silty CLAY					35								NMC
WS6 D1	0.80	Orange/brown with light grey gravelly very sandy silty CLAY					13								NMC

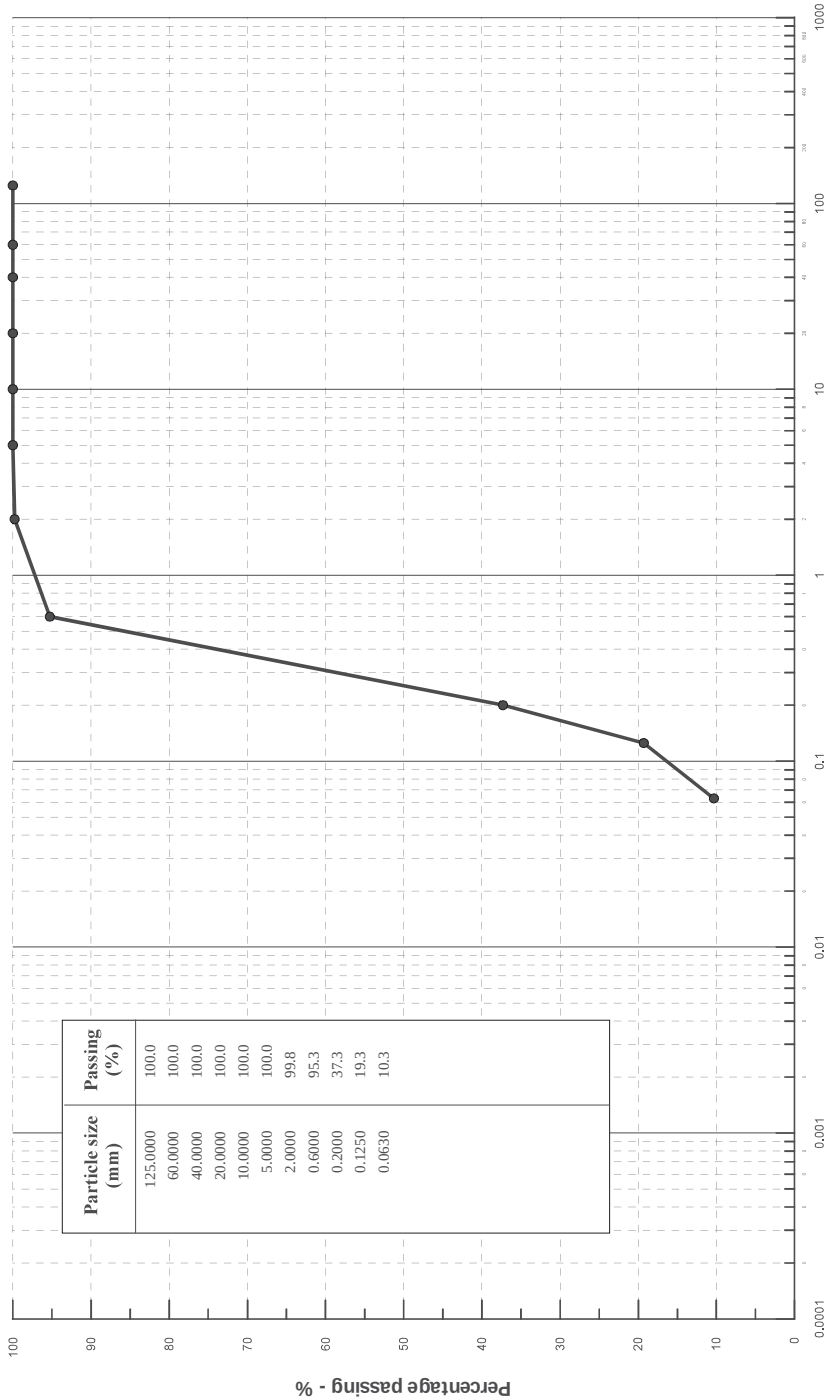
Site Reference:			6192 VCA						
Project Site:			Church Avenue						
Project Location:			Middleton						
Client:			JC Brennan Developments Limited						
Consultant:			0						
CLASSIFICATION TEST									
Borehole Reference	Sample	Depth	Liquid Limit %	Plastic Limit %	Plasticity Index %	passing 425 micron %	Natural Moisture Content %	Modified Plasticity Index %	Material Code
WS1	D2	0.70	38	17	21	96	17	20	CI
WS1	D3	2.50	35	16	19	87	16	17	CL/CI
WS2	D4	3.70	31	13	18	98	20	18	CL
WS2	D7	5.90	18	11	7	62	9.5	4	CL/ML
WS3	D2	1.20	24	14	10	100	21	10	CL
WS3	D5	3.50	21	11	10	97	14	10	CL
		Mean	28	14	14	90	16	13	
		Maximum	38	17	21	100	21	20	
CLAY		Minimum	18	11	7	62	10	4	
		Standard Deviation	8	3	6	14	4	6	
		Count	6	6	6	6	6	6	

Site Reference:			6192	VCA		
Project Site:			Church Avenue			
Project Location:			Middleton			
Client:			C Brennan Developments Limited			
Consultant:			0			
	GEOTECHNICAL SULPHATE AND PH TEST					
Borehole Reference	Sample	Depth	SO4 2:1 Water:Soil extract mg/l	pH	SO4 Water mg/l	
WS1	D1	0.40	400	7.0		
WS2	D1	0.40	580	6.9		
WS3	D1	0.60	400	7.0		
		Mean	460	7.0		
ALL		Maximum	580	7.0		
		Minimum	400	6.9		
	Standard Deviation		104	0.1		
		Count	3			

PARTICLE SIZE DISTRIBUTION GRAPH

Site Number: 6192
Site Reference: VCA

Project: Church Avenue
Location: Middleton
Client: C Brennan Developments Limited
Consultant: 0



BH No: WS3
Sample: D4
Depth: 3.00m

%	SIZE
0.0	Cobbles
0.2	Gravel
89.4	Sand
10.3	Silt and Clay

CLAY	SILT			SAND			GRAVEL	COBBLES	BOULDERS
	Fine	Medium	Coarse	Fine	Medium	Coarse			