



**BROWNFIELD
SOLUTIONS LTD**

GEO-ENVIRONMENTAL ENGINEERING EXCELLENCE

ST MICHAELS UK PROPCO 2 LTD / DOMIS CONSTRUCTION LTD

St Michaels, Jacksons Row, Manchester

Phase II Geo-Environmental Assessment Report

CM/C5128/11668 Rev E

November 2023

EXECUTIVE SUMMARY	
Location and Brief Site Description	The site is located off Jacksons Row, Manchester, M2 5NH. It is situated approximately 200m south-west of Manchester City Centre, centred on National Grid Reference 383645, 398043. The site comprises of a hardstanding car park accessed from Jacksons Row to the north and Bootle Street to the south. A synagogue was present across the central northern section of the site.
Ground Conditions	Generalised ground conditions from the ground investigation comprise (top down): • Made ground encountered from ground level to between 1.20m and 2.85m bgl. • Natural strata (predominantly gravelly sands) encountered from 1.20m bgl to between 4.00m and 4.70m bgl. • Solid geology (sandstone) encountered from 4.00m bgl to 45.00m bgl. • Groundwater recorded between 10.98m and 11.60m bgl. A deeper strike was recorded in BH07 at 17.52m bgl.
Human Health - Soils Contamination	The proposed development is of mixed end-use. The basement and ground floor will be utilised for commercial purposes, with the remainder of the proposed development being used for a mixture of office, a hotel and residential areas. Therefore, commercial screening values have been adopted. It is noted that the majority of the proposed development will comprise a hardstanding or building footprint. Elevated lead was recorded within one location of the made ground. Additional work by BSL recorded trace asbestos in two samples and a suspected ACM in one location. However, the made ground will be removed from site during the construction of the basement. Furthermore, the proposed development will feature hardstanding across the entire footprint of the site.
Controlled Waters – Surface and Groundwater Contamination	The risks to controlled waters are considered to be low and no further action is required.
Ground Gas	Based on the ground gas monitoring, the site is classified as CS1 and no mitigation measures are required.
Outline Remedial Strategy	Based on assessments undertaken, there are no specific remedial requirements in respect to controlled waters and human health.
Waste	Based on the waste classification database assessment, the majority of the made ground soils have been classified as non-hazardous, however, the soils within the made ground to the west of the Synagogue building have all been classified as hazardous. It is noted that during a previous investigation that cement sheeting was identified at location D2 beneath the central eastern part of the car park by WSP, although no confirmatory testing was carried out. No other asbestos was identified in soils during previous investigations.
Foundations and Floor Slabs	Piled foundations are considered the most suitable foundation option socketed into the competent sandstone bedrock. As a preliminary guide, allowable axial loads for a circular pile range between 10.8MN for a 600mm diameter pile with 25m embedment up to 21.0MN for a 750mm diameter pile with 35m embedment. Detailed foundation design will need to be completed by a suitably qualified specialist, also taking into consideration the requirements for the 3 storey deep basement. The basement floor slab should be supported by piles.
Concrete Classification	Made ground: DS3 AC-3 conditions prevail. Natural soils: DS1 AC-1 conditions prevail. Bedrock : DS1 AC-1 conditions prevail.
Highways Design	No dedicated highways will be included on this scheme which will be wholly covered in the proposed structure. Where required for temporary structure placement of construction access roads, equilibrium values in the existing made ground may be assumed as 2%. The above should be confirmed by in-situ testing at formation level by a specialist geotechnical engineer during construction.
Drainage	Much of the site will be covered by structures/hardstanding, which precludes the use of a large underground soakaway drainage. It is anticipated that surface water would need to be positively

EXECUTIVE SUMMARY

	drained into the off-site existing sewer network, subject to agreement with the local utility provider.
Further Work	The following further works will be required to progress to the construction phase: • Detailed foundation design by a structural engineer and piling contractor.

This executive summary should be read in conjunction with the full report, reference CM/C5128/11668 Rev E and not as a standalone document.

PROJECT QUALITY CONTROL DATA SHEET

Site Name:	St Michaels, Jacksons Row, Manchester		
Document Name:	Phase II Geo-Environmental Assessment Report		
Reference:	CM/C5128/11668 Rev E		
Status:	-	26/01/2023	Final.
	A	24/03/2023	Revision following additional pH and Sulphate testing and completion of gas monitoring.
	B	29/03/2023	Revision following client comments.
	C	17/04/2023	Revision following client comments.
	D	10/05/2023	Update to allowable pile load estimations.
	E	29/11/2023	Revision following supplementary site investigation.

Issued By:	Client:	Engineer:
Brownfield Solutions Ltd William Smith House 173 – 183 Witton Street Northwich Cheshire CW9 5LP Tel: 01606 334 844 brownfield-solutions.com	St Michaels UK Propco 2 Ltd / Domis Construction Ltd Unit 3 Birchwood One Business Park Birchwood WA3 7GB	Renaissance Associates Ltd Carvers Warehouse 77 Dale Street Manchester M1 2HG
	Contact:	Contact: Andrew Isherwood

Written by:



C McShane
BSc (Hons) FGS
Project Engineer

Checked by:



J Mather
BSc (Hons) FGS
Senior Project Engineer

Approved by:



A J Stokoe
BSc (Hons) CSci MEnvSc FGS
Associate

CSci
Chartered
Scientist

CONTENTS

1.0	INTRODUCTION	1
1.1	CONTEXT	1
1.2	PROPOSED DEVELOPMENT	1
1.3	PREVIOUS REPORTS	1
1.4	OBJECTIVES AND SCOPE.....	1
1.5	LIMITATIONS	2
2.0	THE SITE	4
2.1	LOCATION.....	4
2.2	SITE DESCRIPTION	4
3.0	SUMMARY OF PREVIOUS REPORTS	5
3.1	WSP PHASE I PRELIMINARY GEO-ENVIRONMENTAL RISK ASSESSMENT (2016)	5
3.2	WSP PRELIMINARY GEOTECHNICAL & ENVIRONMENTAL ASSESSMENT (2016).....	5
3.3	WSP GROUND INVESTIGATION REPORT (2016/2017).....	6
3.4	RAMBOLL GROUND CONTAMINATION ASSESSMENT (2021).....	6
4.0	METHOD OF INVESTIGATION	7
4.1	OBJECTIVES.....	7
4.2	SITE WORKS.....	7
4.3	SAMPLING STRATEGY	8
4.4	LABORATORY TESTING.....	8
4.5	MONITORING	9
5.0	GROUND CONDITIONS	11
5.1	SUMMARY	11
5.2	MADE GROUND.....	11
5.3	NATURAL SUPERFICIAL STRATA	11
5.4	SOLID GEOLOGY.....	11
5.5	GROUNDWATER.....	12
5.6	OBSERVATIONS.....	12
6.0	TEST RESULTS	14
6.1	GEOTECHNICAL LABORATORY TESTING	14
6.2	AGGRESSIVE GROUND CONDITIONS – GEOTECHNICAL CHEMICAL TESTING	14
6.3	IN SITU GEOTECHNICAL TESTING	14
6.4	GEO-ENVIRONMENTAL TESTING.....	14
7.0	GEOTECHNICAL ASSESSMENT.....	15
7.1	GROUND MODEL SUMMARY	15
7.2	DESIGN SOIL PARAMETERS.....	15
7.3	FOUNDATIONS.....	18
7.4	BUILDING NEAR TREES	20
7.5	FLOOR SLABS.....	20
7.6	GENERAL SITE PREPARATION AND CONSTRUCTION	21
7.7	BASEMENT CONSTRUCTION.....	21
7.8	CONCRETE CLASSIFICATION	22
7.9	HIGHWAYS/PAVEMENT DESIGN	23
7.10	SITE DRAINAGE.....	23
8.0	GEO-ENVIRONMENTAL RISK ASSESSMENT	24
8.1	INTRODUCTION	24
8.2	SOILS TEST RESULTS AND RISK ASSESSMENT – HUMAN HEALTH	24
8.3	SUMMARY – HUMAN HEALTH RISK ASSESSMENT	25

CONTENTS	
8.4	CONTROLLED WATERS RISK ASSESSMENT 25
8.5	PERMANENT GROUND GAS AND VAPOURS RESULTS 25
8.6	GROUND GAS RISK ASSESSMENT..... 26
8.7	QUALITATIVE RISK ASSESSMENT..... 27
8.8	OUTLINE REMEDIAL MEASURES 30
8.9	HEALTH AND SAFETY ISSUES 31
8.10	ASBESTOS 32
9.0	WASTE SOIL CLASSIFICATION & ASSESSMENT 33
9.1	SUMMARY 33
9.2	WASTE CLASSIFICATION PROCEDURE 33
9.3	WASTE CLASSIFICATION AND WASTE ACCEPTANCE CRITERIA (WAC) 34
9.4	OPTIONS ASSESSMENT 36
9.5	RE-USE OF SOILS 37
10.0	CONCLUSIONS 38
10.1	GEO-ENVIRONMENTAL..... 38
10.2	GEOTECHNICAL..... 38
10.3	FURTHER WORK 39
11.0	ABBREVIATIONS AND DEFINITIONS 40
12.0	REFERENCES 43

DRAWINGS		
Drawing Number	Rev	Title
S73-000	P03	Proposed Development Layout Plans (Numerous)
C5128/01	-	Site Location Plan
C5128/04	A	Exploratory Hole Location Plan
C5128/05		Hazardous Waste Location Plan

APPENDICES	
Appendix	Title
Appendix A	BSL Methodology and Guidance
Appendix B	Exploratory Hole Logs
Appendix C	Chemical Testing Results
Appendix D	Geotechnical Testing Results
Appendix E	Monitoring Results
Appendix F	Waste Assessment Report

1.0 INTRODUCTION

1.1 Context

This report describes a Phase II Geo-Environmental Assessment carried out by Brownfield Solutions Limited (BSL) for St Michaels UK Propco 2 Ltd / Domis Construction Ltd on a site off Jacksons Row, Manchester, known as St Michaels, and has been completed in general accordance with the following guidance:

-
- Environment Agency guidance - Land Contamination: Risk Management (LCRM).
 - BS 10175:2011+A2:2017 Investigation of Potentially Contaminated Sites.
 - BS5930: 2015+A1:2020 Code of Practice for Ground Investigations.
 - BS EN 1997-1:2004+A1:2013 Eurocode 7. Geotechnical design. General rules plus UK National Annex.
 - BS EN 1997-2:2007 Eurocode 7 Geotechnical design. Ground investigation and testing plus UK National Annex.
-

Definitions of terms and acronyms used within this report is presented in Section 11.0.

1.2 Proposed Development

The proposed development is for a 41-storey tower within the centre of the site along with a 7-storey podium across the entire footprint of the site. A full footprint 3-storey deep basement incorporating car parking, cycle store, water tank and storage rooms is also proposed. The frame is to be of reinforced concrete construction with a mix of post tensioned and traditional RC floor slabs. The end use is mixed, with the ground floor being for a retail use, with the remainder of the structure to be utilised as a mixture of offices, a hotel and residential areas.

1.3 Previous Reports

The following reports have been produced for the site and should be read in conjunction with this assessment (in date order):

-
- WSP, Phase 1 Preliminary Geo-Environmental Risk Assessment, reference 70010925/001/10465, dated January 2016.
 - WSP, Preliminary Geotechnical & Environmental Assessment, reference 70010925/002/10482, dated November 2016.
 - WSP, Ground Investigation Report, reference 700028727/20160109, dated February 2017.
 - Ramboll, Ground Contamination Assessment, dated January 2021.
 - Ramboll, Remedial Statement, dated January 2021.
-

BSL do not have reliance on the above reports, however, raw factual data contained therein has been utilised to aid assessments where relevant.

1.4 Objectives and Scope

The objectives of this report are to determine the geo-environmental setting and ground conditions of the site, highlighting potential risks and areas of concern that may govern the development under the current planning regime.

This report has been produced in general accordance with the recommendations for a Tier 2 Generic Quantitative Risk Assessment as described in LCRM guidance. This assessment is also intended to fulfil the requirements of a Ground Investigation Report (GIR) as detailed in BS EN 1997-2:2007.

The detailed investigation was undertaken using rotary drilling, ground gas and groundwater monitoring, laboratory chemical and geotechnical testing, with reporting on the findings. A summary of previous investigations carried out at the site has also been undertaken.

1.5 Limitations

This assessment has been prepared in accordance with the relevant current legislative framework, guidance and risk assessment methodology as outlined in Appendix A. BSL is not liable for any subsequent changes in the guidance and legislation.

The findings and opinions conveyed via this report are based on information obtained from a number of sources as detailed within this report, BSL have assumed this information is correct and reliable. Nevertheless, BSL cannot and does not guarantee the authenticity or reliability of the information it has relied upon.

BSL have used reasonable skill, care and diligence for the investigation of the site and the production of this report. There may be other conditions prevailing on the site which are outside the scope of work and have not been highlighted by this assessment and therefore have not been considered by this report. Responsibility cannot be accepted for such site conditions not revealed by the assessment.

This report has been prepared for the sole use and reliance of the Client, St Michaels UK Propco 2 Ltd / Domis Construction Ltd. No other third parties may rely upon or reproduce the contents of this report without the written permission of Brownfield Solutions Ltd (BSL). If any unauthorised third party comes into possession of this report, they rely on it at their own risk and BSL do not owe them any Duty of Care.

The investigation carried out on the site has been conducted to provide the best information on the ground conditions within site access and budgetary constraints. The inherent variation of ground conditions allows only for definition of the actual conditions at the locations and depths of exploratory locations at the time of the investigation. Different ground conditions may exist that have not been identified within this investigation.

The recommendations in this report assume that ground levels will remain as existing, unless stated otherwise within the report. If there is to be any re-profiling (e.g. to create development platforms or flood defences) then the recommendations may not apply.

The groundwater results described are only representative of the dates on which they were recorded, and levels may vary seasonally (e.g. due to changes in weather).

This assessment has been based on the proposed planning layouts provided. Any subsequent change to the planning layout may have an impact on the validity of recommendations made within this report. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

Although every effort has been made to position exploratory holes in the least sensitive areas of the site, exploratory hole positions were located approximately as part of this investigation and no guarantee can be given as to their accuracy. Consideration should be given to the possibility that exploratory holes excavated as part of this investigation and indeed any previous ground investigation work by others may be encountered beneath or within the influence of individual foundations. BSL cannot be held responsible for structural failures caused by the location of foundations of any form of structure within the influence of exploratory holes.

Where it has not been possible to reasonably use an EC7 compliant investigation technique, a practical alternative has been adopted to obtain indicative soil parameters and any interpretation is based upon engineering experience, local precedent where applicable and relevant published information.

The chemical testing carried out for this report was not scoped to comply with the requirements of the water supply company and further work may be required, unless otherwise stated.

Notwithstanding site observations concerning the presence or otherwise of archaeological issues, asbestos-containing materials (ACM) or invasive weeds (e.g. Japanese knotweed), this report does not constitute a formal survey of these potential issues.

The site plans enclosed in this report should not be scaled off. Any site boundary line depicted on plans does not imply legal ownership of land.

Any recommendations made in this report should be confirmed with the Regulatory Authorities prior to implementation to ensure compliance.

2.0 THE SITE

2.1 Location

The site is located off Jacksons Row, Manchester, M2 5NH. It is situated approximately 200m south-west of Manchester City Centre, centred on National Grid Reference 383645, 398043 as shown on the Site Location Plan, Drawing No. C5128/01.

2.2 Site Description

The main site features and potential issues identified are detailed below.

Feature	Description
Site Area	The site covers an area of approximately 0.2 hectares.
Site Access	Access to the site is gained off Jackson Row to the north and Bootle Street to the south of the site.
Current Land Use and Site Features	The site comprises of a hard standing car park accessed from Jacksons Row to the north and Bootle Street to the south. A synagogue is present across the central northern section of the site.
Potential Sources of Gross Contamination	No potential sources of gross contamination have been identified during the site walkover.
Vegetation	Sporadic overgrown minor vegetation is present onsite.
Topography	The site is topographically flat.
Site Boundaries	The site is bounded by Jackson Row to the north, Bootle Street to the south, a public house to the south-east, a construction site to the north-east, and a multi-storey block of residential apartments to the west.
Surrounding Area	The site is set within the centre of Manchester City and is surrounded by residential apartments, office blocks and retail/hospitality units.

3.0 SUMMARY OF PREVIOUS REPORTS

3.1 WSP Phase I Preliminary Geo-Environmental Risk Assessment (2016)

A summary of the relevant points from the Phase I Preliminary Geo-Environmental Risk Assessment completed by WSP (reference 70010925/001/10465) is presented below:

- The site has had previous development since 1848 for residential and commercial end use including a public house, police station, car parking and a synagogue.
- Geology comprises glacial Till deposits (Unproductive strata) over The Sherwood Sandstone Formation (Principal Aquifer).
- A conjectured fault, named as the West Manchester Fault, is indicated to cross the south-west corner. The fault trends northwest -southwest with the downthrown side to the north-east.
- The site is within the Coal Mining Reporting Area.
- There are no records of shallow mines in and around the site.
- The nearest water feature is the Rochdale Canal circa 270m to the south-east of the site.
- The site is located in a Zone 1 floodplain.
- The risk to human health is considered to be low to moderate.
- The risk from ground gas is considered to be low and the site is not located in an area requiring radon protection measures.
- The risk to controlled waters is low.
- The site is located in the UXO moderate risk zone.
- Recommendations were for an appropriate Phase II ground investigation to be carried out to confirm the identified risks and obtain information for preliminary design.

3.2 WSP Preliminary Geotechnical & Environmental Assessment (2016)

A summary of the relevant points from the Preliminary Geotechnical & Environmental Assessment completed by WSP (reference 70010925/002/10482) is presented below:

- The investigation undertaken from 2nd to 7th November 2015 comprised of 1 rotary borehole and 3 window sample boreholes with dynamic probe follow on within WS01. All boreholes were installed for groundwater and ground gas monitoring.
- Ground conditions comprised of made ground to 4.00m bgl overlying glacial Till to 2.00m bgl over the Sherwood Sandstone Formation proven to 15.00m bgl.
- Ground water was encountered only within RT01, during the site investigation groundwater was encountered at 13.50m bgl. During the monitoring visits groundwater was encountered between 12.01m and 25.49m bgl.
- Six ground gas monitoring visits were undertaken, the ground gas regime was classified as Characteristic Situation 1 (CS1-very low risk)
- The majority of the soil results did not exceed the adopted screening criteria for a commercial end use. However, arsenic, lead and PAH exceedances were encountered within the made ground. The PAH species exceeding the adopted screening criteria were benzo(a)pyrene and benzo(a)Anthracene.
- The risk to human health considered to be low due to the presence of hardstanding across the proposed commercial development.
- The risk to controlled waters is considered to be low.

3.3 WSP Ground Investigation Report (2016/2017)

A summary of the relevant points from the Ground Investigation Report completed by WSP (reference 700028727/20160109) is presented below:

- The investigation undertaken from 28 November to 12 December 2016 comprised of 6 window sample boreholes, 3 dynamic sampling with rotary follow on, 6 foundation inspection pits and 14 wall cores. Six boreholes were installed for groundwater and ground gas.
- Ground conditions comprised of made ground to 3.00m bgl overlying glacial Till or Glaciofluvial Sheet Deposits to 4.6m bgl, and Sherwood Sandstone bedrock proven to 35.35m bgl.
- During the monitoring visits groundwater was encountered within 4 boreholes (D1-D3 and RT01) from 10.85m and 25.60m bgl.
- The majority of the soil results did not exceed the adopted screening criteria for a commercial end use. However, exceedances for lead were encountered within the made ground.
- Asbestos was not identified in the eighteen samples of made ground that were screened during the two phases of investigation, however the presence of asbestos cement fragments (Chrysotile) was identified within the hand pit for borehole D2.
- The risk to human health was considered to be low due to the presence of hardstanding across the proposed commercial development.
- The risk to controlled waters was considered to be low.

3.4 Ramboll Ground Contamination Assessment (2021)

A summary of the relevant points from the Ground Contamination Assessment completed by Ramboll is presented below:

- Ramboll utilised Structural Soils Ltd to carry out intrusive investigations on a factual basis.
- The soil analytical results obtained during the Structural Soils Ltd 2017 investigation were screened against the Ramboll GACs for a commercial / industrial end use. No contaminants were identified at concentrations above the GAC for a commercial / industrial end use.
- The made ground samples analysed where ash or clinker were noted in the borehole logs contained slightly higher concentrations of PAHs and metals than the remaining samples, but still at relatively low concentrations.
- The TPH results indicated that all TPH carbon fractions were below the laboratory detection limit of 10mg/kg.
- No evidence of any volatile compounds was identified, therefore there is likely to be a low risk to sensitive off-site receptors in this regard.
- Asbestos was not identified in any of the 14 samples analysed.
- The site is underlain by sandstone with groundwater recorded at approximately 10 - 12m bgl. It is therefore considered unlikely that any impact to groundwater beneath the site will be in continuity with local water courses.
- The identified impacts above the drinking water GACs are all minor and inconsistent across the site. These are not considered to pose a significant risk to water receptors.
- The impacts above the surface water environment GAC for chromium are consistent across the site at minor concentrations. It is considered likely this may be a background concentration in the aquifer in this area. There is no evidence to suggest it may be derived from this site. Minor impacts of zinc were noted, however this is a worst case screen assuming all zinc is bioavailable. It is unlikely that the actual bioavailable content is above the GAC. In addition, the distance to the nearest surface water receptors would indicate that this is unlikely to be a significant risk.

4.0 METHOD OF INVESTIGATION

4.1 Objectives

To confirm the risks to the identified receptors and confirm the ground conditions in respect to the identified geotechnical and geo-environmental risks, an appropriate intrusive investigation was undertaken as per the recommendations of the Phase I Desk Study Assessment.

The aim of the fieldwork was to:

- Further investigate the ground conditions on site.
- Install standpipes to allow future monitoring.
- Assess the potential contamination on the site and obtain samples for contamination screening.
- Assess the potential impact of any contamination on controlled waters.
- Obtain geotechnical information on the ground conditions at the site for preliminary foundation design and preliminary pavement design purposes.
- Give an assessment of the geo-environmental risks associated with redevelopment of the site.

4.2 Site Works

The following site works have been undertaken as part of the intrusive investigation between the dates of 14th November and 21st December 2022.

Method	No.	Range Depths (m bgl)	Purpose
Window sample boreholes – Tracked WS rig	3	4.15-4.25	Establish general ground conditions on site. Allow Standard Penetration Tests (SPTs) to be carried out and obtain samples for contamination and geotechnical testing. Installation of ground gas and water monitoring wells.
Rotary cored boreholes – Tracked Multipurpose Rotary Rig	5	19.00-45.00	Obtain information on the deeper strata and obtain rock core for geotechnical testing and parameters for foundation design. Installation of ground gas and water monitoring wells.

The locations of all exploratory holes were provided to BSL by Renaissance Associates Ltd. This particular BSL site investigation was undertaken pre-demolition of the onsite former Synagogue building, and as such only consists of BH01-05 and WS01-03.

During the drilling of BH02 and BH03, the drilling rods and core barrel became stuck in the borehole at depths of 19.00m and 24.50m respectively. Many attempts were made to free the drilling equipment, however, the boreholes were terminated.

BSL returned to site to undertake additional sampling for waste classification purposes between the dates of 23rd and 24th August 2023. The following works were undertaken:

Method	No.	Range Depths (m bgl)	Purpose
Machine excavated trial pits – JCB 3CX	10	1.95 – 3.00	TP03 to TP11, to confirm the depth of made ground and to assist in delineating the areas of hazardous waste in the west of the site. TP12 to add additional information for spread of data.
	5	1.80 – 2.00	Excavated to the base of made ground to inspect and sample strata for the presence of asbestos.

The following site works have been undertaken as part of the post-demolition intrusive investigation between the dates of 30th October and 2nd November 2023.

Method	No.	Range Depths (m bgl)	Purpose
Window sample boreholes – Tracked WS rig	4	2.50-3.70	Establish general ground conditions on site. Allow Standard Penetration Tests (SPTs) to be carried out and obtain samples for contamination testing.
Rotary cored boreholes – Tracked Multipurpose Rotary Rig	2	30.00-31.50	Advanced to bedrock with a window sample rig with rotary core follow on. Obtain information on the deeper strata and obtain rock core for geotechnical testing and parameters for foundation design.

The surveyed locations of the exploratory holes are indicated on the Exploratory Hole Location Plan, Drawing No C5128/04. The exploratory hole logs are presented in Appendix B.

The exploratory holes were logged by an experienced geo-environmental engineer in general accordance with the following guidance:

- BS 5930:2015+A1:2020 Code of Practice for Site Investigations.
- BS EN 14688-1:2018 Geotechnical Investigation and Testing – Identification and classification of soil.
- BS EN ISO 14689:2018 Geotechnical investigation and testing – Identification and classification of rock.

The site is located within an area at medium risk of UXO and in order to minimise the risk to operatives during the ground investigation works, all exploratory locations were scanned with a hand-held magnetometer as boreholes were advanced and works were supervised by a specialist UXO surveyor. No magnetic anomalies were noted during the investigation.

4.3 Sampling Strategy

Representative samples were taken from exploratory holes at regular intervals to assist in the identification of the soils and to allow subsequent laboratory testing. They were stored and transported in general accordance with BS 10175:2011+A2:2017.

The type of sample was dependent upon the stratum and the purpose of analysis in accordance with current environmental and geotechnical guidance. The distribution of samples taken across the site is recorded on the exploratory logs.

4.4 Laboratory Testing

As part of the further assessment for potential contamination of the site, selected samples were taken for the purpose of chemical contamination testing.

In the absence of particularly contaminative processes on site and the lack of visual evidence of potential hydrocarbon impaction representative soil samples from the pre and post-demolition site investigation were screened for the following general suite of determinands at a UKAS approved laboratory:

Determinand	No of Samples
BSL Default Soil Suite: Arsenic, Cadmium, Chromium (III), Chromium (VI), Copper, Nickel, Mercury, Lead, Zinc, Selenium, speciated polycyclic hydrocarbons (PAH 16), water soluble sulphate (2:1 Extract), soil organic matter (SOM) and pH.	12
Soil Suite A: Arsenic, cadmium, chromium (total and hexavalent), copper, lead, mercury, nickel, selenium, zinc and pH.	4
Asbestos Screen & ID	12
Speciated Total Petroleum Hydrocarbons (TPH CWG) inc BTEX and MTBE	4
Waste Acceptance Criteria (WAC).	5

Samples obtained as part of the confirmatory asbestos sampling and waste delineation exercise were scheduled for the following testing:

Determinand	No of Samples
Copper, Lead & Zinc	10
Asbestos Screen & ID	6
Asbestos Quantification	2

The Chemical Laboratory Testing Results are presented in Appendix C.

Representative disturbed samples were obtained for all soil types encountered. Selected samples were scheduled for testing at an approved laboratory in accordance with BS 1377 'Method of Test for Soils for Civil Engineering Purposes' and BS EN ISO 17892- Parts 1-12:2018 'Geotechnical investigation and testing. Laboratory testing of soil'.

The following tests were scheduled for geotechnical purposes:

Description	No of Samples
pH Value.	18
Water Soluble Sulphate Contents.	18
SD1 BRE Full Suite.	5
Point Load Testing.	73
Unconfined Compressive Strength (UCS).	38

The Geotechnical Laboratory Testing Results are presented in Appendix D.

4.5 Monitoring

Ground gas and ground water monitoring standpipes were installed in three boreholes and subsequently six monitoring visits have been undertaken out of six proposed as part of the current scope, in line with the recommendations of CIRIA C665. All gas monitoring was undertaken using either a GA5000 or GFM436 infrared gas meter with integral electronic flow analyser.

Flow measurements on each standpipe (l/hr) were taken. Measurements of the percentage volume in air (%v/v) of oxygen (O₂), carbon dioxide (CO₂) and methane (CH₄) were recorded in addition to the percentage Lower Explosive Limit (%LEL) of methane (Note: 100% LEL equates to 5% by volume), the atmospheric pressure (mb) and average temperature during the visit (°C).

Standpipes were constructed in general accordance with the relevant guidance. A summary of the installation construction is presented in the table below:

Location	Internal Diameter Pipe	Response Zone (m bgl)	Targeted Strata	Purpose
BH01	50mm HDPE	5.00 – 15.00	Bedrock	Ground Gas & Groundwater
BH04	50mm HDPE	5.00 – 15.00	Bedrock	Ground Gas & Groundwater
BH05	50mm HDPE	5.00 – 15.00	Bedrock	Ground Gas & Groundwater
BH07	50mm HDPE	8.00 – 20.00	Bedrock	Ground Gas & Groundwater

Under current proposals, the made ground will be removed from site and therefore is not considered to be a significant potential source of ground gas.

The gas monitoring visits recorded peak and steady state conditions. Peak results are those that occur on opening the valve on the borehole tap. Steady state conditions are those that occur a period of time afterwards when the initial (accumulated) gases have been purged from the borehole.

Final ground gas monitoring results are presented in Appendix E of this report.

5.0 GROUND CONDITIONS

5.1 Summary

A brief summary of the ground conditions encountered is presented in the table below:

Stratum	Range Depths - Top (m bgl)	Range Depths - Base (m bgl)	Range Thickness' (m)	Brief Description
Made Ground	GL	0.06-0.10	0.06-0.10	Reinforced Concrete/ asphalt.
	0.06-0.10	0.25-0.30	0.15-0.24	Sub-base: fine to coarse gravel.
	0.25-0.30	1.20-2.85	0.95-2.60	Sandy gravel.
	0.30	0.95	0.65	Gravelly fine to coarse sand.
	0.95	1.35	0.40	Gravelly clay.
Natural Superficial Strata	1.20-2.85	3.40-4.70	1.25-3.50	Gravelly fine to coarse sand.
Solid Geology	3.40-4.70	3.50-5.00	0.10-0.30	Deconstructed sandstone recovered as gravelly fine to coarse sand.
	3.40-5.00	19.00-45.00	26.60-40.00	Fine to coarse sandstone.

Details are provided in the logs in Appendix B and the individual strata are described in the sections below.

5.2 Made Ground

Made Ground – General

Made ground was encountered within all the exploratory holes across the site and was observed from ground level to depths between 1.35m and 2.85m bgl.

Hardstanding surfacing of tarmacadam, concrete, or building footprint was present across the entirety of the site, recorded as being 0.10m thick.

The composition of the made ground beneath the hardstanding was fairly consistent across the site and represented demolition material comprising sandy gravel and gravelly sand. Cobbles of brick ranged from medium to high content.

No made ground was encountered below the former basement level of the Synagogue. However, to support the development of the site and additional rotary boreholes within the former building footprint the basement had been temporarily infilled with 6F2 type material up to a maximum depth of 3.10m bgl.

5.3 Natural Superficial Strata

The natural strata underlying the site was generally a gravelly fine to coarse sand with varying amounts of silt as a minor constituent. This interpreted to represent glacial Till. The gravel was generally subangular to subrounded fine to coarse of sandstone, mudstone and quartz.

The superficial strata were encountered to depths of between 3.40m and 4.70m bgl.

5.4 Solid Geology

Weak becoming moderately strong sandstone bedrock was encountered from depths of between 3.40m and 5.00m bgl, which was proven to a maximum depth of 45.00m bgl across the site and is interpreted to represent the Chester Formation.

The discontinuities described generally ranged from being closely to moderately spaced, planar, being horizontal to slightly sub-horizontal in orientation, although zones of sub vertical discontinuities were also recorded.

The overall percentage of Total Core Recovery (TCR) in sandstone over each core run within an individual borehole varied from 0% to 100%, although averaged at 94%. Similarly, Solid Core Recovery (SCR) ranged between 0% to 100% and averaged 89%.

Rock Quality Designation (RQD) percentages ranged between 0% up to 94%, averaged at 52%, with most values ranging between 30% and 80%. Overall, there was little consistent pattern to recorded RQD values with depth.

The West Manchester Fault is conjectured to cross the south-west corner of the site, but uncertainty remains over the exact location. The fault trends northwest -southwest with the downthrown side to the north-east. It is possible that the rock mass in the immediate vicinity of the fault may have an increased weathering profile or have a weakened state compared to the typical wider rock mass. Such zones may be very localised and difficult to locate through investigation, particularly as the position of the fault is conjectured. Within the boreholes drilled by BSL, there is no definitive evidence of a fault, such as brecciated areas, although there are a number of zones with more vertical discontinuities. During the drilling of BH02 and BH03, the drilling rods and core barrel became stuck in the borehole at depths of 19.00m and 24.50m respectively, but it is uncertain whether this is due to potential fault materials or due to mechanical issues with the drilling equipment.

5.5 Groundwater

Groundwater was not encountered during the drilling works; due to the water flush method of rock coring, it is likely that the exact location of the water strike was unable to be observed. Groundwater was observed within installed standpipes during the post site works monitoring period as summarised below:

Location	Depth During Monitoring Period (range) (m)	
	Min	Max
Overall min/max	10.75	11.60
BH01	10.75	11.07
BH04	11.30	11.60
BH05	NA*	NA*
BH07	17.52	17.55

*Position obstructed during visits.

5.6 Observations

Contamination

During the works undertaken by BSL, observations for both visual and olfactory evidence of contamination were undertaken. No visual or olfactory evidence of contamination was observed at the site.

Stability of Excavations/Boreholes

The borehole sidewalls were generally stable and window sampling progressed with casing to seal the made ground. Casing was used to seal off the superficial deposits within the rotary boreholes and to prevent collapse within the made ground.

As stated in Section 4.2, during the drilling of BH02 and BH03, the drilling rods and core barrel became stuck in the borehole at depths of 19.00m and 24.50m respectively. Many attempts were made to free the drilling equipment, however, the boreholes were terminated.

UXO

No magnetic anomalies were encountered during the works.

6.0 TEST RESULTS

6.1 Geotechnical Laboratory Testing

Unconfined Compressive Strength (UCS) and Point Load Index

A summary of the information pertaining to the Unconfined Compressive Strength (UCS) of the intact rock material (not rock mass) related to sandstone bedrock at the site is shown in the table below. The point load index results have been used to derive the UCS using the relationship of $UCS=24 \cdot IS50$ for sandstone (ISRM).

Point Load Index (MPa) (range)		UCS Range (MPa)	Method	No. of results
Is	IS50			
0.05 – 2.00	0.07 – 2.63	-	Point load (Axial, Diametral and Irregular)	73
-	-	8.0 – 25.2	UCS test	38

6.2 Aggressive Ground Conditions – Geotechnical Chemical Testing

The test results for the assessment of aggressive ground conditions are presented in Appendix D. The results are summarised and assessed within Section 8.0 of this report.

6.3 In Situ Geotechnical Testing

In Situ Standard Penetration Tests

Standard Penetration Tests (SPTs) were carried out within the window sample boreholes at regular 1.0m intervals. The results of the individual blows and the N-values are recorded on the Exploratory Hole Logs in Appendix B.

All SPT N values are uncorrected. Density and strength descriptors are reported in accordance with the guidelines stated in BS 5930:2015+A1:2020, incorporating requirements of BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004 and BS EN ISO 14689-1:2003.

6.4 Geo-Environmental Testing

Chemical Laboratory Testing

The chemical test results for soils are presented in Appendix C. The results are summarised and assessed within Section 8.0 of this report.

Ground Gas Monitoring

Ground gas monitoring installations have been monitored on six occasions out of six visits scheduled. The final results are presented in Appendix E and are summarised and assessed within Section 8.0 of this report.

7.0 GEOTECHNICAL ASSESSMENT

7.1 Ground Model Summary

The site was formerly occupied by a former Synagogue building of brick construction with associated hard standing car parking. There were known basements associated with the Synagogue building at the site.

The ground conditions can be summarised as below (top down):

- Made ground generally comprising sandy gravel with cobbles from ground level to between 1.20m and 2.85m bgl.
- Natural superficial deposits comprising gravelly sand proven to depths between 3.40m and 4.70m bgl.
- Solid geology comprising sandstone proven to depths ranging between 19.00m and 45.00m bgl.
- Post site works monitoring levels ranging between 10.75m and 11.60m bgl, and 17.52m bgl in BH107.

The West Manchester Fault is conjectured to be present near the southwest corner of the site. It is unlikely that any significant movements are ongoing with the fault, but differences in rock strengths over a potential fault zone will require consideration during detailed design.

Numerous underground drainage/sewers run beneath the eastern section of the site and will need to be taken into consideration for foundation design.

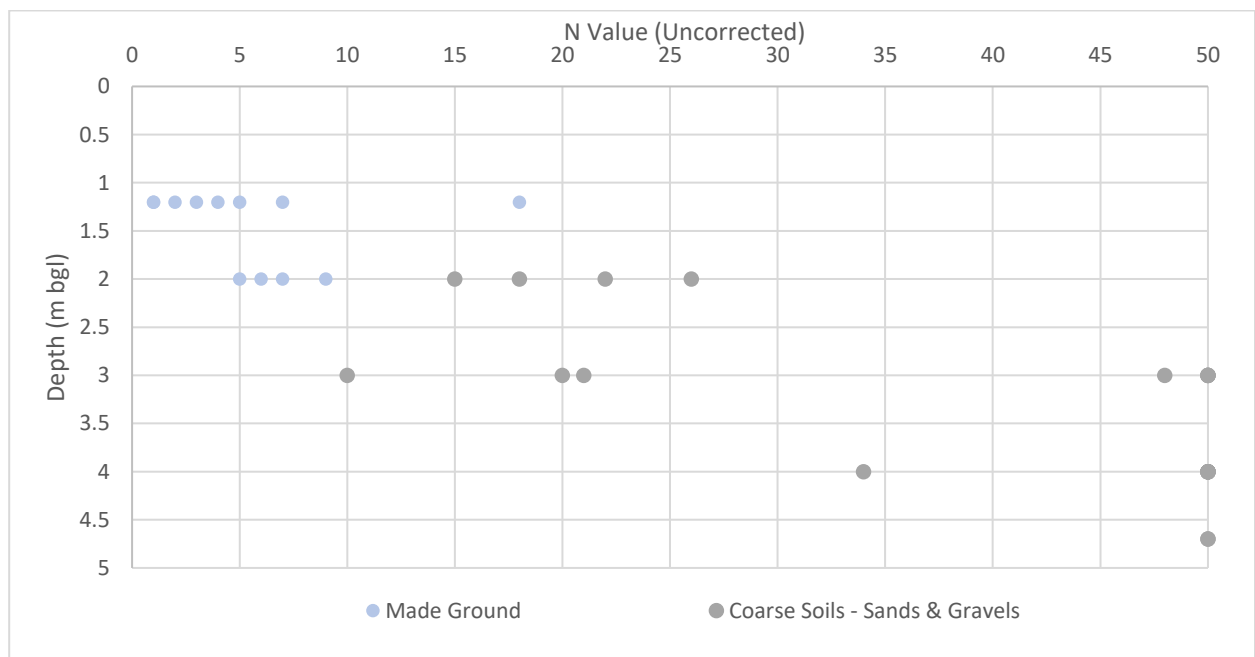
A moderate UXO risk zone spans across the entirety of the site.

7.2 Design Soil Parameters

The relevant test results from the prior section have been evaluated to derive geotechnical soil parameters for the site in the following section.

Characteristic Values – Made Ground and Shallow Superficial Deposits

A depth (m bgl) vs SPT N value graph is provided below to provide a profile of the soils underlying the site.



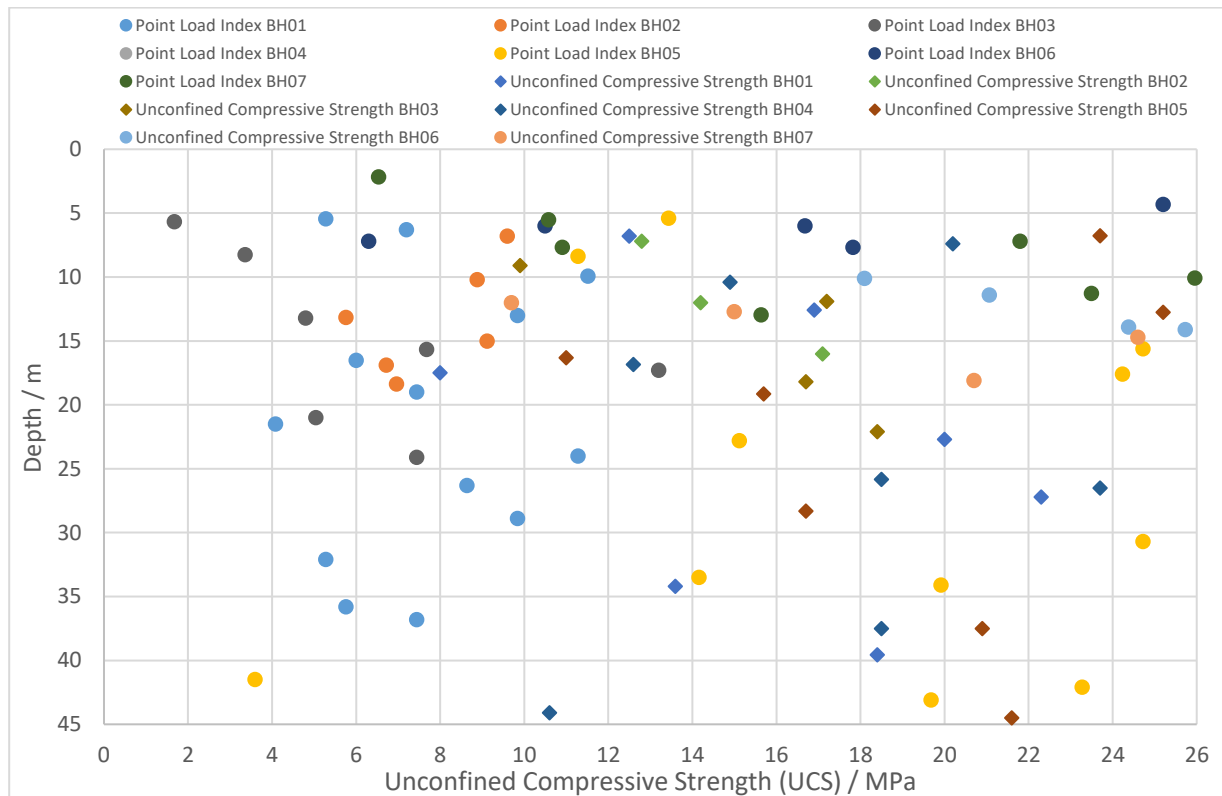
The above graph shows a general increase in soils density as depth increases within the superficial granular strata, with some slight variability between borehole locations. The majority of N values recorded in made ground were less than 10.

Given the inherent variability of the made ground, characteristic values have not been derived for this stratum. In addition, the majority of the superficial deposits will be removed from site during the construction of a basement, therefore values have not been derived for this stratum also in respect to foundation design.

Characteristic Values – Solid Geology

All SPTs undertaken in bedrock refused with an N value of 50.

The Unconfined Compressive Strength (UCS) was determined by laboratory testing and was also derived from laboratory point load testing using the relationship of $UCS = 24 \cdot IS_{50}$ for sandstone (ISRM). A graph showing the variation in UCS and derived UCS vs depth is presented below to provide a profile of the variation rock strengths with depth.

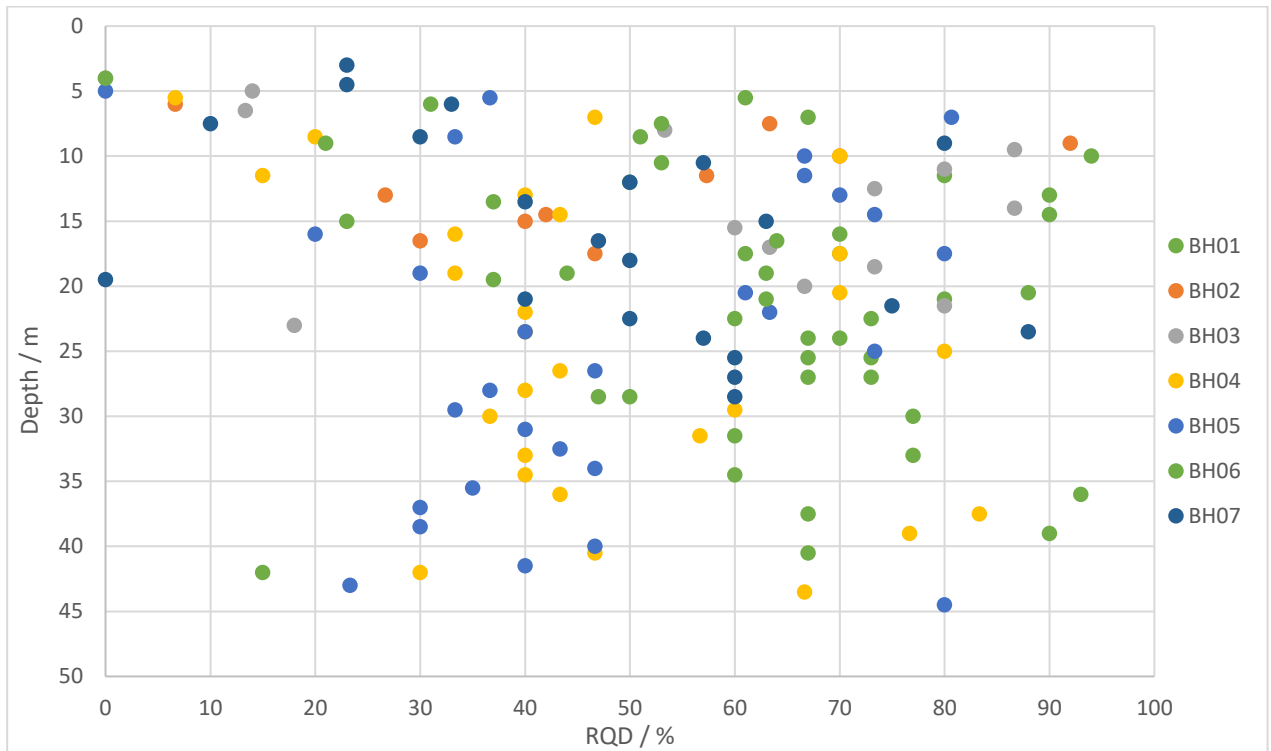


The above graph shows a weak positive correlation between an increase in rock strength with depth. This trend is strengthened with the removal of the correlated Point Load Index results from BH01. There do not appear to be any significant or definitive lower strength zones, with the vast majority of results being above 5 MPa (weak rock) as can be expected of the Chester Formation. Note there is a tendency for bias within the UCS and point load data; UCS is typically undertaken on more intact samples, whereas lower strength area of rock tend to provide samples of rock unsuitable for UCS analysis, hence point load data is used as a proxy for UCS strengths. This should be considered during estimation of characteristic values.

Based on field strength descriptions and the laboratory testing, the characteristic UCS for the bedrock underlying the site has been derived and summarised in the table below.

Bedrock Strata	Depth (m)	Characteristic UCS (MPa)
Sandstone	10	4.5
	15	7.5
	20	11
	25	14
	30	16
	35	14
	40	19
	45	21

A graph showing the variations in RQD percentages with depth in each borehole is presented below, where RQD should be considered in respect to reduction factors for shaft resistance during detailed design (Rowe 2001).



The RQD of BH01, BH02, BH03, BH04, BH05, BH06 and BH07 averaged 70%, 47%, 59%, 47%, 47%, 48% and 47% respectively along the entire profile. Based on the above, the characteristic RQD values for the solid geology underlying the site at various depths have been derived, taking into consideration the averages above and are summarised in the table below, selected to the nearest 5% RQD:

Bedrock Strata	Depth (m)	Characteristic RQD (%)
Sandstone	10	45
	15	45
	20	50
	25	50
	30	50
	35	55
	40	65
	45	65

7.3 Foundations

The development will comprise the demolition of the former building and the construction of a part 41-storey, part 7-storey residential tower with ground floor commercial space in addition to a 3 level basement and is considered to be classed as Geotechnical Category 2 in accordance with Eurocode 7.

Preliminary design by calculation has been undertaken to determine the design resistance of the bearing strata in the following section. No proposed structural loads were available at the time of writing, therefore the following recommendations are provisional and should be reviewed at the detailed design stage by a suitably competent engineer.

Piles

Due to the magnitude of the column loads expected to be imposed by the proposed high rise multi-storey structure, the use of shallow foundations is not considered to be feasible. Therefore, the most suitable foundations are considered to be piles extending through the made ground and superficial deposits, socketed into the sandstone bedrock which was observed from depths between 4.00-4.70m bgl and proven to a maximum depth of 45.00m bgl.

The selection of pile type and detailed design of pile foundations is typically completed by specialist piling contractors; the following general information is provided for guidance only. Based on the information from the site investigation, a replacement type piled solution will be required, such as rotary bored piles.

To provide a guide on potential requirements, preliminary calculations were undertaken for a circular concrete pile, taking into account shaft resistance, end bearing resistance and potential effects of negative skin friction. For piles socketed into bedrock, the ultimate shaft resistance for the portion of the pile embedded in the bedrock may be determined through the following equation:

$$q_s = k_1 p_{ref} \left(\frac{q_u}{p_{ref}} \right)^{k_2}$$

In this equation, q_s is the ultimate shaft resistance in kN/m^2 , q_u is the UCS value of the bedrock, p_{ref} is a reference pressure of 100kPa and k_1 and k_2 are coefficients selected from the range presented in BS 8004 as 1.0 and 0.5 respectively.

The frictional contribution of the made ground and the superficial deposits has been omitted from these calculations as these material will largely be removed from the site during the creation of the basement.

The ultimate end bearing resistance of the competent bedrock has been determined using the following equation:

$$q_b = k_3 p_{ref} \left(\frac{q_u}{p_{ref}} \right)^{k_4}$$

In this equation, q_b is the ultimate base resistance in kN/m^2 , q_u is the UCS value of the bedrock, p_{ref} is a reference pressure of 100kPa and k_3 and k_4 are coefficients identified in BS 8004 as 15 and 0.5 respectively for cemented materials. The design base resistance may be limited by the compressive strength of the concrete used to construct the pile or the structural capacity of the pile itself.

Following guidance provided in Rowe (2001), the ultimate bedrock shaft resistances should be reduced by a suitable factor to account for discontinuities in the rock mass. Adopting a conservative characteristic RQD of between 45% and 65%, BSL has adopted a reduction factor of 0.6 for the ultimate shaft resistance in the preliminary calculations.

Based methodology outlined above, the preliminary estimated factored allowable loads for a single circular concrete pile, to be socketed into sandstone bedrock of variable lengths and a variety of diameters (based on standard rotary pile boring equipment) are presented in the table below. For the purposes of this assessment, pile lengths are taken from the existing surface level. A global factor of safety of 3 has been used in this assessment for conservatism. The preliminary allowable loads are shown in the table below. Note these recommendations are provisional and subject to review at the detailed design stage.

Pile Length (m)	Embedment into Rock (m)	Allowable Loads (MN) for Specified Pile Diameters	
		600mm	750mm
30	25	10.8	14.1
35	30	13.4	17.2
40	35	16.3	21.0

These calculations have been based on a single pile, it is likely that piles will be installed in groups and the group action of the piles should be considered.

Supplementary boreholes are also proposed and the recommendations within this report should be updated once information from those boreholes is available.

During the construction phase supervision should be on a continuous basis to check the design assumptions are correct and construction conforms to design. Supervision should include inspections, Control Ground Investigations and monitoring. If the ground conditions encountered during the construction phase differ significantly to the conditions encountered during construction, work should cease and BSL contacted for further advice.

Trial piles are recommended to verify design assumptions including confirmation that a reasonable socket length into bedrock can be achieved using the proposed rig. Load testing can also be completed on trial piles to confirm a final design, verify that the design resistance can be achieved and confirm settlements are within the required parameters.

A conjectured outcrop of the West Manchester Fault is indicated to cross the south-west corner. The fault trends northwest-southwest with the downthrown side to the north-east. The potential presence of this fault, and possible impacts on pile emplacement alongside differential settlements should be considered during the detailed design stage. BSL have contacted a number of piling contractors (Van Elle, Keller Group and Bachy Soletanche) for general advice on piling through a potential geological fault, where feedback suggested it would be important to ascertain if any significant reduction in rock strength in a shear zone area existed. Where hard rock is underlain by weaker fractured rock, this may impact the auger during drilling and require further casing. The angle of the fault may also impact drilling works. Furthermore, there would be the potential for differential settlements over this zone, where a sufficient factor of safety should be incorporated into the pile design, with differential settlements generally be limited to 1% of the total pile diameter (i.e. 6mm for a 600mm diameter pile), however this would need to be confirmed with the preferred piling contractor and designer.

Whilst detailed design is beyond the scope of this report, the following general advice should be taken into consideration during the detailed design stage by a suitably competent contractor/engineer:

- Piles should extend a minimum of five pile diameters into the bearing stratum to fully mobilise end-bearing resistance and shaft resistance.
- Higher allowable loads than those listed in the table above could be achieved by increasing the diameter of the piles or by using pile groups.
- Obstructions in the ground (e.g. relict foundations) could cause piles to stop shallower than their anticipated design depth, or deviate from the vertical, therefore reducing their capacity.

-
- Bored piles through coarse soils will likely result in loosening, with resultant reduced shaft friction.
 - The execution of bored cast-in-place piles should conform to BS EN 1536 and also any relevant standards associated with manufacturing the piles.
 - In accordance with Eurocode 7 it would be prudent to verify the compressive resistance of the strata and the pile design should be by static load testing on working piles 1.5 times the characteristic load on more than 1% of working piles. This will provide an accurate strength of the end bearing stratum.
-

Hybrid Piled Raft Solution

As a slight variance on a piled option, a raft assisted pile solution could also be adopted at the site. These solutions are typically used for large structures such as high-rise buildings.

Piled-raft behaviour is complex and basic empirically derived calculations are unlikely to provide the degree of precision required for settlement estimation. Therefore, if a piled raft solution is to be explored, BSL recommends that detailed analysis is carried out using finite element methods (e.g. modelling using PLAXIS). This should be undertaken by a suitably competent engineer. During the design process, the optimum number and position of piles, as well as their diameter, reinforcement and length, will need to be determined to ensure the stability of the structure, while providing an economical solution, with the raft and piles acting together to ensure the required settlements are not exceeded. It is envisaged the piles would provide most of the stiffness while the raft provides additional capacity at the ultimate loading end.

Other Considerations

Working Platform

Prior to the commencement of piling works, a working platform will be required for tracked plant. This should be designed and installed in accordance with BR470 (BRE 2004) based on the plant requirements, data and rig loadings.

UXO

Based on the available information to date, specialist UXO advice and/or supervision will be required for all groundworks, including piling.

Piling Risk Assessment

A risk assessment is likely to be necessary for piling, as there is a possibility that this could lead to creation of new pathways for migration of contamination.

7.4 Building Near Trees

Due to the presence of non-shrinkable granular soils beneath the entire site, it is not considered that special precautions will be required in respect to trees. Should any clay soils be identified on site during construction, then this should be reported to the Geotechnical Engineer immediately and remedial actions agreed.

7.5 Floor Slabs

A basement is due to be incorporated into the structure, whereby the basement floor slab should effectively be supported by and suitably tied into piles. The following general criteria should be considered during design:

-
- Any fill beneath the slab is suitable, well-compacted granular material placed in an appropriate thickness in accordance with a suitable specification with the end performance validated.
 - Any compressible or unsuitable materials are excavated and either improved or removed and replaced with suitable materials.
-

- The final floor slab design should be of sufficient thickness and sufficiently reinforced to accept the envisaged applied loads, without unacceptable total or differential movement.
- As the slab will be below ground level, waterproofing requirements will require consideration; the effects of hydrostatic uplift on the slab may also require consideration, with recorded post site works groundwater levels ranging between 10.75m and 11.60m bgl (24.58m and 25.57m AOD). A deeper strike was recorded in BH07 at 17.52m bgl.

7.6 General Site Preparation and Construction

The existing structures will need to be demolished and relict foundations/infrastructure grubbed out. Under existing proposals, all made ground and superficial deposits will be removed from site to facilitate the construction of a three-storey basement.

There are a number of services crossing the site. To allow construction, all services will need to be disconnected and any suspected dead services are confirmed as dead by testing.

Instability of the made ground and natural granular soils should be allowed for. All excavations should be carried out in accordance with CIRIA Report 97 'Trenching Practice'. Temporary support should be designed in accordance with BS 5975 "Code of practice for temporary works procedures and the permissible stress design of falsework".

Excavation depths should generally be readily achieved using conventional plant (JCB or similar) although high specification plant (tracked 360° or similar) is recommended to maintain the build programme. Breaking equipment may also be required locally to penetrate old foundations associated with former construction.

Groundwater and Construction

Recorded post site works groundwater levels ranged between 10.98m and 11.60m bgl (24.58m and 25.57m AOD). A deeper strike was recorded in BH07 at 17.52m bgl and there is the potential to encounter the groundwater table during basement excavations.

During 2017, BSL note that two packer tests were undertaken by WSP within borehole D2 (situated on the car park next to the Synagogue) at 7m and 12m bgl. The mean hydraulic conductivities derived from the tests were $1.7 \times 10^{-9} \text{ ms}^{-1}$ and $2.1 \times 10^{-6} \text{ ms}^{-1}$, respectively. It was stated that the dominant control on the hydraulic conductivity of a rock mass is the frequency and condition of discontinuities; therefore the test results may indicate an increase in the frequency of discontinuities with depth or a change in the degree of weathering / condition of discontinuities i.e. more open joints or less infilling or mineral coating.

Taking the above into consideration, a specialist dewatering contractor should be consulted for advice in this instance. Further guidance is provided in CIRIA C750 "Groundwater Control: Design and Practice". It should be noted that groundwater levels will vary seasonally and the timing of construction may influence requirements.

7.7 Basement Construction

A basement structure is proposed beneath the majority of the proposed building. Depths to the base of the existing structure are approximately 2.50m bgl.

Based on the proposed development layout, the excavations for the basement will likely encounter made ground down to approximately 2.85m bgl, overlying natural sands to a maximum depth of between 4.00m and 4.70m, in turn overlying sandstone bedrock. As stated above in Section 7.6, there is the potential to come into contact with groundwater during excavations and a specialist dewatering contractor should be consulted for advice.

The following points need to be considered in the design and construction of the basement:

- The method of excavation of materials within the basement.
- Temporary and permanent support of the excavation.
- Groundwater levels, control and water proofing of basement sidewalls/base.
- Active pressures from groundwater and the surrounding earth acting on the sidewalls/base.
- Potential settlement of adjacent structures or infrastructure due to ground deformation or dewatering.
- Differential settlement between the basement structure and other foundations or floor slab elements.
- Cut and fill requirements across the wider site.
- Floor heave/settlement.

It is likely that embedded retaining walls would be the most suitable option for constructing the basement using temporary support, where one advantage is that they could be incorporated into the foundation design for the proposed structure. This could include either a contiguous or secant piled wall or a diaphragm wall.

The selection of the type of embedded retaining wall, will depend on a range of factors such as environmental constraints, including noise and vibration, as well as cost.

The retaining basement walls which are incorporated into the structure will need to be designed by an engineer, taking into account the ground conditions and the serviceability requirements of the scheme. Specialist advice should be sought on all aspects of the construction.

Methods of water proofing basements and below ground structures are detailed in BS 8102 (2022), "Code of practice for protection of below ground structures against water from the ground".

Any water from excavations should be treated either prior to construction or during the operation of the site in accordance with the relevant permits and licences.

Temporary support should be designed in accordance with BS 5975 "Code of practice for temporary works procedures and the permissible stress design of falsework".

The design of the basement should also take into account ground gas protection measures, although at present none are required. A full assessment will be made upon completion of the ground gas monitoring programme.

7.8 Concrete Classification

The soluble sulphate and pH test results have been assessed in accordance with BRE Special Digest 1 "Concrete in aggressive ground" 2005. The Design Sulphate (DS) classification and the Aggressive Chemical Environment for Concrete (ACEC) classification are presented in the table below.

For the purposes of this assessment, the made ground and natural strata is considered to be relatively permeable, therefore the groundwater has been classed as mobile.

Stratum	No. Samples	Characteristic SO ₄ (g/l)	Characteristic pH	DS Class	ACEC Class
Made Ground	10	2.23	7.70	DS3	AC-3
Natural Superficial Strata	10	0.08	7.50	DS1	AC-1
Sandstone Bedrock	6	0.07	7.55	DS1	AC-1

Previous investigations onsite also determined the sandstone bedrock to be classified as DS1.

Based on the above, the results of laboratory pH and sulphate content, alongside the BRE full suite tests, indicate that sulphate class DS-3 and ACEC Class AC-3 conditions prevail for the made ground soils, sulphate class DS-1 and ACEC class AC-1 for natural soils and sulphate class DS-1 and ACEC class AC-1 for bedrock, in accordance with BRE Special Digest 1 "Concrete in aggressive ground" 2005.

The specific concrete mixes (the Design Concrete Class) to be used on site will be determined by the site-specific concrete requirements in terms of the durability and structural performance. These are assessed in terms of the Structural Performance Level (SPL) and any need for Additional Protective Measures (APM) detailed in Part D of BRE Special Digest 1 with further guidance in Pt E and F.

7.9 Highways/Pavement Design

No dedicated highways will be included on this scheme which will be wholly covered in the proposed structure.

Where required for temporary structure placement of construction access roads, equilibrium CBR values in the existing made ground may be assumed as 2%, subject to confirmation via in situ testing. For the construction of the basement, all made ground and superficial deposits will be removed from the site therefore no CBR values have been provided for these materials. Where fill materials are imported to form a base for structural slabs and highways, they should be placed to an appropriate engineering specification to achieve the desired design CBR value.

7.10 Site Drainage

Much of the site will be covered by structures/hardstanding, which precludes the use of a large underground soakaway drainage. It is anticipated that surface water would need to be positively drained into the off site existing sewer network, subject to agreement with the local utility provider.

8.0 GEO-ENVIRONMENTAL RISK ASSESSMENT

8.1 Introduction

The samples were tested for an assessment of the chemical contamination that may pose a risk to human health. The results were examined with reference to a selection of guidance documents as detailed in Appendix A. In this case the LQM/CIEH S4ULs and DEFRA C4SLs for a commercial end use have been adopted as Tier 1 generic screening values, due to the currently proposed commercial space occupying the ground floor of the structure. No viable pathways from soils are considered to exist to the hotel residents in the floors above.

The apparent exceedance of the relevant screening value is taken as indicating further detailed assessment or remedial action is required.

A summary assessment sheet is presented in Appendix C alongside the chemical test results. Results are discussed in detail in the sections below.

8.2 Soils Test Results and Risk Assessment – Human Health

The following elevated metals were detected during this investigation:

Exploratory Hole	Depth (m)	Stratum	Metal	Concentration (mg/kg)	Adopted Screening Value (mg/kg)
WS01	0.50-0.70	Made Ground	Lead	5200	2300
BH01	0.30-0.50	Made Ground		19000	2300
	2.00-2.20	Made Ground		8300	2300

Previous investigations have also noted elevated concentrations of arsenic and lead within the made ground soils.

Asbestos

No asbestos fibres have been detected in any of the twelve samples screened by BSL as part of the pre and post-demolition site investigation.

It is noted that during a previous investigation asbestos cement sheeting was identified at location D2 beneath the central eastern part of the car park by WSP, although no confirmatory testing was carried out. No other asbestos was identified in soils during previous investigations. Further testing done by BSL in this area identified asbestos (chrysotile loose fibres) within ASB05 (0.00-1.40m bgl). However, quantification confirmed this to be at trace level.

As part of the further investigation for waste delineation in the west of the site, TP04 identified a suspected ACM. This was the only occurrence identified during the extensive works undertaken by BSL. The associated soils were tested (0.20 – 1.95m bgl) and identified asbestos (chrysotile loose fibres). However, quantification also confirmed this to be at trace level.

Poly Aromatic Hydrocarbons (PAHs)

No PAHs have been detected above the adopted screening criteria during this investigation.

Total Petroleum Hydrocarbons (TPH CWG)

No petroleum hydrocarbons have been identified above the adopted screening criteria.

BTEX and MTBE

No BTEX or MTBE compounds have been identified above the adopted screening criteria.

Volatile Organic Compounds (VOCs)

No VOCs have been identified above the adopted screening criteria.

Semi - Volatile Organic Compounds (SVOCs)

No SVOCs have been identified above the adopted screening criteria.

8.3 Summary – Human Health Risk Assessment

Based on the testing and assessment undertaken it would appear that there is localised contamination within the made ground in the north-western section of the site in the form of elevated levels of lead. This is generally in line with the findings of previous ground investigation on site, whereby lead and arsenic have been identified.

Asbestos fragments were also noted at a single location (D2) within the made ground during a historical investigation beneath the central eastern section of the car park, to east of the synagogue.

The above potentially pose a risk to human health and will require further consideration.

8.4 Controlled Waters Risk Assessment

Groundwater/surface water testing has not been carried out based on the preliminary CSM risk assessment and the site is not considered to pose a significant risk to controlled water for the following reasons:

- No significant gross or mobile contamination has been identified on site in soils based on the results obtained as a potential indicator of groundwater contamination.
- There is no indication under present conditions of significant pollution of controlled waters and conditions following development of the site will not be any worse.
- The nearest watercourse is the River Irwell over 400m away, which provides considerable distance for attenuation and contaminant degradation.
- The site does not lie within 500m of an SPZ.
- There are no groundwater abstractions within 2000m.
- There are no potable (sensitive) water abstractions within 2000m.
- The previous reporting undertaken by Ramboll (2021) highlighted minor concentrations of chromium, however, this is considered to be derived from natural background concentrations in the aquifer and not derived from site, with a low risk assessed. Minor impacts of zinc were also noted, however, this was deemed to also be of low risk, with the actual bioavailable content being unlikely to be above the GAC.

Based on the above, no further action is required, although given a piled foundation solution is to be adopted, which may lead to the creation of new pathways, the Local Authority and EA may condition that a piling risk assessment is carried out to support the assessed low level of risk.

8.5 Permanent Ground Gas and Vapours Results

Six gas monitoring visits have been carried out between the dates of 22nd December 2022 and 8th March 2023. An additional confirmatory visit was undertaken in BH07, post-demolition, on 8th November 2023. Results are summarised in the table below:

	CH ₄ (%)		CO ₂ (%)		O ₂ (%)		CO (ppm)		H ₂ S (ppm)		TVOC (ppm)		Steady Flow (l/hr)	
	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max
Peak	0.0	0.1	0.0	1.9	16.4	20.9	0.0	0.0	0.0	0.0	0.1	0.4	0.1	0.1
Steady	0.1	0.1	0.1	0.6	19.4	21.2							0.1	0.1

Notes: CH₄ = Methane; CO₂ = Carbon dioxide; O₂ = Oxygen; CO = Carbon Monoxide; H₂S = Hydrogen Sulphide; TVOC (PID) = Total Volatile Organic Compounds (as measured with Photo Ionisation Detector); ppm = Parts Per Million.

The highest methane concentrations were recorded within in both BH01 and BH04 (0.1% v/v), whilst the highest carbon dioxide concentrations were recorded in BH04 (1.9% v/v). No flows have been detected and the limit of detection of the monitoring device was noted down (i. e. 0.1 l/hr).

The atmospheric pressure ranged between 980mb and 1020mb over the monitoring period, of which visits were conducted over falling pressure trends.

Groundwater levels were not recorded above the response zones.

8.6 Ground Gas Risk Assessment

Basis of Assessment

In order to assess the ground gas situation and the requirement for ground gas precautionary measures at the site, guidance was taken from CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings', BS8485:2015+A1:2019 'Code of Practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings' and CL:AIRE Technical Bulletin TB17 'Ground Gas Monitoring and 'Worst-Case' Conditions'.

Rationale and Suitability of Dataset

In accordance with CIRIA C665 and as set out in Appendix A of this report, the ground gas generation potential is considered to be **very low**. The sensitivity of the development is **low** on account of the proposed mixed end-use.

As part of this commission, 6 No. visits over 2 No. months has been carried out, which meets the minimum suggested monitoring within CIRIA C665. An additional confirmatory visit was undertaken in BH07, post-demolition.

As installations have been monitored under falling pressure on a number of occasions and what can be considered to be "worse case" conditions, the data set is considered to be suitable for assessment purposes and no further visits would be required – further visits would be unlikely to change the outcome of this assessment given the readings obtained under the conditions observed (as per CL:AIRE TB17 and BS8576).

Assessment of Data

As the proposed end-use is for a mixed end-use with a commercial basement and ground floor, guidance dictates that the gas monitoring results should be assessed in accordance with the Wilson and Card methodology.

The Wilson and Card methodology uses the concept of a Gas Screening Value (GSV) which is derived using the following equation: (max gas concentration / 100) x maximum steady flow.

A maximum steady flow of 0.1l/hr has been used to derive the GSVs. The GSV's for the site are presented below.

Ground Gas	Adopted Typical Flow Rate (l/hr)	Max Concentration (% v/v)	GSV (l/h)	Classification based on GSV	Typical Threshold Concentration Exceeded
Methane	0.1	0.1	<0.7	CS1	No
Carbon Dioxide	0.1	1.9	<0.7	CS1	No

The GSVs place the site the site into Characteristic Situation 1 (CS1).

Based on the data, the site should be classified as CS1, which is in line with the assessments of previous investigations.

8.7 Qualitative Risk Assessment

The CSM has been revised based on the findings of the site investigation and laboratory testing results and these are presented overleaf. Unless stated otherwise, in respect to off-site sources, only risks that are assessed as moderate and above within the preliminary CSM have been carried forward to this section, or where a previously unidentified potential source, pathway and / or receptor has been identified from the recent site works.

Human Health						
Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk	Justification
On site Made Ground Metals, PAH's, asbestos	Root uptake, ingestion, direct contact, inhalation of dusts	End-users	Unlikely	Medium	Low	Elevated levels of metals have been detected within an isolated area of made ground in the northwest section of the site. Asbestos loose fibres were recorded in two locations at trace levels, and one recorded ACM was noted. However, the proposed development plan demonstrates that the made ground will be removed during the construction of the basement. Furthermore, the presence of hardstanding across the entire development will break the pathway to final end users. The risk is considered to be low.
On site Made Ground Metals and organic contamination	Migration into/chemical attack of water supply pipelines	Water Pipelines / End users	Unlikely	Mild/Minor	Very low	It is unlikely any contaminants within the soil/groundwater could potentially attack the clean potable water supply pipe as the development of a basement will result in the removal of the made ground from site.
Made Ground Ground Gas (carbon dioxide and methane)	Migration into confined spaces, inhalation and asphyxiation/explosion	End-users / property / structures	Unlikely	Medium	Low	Based on the gas risk assessment, taking into account the results of the gas monitoring programme, the conditions on site and the proposed construction, the site has been classified as CS1. Therefore, the risk is considered to be low and no mitigation measures will be required.

Controlled Waters						
Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk	Justification
Made Ground PAH's, Metals	Overland flow, / migration through saturated zone	River Irwell 433m away (Surface waters)	Unlikely	Medium	Low	It is considered contaminants associated with the made ground and other past industrial uses are unlikely to impact the River. This is due to the distance between the site and the river, and the potential for contaminants to attenuate and degrade over this distance. Therefore a low risk is posed to the river from the made ground.
	Leaching through unsaturated zone / Migration through saturated zone	Secondary Undifferentiated Aquifer (Ground-water)	Unlikely	Medium	Low	Made ground onsite will be removed during the construction of proposed basement, removing the potential contaminants from site. Furthermore, the site is currently surfaced in hardstanding, and will remain as such, which will further reduce the risk to controlled waters. The risk is considered to be low at this stage.
	Migration through saturated zone	Principal Aquifer (Ground-water)	Unlikely	Medium	Low	There are no groundwater abstraction licences or Source Protection Zones near the site. As stated above, the site will be surfaced in hardstanding and made ground onsite will be removed during the construction of proposed basement, removing the potential contaminants from site which will reduce the risk to controlled waters.

8.8 Outline Remedial Measures

The made ground onsite will be removed during the construction of the basement, which will remove the source of the identified lead contamination, alongside the previous reported arsenic and asbestos. This will effectively remediate the site, therefore no specific remedial measures are required for soils in respect to human health for the proposed end use.

Based on the proposed development plans, no soft landscaping is proposed – however should this not be the case, where soft landscaping is present a cover of “clean” subsoil and topsoil should be provided to break the pathway to site end users. This should be 450mm in soft landscaping areas (Public Open Space – POS) in accordance with BRE 465. This will allow plants to be grown and prevent undesirable soils being brought to the surface. The inclusion of a geotextile marker layer at the base or a coarse granular, ‘hard dig’ layer is recommended.

Prior to import or re-use of clean cover soils, they should be tested to confirm chemical suitability. After installation of the clean cover, soil depths should be verified by a suitably qualified independent geo-environmental engineer, such as BSL.

Utilities

The level of protection for the clean potable water supply pipes should be determined using the local water company risk assessment criteria in accordance with UKWIR. As the majority of the made ground will be removed, PE would potentially be suitable, subject to a risk assessment. Service corridors should be placed by over-excavation and replacement of materials with “clean” validated backfill during the earthworks in accordance with the utility providers requirements. Photographic evidence of over excavation and installation of clean corridors should be provided for validation purposes.

Waste Arisings / Stockpile Management

It is understood that excavation of made ground and natural soils across the entire site is proposed in order to construct a new basement structure. Any arisings from the excavation works should be stockpiled prior to determining an appropriate disposal route.

Segregation of materials and stockpiles should be maintained, and accurate records kept to avoid the potential for cross-contamination. Good site practice for stockpile management includes, but is not limited to:

-
- Damping down of the site surface, excavations and stockpiles to prevent the generation of dust.
 - Stockpiles sizes should be kept to a minimum to reduce ‘wind whip’ causing potentially hazardous material to be blown from the pile.
 - Once at the intended size, stockpiles should be “sealed” to ensure no excess materials are placed and mixed into the stockpiled to prevent cross contamination.
 - Appropriate loading of plant to prevent spillages.
 - Appropriate signage should be displayed so that site workers/visitors are aware of the intended use and are alerted to the potential hazards associated with the material to be stored on site.
-

Site won material shall be tested to confirm its chemical suitability. Contaminated material for disposal should be tested to define the most economical disposal route. These may include, but are not limited to, Muckaway, grab-hire or the use of a six wheeled wagon. In addition, any material to be imported to the site shall be tested and its suitability demonstrated prior to it being brought to the site.

Ground Gas Protection Systems

Based on the ground gas risk assessment no mitigation measures are required and no radon protection is required for new buildings at this location.

General

It is recommended that the approval of the Regulators (Local Authority / NHBC / Environment Agency) is obtained in regard to the above prior to any irrevocable action is taken at the site.

Once the above bodies have approved the above outline remedial proposals, a Remedial Strategy will need to be produced to meet planning requirements and submitted to the regulatory authorities for approval. This will also give guidance to enable a suitably qualified contractor to carry out the works.

A watching brief is recommended during groundworks for any unidentified sources of contamination. If any gross contaminated material is encountered works should cease in that area and BSL consulted.

Once remediation is complete, verification reports will need to be produced by a suitably qualified independent geo-environmental engineer, such as BSL, in order to achieve regulatory sign off.

8.9 Health and Safety Issues

During the reclamation and construction phases of the site development it will be necessary to protect the health and safety of site personnel. The risk to construction and ground workers is assessed in the table below:

Potential Source	Potential Pathway	Potential Receptor	Likelihood	Severity	Level of Risk
Made Ground (heavy metals, PAHs, petroleum hydrocarbons)	Ingestion, direct contact, inhalation of dusts.	Construction Workers	Likely	Medium	Moderate
Asbestos	Ingestion, direct contact, inhalation of dusts.	Construction Workers	Likely	Medium	Moderate
Ground gas	Inhalation in confined spaces/trenches	Construction Workers	Unlikely	Medium	Low

Potential asbestos fragments were identified at the location of D2 during previous ground investigations. The risk from asbestos in the area of D2 should be highlighted in the method statements and site induction. If further evidence of asbestos is encountered in the soils, work should cease until asbestos control measures have been agreed and put in place. Asbestos is further discussed in Section 8.10 below.

The risk from the general made ground will be mitigated by standard PPE including gloves. Welfare facilities should be made available to wash before hand to mouth activities.

General guidance on these matters is given in the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Redevelopment of Contaminated Land". In summary, the following measures are suggested to provide a minimum level of protection:

- All ground workers should be issued with the relevant protective clothing, footwear and gloves. These protective items should not be removed from the site and personnel should be instructed as to why and how they are to be used.
- Hand-washing and boot-washing facilities should be provided.
- Care should be taken to minimise the potential for off-site migration of contamination by the provision of dust suppression control and wheel cleaning equipment during the construction works.
- Good practices relating to personal hygiene should be adopted on the site.
- The contractor shall satisfy the Health and Safety Executive with regard to any other matters concerning the health, safety and welfare of persons on the site.

8.10 Asbestos

The investigation of asbestos issues within structures was beyond the scope of this report. However, guidance from UK Government indicates that asbestos should be assumed to be present in buildings unless proven otherwise.

Any asbestos within structures will require removal prior to re-development. This will need to be done by a suitably qualified experienced and licensed contractor, who ensures that adequate PPE is provided to operatives, and that all the relevant legislation is adhered to.

In addition, the presence of asbestos within the ground will require a safe system of work to be set up on site, largely in relation to the location of D2 highlighted by WSP. This may include, but be not limited to:

- The use of qualified personnel where required.
- Careful segregation of stockpiles on site.
- Defining transport routes.
- Cleaning down of machinery in designated areas.
- Decontamination unit for ground workers.
- Damping down of soils to prevent dust migration.

Excavations in soils containing asbestos should comply with the CL:AIRE publication 'Interpretation for Managing and working with Asbestos in Soil and Construction and Demolition Materials' (CARSOIL) and CAR 2012. All such works will need to be agreed with the regulatory bodies (HSE and/or LA).

Additional guidance is provided within the BSL methodology Guidance Note in Appendix A.

9.0 WASTE SOIL CLASSIFICATION & ASSESSMENT

9.1 Summary

BSL have undertaken a preliminary assessment of potential excavation waste to arise from the site during redevelopment to:

- Classify the excavation waste to arise as either hazardous or non-hazardous.
- Identify the most sustainable options for the wastes to arise in accordance with the waste hierarchy.
- Provide a written description of the waste required as part of the Duty of Care.
- Provide details of “hazardous properties” to complete hazardous waste consignment note (where applicable).
- Be able to provide a basic classification report to a landfill operator (where waste is destined for landfill disposal).

9.2 Waste Classification Procedure

As described in the ‘Waste Duty of Care Code of Practice (2016)’ any substance or object that the holder discards, intends to discard or is required to discard is a waste. It is the responsibility of the waste producer to classify this waste. The classification process is described in the ‘Guidance on the classification and assessment of waste’ WM3 and aims to determine whether the waste is Hazardous or Non-Hazardous to human health and the environment.

Hazardous wastes are signified by entries where the code is followed by an asterisk, where some wastes are deemed hazardous without further assessment, which are termed “Absolute Entries” e.g. most waste oils. Alternatively, waste entries are termed “Mirror” entries that require further assessment of hazardous properties, in order to determine whether they are hazardous waste or not (e.g. soil and stones). The EWC codes relevant to excavation wastes are:

- 17 05 03* - soil and stones containing dangerous substances.
- 17 05 04 – soil and stones other than those mentioned in 17 05 03.

The Landfill Directive (Directive 1999/31/EC on the landfilling of waste, Decision 2003/33/EC and Landfill Regulations 2005) led to the establishment of a methodology for classifying wastes.

Wastes first need to be classified based on their total concentrations and classified as either hazardous or non-hazardous waste. WAC testing is only required if the end disposal route is a landfill and WAC analysis must not be used for waste classification.

Wastes can only be accepted at a landfill if they meet the relevant Waste Acceptance Criteria (WAC) for that type of landfill. A waste must comply with the WAC limits for the relevant landfill, otherwise the soil will need to be pre-treated. There are three different WAC criteria, these are:

- Inert waste.
- Stable Non-Reactive Hazardous Waste (SNRHW).
- Hazardous waste.

There are no standard set of WAC limits for non-hazardous landfill sites and each non-hazardous landfill will have its own set of criteria under which it is licenced to accept non-hazardous waste. These will need to be determined through the selected waste receiver prior to disposal.

A non-hazardous waste should not be compared with WAC limits for hazardous or SNRHW waste sites and the WAC test should only be used to determine if the waste is suitable for disposal at an inert waste landfill site. Likewise, wastes classified as hazardous based on their total concentrations should not be compared with WAC limits for inert waste landfill sites, as these will not be accepted.

Details of how material should be classified for waste disposal are presented in the BSL Methodology and Guidance in Appendix A and are summarised in the table below:

Classification based on Total Concentrations ¹	PRIOR TO LEAVING SITE			
	Non-Hazardous Waste		Hazardous Waste	
	IF SOILS CANNOT BE RE-USED ELSEWHERE AND MUST GO TO LANDFILL			
WAC testing	Below inert WAC limit values	Above inert WAC limit values	Below hazardous WAC limit values ⁴	> WAC limit values
Landfill requirements	INERT landfill	NON-HAZARDOUS landfill ²	HAZARDOUS landfill	PRE-TREATMENT ³

1 Total concentrations are defined as tests results on solids as opposed to leachate (i.e. a liquid).

2 Individual sites may have certain limit values pre-determined in their licence.

3 After pre-treatment the material characteristics may have changed to an extent that allow the soil to be re-classified.

4 Possibility that wastes could be classified as stable Nonreactive HAZARDOUS waste in non-hazardous Landfill (e.g. soils containing low concentrations of asbestos, gypsum or sulphate bearing soils).

Waste classified as non-hazardous can be accepted into a non-hazardous landfill without having to pass any numerical WAC.

Soils above hazardous WAC limit values require pre-treatment prior to disposal. The effective pre-treatment, typically involving separation, sorting and screening, can offer cost savings through reducing the hazardous nature and volumes of soil. Costs for disposal of non-hazardous/hazardous soils are significant compared to the disposal of inert material.

Inert Waste

The possibility of automatic inert classification of the naturally occurring “clean” soils should be explored in accordance with Section 4.3 of the EA guidance document. The Council Decision includes a list of wastes in Section 2.1.1 of the document that are assumed to be inert and therefore acceptable at a landfill for inert waste without testing. This is the case if:

- They are single stream waste of a single waste type (although different waste types from the list may be accepted together if they are from a single source); and
- There is no suspicion of material or substances such as metals, asbestos, plastics, chemicals, etc to an extent which increases the risk associated with the waste sufficiently to justify contamination and they do not contain other classes of landfill.

9.3 Waste Classification and Waste Acceptance Criteria (WAC)

We have reviewed the testing results and assessed them through a waste classification database which allows users to code and classify waste as defined in the EWC (European Waste Catalogue) based on EC Regulation 1272/2008 on the Classification, Labelling and Packaging of Substances and Mixtures (CLP) and latest Environment Agency guidance (WM3 “Guidance on the classification and assessment of waste - Technical Guidance”).

The samples tested were screened against assessment criteria within WM3 using the HazWasteOnline tool to assess whether they contained any contaminants in the hazardous range.

The Waste Classification Report and WAC testing results are presented in Appendix E/ The results of the waste assessment based on total concentrations are presented in the table below, alongside the WAC analysis test results.

Location	Depth (m)	Stratum	Waste Classification	WAC Analysis	Landfill	Comments
WS01	0.50-0.70	Made Ground	Hazardous	Hazardous	Hazardous	HP7, 10, 14
WS02	0.30-0.50	Made Ground	Non-hazardous	Below Inert WAC	Inert	-
WS03	1.50-1.70	Made Ground	Non-hazardous	-	-	-
WS04	3.10-3.60	Gravelly SAND	Non-hazardous			
WS05	2.90-3.90	Gravelly SAND	Non-hazardous	Below Inert WAC	Inert	-
WS07	2.90-3.60	Gravelly SAND	Non-hazardous			
BH01	0.30-0.50	Made Ground	Hazardous	Hazardous	Hazardous	HP7, 10, 14
	2.00-2.20	Made Ground	Hazardous	-	-	HP7, 10, 14
BH02	1.30-1.50	Made Ground	Hazardous	-	-	HP14
BH02	1.50-1.70	Made Ground	Non-hazardous	-	-	-
BH03	1.20-1.40	Made Ground	Non-hazardous	-	-	-
BH04	0.30-0.50	Made Ground	Non-hazardous	-	-	-
BH05	1.20-1.40	Gravelly SAND	Non-hazardous	-	-	-
BH06 (WS08)	3.00-3.50	Gravelly SAND	Non-hazardous	-	-	-
BH07 (WS09)	3.00-3.40	Gravelly SAND	Non-hazardous	-	-	-
BH07 (WS09)	3.40-3.50	SANDSTONE	Non-hazardous	-	-	-
ASB05	0-1.40	Made Ground	Non-hazardous	-	-	-
TP03	0.20-1.80	Made Ground	Non-hazardous	-	-	-
TP03	1.80-2.00	Made Ground	Non-hazardous	-	-	-
TP04	0.20-1.95	Made Ground	Non-hazardous	-	-	-
TP05	0.20-1.80	Made Ground	Hazardous	-	-	HP14
TP06	0.20-2.10	Made Ground	Hazardous	-	-	HP14
TP07	0.30-0.85	Made Ground	Non-hazardous	-	-	-
TP07	0.85-1.60	Made Ground	Non-hazardous	-	-	-
TP07	1.60-2.40	Made Ground	Non-hazardous	-	-	-
TP08	0.20-1.30	Made Ground	Non-hazardous	-	-	-
TP08	1.30-2.10	Made Ground	Non-hazardous	-	-	-

Based on the waste classification database assessment, the majority of the made ground soils have been classified as **non-hazardous**, however, the soils within the made ground to the west of the Synagogue building have all been classified as **hazardous**. A plan detailing the area of hazardous waste is shown on drawing ref. C5128/05 – Hazardous Waste Location Plan.

Waste Containing Asbestos

Should soils contain asbestos, the concentration and type of asbestos identified, in addition to the chemical composition (i.e. hazardous or non-hazardous detailed above), will determine which waste code is applicable to the soils and which landfill will accept it.

Waste	Conc. by Weight (%)	EWG 2002 Catalogue Entry Code	Waste Disposal Route
Non-hazardous containing asbestos fibres	<0.001 - <0.1%	17 05 04 (soil and stones other than those mentioned in 17 05 03*)	Non-hazardous landfill subject to achieving Waste Acceptance Criteria (WAC) for a stable non-reactive hazardous landfill site.
Hazardous containing asbestos fibres	<0.001 - <0.1%	17 05 03* (soil and stones containing dangerous substances)	Hazardous landfill subject to achieving Waste Acceptance Criteria (WAC) for a hazardous landfill site.
Non-hazardous soils containing asbestos fibres	>0.1%	17 05 03* (soil and stones containing dangerous substances)	Hazardous landfill authorised to receive asbestos, or in a stable non-reactive hazardous waste cell at a non-hazardous landfill authorised to receive asbestos.
Non-hazardous Soils containing ACM (Mechanically separable)	>0.1%	17 06 05 (construction material containing asbestos) 17 05 04 (soil and stones other than those mentioned in 17 05 03*)	ACMs disposed of at a hazardous landfill authorised to receive asbestos, or in a stable non-reactive hazardous waste cell at a non-hazardous landfill authorised to receive asbestos. Soils should be disposed of at a non-hazardous landfill subject to achieving Waste Acceptance Criteria (WAC) for a stable non-reactive hazardous landfill site.
Hazardous soils containing ACM	>0.1%	17 05 03* (soil and stones containing dangerous substances)	Hazardous landfill subject to achieving Waste Acceptance Criteria (WAC) for a hazardous landfill site.

The soils at WSP location D2 will likely be classified as hazardous as visible fragments of asbestos were identified at this position.

A watching brief should be maintained for evidence of Asbestos Containing Materials (ACMs), any ACMs observed should be handpicked and disposed of in accordance with current asbestos disposal regulations.

9.4 Options Assessment

Following the classification of waste materials, the options available for the waste can be considered in the context of the waste hierarchy as below:

- Onsite re-use (with or without prior treatment) under suitable exceptions/permits.
- Offsite processing for recycling or recovery e.g. screening.
- Offsite disposal (with or without prior treatment) i.e. landfill.

Where feasible, efforts should be made to retain soils for onsite re-use to minimise costs and maximise the sustainability of projects.

Based on the above, the possible options for the generation of waste soils at the site are described in the table below:

Waste Generation Source	Comments
Crush	Crushed concrete is/will be site derived from structures which had not been used for potentially contaminative activities. Assuming the above criteria are met, with materials containing no asbestos or ACM, crushed concrete is considered to be inert without testing. Where samples of crushed concrete have been subject to totals testing this is likely to be hazardous due to pH, and where subject to WAC testing, the sulphate and TDS limits are breached, this is to be expected due to the presence of concrete.
Made Ground from site levelling/foundations excavations/services excavations	Samples of made ground from across the site have been classified as non-hazardous and hazardous for off-site disposal purposes, although should be suitable for re-use on site if required under suitable exemptions/permits.
Natural ground from site levelling/foundations excavations/services excavations	The Till may be considered suitable for re-use onsite as fill where the criteria of the WFD exception for re-use of naturally occurring soils can be met. Naturally occurring clean materials could also be exported to another site under the direct transfer scenario of the DoWCoP. Classified as non-hazardous and below inert WAC testing criteria for off-site disposal purposes.

General

If any gross hydrocarbon contaminated material is encountered during the construction phase, it is possible that this may be classified as hazardous and testing should be undertaken at that time.

Where it is necessary to dispose material off site it is recommended that materials are segregated and sufficient time is allowed to further classify the actual soil arisings that constitute the waste, including discussion with landfill sites and waste transfer stations to find the best disposal route. It is illegal to dilute and mix soils without a suitable permit.

9.5 Re-use of Soils

By definition in law, any material excavated from the ground becomes waste at the moment of excavation. If that soil (now a “waste”) is then placed on another part of the development site (or used on another development site) without an appropriate materials management plan, permit or exemption being in place, by law this material is defined as “illegally deposited waste”.

In order to comply with UK legislation and avoid excessive costs, if any re-use of soils is proposed on site, this should be done in accordance with the relevant exemptions or permits in place, although under current proposals the majority of soils will likely be removed and will require off-site disposal.

10.0 CONCLUSIONS

10.1 Geo-Environmental

Geo-Environmental – Human Health

The proposed development is of mixed end-use. The basement and ground floor will be utilised for commercial purposes, with the remainder of the proposed development being a mixture of offices, a hotel and residential areas. Therefore, commercial screening values have been adopted. It is noted that the majority of the proposed development will comprise hardstanding or building footprint.

Elevated lead was recorded within one location of the made ground. Previous investigations also encountered elevated lead and arsenic, alongside potential ACM fragments. Additional work by BSL recorded trace asbestos in two samples and a suspected ACM in one location. However, the made ground will be removed from site during the construction of the basement which will effectively remove the source of contamination. Furthermore, the proposed development will feature hardstanding across the entire footprint of the site, therefore the risk is considered to be low and no specific further remedial action is required.

Ground gas monitoring has revealed a maximum peak carbon dioxide concentration of 1.9%v/v and methane concentrations of 0.1%v/v. Based on the gas monitoring and the ground gas risk assessment the site is classified as Characteristic Situation 1 and ground gas protection measures are not required. This is in line with previous assessments.

Geo-Environmental – Controlled Waters

The overall risk to controlled waters is considered to be low and no further action is required.

Waste

Based on the waste classification database assessment, the majority of the made ground soils have been classified as non-hazardous, however, the soils within the made ground to the west of the Synagogue building have all been classified as hazardous.

10.2 Geotechnical

Foundations

Based on the proposed development, the recommended foundation type is a replacement pile technique, such as emplacement by rotary bored methods, socketed into the competent sandstone bedrock. As a preliminary guide, allowable axial loads for a circular pile range between 10.8MN for a 600mm diameter pile with 25m embedment up to 21MN for a 750mm diameter pile with 35m embedment. Detailed foundation design should be completed by a suitably qualified specialist. Design of the basement walls should be undertaken in conjunction with the detailed foundation design.

BSL note that a conjectured outcrop of the West Manchester Fault is indicated to cross the south-west corner. The potential presence of this fault, and possible impacts on pile emplacement alongside differential settlements should be considered during detailed design by the piling contractor.

Floor slabs

The basement floor slab should be supported by piles.

Concrete classification

The results of laboratory pH and sulphate content, indicate that sulphate class DS-3 and ACEC class AC-3 conditions prevail for the made ground soils, sulphate class DS-1 and ACEC class AC-1 for natural soils, and DS-1 AC-1 conditions prevail for the sandstone bedrock in accordance with BRE Special Digest 1 "Concrete in aggressive ground" 2005.

Highways

No dedicated highways will be included on this scheme which will be wholly covered in the proposed structure.

Where required for temporary structure placement of construction access roads, equilibrium values in the existing made ground may be assumed as 2%. This should be confirmed by in-situ testing at formation level by a specialist geotechnical engineer during construction.

Drainage (SuDS)

Much of the site will be covered by structures/hardstanding, which precludes the use of a large underground soakaway drainage. It is anticipated that surface water would need to be positively drained into the off site existing sewer network, subject to agreement with the local utility provider.

10.3 Further Work

The following further work is considered necessary to progress the site to construction phase:

-
- Detailed foundation design by a structural engineer and piling contractor.
-

11.0 ABBREVIATIONS AND DEFINITIONS

GLOSSARY	
Term / Abbreviation	Definition
AST	Above Ground Storage Tank.
B(a)P	Benzo (a) Pyrene.
BGS	British Geological Survey.
BRE	Building Research Establishment.
BS	British Standard.
BSL	Brownfield Solutions Ltd.
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes.
CBR	California Bearing Ratio (used in pavement/highways design).
CAR 2012	Control of Asbestos Regulations (2012).
CBCB	Cheshire Brine Compensation Board.
CBCD	Cheshire Brine Compensation District.
CBR	California Bearing Ratio.
CIEH	Chartered Institute of Environmental Health.
CIRIA	Construction Industry Research Association.
CL:AIRE	Contaminated Land: Applications in Real Environments.
CLEA	Contaminated Land Exposure Assessment.
CLO	Contaminated Land Officer.
COMAH	Control of Major Accident Hazards.
Contamination	Presence of a substance which is in, on or under land, and which has the potential to cause significant harm or to cause significant pollution of controlled water. There is no assumption in this definition that harm results from the presence of the contamination. Naturally enhanced concentrations of harmful substances can fall within this definition of contamination. Contamination may relate to soils, surface water, groundwater or ground gas.
Controlled Waters	Inland freshwater (any lake, pond or watercourse above the freshwater limit), water contained in underground strata and any coastal water between the limit of highest tide or the freshwater line to the three-mile limit of territorial waters.
CPT	Cone Penetration Test.
CSM	Conceptual Site Model. A schematic hypothesis of the nature and sources of contamination, potential migration pathways (including description of the ground and groundwater) and potential receptors, developed on the basis of the information from the preliminary investigation and refined during subsequent phases of investigation and which is an essential part of the risk assessment process. The conceptual site model is initially derived from the information obtained by the preliminary investigation (i.e. the Phase I Desk Study). This conceptual model is used to focus subsequent investigations, where these are considered to be necessary, in order to meet the objectives of the investigations and the risk assessment. The results of intrusive investigations can provide additional data that can be used to further refine the conceptual site model.
DCP	Dynamic Cone Penetrometer.
DNAPL	Dense Non-Aqueous Phase Liquid.
DoWCoP	Definition of Waste Code of Practice.
DWS	Drinking Water Standard.
EA	Environment Agency.
EHO	Environmental health Officer.
EQS	Environmental Quality Standard.
GAC	Generic Assessment Criteria.

GLOSSARY	
Term / Abbreviation	Definition
GDR	Geotechnical Design Report.
GFR	Geotechnical Feedback Report.
GIR	Ground Investigation Report.
GSV	Gas Screening Value.
Harm	Adverse effect on the health of living organisms, or other interference with ecological systems of which they form part, and, in the case of human health, including property/structures and water supply pipelines.
Hazard	Inherently dangerous quality of a substance, procedure or event.
HDPE	High Density Polyethylene.
HSV	Hand Shear Vane.
K	Modulus of Subgrade Reaction.
LCRM	Land Contamination: Risk Management (EA guidance).
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene).
LOD	Limit of Detection (for particular method adopted).
MMP	Materials Management Plan.
Mv	Modulus of Volume of Compressibility.
ND	Not Detected.
NHBC	National House Building Council.
NR	Not Recorded.
OS	Ordnance Survey.
PAH	Polycyclic Aromatic Hydrocarbon.
Pathway	Mechanism or route by which a contaminant comes into contact with, or otherwise affects, a receptor.
PCB	Poly-Chlorinated Biphenyl.
PCSM	Preliminary Conceptual Site Model.
pH	Scale used to specify how acidic or basic a water-based solution is.
PHC	Petroleum Hydrocarbons.
PID	Photo Ionisation Detector.
PNEC	Predicted No-Effect Concentration.
Precision	Level of agreement within a series of measurements of a parameter.
PSD	Particle Size Distribution.
PVC	Polyvinyl Chloride.
Receptor	Human health, living organisms, ecological systems, controlled waters (surface waters and groundwater within aquifers), atmosphere, structures and utilities that could potentially be adversely affected by contaminant(s).
Risk	Probability of the occurrence, magnitude and consequences of an unwanted adverse effect on a receptor.
Risk Assessment	Process of establishing, to the extent possible, the existence, nature and significance of risk.
Sampling	Methods and techniques used to obtain a representative sample of the material under investigation.
SOM	Soil Organic Matter.
Source	Location from which contamination is, or was, derived. This could possibly be the location of the highest soil, groundwater or gas concentration of the contaminant(s).
SPT	Standard Penetration Test.
SVOCs	Semi Volatile Organic Compounds.
TOC	Total Organic Carbon.
TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group).

GLOSSARY	
Term / Abbreviation	Definition
TVOCs	Total volatile organic compounds.
UCS	Unconfined Compressive Strength.
Uncertainty	Parameter, associated with the result of a measurement that characterises the dispersion of the values that could reasonably be attributed to the measurement.
UST	Underground Storage Tank.
UXO	Unexploded Ordnance.
VCCs	Vibro Concrete Columns.
VSCs	Vibro Stone Columns
VOCs	Volatile Organic Compounds.
WAC	Waste Assessment Criteria.
WFD (in waste context)	Waste Framework Directive.
WFD (in water context)	Water Framework Directive.
Units	Definition
°	Degrees
Φ	Phi angle (in degrees)
g/l	Grams per Litre
Km	Kilometres
kPa	Kilo Pascal (Equivalent to kN/m ²)
KN/m ² /mm	Kilo Newton per metered squared per millimeter
kN/m ²	Kilo Newtons per metre squared
kPa	Kilo Pascal (Equivalent to kN/m ²)
l/hr	Litres per hour
MJ/kg	Mega joule per kilogram
MN	Mega Newton
M ² /MN	Mega Newton per metre squared
M	Metres
m bgl	Metres Below Ground Level
m OD	Metres Ordnance Datum (sea level)
µg/l	Micrograms per Litre (parts per billion)
µm	Micrometre
mb	Millibars (atmospheric pressure)
mg/kg	Milligrams per kilogram (parts per million)
mg/m ³	Milligram per metre cubed
mm	Millimetre
ppb	Parts Per Billion
Ppm	Parts Per Million

12.0 REFERENCES

- Association of Ground Investigation Specialists. 'Guidelines for Good Practice in Site Investigation'. Issue 2, March 2006.
- Black, W.P.M. & Lister, N.W. The strength of clay fill subgrades, its prediction in relation to road performance Report LR889, TRRL. 1979.
- BRE Special Digest 1: 'Concrete in Aggressive Ground' 3rd Ed 2005.
- BRE Report BR211, Scivyer, C. 'Radon – Guidance on protective measures for new buildings' 2015 Edition.
- BRE Digest, vols. 240 and 241 'Low-rise buildings on shrinkable clay soils'. 1993.
- BRE Digest 298 'The influence of trees on house foundations in clay soils'. 1999.
- BRE Digest 365 'Soakaway Design'. 2016.
- BRE Report 391 "Specifying vibro stone columns". 2000.
- BRE Report 414. 'Protective measures for housing on gas contaminated land. Building Research Establishment Report'. 2011.
- BRE Report 465 'Cover Systems for Land Regeneration'. 2004.
- BRE Report 470 'Working platforms for tracked plant: good practice guide to the design, installation, maintenance and repair of ground-supported working platforms'. 2004.
- British Geological Survey Technical Report WD/97/34. 312pp. Environment Agency R&D Publication 8. 'The physical properties of major aquifers in England and Wales'. 1997.
- British Geological Survey Technical Report WD/00/04. 234pp. Environment Agency R&D Publication 68 'The physical properties of minor aquifers in England and Wales'.
- British Geological Survey 'The advanced soil geochemical atlas of England and Wales'. 2012.
- BS 1377 'Method of Test for Soils for Civil Engineering Purposes'. 1990.
- BS EN 1997-1. 'Eurocode 7 – Geotechnical design - Part 1: General rules'. Plus associated UK National Annex. 2004.
- BS EN 1997-2. 'Eurocode 7 – Geotechnical design - Part 2: 'Geotechnical investigation and testing'. Plus associated UK National Annex. 2007.
- BS 3882: 'Specification for topsoil'. 2015.
- BS 5837: 'Trees in relation to design, demolition and construction Recommendations'. 2012.
- BS 5930+A1:2020: 'Code of Practice for Site Investigations'. 2020.
- BS 6031: 'Code of practice for earthworks'. 2009.
- BS 8004: 'Code of practice for foundations'. 2015.
- BS 8102:2022: 'Protection of Below Ground Structures Against Water Ingress'. 2022.
- BS 8485+A1: 'Code of practise for the design of protective measures for methane and carbon dioxide ground gases for new buildings'. 2019.
- BS 8500-1 AMD 2. Concrete. Complementary BS to BS EN 206. Part 1. 'Method of specifying and guidance for the specifier'. 2018.
- BS 8576 'Guidance on investigations for ground gas – Permanent gases and Volatile Organic Compounds (VOCs)'. 2013.

- BS 10175:2011+A2 'Investigation of Potentially Contaminated sites - code of practice'. 2017.
- BS 10176:2020 'Taking soil samples for determination of volatile organic compounds (VOCs)'. 2020.
- BS EN ISO 14688 'Geotechnical investigation and testing – Identification and classification of soil'. 2018.
- BS EN ISO 14689 'Geotechnical investigation and testing – Identification and classification of rock'. 2018.
- BS EN ISO 17892 'Geotechnical investigation and testing. Laboratory testing of soil.' Parts 1-12 :2018.
- BULL ET AL. Promoting the Use of B(a)P as a Marker for PAH Exposure in UK Soils. February 2013.
- CIRIA Special Publication SP32, PSA Civil Engineering Technical Guide 34, 'Construction over abandoned mine workings'. 1984.
- CIRIA Special Publications 101-112, 'Remedial Treatment for Contaminated Land'. 1998.
- CIRIA Special Publication 124, 'Barriers, liners and cover systems for containment and control of land contamination'. 1996.
- CIRIA R143, 'The Standard Penetration Test (SPT): methods and use'. 1995.
- CIRIA 149 'Protecting Development from Methane'. 1995.
- CIRIA 150 'Methane Investigation Strategies'. 1995.
- CIRIA 151 'Interpreting Measurements of Gas in the Ground'. 1995.
- CIRIA 152 'Risk assessment for Methane and Other Gases from the Ground'. 1995.
- CIRIA 552 'Contaminated Land Risk Assessment – A guide to good practice'. 2001.
- CIRIA C659 'Assessing risks posed by hazardous ground gases to buildings.' 2006.
- CIRIA C665 'Assessing Risks Posed by Hazardous Ground Gases to Buildings'. 2007.
- CIRIA C681 'Unexploded Ordnance (UXO) A guide for the construction industry'. 2009.
- CIRIA C716 'Remediating and mitigating risks from volatile organic compound (VOC) vapours from land affected by contamination'. 2012.
- CIRIA C733 'Asbestos in Soil And Made Ground: A Guide To Understanding And Managing Risks'. 2014.
- CIRIA C735 'Good Practice on The Testing and Verification of Protection Systems for Buildings Against Hazardous Ground Gases'. 2014.
- CIRIA C748 'Guidance on the Use of Plastic Membranes as VOC Vapour Barriers'. 2014.
- CIRIA C750 'Groundwater control: design and practice, second edition". 2016.
- CIRIA C753 'The SuDS Manual'. 2015.
- CIRIA C758 'Abandoned Mine Workings Manual'. 2019.
- CL:AIRE and CIEH. 'Guidance on Comparing Soil Contamination Data with a Critical Concentration'. May 2008.
- CL:AIRE 'The Definition of Waste: Development Industry Code of Practice'. Version 2. March 2011.
- CL:AIRE RB17 'A Pragmatic Approach to Ground Gas Risk Assessment'. 2012.
- CL:AIRE SP1010 'Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination'. Rev 2 2014.
- CL:AIRE 'Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials – CAR-SOILTM'. 2016.

- CL:AIRE 'Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing hydrogeological risk assessment methodologies' Version 1. March 2017.
- CULP, S.J., ET AL., A comparison of the tumours induced by coal tar and benzo[a]pyrene in a 2-year bioassay. Carcinogenesis. 1998.
- DEFRA and the Environment Agency, CLR10 'Soil Guideline Value Reports for Individual Soil Contaminants'. 2002-2004.
- DEFRA and the Environment Agency, CLR Report No 11 'Model Procedures for the Management of Contaminated Land'. 2004. [Withdrawn 2019.]
- Department of the Environment, CLR Report No 1 'A framework for assessing the impact of contaminated land on groundwater and surface water'. 1994.
- Department of the Environment, CLR Report No 2 'Guidance on Preliminary Site Inspection of Contaminated Land'. 1994.
- Department of the Environment, CLR Report No 3 'Documentary research on Industrial Sites'. 1994.
- Department of the Environment, CLR Report No 4 'Sampling Strategies for Contaminated Land'. 1994.
- Department of the Environment Waste Management Paper No. 27. 'Landfill Gas: A Technical Memorandum Providing Guidance on the Monitoring and Control of Landfill Gas'. 1992.
- Department of the Environment. 'Industry Profiles' - 48 separate publications available from The Stationery Office, London. 1995.
- DETR. Circular: Contaminated Land. 2006.
- EC Regulation 1272/2008 'The Classification, labelling and packaging of substances and mixtures (CLP)' 2008.
- Environment Agency guidance - Land Contamination: Risk Management (LCRM). 2019.
- Environment Agency 'Using Soil Guideline Values'. 2009.
- Environment Agency, 'Updated Technical Background to the CLEA model'. 2009.
- Environment Agency, 'Human health toxicological assessment of contaminants in soil'. 2009.
- Environment Agency Hazardous Waste: 'Guidance on the classification and assessment of waste' WM3 ver 1.1 May 2018.
- Environment Agency. 'Remedial Targets Methodology. Hydrogeological Risk Assessment for Land Contamination'. 2006.
- Environment Agency & NHBC. R&D Publication 66. 'Guidance for the Safe Development of Housing on Land Affected by Contamination'. 2008.
- Environment Agency. R&D Publication 20. 'Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources'. 1999.
- Environment Agency Technical Guidance Note 01. Hydrogeological Risk Assessment for Landfills. [Withdrawn Feb 2016. Replaced with below].
- Environment Agency and DEFRA 'Landfill developments: groundwater risk assessment for leachate'. 2016.
- Environment Agency Petroleum Hydrocarbons in Groundwater 'Supplementary Guidance for Hydrogeological Risk Assessment'. 2009.
- Environment Agency 'Groundwater protection: Principles and practice (GP3)'. 2013. [Superseded 2017 by www.gov.uk online guidance].

- Environmental Permitting Guidance: version 3.1 'The Landfill Directive for the Environmental Permitting (England and Wales) Regulations'. 2010.
- Environmental Quality Standards. 2008.
- European Parliament Directive 2008/98/EC of the Council of 19 November 2008 on waste and repealing certain Directives. 2008.
- European Parliament. Directive 2014/955/EU: Commission Decision of 18 December 2014 amending Decision 2000/532/EC on the list of waste pursuant to Directive 2008/98/EC.
- Ground Engineering. Wilson & Card 'Proposed method classifying gassing sites' /1999.
- Hazardous Waste (England and Wales) Regulations. 2005.
- Health & Safety Executive (HSE). 'Protection of Workers & the General Public during the Development of Contaminated Land'. 1991.
- Health and Safety Executive (HSE). Control of Asbestos Regulations (CAR). 2012.
- Highways Agency. Design Guidance for Road Pavement Foundations (Draft HD25). Interim Advice Note 73/06. Rev 1. Highway Agency, London. 2009. [Withdrawn 30th May 2017].
- ICE Thomas Telford 'Applications of Dynamic Cone Penetrometer testing in East Anglia'. 1989.
- Land Quality Press, Nathanail, C. P., McCaffrey, C., Gillett, A., Ogden, R. C. and Nathanail, J.F. 'The LQM/CIEH S4ULs for Human Health Risk Assessment.' 2015.
- Landfill Directive 'Directive 1999/31/EC on the landfilling of waste'. 1999.
- Japanese Geotechnical Society. Hatanaka and Uchida 'Empirical correlation between penetration resistance and effective friction of sandy soil'. Soils & Foundations, 36 (4), 1-9. 1996.
- Manual of Contract Documents for Highway Works, Specification for Highway Works: Volume 1, Amendment August 2014. [Withdrawn 30th May 2017].
- Manual of Contract Documents for Highway Works, Specification for Highways Works – Series 600 Earthworks November 2006. [Withdrawn 30th May 2017, Replacement unknown].
- National Planning Policy Framework (NPPF). July 2018.
- National Planning Policy Framework - Technical Guidance. March 2012.
- NHBC Standards 2020, Part 1 'Introduction and Technical Requirements.' 2020.
- NHBC Standards, Part 4 'Foundations.' 2020.
- NHBC Standards. Chapter 4.1: Land Quality - Managing Ground Conditions. 2020.
- NHBC. Boyle and Witherington. 'Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present.' Report No. 10627-R01(04). 2007.
- Public Health England (PHE). Contaminated land information sheet: risk assessment approaches for polycyclic aromatic hydrocarbons (PAHs). September 2017.
- Total Petroleum Hydrocarbon Criteria Working Group Volume 1 'Analysis of Petroleum Hydrocarbons in Environmental Media'. 1999.
- Total Petroleum Hydrocarbon Criteria Working Group Volume 2 Composition of Petroleum Mixtures. May 1998.
- Total Petroleum Hydrocarbon Criteria Working Group Volume 3 'Selection of Representative TPH Fractions Based on Fate and Transport Considerations'. July 1997.

Total Petroleum Hydrocarbon Criteria Working Group Volume 4 'Development of Fraction Specific Reference Doses (RfDs) and Reference Concentrations (RfCs) for Total Petroleum Hydrocarbons (TPH)'. 1997

Total Petroleum Hydrocarbon Criteria Working Group Volume 5 'Human Health Risk-Based Evaluation of Petroleum Release Sites: Implementing the Working Group Approach' June 1999.

SEPA 'Land remediation and waste management guidelines' publication date unknown.

UK Drinking Water Standards: Water Supply (Water Quality) Regulations 1989 (SI 1989/1147) and Water Supply (Water Quality) Regulations 2000 (SI 2000/3184).

UKTAG. Updated recommendations on environmental standards. River Basin Management (2015-21). UK Technical Advisory Group on the Water Framework Directive. November 2013 (updated January 2018).

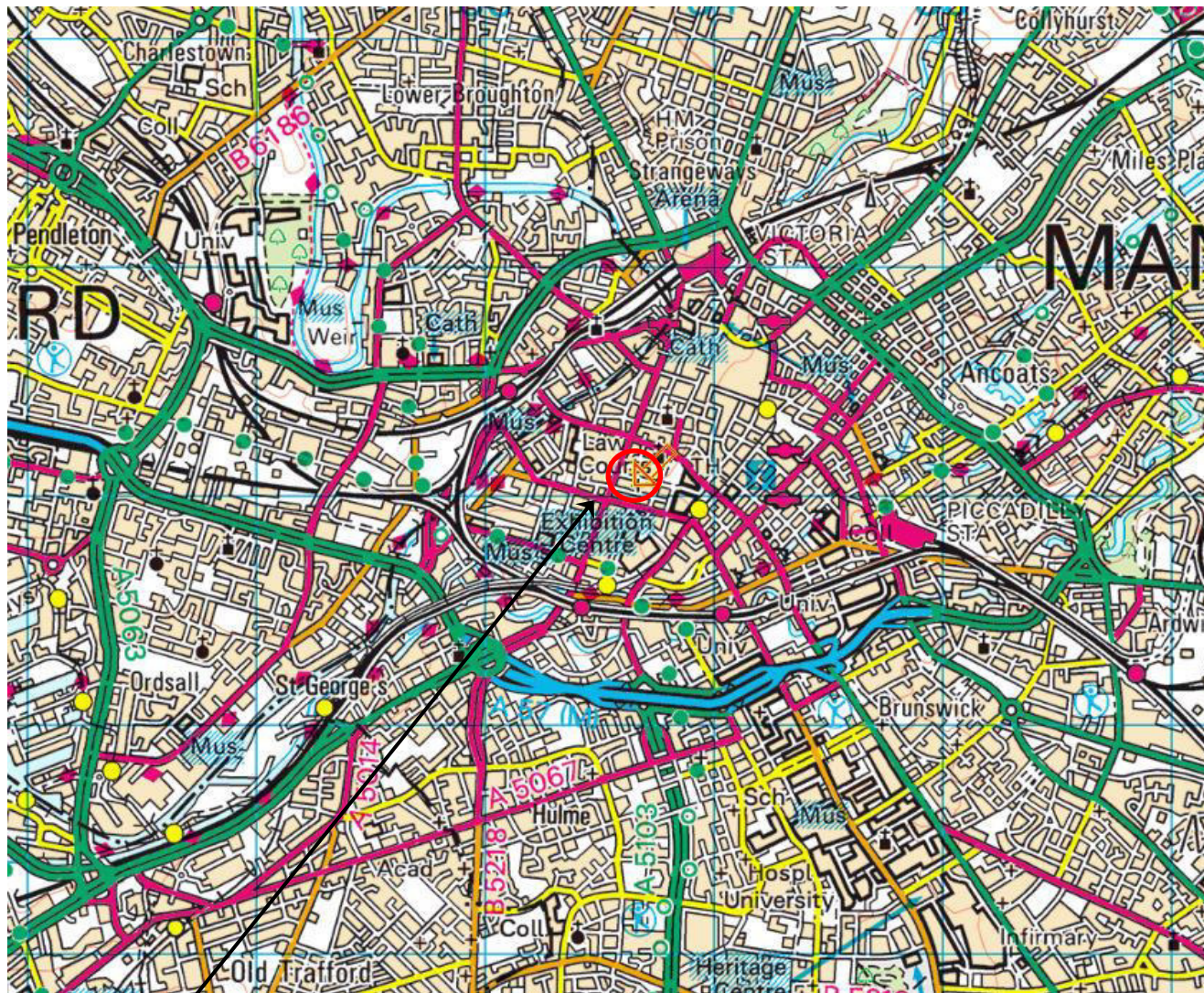
UKTAG-WFD. UKTAG River & Lake Assessment Method, Specific Pollutants (Metals), Metal Bioavailability Assessment Tool (M-BAT). Water Framework Directive – United Kingdom Technical Advisory Group. 2014.-

UKWIR Report 10/WM/03/21 2010 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' 2010.

Water Framework Directive, 2000.

Water UK HBF. Contaminated Land Assessment Guidance. Water UK and the Home Builders Federation.

DRAWINGS



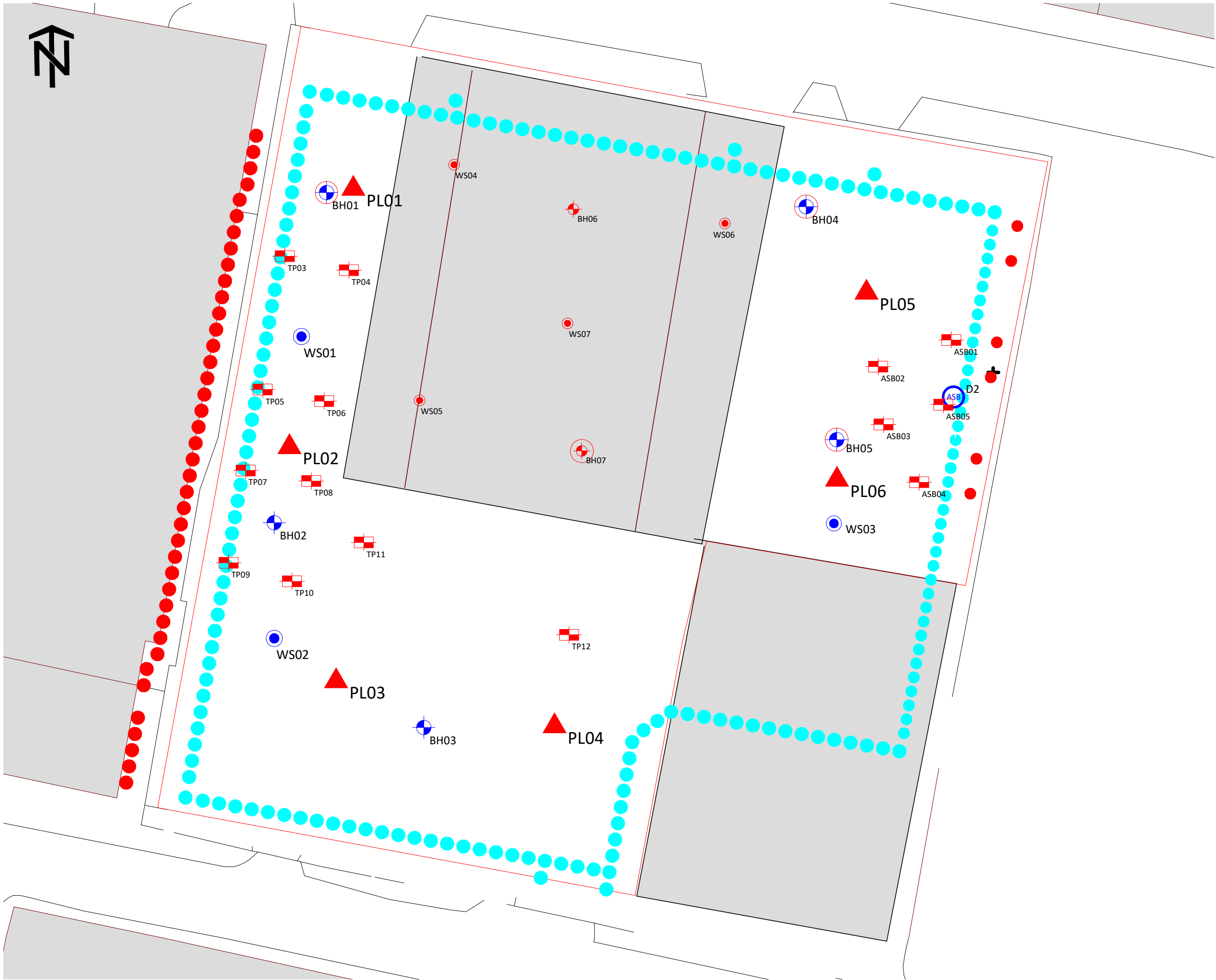
SITE LOCATION

NEAREST POSTCODE: M2 5NH

SITE ENTRANCE WHAT3WORDS:
///middle.ears.stack



REV	DATE	DESCRIPTION	BY	CKD
 BROWNFIELD SOLUTIONS LTD CEO ENVIRONMENTAL ENGINEERING EXCELLENCE				
CLIENT ST MICHAELS UK PROPCO 2 LTD / DOMIS CONSTRUCTION LTD				
PROJECT TITLE ST MICHAELS, MANCHESTER				
DRAWING TITLE SITE LOCATION PLAN				
DRAWING No. C5128/01	REVISION -	SCALE NTS	DATE 03/09/22	
DRAWN BY SD		CHECKED BY JM		



KEY	
	APPROXIMATE SITE BOUNDARY
	WINDOW SAMPLE BOREHOLE
	ROTARY CORED BOREHOLE
	BOREHOLE INSTALLATION
	ASBESTOS IDENTIFICATION IN WSP EXPLORATORY HOLE LOCATION D2
	TRIAL PIT TO OBTAIN SAMPLES FOR WASTE CLASSIFICATION
	TRIAL PIT TO OBTAIN SAMPLES FOR ASBESTOS ID
	POST-DEMO ROTARY BOREHOLE (GEOTECHNICAL)
	POST DEMO WINDOW SAMPLE BOREHOLE TO OBTAIN SAMPLES FOR WASTE CLASSIFICATION
	PLATE LOAD TEST LOCATION

- NOTES
- ALL DIMENSIONS TO BE CHECKED ON SITE BEFORE COMMENCING WORKS. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ARCHITECT & ENGINEER FOR VERIFICATION. FIGURED DIMENSIONS ONLY ARE TO BE TAKEN FROM THIS DRAWING.
 - THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS REPORTS. THIS DRAWING IS COPYRIGHT OF BSL.
 - DRAWING NOT FOR CONSTRUCTION PURPOSES.

REV	DATE	DESCRIPTION	BY	CKD

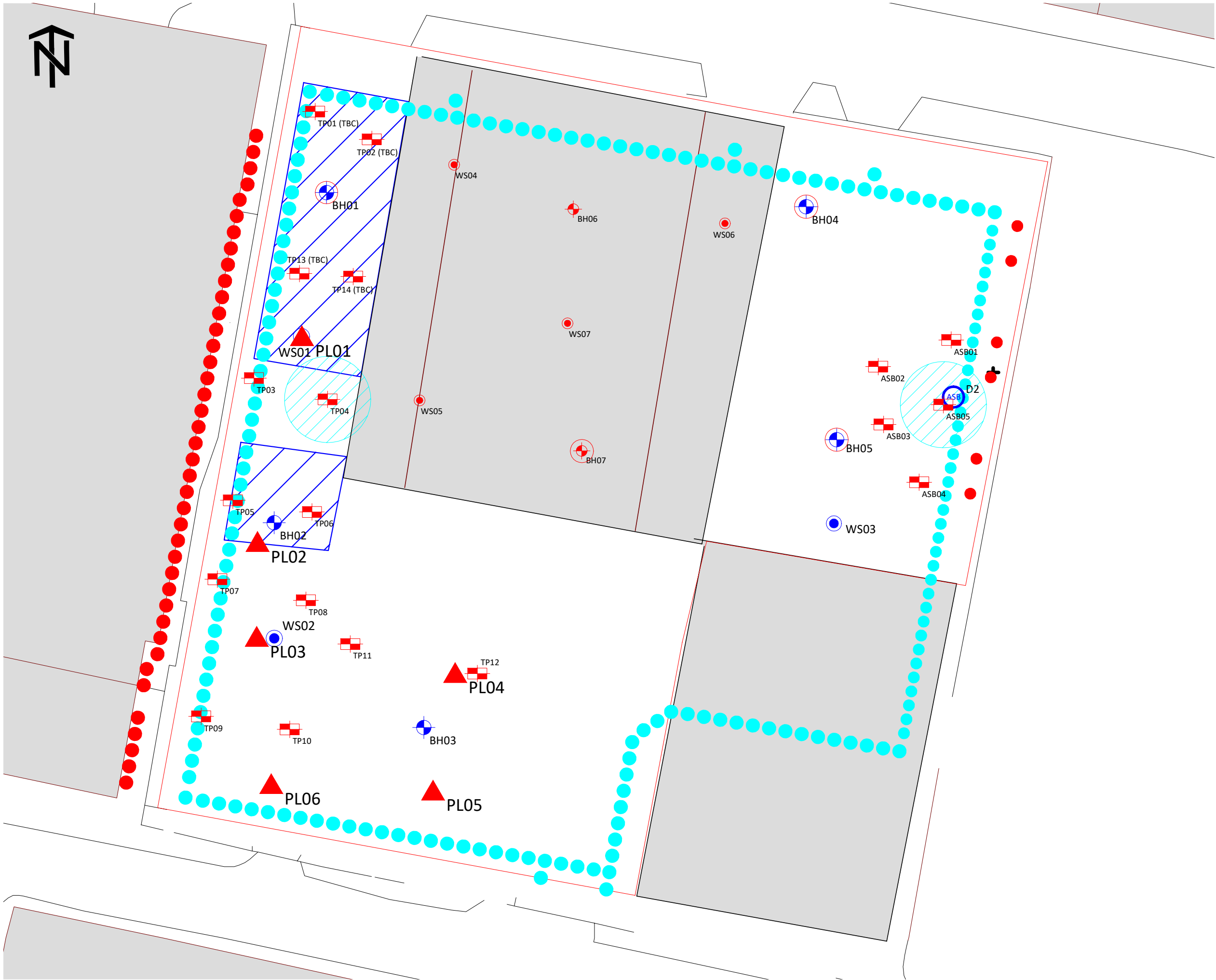


CLIENT
ST MICHAELS UK PROPCO 2 LTD
/ DOMIS CONSTRUCTION LTD

PROJECT TITLE
ST MICHAELS, MANCHESTER

DRAWING TITLE
EXPLORATORY HOLE LOCATION
PLAN

DRAWING No.	REVISION	SCALE	DATE
C5128/04	A	NTS	22/11/23
DRAWN BY NS		CHECKED BY JM	



KEY	
	APPROXIMATE SITE BOUNDARY
	WINDOW SAMPLE BOREHOLE
	ROTARY CORED BOREHOLE
	BOREHOLE INSTALLATION
	ASBESTOS IDENTIFICATION IN WSP EXPLORATORY HOLE LOCATION D2
	TRIAL PIT TO OBTAIN SAMPLES FOR WASTE CLASSIFICATION
	TRIAL PIT TO OBTAIN SAMPLES FOR ASBESTOS ID
	PROPOSED POST-DEMO ROTARY BOREHOLE (GEOTECHNICAL)
	PROPOSED POST DEMO WINDOW SAMPLE BOREHOLE TO OBTAIN SAMPLES FOR WASTE CLASSIFICATION
	PLATE LOAD TEST LOCATION
	HAZARDOUS WASTE (METALS)
	TRACE ASBESTOS (<0.001%)

- NOTES
- ALL DIMENSIONS TO BE CHECKED ON SITE BEFORE COMMENCING WORKS. ANY DISCREPANCIES ARE TO BE REPORTED TO THE ARCHITECT & ENGINEER FOR VERIFICATION. FIGURED DIMENSIONS ONLY ARE TO BE TAKEN FROM THIS DRAWING.
 - THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ENGINEERS REPORTS. THIS DRAWING IS COPYRIGHT OF BSL.
 - DRAWING NOT FOR CONSTRUCTION PURPOSES.

REV	DATE	DESCRIPTION	BY	CKD

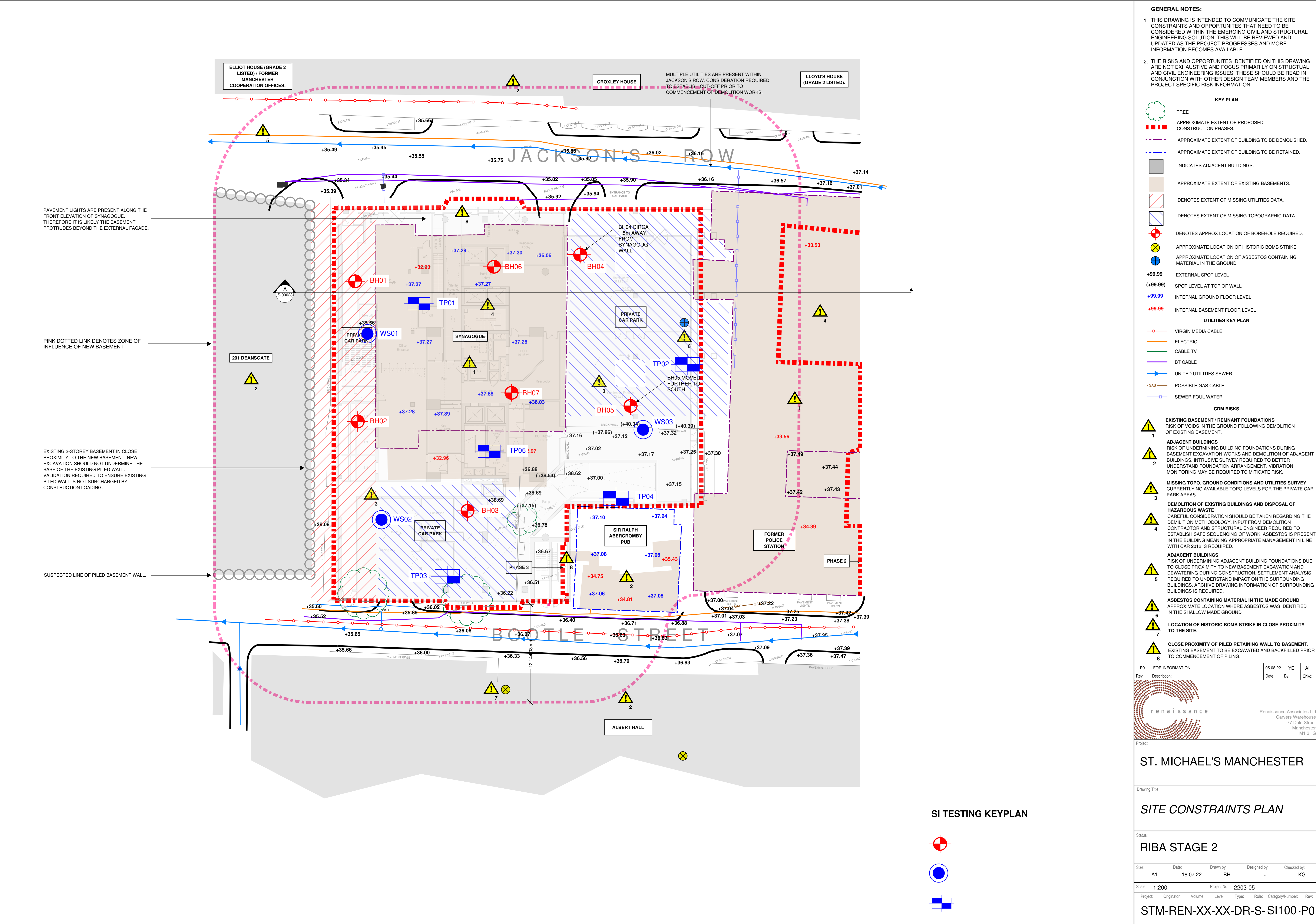


CLIENT
ST MICHAELS UK PROPCO 2 LTD / DOMIS CONSTRUCTION LTD

PROJECT TITLE
ST MICHAELS, MANCHESTER

DRAWING TITLE
HAZARDOUS WASTE LOCATION PLAN

DRAWING No.	REVISION	SCALE	DATE
C5128/05	-	NTS	14/09/23
DRAWN BY NS		CHECKED BY JM	





ST. MICHAELS
DEVELOPMENT,
MANCHESTER

ST

M

S73 SUBMISSION

218739

© COPYRIGHT SKIDMORE, OWINGS & MERRILL (EUROPE) LLP, 2021

Interior Designer	Synagogue Consultant	Design Consultant	hodder+partners
BOWLER JAMES BRINDLEY	FDG fairhursts design group		
Civil Engineer	Curtins		
Services Engineer	HOARE LEA (H.)		
Fire Engineer	DESIGN FIRE CONSULTANTS		
Client	ST M		Landscape Designer
			p-ie
			Project Manager
			zerum
Architect / Structural Engineer			
SOM			
Skidmore, Owings & Merrill (Europe) LLP The Broadgate Tower, 20 Primrose Street London EC2A 2EW, UK Tel: +44 (0)20 7798 1000 Fax: +44 (0)20 7798 1100			
STM-SOM-XX-XX-DR-A-0000			
SOM Drawing No		Revision	
S73-000		P03	

ABBREVIATIONS

AI	Above
AOD	Above Ordnance Datum
AP	Access Panel
APT	Apartment
BAC	Brickwork/Blockwork Accessories
BD	Board type, see schedule
BLK	Block/Blockwork type, see schedule
BMU	Building Maintenance Unit
BLRD	Bolard
BST	Basement steps
BT	Bathroom type
CJ	Control joint
CBD	Cupboard
CR	Cooker
CLG	Ceiling
CLR	Ceiling/sloft type, see schedule
CNR	Corner
COP	(Lift) Car Operating Panel
CON	Concrete
CPT	Carpet type, see schedule
CT	Curtain Wall type, see schedule
CW	Curtain Wall
DFN	Deflection
DIM	Dimension
BLD	Bolard
DR	Drain
DRI	Dry Riser Inlet
DRD	Dry Riser Outlet
DW	Dishwasher
DWR	Draw(s)
E	East, easting
EL	Fire Rating Integrity/Insulation
EQ	Equipment Lift
EQ	Equal(s)
ES	External render system, see schedule
ELEC	Electrical utility cupboard
EWS	External wall type, see schedule
EXH	Exhaust
FF	Fridge freezer
FFL	Finished floor level
FL	Fireman's Lift
FL	Floor finish type, see schedule
GA	General Arrangement (drawing)
GA	Gasket
GL	Grid line
GL	Glass type, see schedule
H	Height
HU	Heat Interface Unit
HW	Hard wood
IC	Inspection chamber, access cover
INS	Insulation type, see schedule
INT	Interior Design
KT	Kitchen type
LAN	Landscape Design
LA	Landscape Architect
LV	Louvre type, see schedule
MFR	Manufacturer
MIN	Minimum
MJ	Movement joint
MTL	Meat finish type, see schedule
MTR	Mortar type, see schedule
MVHR	Mechanical ventilation heat recovery
N	North, nothing
NOM	Nominally
NR	Not noted
OPNG	Opening
OPH	Opposite handed
PAN	Panel & board material, see schedule
PAS	Private Amenity Space
PBD	Plasterboard
PL	Passenger lift
PNL	Panel
PPC	Polyester powder coated(s)
PT	Paint type, see schedule
R	Radius
RC	Reinforced Concrete
RCH	Reliance Chute
RCP	Reflected ceiling plan
RES	Residential
RF	Resilient flooring type, see schedule
RFS	Roof system, see schedule
RWO	Rainwater outlet
RWP	Rainwater pipe
S	South
SCR	Screed
SE	Sealant type, see schedule
SGN	Sign
SIM	Similar
SO	Structural Opening
SOP	Setting out point
SS	Stainless steel
SSH	Smoke shaft
SSL	Structural slab level
ST	Stone type, see schedule
STL	Steel
STR	Storage
SVP	Soil vent pipe
SW	Softwood
T	Tread
T/	Top of
TBC	To be confirmed
TOL	Tolerance
TYP	Typical
U/	Underside of
UNO	Unless noted otherwise
UFH	Under Floor Heating Manifold
VNR	Veneer type, see schedule
W	Wide/Width
W	West
WD	Wood type, see schedule
WDB	Wardrobe type, see drawings
WKTP	Worktop
WM	Washing machine
WPS	Waterproofing system, see schedule
WP	Wind post
WTR	Solar shading fabric
WRI	Wet riser inlet
WRO	Wet riser outlet
WV	Wood veneer

MATERIAL GRAPHIC

	EARTH
	GRAVEL / GRANULAR FILL
	MORTAR SETTING BED
	SCREED
	CONCRETE SCALES 1:500 TO 1:50
	CONCRETE SCALES 1:20 TO 1:1
	WATERPROOFING / DAMPROOFING MEMBRANE
	CONCRETE BLOCKWORK
	BRICKWORK
	STONE
	STEEL
	ALUMINIUM
	WOOD BLOCKING
	MDF BOARD
	PLYWOOD
	FINISHED SOLID STOCK WOOD
	PLASTERBOARD / CEMENT PLASTER
	BATT INSULATION
	RIGID INSULATION
	GLASS
	GASKET
	INTENSIVE GREEN ROOF
	EXTENSIVE GREEN ROOF
	VENTILATION LOUVRE
	PLASTERBOARD

ANNOTATION SYMBOLS

Symbol	Description:
	Detail Section Marks
	Section Marks
	Detail Callouts
	Grid Heads
	Level Marker
	Room Tags
	Room Tags with areas and room number
	Spot Elevation Symbols - Plans
	Spot Elevation Symbols - Sections
	Workpoint
	Centre Line
	North Arrow
	Specialty Equipment Tags
	Casework Tags
	Door Tags
	Furniture Tags
	Keynote Tags
	Lighting Fixture Tags
	Multi-Category Tags
	Wall Tags with acoustic and fire ratings
	Window Tags
	Revision Cloud Tags
	Ceiling Tags
	Wall and doors to be in interiors fit out package
	View Name
	View Titles

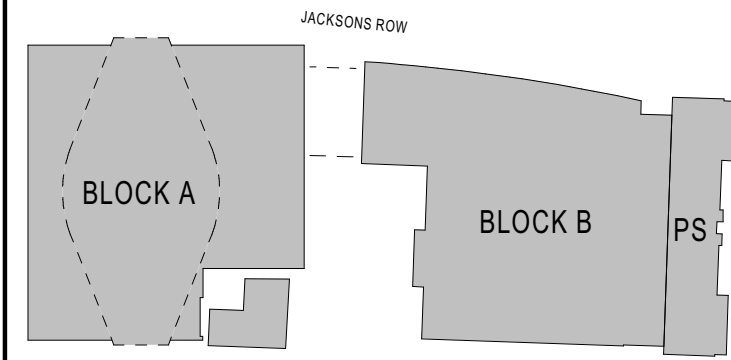
SYMBOLS

	GULLY
	STEP IN SLAB
	UPSTAND

GENERAL NOTES

- General**
- These drawings are to be read in conjunction with project specifications.
 - All references to codes, specifications and standards referred to in the contract documents shall mean, and are intended to be, the latest edition, amendment or revision of such reference standard in effect as of the contract documents.
 - Except where the contract documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the contract documents to the extent referenced. Such standards are made a part of the contract documents by reference.
 - When there appears to be a conflict between drawings and specifications, contractor to notify the architect of the discrepancy and seek clarification before proceeding with the work.
 - Project levels, in 7.50 are quoted Above Ordnance Datum (Ordnance Datum Newlyn).
 - Details shown are indicative of the character, profiles, materials and systems required for the work including those conditions not covered by specific details.
 - Refer to drawings of all other disciplines (structural, mechanical, plumbing, electrical, fire protection, and landscape) for additional information and coordination of work. Coordinate all work with overall aesthetic appearance of the project.
 - Where the design intent cannot be determined from the drawings or specifications, consult the architect before proceeding with the work.
 - The contractor shall visit the site and be knowledgeable of conditions thereon. The contractor shall investigate, verify and be responsible for all conditions of the project and shall notify the architect of any conditions requiring modification before proceeding with the work.
 - The owner has made available a survey of the site, existing utilities and existing construction. The survey represents all conditions known to the owner. Other construction, of which no records are available, may be encountered. The contractor shall formulate his own conclusions as to the extent of such construction, and shall notify the owner and the architect immediately if the survey appears to be at variance with the actual conditions encountered.
 - The contractor is solely responsible for properly setting out the work and for all lines and measurements for the work.
 - There shall be no manufacturer's logos, trademarks or identification on any exposed items, including doors and lifts. Only plant rooms, window washing equipment and other area not seen by the general public are exempt from this requirement.
- B. Dimensioning**
- Unless noted otherwise, all dimensions are in mm.
 - Dimensions shall govern, do not scale drawings. Where there appears to be a conflict between dimensions or where dimensions cannot be determined from the drawings, consult the architect before proceeding with the work.
 - Contractor shall verify the dimensions shown on the drawings before setting out the work and be responsible for any errors or inaccuracies resulting from his failure to do so. Contractor shall also notify the architect of any discrepancies between the drawings and the site conditions encountered. All core walls and partitions (ie, stairs, lift shafts, mechanical shafts and cavity/chase walls) are dimensioned to the inside face of walls relative to the clear opening requirements.
 - Exterior wall geometry elements are dimensioned to exterior face of main glazing lines. Unless shown otherwise, all doors shall be located such that there is a 50-mm wall return between the jamb frame and the adjacent perpendicular wall.
 - Unless noted otherwise, typical floor elevations shown are to the top of the structural slab. Where structural slabs are depressed to receive an architectural floor finish, such as in public areas, elevations shown are to the finished architectural floor surface.
 - Unless noted otherwise, roof elevations shown on the roof plan are to the high and low points of sloped concrete fill (excluding insulation thickness), or to the high and low points of tapered roof insulation in the case of flat structural slabs.

Key Plan



General Notes

P03	06/09/21	S73 Submission
P02	20/08/21	S73 Submission DRAFT
P01	15/11/19	S73 Submission
NO:	DATE:	ISSUE:

Status

FOR INFORMATION

Interior Designer	Synagogue Consultant	Design Consultant
Services Engineer		
Fire Engineer		
Client		Landscape Designer
		Project Manager

Architect
Skidmore, Owings & Merrill, Inc. The Broadgate Tower, 20 Primrose Street London EC2A 2EW, UK Tel: +44 (0)20 7798 1000 Fax: +44 (0)20 7798 1100

Project Name
ST. MICHAELS DEVELOPMENT, MANCHESTER

Drawing Title

GENERAL NOTES

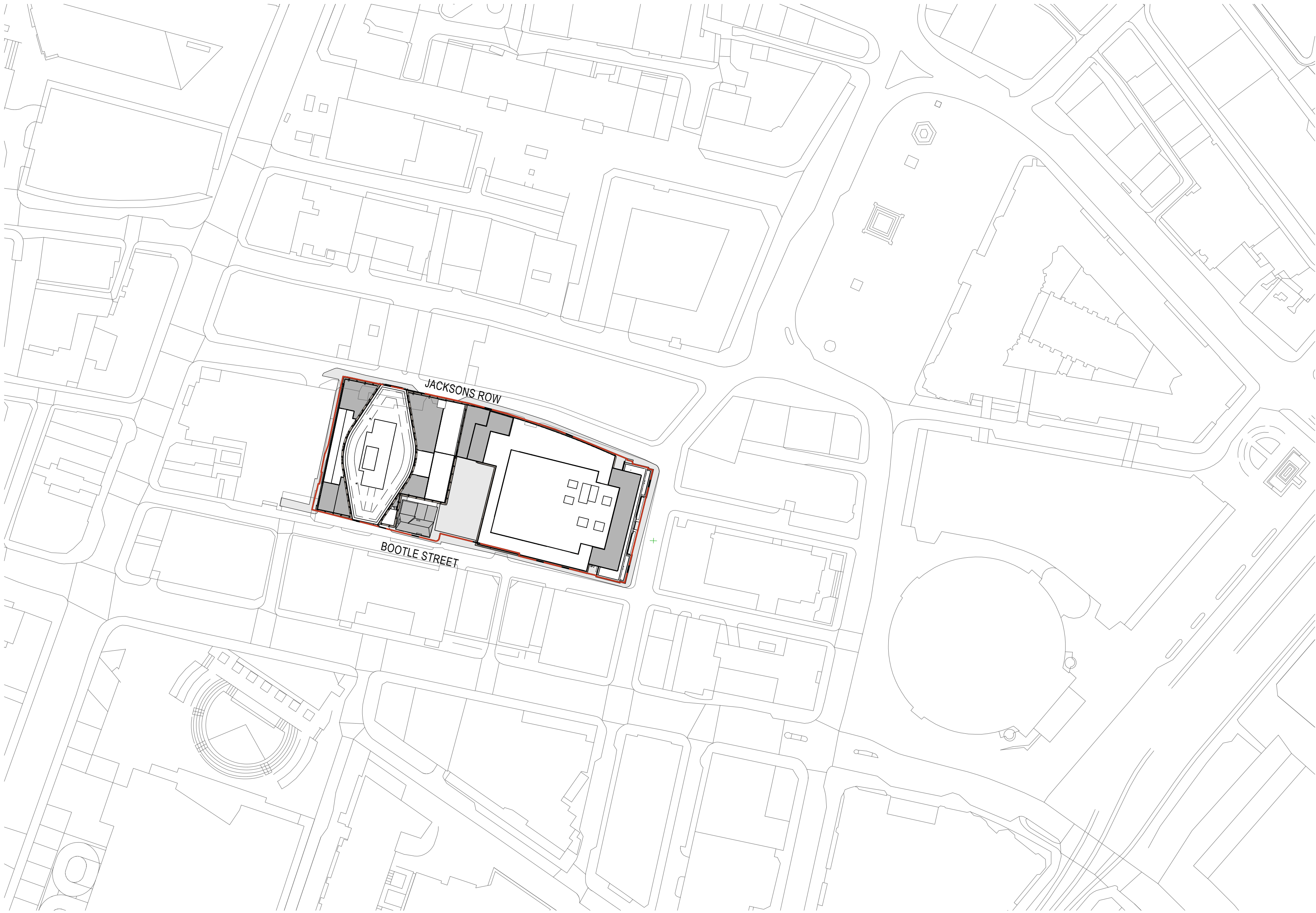
Project No	Drawing No	Revision
	218739	
Scale @ A0	S73-002	P03
	1 : 1250	

9/6/2021 6:35:42 PM

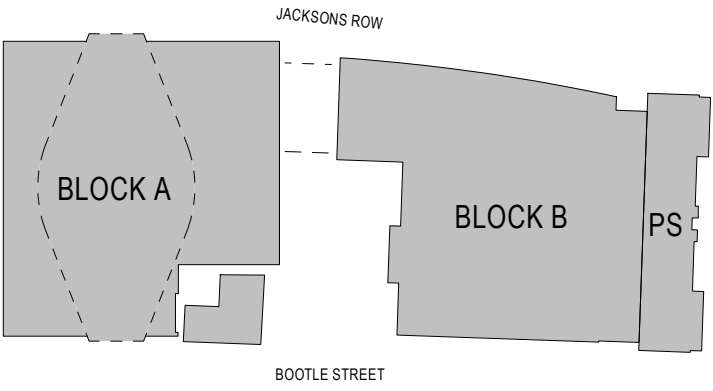
A7

SITE PLAN

1 : 1000



Key Plan



General Notes

P03	06/09/21	S73 Submission
P02	20/08/21	S73 Submission DRAFT
P01	15/11/19	S73 Submission
NO:	DATE:	ISSUE:

Status

FOR INFORMATION

Interior Designer ROWLER JAMES BRINDLEY	Synagogue Consultant FDG fairhurst design group	Design Consultant hodder+partners
Civil Engineer Curtins	Services Engineer HOARE LEA (H)	Fire Engineer DESIGN FIRE
Client ST!M	Landscape Designer p+pe	Project Manager zerum

Architect
SOM
Skidmore, Owings & Merrill, Inc.
The Broadgate Tower, 20 Primrose Street
London EC2A 2EW, UK
Tel: +44 (0)20 7798 1000 Fax: +44 (0)20 7798 1100

Project Name
**ST. MICHAELS DEVELOPMENT,
MANCHESTER**

Drawing Title
SITE PLAN

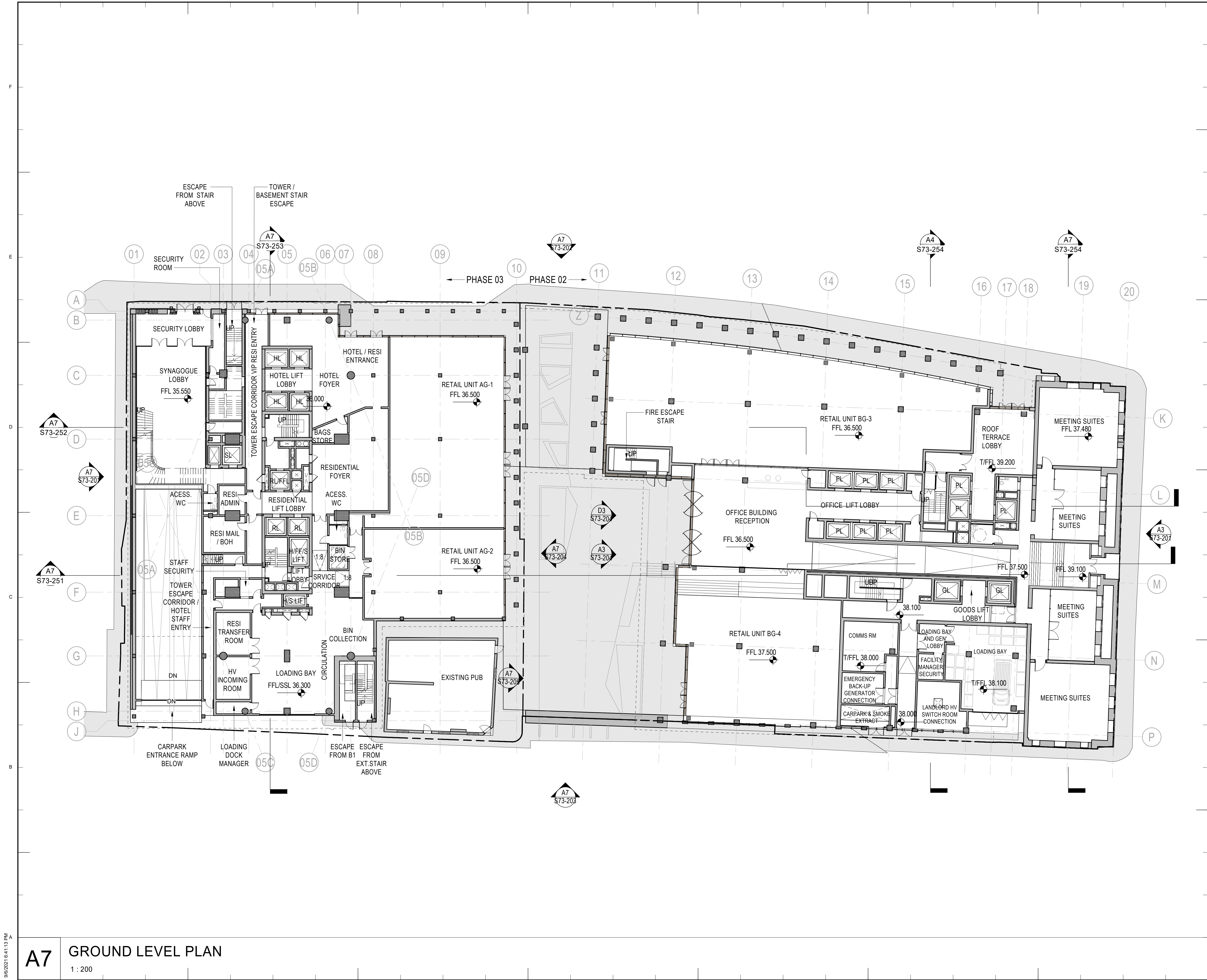
Project No 218739	Drawing No S73-011	Revision P03
Scale @ A0 As indicated		

© COPYRIGHT SKIDMORE, OWINGS & MERRILL (EUROPE) LLP. 2021

A7

GROUND LEVEL PLAN

1 : 200



Key Plan

General Notes

P03	06/09/21	S73 Submission
P02	20/08/21	S73 Submission DRAFT
P01	15/11/19	S73 Submission
NO:	DATE:	ISSUE:

Status

FOR INFORMATION

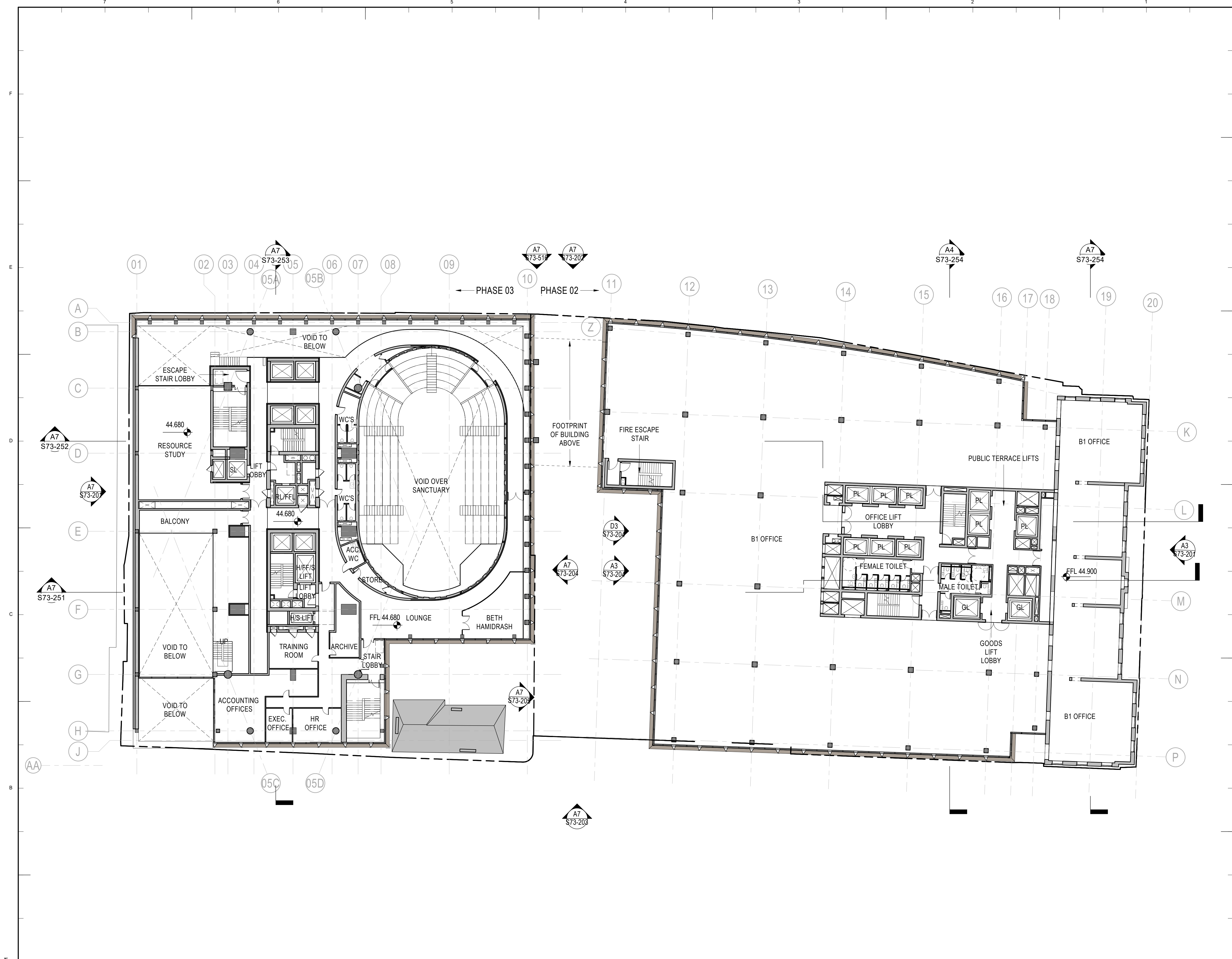
Interior Designer	Synagogue Consultant	Design Consultant
ROWLER JAMES BRINDLEY	FDG fairhurst design group	hodder+partners
Civil Engineer	McCurtins	
Services Engineer	HOARE LEA (HL)	
Fire Engineer	DESIGN FIRE	
Client	S!M	Landscape Designer
		zerum
Architect	SOM Skidmore, Owings & Merrill, Inc. The Broadgate Tower, 20 Primrose Street London EC2A 2EW, UK Tel: +44 (0)20 7798 1000 Fax: +44 (0)20 7798 1100	
Project Name		
ST. MICHAELS DEVELOPMENT, MANCHESTER		
Drawing Title		
GROUND LEVEL GA PLAN		
Project No	Drawing No	Revision
218739	S73-103	P03
Scale @ A0	As indicated	
© COPYRIGHT SKIDMORE, OWINGS & MERRILL (EUROPE) LLP. 2021		



A7

LEVEL 02 PLAN

1 : 200



Key Plan

General Notes

P03	06/09/21	S73 Submission
P02	20/08/21	S73 Submission DRAFT
P01	15/11/19	S73 Submission
NO:	DATE:	ISSUE:

Status

FOR INFORMATION

Interior Designer	Synagogue Consultant	Design Consultant
ROWLER JAMES BRINDLEY	FDG	hodder+partners
Civil Engineer	Curatins	
Services Engineer	HOARE LEA	
Fire Engineer	DESIGN FIRE	
Client	ST M	Landscape Designer
		p-1e
Architect	SOM	Project Manager
	Skidmore, Owings & Merrill, Inc. The Broadgate Tower, 20 Primrose Street London EC2A 2EW, UK Tel: +44 (0)20 7798 1000 Fax: +44 (0)20 7798 1100	zerum

Project Name

ST. MICHAELS DEVELOPMENT,
MANCHESTER

Drawing Title

LEVEL 02 GA PLAN

Project No	Drawing No	Revision
218739	S73-105	P03
Scale @ A0	As indicated	

© COPYRIGHT SKIDMORE, OWINGS & MERRILL (EUROPE) LLP. 2021

