

St. Michaels

Phase 2 Ground Investigation

Curtins Ref: 078847-CUR-00-XX-RP-GE-001

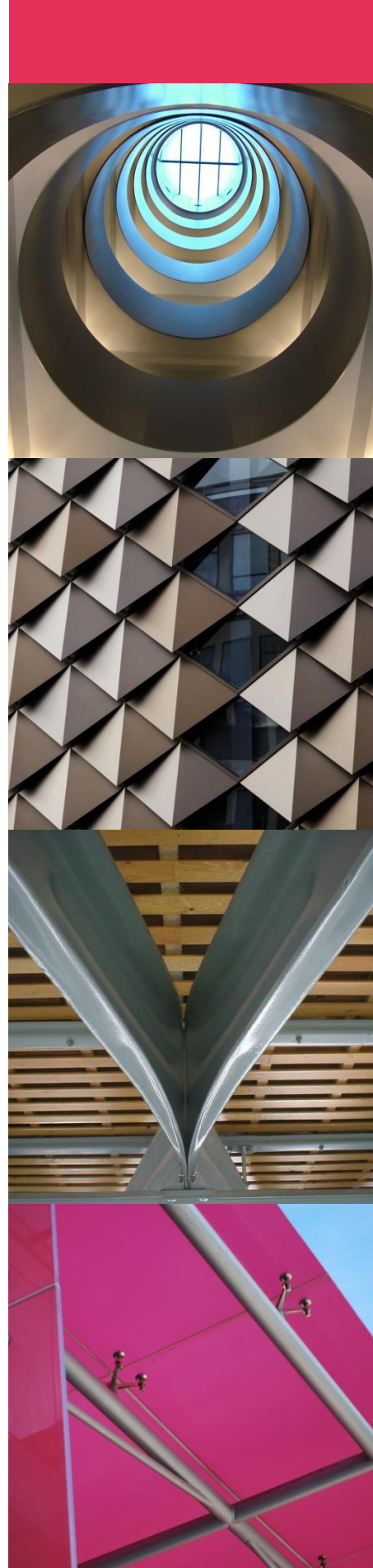
Revision: P02

Issue Date: 03 October 2022

Client Name: Bowmer & Kirkland

Client Address: NW Regional Office, 1st Floor, Altitude, Atlas Business Park, Manchester M22 5PR

Site Address: Bootle Street, Manchester M2 5GU



Curtins
Merchant Exchange
17-19 Whitworth Street West
Manchester, M1 5WG
Tel: 0161 236 2394
www.curtins.com

STRUCTURES • TRANSPORT PLANNING • ENVIRONMENTAL • CIVILS & INFRASTRUCTURE • EXPERT ADVICE • SUSTAINABILITY • STAKEHOLDER ENGAGEMENT
Birmingham • Bristol • Cardiff • Douglas • Dublin • Edinburgh • Glasgow • Kendal • Leeds • Liverpool • London • Manchester • Nottingham



Rev	Description	Issued by	Checked	Date
P01	Pre-Demo Investigation	ZH	RA	02 December 2021
P02	Updated to Include Post-Demolition Investigation	JL	NF	03 October 2022

This report has been prepared for the sole benefit, use, and information for the client. The liability of Curtins Limited with respect to the information contained in the report will not extend to any third party.

Author	Signature	Date
Z Henderson BSc (Hons) FGS Geo-Environmental Engineer		02 December 2021

Reviewed	Signature	Date
Andrew Smith BSc Hons CGeol FGS MCIWEM RoGEP Principal Geotechnical Engineer		02 December 2021
R Allen BSc (Hons) MSc FGS MCIWEM C.WEM CEng Principal Engineer		02 December 2021

Authorised	Signature	Date
R Allen BSc (Hons) MSc FGS MCIWEM C.WEM CEng Principal Engineer		02 December 2021

Executive Summary

Appointment	In June 2021 Curtins were instructed by Bowmer and Kirkland to undertake a Phase 2 Ground Investigation of land off Bootle Street, Manchester, M2 5GU. The site is centred at the approximate NGR SJ 83656 98006 and is approximately 0.3Ha in size. Ground investigation has been undertaken over two phases, the first stage was prior to demolition of existing buildings on site and the second stage following the demolition of the existing buildings. Development proposals for the partial redevelopment of the site include the construction of a new office building and the refurbishment of the existing building on site.
Current Site Status	The site is currently occupied by a central area of hardstanding used for car parking, surrounded by abandoned buildings to the north, east, south and west on site. The site bound by roads to the north (Jackson's Row), east (Southmill Street) and south (Bootle Street). The surrounding land comprises office blocks, restaurants and high-rise apartments.
Summary of Phase 1 and Previous Investigations	Earliest mapping (1848) shows buildings on site, with no specific use and Jackson's Row and Bootle Street are present in their current arrangement. By 1850, several small buildings and associated courtyards are located on site. Between 1894 and 1896, a courtyard is noted in the centre of the site and by 1908, the courtyard is labelled as a Fire Engine Station. It was no longer recorded by 1922. During WWII, the building in the southeast corner of the site was damaged during a bomb strike. By 1948, a police station is recorded in the northeast, east and southeast boundaries of the site. A sunken tank is located to the north of the police station. In 1955, the Poster Services Ltd print works covers the south east corner of the site including a garage and a petrol tank. By 1970, the print works have been demolished and replaced with car parking. The site configuration remains unchanged. Based on the site's historical land use, made ground is anticipated. BGS mapping indicates superficial deposits comprise glacial till underlain by bedrock noted as Chester Formation. The site is underlain by a Principal Aquifer within the bedrock formation and a Secondary Undifferentiated Aquifer within the superficial deposits. The nearest surface water feature is Rochdale Canal located 270m south east. The previous ground investigations undertaken on site by WSP in 2015, Structural Soils in 2016 and IFA in 2020 indicate made ground to a maximum depth of 4.90m bgl underlain by cohesive and granular glacial till. Sherwood Sandstone bedrock (Chester Formation) was encountered as residual soils (reddish brown medium to coarse sand) and intact bedrock (weak reddish brown medium grained sandstone). Primary potential risks to be investigated during this report, as well as established ground conditions for geotechnical design, included; potential for land gas and risks to human health from made ground soils.
Fieldworks Undertaken	The (pre-demolition) ground investigation was undertaken between 26th July and 13th August 2021 and comprised ten window samples, with three rotary follow on. Four window samples, three of which were rotary follow on, were undertaken at ground level and six within the existing basement. Boreholes were undertaken in positions reflecting the proposed location of the new structures and hardstanding to aid piled foundation design, and to undertake soil sampling, ground gas monitoring and groundwater level monitoring. Following demolition of the pre-existing structure on site, additional post-demolition investigation works were undertaken on the 24th August 2022, and comprised six machine excavated trial pits to obtain environmental sampling beneath the footprint of the pre-existing building. Ground gas monitoring standpipes were installed within the 4 window samples at ground level. Selected soil samples and groundwater samples were subjected to laboratory analysis. Six ground gas and groundwater monitoring visits have been undertaken over a period of 12 weeks.
Encountered Ground Conditions	Made ground was encountered in all exploratory holes from ground level to depths between 0.20m and 1.40m bgl. In all positions, an upper layer of concrete was encountered between 0.10m and 0.33m thick. Made ground was predominantly granular, recorded as reddish brown gravely slightly clayey sand/brown sandy gravel. In RBH101, made ground was encountered as brown sandy gravelly clay. Glacial Till deposits were encountered underlying the made ground to depths between 0.30m and 5.00m bgl. Cohesive glacial till was encountered in RBH102, RBH103 and WS104 as firm to very stiff reddish brown slightly gravelly clay. Granular till was encountered below or instead of cohesive till in RBH101-103 and WS104 – WS107 and WS109 – WS110 as reddish brown slightly gravelly fine to coarse sand/brown slightly gravelly coarse sand. The Chester Formation bedrock was encountered underlying the glacial till. It was encountered between depths of 0.20m and 5.00m bgl (34.18m – 32.40m AOD) to a maximum depth of 50.05m bgl (-13.20m AOD). Bedrock typically comprised interbedded variations of extremely weak to medium strong reddish brown fine to coarse grained sandstone. Groundwater was not encountered during the investigation. Post investigation monitoring has shown perched groundwater at depths of 0.33m – 1.18m bgl (36.23m – 37.08m AOD) within the cohesive glacial till. Groundwater within the bedrock was recorded between 11.45m – 13.94m (25.96m – 23.44m AOD).
Environmental Laboratory Testing	With respect to the proposed end-use of the site, soil testing results were compared against the conservative 'Commercial' GACs. No suspected asbestos containing materials (ACMs) were identified within any of the exploratory hole logs or laboratory screening. The risk to site end users from soils is therefore considered to be Low.

Ground Gas Assessment	During the ground gas monitoring programme, methane was not recorded within the boreholes. Maximum carbon dioxide concentrations were recorded at 0.7% v/v in RBH103 on the fourth visit. Peak flow and steady state flow rates were recorded at -1.3l/hr in RBH103 on the fifth visit. High peak and steady state flows recorded in RBH102 have been discounted as the response zone was flooded for the duration of the monitoring period. As such evaluation of the 'representative borehole' Q_{hg} of 0.0039 l/hr for carbon dioxide is calculated. Considering the above, it is recommended that the site is characterised with CS1 classification, with no gas protection measures required for the proposed development.
Geotechnical Assessment and Recommendations	It is understood that the proposed development is to comprise the construction of a new office building. Due to the risk associated with shallow ground conditions, it is unlikely that the made ground or glacial till will provide a suitable bearing stratum. It is understood that a raft foundation is the preferred option for the new development and further consideration of this solution is presented in this document. In the event the raft foundation does not provide suitable bearing capacities for the proposed structures, piled foundations may be adopted socketed into the Chester Formation. The site has been classified in accordance with BRE Special Digest 1 and it is considered that a Design Sulphate Class may be taken as DS-1 with an ACEC class of AC-1 for the made ground, glacial till and bedrock.
Recommendations	Based on the findings of the ground investigation, the following recommendations are made: 1) It is recommended that construction workers are provided with appropriate PPE and sanitary facilities, with reference to the environmental testing results presented herein and within Appendix C. 2) Should unexpected contamination be observed during construction advice should be obtained from a Geo-environmental Engineer. 3) A full raft design will be required to evaluate the proposed raft foundation performance under gravity loading once frozen layouts are provided. The recommendations in this report can then be re-assessed. 4) It is noted that the groundwater readings are recorded below the proposed raft foundation therefore groundwater management techniques are unlikely to be required during the construction works. Despite this ongoing groundwater monitoring is recommended so seasonal changes can be factored into the final raft design. 5) If a piled foundation solution is adopted for the proposed structures, consultation with piling contractors with experience in piling in similar ground conditions should be considered

Table of Contents

1.0	Introduction	1
1.1	Project Background	1
1.2	Scope of Services	1
2.0	Phase 1 Preliminary Site Assessment Summary	2
2.1	Current Setting	2
2.2	Previous Site Use	3
2.3	Published Geology	3
2.3.1	Made Ground Deposits	3
2.3.2	Superficial Deposits	3
2.3.3	Bedrock Deposits	4
2.3.4	BGS Recorded Borehole Logs	4
2.3.5	Mining	5
2.3.6	Radon	5
2.4	Hydrogeology and Hydrology	5
2.5	Unexploded Ordnance (UXO) Risk Assessment	6
2.6	Landfill	7
2.7	Previous Reports	7
2.7.1	WSP Ground Investigation Report, 2017	7
2.7.2	IFA Factual Report, 2020	8
2.7.3	Ramboll Ground Contamination Assessment, 2021	8
2.7.4	Ramboll Remedial Statement, 2021	9
2.8	Summary of Phase 1 PCSM	9
3.0	Ground Investigation Scope of Works	11
3.1	Soil Logging and Sampling	12
3.2	Monitoring Well Installations	12
3.3	Post-Investigation Monitoring	12
3.3.1	Groundwater and Ground Gas Monitoring	12

4.0	Laboratory Analysis	14
4.1	Geo-environmental Analysis	14
4.1.1	Soil Analysis	14
4.1.2	Groundwater Analysis	15
4.2	Geotechnical Testing	16
5.0	Ground Conditions.....	17
5.1	Encountered Ground Conditions.....	17
5.2	Made Ground	17
5.3	Glacial Till.....	18
5.3.1	Cohesive Glacial Till.....	18
5.3.2	Granular Glacial Till.....	18
5.4	Chester Formation.....	19
5.5	Observed Potential Contamination	19
5.6	Obstructions Encountered.....	19
5.7	Groundwater.....	19
6.0	Ground Model.....	21
6.1	Made Ground	21
6.2	Glacial Till.....	21
6.2.1	Cohesive Glacial Till.....	21
6.2.2	Granular Glacial Till Deposits.....	22
6.3	Chester Formation.....	23
6.3.1	Sandstone	26
6.4	Aggressive Ground Conditions	30
7.0	Ground and Groundwater Contamination Assessment.....	32
7.1	Human Health GQRA.....	32
7.1.1	Adopted Soil Human Health GACs Screening Methodology	33
7.1.2	Generic Assessment Criteria Screening of Soil Laboratory Results – Pre Demolition.....	33
7.1.3	Generic Assessment Criteria Screening of Soil Laboratory Results – Post Demolition	34

7.2	Controlled Waters GQRA.....	34
7.2.1	Adopted Controlled Waters Tier 1 Screening Values and Methodology.....	34
7.2.2	Tier 1 Screening of Groundwater Laboratory Results.....	35
8.0	Ground Gas Assessment	36
8.1	Ground Gas Monitoring Results.....	36
8.2	Ground Gas Assessment	37
9.0	Revised Conceptual Site Model	39
9.1	Summary of Significant Pollutant Linkages.....	41
10.0	Geotechnical Assessment and Recommendations.....	42
10.1	Introduction.....	42
10.2	Key Geotechnical Considerations	42
10.2.1	Site Preparation.....	42
10.2.2	Presence of Existing Services.....	42
10.2.3	Obstructions and Relict Foundations	42
10.2.4	Variable Superficial Deposits	43
10.3	Foundation Design	43
10.4	Ground Floor Slabs	45
10.5	Chemical Attack on Buried Concrete	45
10.6	Excavation and Support	45
11.0	Conclusions & Recommendations	46
11.1	Conclusions	46
11.1.1	Ground and Groundwater Contamination	46
11.1.2	Ground Gas Assessment	46
11.1.3	Geotechnical Assessment.....	47
11.2	Recommendations	47
12.0	References	48

Appendices

- Appendix A - Drawings
- Appendix B - Exploratory Hole Logs
- Appendix C - Chemical Laboratory Testing Results
- Appendix D - Geotechnical Analysis Results
- Appendix E - Ground Gas and Groundwater Monitoring Results
- Appendix F - GAC Screening Thresholds
- Appendix G - Risk Assessment Methodology

1.0 Introduction

1.1 Project Background

In June 2021 Curtins were instructed by Bowmer and Kirkland to undertake a Phase 2 Ground Investigation of land off Bootle Street, Manchester, M2 5GU. The site is centred at the approximate national grid reference SJ 83656 98006 and is approximately 0.30 Ha in size. A site location plan is presented on *Figure 2.1*. Ground investigation has been undertaken over two phases, the first stage was prior to demolition of existing buildings on site and the second stage following the demolition of the existing buildings.

Development proposals for the partial redevelopment of the site include the construction of a new office building and the refurbishment of the existing building on site.

Relevant development proposals are included within *Appendix A* for review.

1.2 Scope of Services

A scope for the intrusive ground investigation was developed with the following aims:

- i) Obtain additional geotechnical information to further characterise shallow and deeper site soils for foundation design for the proposed structure.

Specifically, the Phase 2 Ground Investigation Report is intended to:

- a) Determine the risk of the proposed end-user being adversely impacted by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use;
- b) Determine if there is a risk to the end-user from soil gases including methane, carbon dioxide, carbon monoxide and hydrogen sulphide;
- c) Characterise site wide natural soils;
- d) Recommendations for the design of foundations and building ground floor slabs; and
- e) Recommendations for the specification of sub-structure concrete.

Detailed flood risk assessment, ecology, archaeological studies and waste classification for off-site disposal are outside of the scope of this report.

2.0 Phase 1 Preliminary Site Assessment Summary

A Phase 1 Desk Study was undertaken for the site and the wider site area to the west by WSP in January 2016 (Ref.1). A summary of the detailed findings of this Desk Study, comprising current site setting, history, geology and hydrogeology/hydrology is presented within this Section with reference to additional information sources. The area referred to as '*the site*' is the area of land included within the Curtins ground investigation, as shown in *Figure 2.1*.

2.1 Current Setting

The site is currently occupied by a central area of hardstanding used for carparking surrounded by abandoned buildings to the north, east, south and west on-site. The site is bounded by roads to the north (Jackson's Row), east (Southmill Street) and south (Bootle Street). The surrounding land comprises office blocks, restaurants and high-rise apartments and hotels.

The sites topography is generally flat across the site.

The site location and boundary are illustrated in *Figure 2.1*.

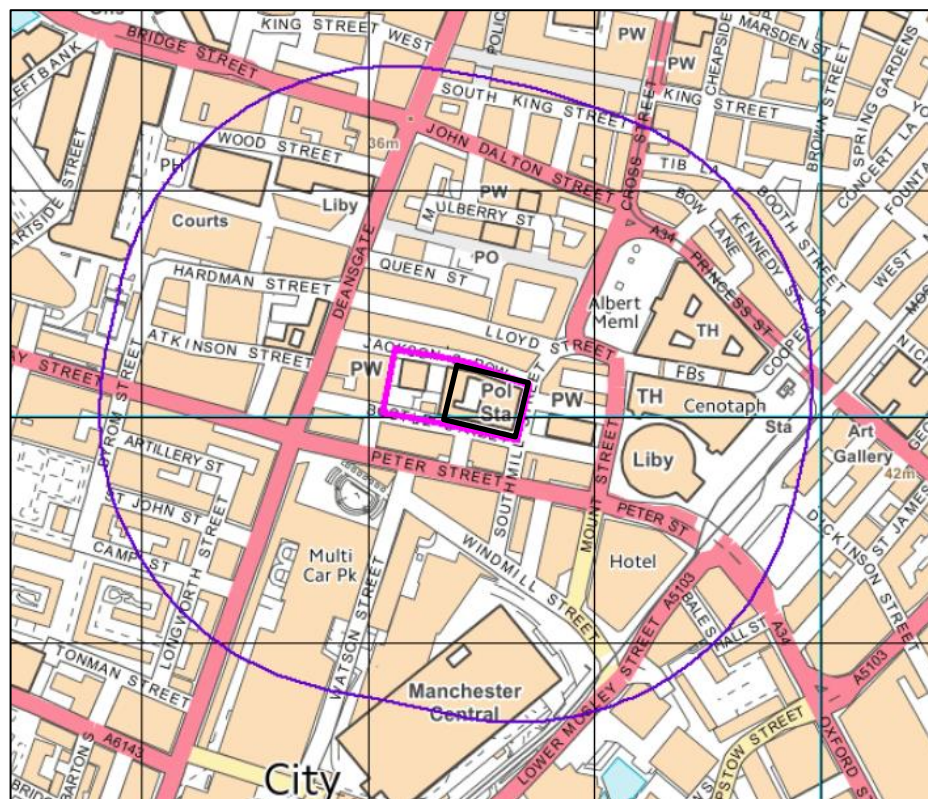


Figure 2.1 – Site Location Plan (wider site area from WSP report shown in pink, approximate Curtins site boundary shown in black).
(Ref. 1)

2.2 Previous Site Use

Earliest mapping (1848) shows buildings on site, with no specific use. Jackson's Row and Bootle Street are present in their current arrangement. From 1850 several small courtyards with small buildings, likely to be residential, are located on site. Two alleys are located on site (Roger's Row and South Sea) connect to Jackson's Row and Bootle Street on the eastern half of the site. To the east of South Sea alley, a Cotton Dye Works is noted. Between 1894 and 1896 a courtyard is noted in the centre of the site, with several buildings demolished during this period. By 1908 the courtyard is labelled as a Fire Engine Station and many of the courtyards and associated residential buildings have been replaced by larger structures. By 1922 the Fire Engine Station is no longer present on historical mapping.

During the early 1940s the building in the southeast corner of the site was damaged during a bomb strike. By 1948 a police station appears located across the northeast, east and southeast boundaries of site and a building of an unknown use to the west of the site. The South Sea alley is no longer present on historical mapping. A sunken tank is located to the north of the police station. In 1955, alongside the current buildings on site, the Poster Services limited print works covers the southeast corner of site, including a garage and by 1962 a sunken petrol tank. From 1970 the print works have been demolished and replaced with car parking.

2.3 Published Geology

A study of the Phase 1 Preliminary Risk Assessment (Ref. 1) Report and the British Geological Survey (BGS) 1:50,000 mapping records (Solid and Drift) for Manchester (Sheet 085) dated 2011 (Ref. 2) indicates the following geological and hydrogeological succession underlying the site:

- **Superficial Deposits:** Glacial Till
- **Solid Geology:** Chester Formation

There is a fault recorded approximately 15m south west of the site orientated north west south east. An additional fault runs parallel approximately 90m south west.

2.3.1 Made Ground Deposits

BGS mapping records does not indicate the presence of Made Ground on site however, borehole scans in the surrounding area and the site's history would suggest the presence of Made Ground on site.

2.3.2 Superficial Deposits

Superficial deposits are recorded by the BGS as Glacial Till made up of granular and cohesive deposits.

A summary of the superficial stratigraphy is presented in *Figure 2.3.2*.



Figure 2.3.2 – Extract of BGS 1:50,000 Geological Map. Approximate site location in Red.

The glacial till comprises a heterogenous mixture of clay, sand, gravel, and boulders varying widely in size and shape.

Glaciofluvial Sheet Deposits are detailed approximately 25m SW of the site comprising sand and gravel.

2.3.3 Bedrock Deposits

The site is underlain by the Chester Formation, comprising a fine to coarse-grained sandstone.

2.3.4 BGS Recorded Borehole Logs

There are no available BGS borehole scans on site, however there are several boreholes located within 50m of the site boundary, presented in *Table 2.3.4*.

Table 2.3.4 – Summary of BGS Recorded Borehole Logs

Record Reference	Location (NGR)	Details (bottom to top of strata/details/thickness of strata)	
SJ89NW3735	Approx. 30m north (383750, 398060)	0.00m to 0.10m bgl	MADE GROUND: Bituminous surfacing (0.10m)
		0.10m to 0.40m bgl	MADE GROUND: Ash (0.40m)
		0.40m to 3.50m bgl	Stiff to very stiff brown sandy silty CLAY with stone and coal inclusions (3.10m)
		3.50m to 5.00m bgl	Very dense red/brown very silty fine to medium grained SANDSTONE (1.50m)
		5.00m bgl	Borehole complete
SJ89NW3736	Approx. 36m northwest (383660, 398080)	0.00m to 0.15m bgl	MADE GROUND: Bituminous surfacing (0.15m)
		0.15m to 1.20m bgl	MADE GROUND: Ash and brick (1.05m)

		1.20m to 2.20m bgl	Soft to firm brown sandy silty CLAY with sand lenses and stone and coal inclusions (1.00m)
		2.20m to 4.90m bgl	Medium dense to dense silty SAND and GRAVEL (2.70m)
		4.90m to 6.50m bgl	Very dense red/brown fine to medium grained SANDSTONE (1.60m).
		6.50m bgl	Borehole complete

2.3.5 Mining

A review of the Coal Authority interactive mapping (Ref. 3) for the area indicates that the site is located within a Coal Mining Reporting Area but is not within a Development High Risk Area.

There are no recorded mine entries, coal workings or probable coal workings within 1km of the site. The closest entry is approx. 2km northeast, and the closest workings and outcrop are located approximately 2.7km northeast of the site.

Consequently, the risk to development from historic coal mining is considered to be **Low**. No further actions are required to further assess the risk to development from historic coal mining.

2.3.6 Radon

The site is located within a Lower Probability Radon Area (<1% of homes are estimated to be at or above the Action Level). No radon protective measures are necessary.

If a basement is proposed, a radon specialist should be contacted for advice.

2.4 Hydrogeology and Hydrology

The Phase 1 Preliminary Risk Assessment (Ref. 1) data indicates that the geological sequence underlying the site has the following hydrogeological characteristics:

Table 2.4 – Hydrogeology and Hydrology Summary

Geology	Associated Hydrogeological Classification
Glacial Till	Secondary Undifferentiated Aquifer ¹
Chester Formation, Sherwood Group	Principal Aquifer ²

Notes:

1. Assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
2. Low permeability and negligible significance for water supply or river base flow.

The site is not located within a Source Protection Zone (SPZ).

The nearest surface water feature identified is the Rochdale Canal, approximately 270m southeast of the site. No water quality data is available for this watercourse.

There are five discharge consents within 500m of the site, the closest is located approximately 450m northwest of site, relating to the discharge of cooling water into the River Irwell.

2.5 Unexploded Ordnance (UXO) Risk Assessment

The likelihood of UXO being encountered on a development site is influenced by several factors including; the proximity to strategic targets, the nature of the development works being undertaken and evidence of local damage in the post-war periods amongst others. To determine the likelihood of UXO being present on a site, a step-wise risk assessment process is followed. This process is outlined within CIRIA C681 Unexploded Ordnance: A Guide for the Construction Industry (Ref. 4).

Risk mapping (Ref. 5) for UXO's has placed the site in a **Low** risk area. Low-risk regions are those with a bombing density of less than 15 bombs per 1000 acres. However, a Luftwaffe target is located 250m north and an UXO was found 265m south of the site.

A review of the available historic mapping identified the presence of ruins 20m and 80m west of the site during 1940 and 1941. There was also indication of bomb damage on site to the southeast noted on historical mapping.

A Detailed UXO Assessment was commissioned by WSP, identifying the Curtins site as low risk. Within the report the Manchester damage map for the area is included, *Figure 2.5* below. This notes a bomb strike on site in the southeast corner and another approximately 60m southeast of the site. Areas of minor to moderate damage are noted on site to the southeast and 15m west and 60m southeast, and serious damage noted 20m and 80m northwest of the site, associated with the ruins noted on historical mapping.



Figure 2.5 – Extract of Manchester Damage Map (wider site area from WSP report shown in blue, approximate Curtins site boundary shown in black).

Considering the above, the risk of encountering potential UXO as part of future intrusive works is considered **Low**, and no further action is required.

If unexploded ordnance is discovered during any works, stop immediately, prevent access to the area, and inform the police. If the site boundary or location changes then the UXO risk should be reassessed.

Contractors undertaking excavations works should carry out their own UXO Risk Assessment in respect to their works.

2.6 Landfill

There are no recorded landfill sites within 500m of the site. There is one Licensed Waste Management Facility 323m southeast of the site, licensed to operate mobile plant for reclamation and restoration.

2.7 Previous Reports

A number of previous reports have been written for the wider site area. Details of these are outlined below in *Section 2.7.1* to *Section 2.7.4*. WSP also issued a Phase 1 Preliminary Risk Assessment (Ref.1) to provide an initial assessment of the wider site area accounting for potential for ground and groundwater contamination, potential geotechnical hazards associated with ground conditions pertaining to the development site and the location of apparent sub-surface obstructions that may affect the proposed redevelopment. Details of this are included within *Section 2.1* to *Section 2.6*.

2.7.1 WSP Ground Investigation Report, 2017

In February 2017 WSP produced a Ground Investigation Report (Ref. 6) based on the fieldworks undertaken by WSP in 2015 and Structural Soils Ltd in 2016, for ground and groundwater conditions across the site as part of feasibility assessments. The report also includes information reported on in the WSP Preliminary Geotechnical and Environmental Assessment in December 2015 (Ref. 7).

The WSP ground investigation comprised 3 No. window sample boreholes to depths between 3.00m and 4.00m bgl, 1 No. dynamic probe to 4.50m bgl and 1 No. rotary borehole to 15.00m bgl. The Structural Soils ground investigation comprised 6 No. window sample boreholes to depths between 0.50m and 5.15m bgl, 3 No. dynamic sampling boreholes with rotary follow-on to depths between 33.00m and 35.35m bgl, 6 No. foundation inspection pits to depths between 0.60m and 1.00m bgl and 14 No. horizontal wall cores.

Geotechnical in-situ and laboratory testing was undertaken as part of the investigation including; Point Load Index, Unconfined Compressive Strength and Particle Size Distribution.

Ground conditions encountered across both ground investigations generally comprised Made Ground from ground level to maximum depth of 4.90m bgl (32.51m AOD) comprising laminate floor, over concrete, over granular and cohesive materials recorded as a loose gravelly sand with brick and concrete, and a sandy gravelly clay, respectively.

Below the Made Ground Cohesive Glacial Till deposits were encountered locally to 2.00m bgl (35.50m AOD) and/or Glaciofluvial Sheet Deposits to a maximum depth of 4.60m bgl (30.35m AOD). The Glacial Till was recorded as a soft slightly sandy slightly gravelly Clay, and the Glaciofluvial Sheet Deposits recorded as a gravelly slightly silty fine to medium Sand.

The Sherwood Sandstone bedrock was encountered below the superficial deposits to the base of the boreholes, recorded as a residual soil (reddish brown medium to coarse Sand) above the intact bedrock (weak reddish brown medium grained Sandstone).

A deep groundwater level was recorded in the Sherwood Sandstone bedrock at approximately 25m AOD.

Based on the 2015 and 2016 ground investigations. no chemical exceedances were noted within the area of the Curtins site boundary. The gas risk assessment for the site as a whole was classified under Characteristic Situation 1 (CS1) for the site.

2.7.2 IFA Factual Report, 2020

In December 2020 IFA issued a Factual Report on Ground Investigation (Ref. 8) for the site investigation works that were undertaken during March 2020. The ground investigation comprised 7 No. hand excavated trial pits to depths between 4.00m and 5.00m bgl and 3 No. wall cores.

Ground conditions comprised a Made Ground to a maximum depth of 1.24m bgl (TP07), typically to a depth of 0.24m bgl. The Made Ground typically consisted of concrete over a layer of bitumen over concrete. In TP07 the Made Ground comprised tarmacadam, over paving slabs, over a firm brown slightly gravelly sandy clay.

No geotechnical or environmental samples were taken during the ground investigation for testing.

2.7.3 Ramboll Ground Contamination Assessment, 2021

In January 2021 Ramboll produced a Ground Contamination Assessment report (Ref. 9) based on the intrusive site works undertaken by Structural Soils. The report was issued to assess the data obtained during the ground investigations and produce a refined conceptual model and qualitative risk assessment, as well as identify any residual ground contaminations issues on site that need addressing.

The results from the environmental testing were selected for soil a preliminary waste classification assessment and landfill acceptance criteria testing. The results of this classed the samples as non-hazardous and, however any Made Ground on site should be segregated according to material type. Also, any material different from what was encountered during the ground investigations or material with visible contamination must be separated from the remaining soils.

Based on the report, a remedial strategy report has been produced to address residual ground contamination risks on site.

2.7.4 Ramboll Remedial Statement, 2021

A remediation report was issued by Ramboll in March 2021 (Ref. 10) based on the data obtained during the Structural Soils ground investigation. Remedial mitigation measures have been identified based on potential pollution linkages identified in the Ground Contamination Assessment report.

The following are to be incorporated into the development of the design and construction to allow for safe development:

- Additional site investigation post-demolition of the buildings on site, where previously inaccessible.
- Management of asbestos containing soils on site.
- Soil excavations and any potential reuse to be under the CL:AIRE Definition of Waste, Code of Practice protocol.
- Procedures for dealing with previously unidentified contamination.

2.8 Summary of Phase 1 PCSM

A summary of potential pollutant linkages at the development site as identified in the WSP Phase 1 Report (Ref. 1) are presented in *Table 2.8*. These potential pollutant linkages were identified as requiring further investigation to enable the safe redevelopment of the site.

Potential contaminants of concern associated with any Made Ground present include, amongst others; broad range aliphatic and aromatic hydrocarbons present within any fuel oils; inorganic compounds including heavy metals; and asbestos present in discarded building materials.

The risks presented to controlled waters (groundwater and surface water) were identified as Low and Very Low respectively due to the site not located in a SPZ and distance from the nearest surface water feature. Water samples are therefore considered unlikely to be required unless visual or olfactory evidence of soil contamination suggests there may be a risk to controlled waters.

Table 2.8 – Preliminary Conceptual Site Model

Source	Pathway	Receptor	Risk Rating
On-site sources of potential contamination: Potential contamination from Made Ground of unknown composition associated with phases of construction, demolition and redevelopment on site.	Direct contact, ingestion, inhalation (dust and vapours)	Site End Users	Low / Moderate
		Construction and Maintenance Workers	
	Vertical migration through the superficial deposits (soils)	Controlled Waters (Groundwater – Secondary Undifferentiated Aquifer and Principal Aquifer)	Low
Off-site sources of potential contamination: Potential contamination associated with phases of construction, and demotion in the surrounding area.	Horizontal migration over and through the superficial deposits (soils)	Controlled Waters (Surface Waters – Rochdale Canal approx. 270m southeast)	Very Low
On and off-site soils with the potential to generate ground gases: Potential ground gas generation from Made Ground containing organic / putrescible content on and off site.	Vertical and horizontal migration through underlying superficial deposits into buildings and air spaces	Site End Users	Low

3.0 Ground Investigation Scope of Works

Site investigation works were undertaken by Curtins between 26th July to 13th August 2021. Post demolition site investigation works were undertaken by Curtins on the 24th August 2022.

The scope of the ground investigation was designed in general accordance with current UK guidance including:

- LCRM (Ref. 11);
- British Standard (BS) 10175:2011+A2:2017 (Ref. 12);
- BS5930:2015+2020 (Ref. 13); and
- BS EN1997: Part 2:2007 Eurocode 7 (Ref. 14).

The scope and rationale are summarised in *Table 3.0*.

Table 3.0 – Scope and Rationale of Fieldwork Undertaken

Stage	Exploratory Hole Type	Exploratory Hole Ref.	Ground level (m AOD)	Exploratory Hole Depth (m bgl)	Rationale
Pre Demo	Window Sample Boreholes	WS104 WS105 WS106 WS107 WS108 WS109 WS110	37.41 34.31 34.30 33.53 34.39 34.33 34.34	1.82 0.37 0.32 0.42 0.30 0.31 0.32	Confirm shallow ground and groundwater conditions and supplement previous investigations; Collect soil samples for chemical analysis; Collect samples for geotechnical soil testing; and Gas and groundwater level monitoring.
	Geobore S Boreholes	WS101/RBH101 WS102/RBH102 WS103/RBH103	37.38 37.37 37.41	50.50 50.00 50.00	Confirm deeper ground and groundwater conditions and supplement previous investigations; Collect soil samples for chemical analysis; Collect samples for geotechnical soil and rock testing; To aid foundation design; and Gas and groundwater level monitoring.
Post Demo	Machine Excavated Trial Pits	TP01 TP02 TP03 TP04 TP05 TP06	-	1.00 1.00 1.00 1.00 1.00 1.00	Confirm shallow ground conditions in previously inaccessible areas; Collect soil samples for chemical analysis.

For the location of the exploratory holes refer to Curtins drawing ref: 078847-CUR-00-XX-DR-GE-003-V02 Exploratory Hole Location Plan included in *Appendix A*.

3.1 Soil Logging and Sampling

Exploratory hole arisings were logged onsite by an Engineer from Curtins and in accordance with the requirements of BS5930 (Ref. 13). No observed visual and olfactory indications of contamination were recorded. Exploratory hole logs can be referred to *Appendix B*.

3.2 Monitoring Well Installations

Ground gas and groundwater monitoring 50mm diameter slotted pipes were installed within all three Geobore S boreholes (RBH101 to RBH103) and in one window sample borehole (WS104). A bentonite seal was placed at the top and bottom of each of the exploratory holes, surrounding the screened sections of the pipe. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of the pipe.

The monitoring wells installed in the window sample boreholes were designed to assess the potential for ground gas and monitor shallow / perched groundwater levels. The monitoring wells installed in the cable percussion boreholes were designed to monitor the groundwater levels at depth.

The screened sections therefore focused on the more permeable deposits where encountered, where ground gas and groundwater may be encountered.

A summary of the response zone is presented in *Table 3.2*.

Table 3.2 – Monitoring Well Response Zones

Borehole Ref.	Response Zone m bgl (m AOD)	Strata Description(s)
RBH101	35.00 – 50.00 (2.38 – -12.62)	SANDSTONE (Chester Formation, Sherwood Sandstone Group)
RBH102	20.00 – 35.00 (17.37 – 2.37)	SANDSTONE (Chester Formation, Sherwood Sandstone Group)
RBH103	5.00 – 20.00 (32.41 – 17.41)	SANDSTONE (Chester Formation, Sherwood Sandstone Group)
WS104	0.50 – 1.00 (36.91 – 36.41)	CLAY (Glacial Till)

A copy of the borehole logs can be referred to in *Appendix B* of this report.

3.3 Post-Investigation Monitoring

3.3.1 Groundwater and Ground Gas Monitoring

Six groundwater level and ground gas monitoring visits over three months have been undertaken, to assess the groundwater levels and the ground gas conditions. These were undertaken from 17th August to 5th November 2021.

The results of the groundwater level monitoring are detailed in *Section 5.8*.

The results of the ground gas monitoring are detailed in 8.0.

4.0 Laboratory Analysis

4.1 Geo-environmental Analysis

Representative soil samples were selected for laboratory chemical analysis, based on field observations and to provide information about the encountered ground conditions.

A total of 4 No. soils samples, 3 No. in the Made Ground and 1 No. in the glacial till, were selected for chemical testing. Soil samples were placed in laboratory provided containers and stored in cool boxes prior to being transported to the nominated laboratory under the laboratory's chain of custody documentation. The laboratory selected by Curtins for chemical and geotechnical analysis was Envirolab Ltd (UKAS and MCERTS accredited). Geotechnical analysis was sub-contracted to Ian Farmers Associates, RSK Group, a UKAS accredited laboratory.

Given the lack of any obvious sources of potential contamination the sampling positions were generally located in a non-targeted, systematic array, beneath the proposed school footprint, to give adequate and representative coverage of the sites proposed end use and the immediate environmental setting, concentrated in the near surface deposits.

4.1.1 Soil Analysis

The source material of contaminants of concern potentially present on the site was considered to include, amongst others; organic matter, ash and fill, hydrocarbons (e.g. fuel/oils), polyaromatic hydrocarbons (PAHs), heavy metals, and asbestos.

The extent of the above is captured by the broad environmental testing suites listed in *Table 4.1.1*.

Table 4.1.1 – Environmental Chemistry Analysis Suite: Soils

Suite Ref.	Analyte	LOD
Soils Suite A	Asbestos Screen	-
	pH Value	0.1 pH
	2:1 Water Soluble Sulphate	0.01 g/l
	Soil Organic Matter (SOM)	0.4% w/w
	Arsenic, Chromium, Chromium VI, Copper, Lead, Nickel, Selenium	0.20 - 1 mg/kg
	Zinc	0.5 mg/kg
	Boron (water soluble)	0.4 mg/kg
	Cadmium	0.1 mg/kg
	Mercury	0.1 mg/kg
	Cyanide (total)	0.5 mg/kg

Suite Ref.	Analyte	LOD
	Phenols (screen)	0.3 mg/kg
	PAHs (USEPA 16)	0.1 mg/kg
	TPH (Aro/Ali Split)	1 mg/kg

A total of four soil samples were obtained from the boreholes and tested for Suite A. No visual or olfactory evidence of contamination was identified during the ground investigation to justify increasing the testing to incorporate other contaminants such as VOC or SVOC analysis.

Following demolition of the pre-existing structure on site, additional sampling and testing was undertaken beneath the footprint of the building. A total of six soil samples were obtained following demolition and tested for Suite A.

Copies of the environmental chemistry testing certificates are presented in *Appendix C*.

4.1.2 Groundwater Analysis

Monitoring wells installed in RBH101, RBH102 and RBH103 were developed to remove potential contamination associated with the drilling of the boreholes and subsequent installation.

Three groundwater samples were obtained from RBH101, RBH102 and RBH103 on the second ground gas and groundwater level monitoring visit, on 2nd September 2021.

The three samples were subject to chemical analysis for a suite of contaminants of concern similar to that described for shallow site soils. The testing suite is summarised in *Table 4.1.2*.

Table 4.1.2 – Environmental Chemistry Analysis Suite: Water

Suite Ref.	Analyte	LOD
Soils Suite A	TPH CWG, EPHCWG – Ali/Aro Split	1 – 10 µg/l
	BTEX Compounds	1 µg/l
	Dissolved arsenic, boron, cadmium, copper, chromium, lead, mercury, nickel selenium, zinc	0.2 – 10 µg/l
	PAH 16MS	0.01 µg/l
	pH	0.01 pH
	Hardness Total	2 mg/l CaCO ₃
	Sulphate, Dissolved calcium	1 mg/l
	Cyanide (total)	0.005 mg/l
	Phenols – Total by HPLC	0.01 mg/l
	Sulphide	0.1 mg/kg
	DOC	0.2 mg/l

Copies of the environmental chemistry testing certificates are presented in *Appendix C*.

4.2 Geotechnical Testing

Soil samples for testing were prepared in accordance with BS1377: Part 1:2016 (Ref. 15). Rock samples for geotechnical testing were prepared and tested in accordance with ISRM Suggested Methods (Ref 16.) The undertaken geotechnical testing is summarised in *Table 4.2*.

Table 4.2 – Geotechnical Testing

Test Type	Quantity	Standard
In Situ Testing		
Standard Penetration Testing	18	BS 5930: 2015+2020, Clause 41
Laboratory Testing (General Testing - Foundation Design)		
Water Soluble Sulphate	9	ISO 17025 MCERTS
pH Value	9	ISO 17025 MCERTS
Point Load	Axial Plane: 51	ISRM Suggested Methods: 2007
	Diametral Plane: 52	
	Irregular Plane: 1	
Uniaxial Compressive Strength Test (UCS)	44	ISRM: 1089 Non UKAS Accredited
Young's Modulus	3	ISRM Suggested Methods: 2007
Poisson's Ratio	3	ISRM Suggested Methods: 2007

The results of the geotechnical testing are summarised in *Section 6.0* of this report.

Copies of the geotechnical testing certificates can be referred to in *Appendix D*.

5.0 Ground Conditions

The ground conditions across the site, determined during the Curtins ground investigation works, generally comprised a surface layer of concrete overlying a Made Ground of various compositions. This was underlain by a firm to very stiff Clay and/or very dense sand which has been described as Cohesive and Granular Glacial Till in this report. Underlying this the Chester Formation was encountered, recorded as an interbedded extremely weak to medium strong reddish-brown fine to coarse grained Sandstone.

5.1 Encountered Ground Conditions

A summary of the ground conditions encountered during the Curtins site investigation works is presented below, with detailed information presented on the exploratory hole logs which can be referred to in *Appendix B*.

Table 5.1 – Summary of Ground Conditions Encountered in the Curtins Investigation

Stratum	Depth to top of strata, m bgl (m AOD)	Recorded Thickness (m)		Description
		Min	Max	
Made Ground	0.00 (37.41 – 33.30)	0.20	1.40	MADE GROUND: Concrete
				- MADE GROUND of clay, gravel and sand variations. See <i>Section 5.2</i> for details.
Glacial Till (Cohesive)	0.20 – 1.40 (37.19 – 33.16)	0.05	4.00 ¹	Firm to very stiff reddish brown slightly gravelly CLAY. Gravel is subrounded fine to coarse of sandstone.
Glacial Till (Granular)				Very dense brown to reddish brown gravelly medium to coarse SAND. Gravel is subrounded to well-rounded fine to coarse of sandstone and quartz.
Chester Formation	0.20 – 5.00 (34.18 – 32.40)	0.02 ²	47.00 ²	Interbedded extremely weak to medium strong reddish-brown fine to coarse grained SANDSTONE, with extremely closely spaced to medium spaced planar rough fractures. Descriptions vary with boreholes location and depth; bedrock frequent noted as sandstone with gravel clasts. The bedrock notably becomes stronger and less fractured with an increase in depth. See <i>Section 5.4</i> and <i>Appendix B</i> (Exploratory Hole Logs) for details.

¹ Base of Glacial Till not proven in all exploratory holes

² Base of Chester Formation bedrock not proved in any exploratory holes

5.2 Made Ground

Made Ground was encountered in all exploratory holes from ground level to depths between 0.20m and 1.40m bgl (37.19m to 33.16m AOD). In all positions an upper layer of concrete was encountered with

a thickness between 0.10m and 0.33m, except in WS108 where laminate floor (0.01m thickness) overlies concrete (0.19m thickness).

In RBH101 a Made Ground comprising brown sandy gravelly clay with intact bricks was encountered, while in RBH102 and RBH103 the Made Ground was recorded as a reddish-brown gravelly slightly clayey fine to coarse sand with intact bricks. In WS105 and WS106 Made Ground comprising brown sandy angular to subangular fine to coarse gravel was encountered below the concrete.

In WS104 and WS107 the concrete directly overlies the natural stratum below and in WS109 and WS110 the Made Ground comprised a 0.10m thick layer of concrete, overlying a 0.02m thick layer of bitumen, followed by a 0.08m thick layer of intact bricks.

The sand is fine to coarse and the gravel across site is recorded as angular to subangular fine to coarse of sandstone, brick, ceramic, concrete, bitumen and coal.

5.3 Glacial Till

Deposits of Glacial Till were encountered below the Made Ground in all exploratory holes except WS108 underlying the Made Ground to maximum depths between 0.30m and 5.00m bgl (35.59m and 32.40m AOD).

Due to the variability in the composition of the Glacial Till (i.e., interbedded granular and cohesive materials) this report has classified the soils based on engineering behavior as opposed to the nomenclature used by the BGS. Therefore, the natural superficial deposits have been interpreted and assessed as either 'Cohesive Till' or 'Granular Till' in respect to their geotechnical assessment.

5.3.1 Cohesive Glacial Till

The cohesive Glacial Till was encountered in exploratory holes RBH102, RBH103 and WS104. It is recorded as a firm to very stiff reddish-brown slightly gravelly Clay. The gravel was found to comprise subrounded fine to coarse of sandstone and quartz.

In WS104 rounded cobbles of sandstone and mudstone are present.

5.3.2 Granular Glacial Till

The granular Glacial Till was encountered below the Made Ground, in RBH101, RBH102, RBH103, WS104, WS105, WS106, WS107, WS109 and WS110. It was recorded as a very dense reddish-brown slightly gravelly fine to coarse Sand in RBH101 to RBH103 and WS104, and as a brown slightly gravelly coarse Sand in WS105, WS106, WS107, WS109 and WS110. The gravel was subangular to well-rounded fine to coarse of sandstone and quartz.

5.4 Chester Formation

The Chester Formation bedrock was encountered all exploratory hole locations except WS104.

The bedrock was encountered between depths of 0.20m and 5.00m bgl (34.18m and 32.40m AOD) to the maximum depth drilling of up to 50.50m bgl (-13.12m AOD).

The bedrock typically comprised interbedded variations of extremely weak to medium strong reddish-brown fine to coarse grained Sandstone. In RBH102 from 46.02m to 50.00m bgl (-8.62m to -12.60m AOD) the sandstone was recorded as strong.

In RBH101, RBH102 and RBH103 the sandstone was recorded to contain subangular to subrounded fine to medium gravel clasts at various depths. In RBH102 from 16.62m to 21.50m (20.75m to 15.87m AOD) a micaceous sandstone was noted

Details of the bedrock can be referred to in the exploratory logs in *Appendix B*.

5.5 Observed Potential Contamination

No potential visual or olfactory contamination was observed during the intrusive investigation works.

5.6 Obstructions Encountered

No obstructions were noted during the intrusive investigation works.

5.7 Groundwater

No groundwater strikes were recorded during the siteworks although they may have been concealed by use of the water flush in the boreholes.

Six rounds of groundwater monitoring have been undertaken between 17th August and 5th November 2021, the results of which are presented in *Table 5.7*.

Table 5.7 – Groundwater Monitoring Results

Borehole Ref.	Installation Strata	Response Zone m bgl (m AOD)	Depth, m bgl (m AOD)					
			17/08/21	02/09/21	16/09/21	29/09/21	21/10/21	05/11/21
RBH101	Sandstone	35.00 – 50.00 (2.38 – -12.62)	13.83 (23.55)	13.93 (23.45)	13.94 (23.44)	-	-	-
RBH102	Sandstone	20.00 – 35.00 (17.37 – 2.37)	-	13.03 (24.34)	13.24 (24.13)	13.28 (24.09)	13.12 (24.25)	13.21 (24.25)
RBH103	Sandstone	5.00 – 20.00 (32.41 – 17.41)	11.45 (25.96)	12.88 (24.53)	12.93 (24.48)	13.04 (24.37)	12.94 (24.47)	12.94 (24.47)
WS104	Cohesive Glacial Till	0.50 – 1.00 (36.91 – 36.41)	-	Dry	Dry	1.18 (36.23)	0.33 (37.08)	1.17 (36.24)

Based upon groundwater elevations and the underlying geology, the following considerations are given to the underlying groundwater regime:

- A variable groundwater table appears to be present below the site within the cohesive Glacial Till at an elevation range of between 37m and 36m AOD, and within the Sandstone bedrock between 26m and 23m AOD.
- It is evident that the groundwater levels within the cohesive Glacial Till in WS104 vary considerably. For example, it is noted as the installation pipework being flooded following periods of heavy rain, and then the water level recorded as dry during drier weather conditions. This indicates that surface water inflows possibly due to heavy periods of rain may be impacting the borehole causing the large change in groundwater levels. This groundwater level is not considered to be representative of a shallow groundwater table across the site however further groundwater monitoring is recommended to confirm this.

6.0 Ground Model

6.1 Made Ground

Made Ground was encountered in all exploratory holes on site from ground level to a maximum depth between 0.20m and 1.40m bgl (37.19m to 33.16m AOD)

No parametric geotechnical analysis has been undertaken on this stratum due to its unsuitable properties for use as a founding stratum.

The geotechnical test results recorded within the Made Ground are summarised in *Table 6.1*.

Table 6.1 – Summary of Topsoil geotechnical test results

Parameter	No. of tests	Results
SPT 'N' Value	1	17
pH	4	Min: 7.57 Max: 11.80 Average: 9.23
Water Soluble Sulphate (mg/l)	4	Min: 50 Max: 390 Average: 167.50

6.2 Glacial Till

The Made Ground is underlain by Glacial Till deposits, recorded as various compositions of clay, sandy and gravel.

6.2.1 Cohesive Glacial Till

The geotechnical test results recorded within the cohesive Glacial Till deposits are summarised in *Table 6.2.1*.

Table 6.2.1 – Summary of geotechnical test results – Cohesive Glacial Till

Parameter	No. of Tests	Results
In-Situ Tests		
SPT 'N' Value ⁽¹⁾ – Cohesive	2	12, 36

(1) Only includes SPTs tests in which full penetration was achieved.

Two SPT N results were recorded within the cohesive Glacial Till, with the results indicating firm to very stiff clays. Due to the limited set of results, the data was not presented graphically.

The Undrained Shear Strength, C_u , of cohesive soils can be estimated from the correlation between Plasticity Indices (PI) and SPT 'N' values using Equation 1:

$$C_u = f_1 \times \text{SPT N}$$

Equation 1

Where:

C_u is the Undrained Shear Strength

f_1 is the Stroud Factor determined from Figure 1.5 (Ref. 11)

SPT N is Characteristic Standard Penetration Test Result

Due to lack of laboratory analysis, a f_1 factor of 5.2 in accordance with CIRIA C504 Engineering in Glacial Till has been used. Estimated C_u values were recorded ranging between 62.4kPa and 187.2kPa indicating medium to very high strength deposits.

A moderately conservative unit weight of between 18 and 23 kN/m³ is deemed suitable for high to very high strength cohesive soils in accordance with BS8002:2015 (Ref. 17).

As no laboratory testing was undertaken in this stratum, the coefficient of volume compressibility, M_v , of cohesive soils has not been estimated.

6.2.2 Granular Glacial Till Deposits

The geotechnical test results recorded within the Granular Glacial Till deposits are summarised in Table 6.2.2.

Table 6.2.2 – Summary of geotechnical test results – Granular Glacial Till

Parameter	No. of Tests	Results
In-Situ Tests		
SPT 'N' Value ⁽¹⁾	4	Min: 5 Max: 48 Average: 18.5
Laboratory Tests – General		
pH	4	Min: 8.75 Max: 11.99 Average: 10.72
Water Soluble Sulphate (mg/l)	4	Min: 20 Max: 40 Average: 32.50

(1) Only includes SPTs tests in which full penetration was achieved.

Fourteen SPT 'N' values were undertaken in the granular glacial till. Four results reached full penetration with values ranging between 5 to 48 indicating loose to very dense soils. Ten SPT 'N' values of >50 (refusal) were recorded indicating very dense deposits.

A moderately conservative unit weight of 16 – 20 kN/m³ is deemed suitable for loose to very dense granular soils above water and a unit weight of 18 – 22 kN/m³ is deemed suitable for deposits below groundwater in accordance with BS8002:2015 (Ref. 17).

The Angle of Internal Friction, ϕ' , for the granular Glacial Till can be derived from a review of relationships with SPT N values (Ref. 18) and published values. However due to the limited

cohort of results, values have not been presented graphically. The results range from 28.60° to 41.47°, with an average of 30.94°.

The Drained Young's Modulus, E' , can be derived for granular material from the relationship with SPT N values (Ref. 16), as presented in Equation 5.

$$E' = (\text{SPT } N / 2) + 7.5 \quad \text{Equation 5}$$

Where:

E' is the Drained Young's Modulus

SPT N is Characteristic Standard Penetration Test Result

It should be noted that care should be taken in using linear stiffness values derived from relationships as they do not necessarily reflect the non-linear nature of soil stiffness. The actual stiffness will be strain dependent and non-linear and thus should be considered in detailed design of sensitive structures. The results range from 7.5° to 31.5°, with an average of 13.92°.

6.3 Chester Formation

The Chester Formation Sandstone was encountered in all exploratory boreholes except in WS104 from depths between 0.20m and 5.00m bgl (34.18m and 32.40m AOD) across the site.

There were a number of areas of assumed zones of core loss were recorded within RBH101, RBH102 and RBH103. There were zones non-intact core recorded throughout the same exploratory boreholes. Details of this are presented in *Table 6.3a* and *Table 6.3b* below. Further details can be referred to in the exploratory logs found in *Appendix B*.

Table 6.3a – Assumed Zones of Core Loss, Chester Formation

Exploratory Hole ID	Depth (m bgl)	Stratum Description
RBH101	4.89 – 4.98	Weak reddish-brown medium to coarse grained SANDSTONE
	6.82 – 7.00	
	8.37 – 8.58	
	11.27 – 11.50	Very weak reddish-brown medium to coarse grained SANDSTONE
	14.50 – 14.58	Medium strong reddish-brown brown to medium grained SANDSTONE
	17.35 – 17.50	
	18.92 – 19.00	
	23.32 – 23.50	Medium strong reddish-brown medium to coarse grained SANDSTONE with occasional subrounded to rounded coarse gravel.
	26.29 – 26.50	
	27.91 – 28.00	
	29.32 – 29.35	
	29.73 – 31.00	

Exploratory Hole ID	Depth (m bgl)	Stratum Description
	31.33 – 32.50	Medium strong reddish-brown fine to medium grained SANDSTONE
	38.44 – 38.50	
	39.90 – 40.00	
	41.38 – 41.50	Medium strong reddish-brown medium to coarse grained SANDSTONE
	44.16 – 44.50	
	45.66 – 46.00	
	47.42 – 47.50	
	48.61 – 49.00	
	50.16 – 50.50	
RBH102	6.40 – 6.50	Extremely weak reddish-brown medium to coarse grained SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts.
	7.95 – 8.00	Very weak reddish-brown fine to medium grained SANDSTONE
	21.47 – 21.50	Medium strong reddish-brown fine grained micaceous SANDSTONE
	25.84 – 26.00	Medium strong reddish-brown medium to coarse grained SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts
	30.37 – 30.50	
	31.94 – 32.00	Medium strong reddish-brown fine grained SANDSTONE
	40.94 – 41.00	Medium strong reddish-brown medium to coarse grained SANDSTONE with rare subangular to subrounded fine to medium gravel clasts
	46.92 – 47.00	Strong reddish-brown medium to coarse grained SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts
RBH103	5.95 – 6.50	Very weak reddish-brown medium to coarse grained SANDSTONE
	7.25 – 8.00	
	9.00 – 11.00	Very weak reddish-brown medium to coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts
	12.17 – 12.50	
	13.20 – 14.00	
	15.30 – 15.50	
	19.85 – 20.00	Weak reddish-brown medium to coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts
	25.87 – 26.00	
	30.45 – 30.50	Medium strong reddish-brown medium to coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts
	31.32 – 31.42	
	37.76 – 38.00	Weak reddish-brown medium to coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts
	40.83 – 41.00	Medium strong reddish-brown fine grained SANDSTONE
	42.36 – 42.50	Medium strong reddish-brown coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts
	43.73 – 44.00	Weak reddish-brown fine to medium grained SANDSTONE

Exploratory Hole ID	Depth (m bgl)	Stratum Description
	45.38 – 45.50	Medium strong reddish-brown medium to coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts

Table 6.3b – Areas of Non-intact Core, Chester Formation

Exploratory Hole ID	Depth (m bgl)	Stratum Description
RBH101	4.67 – 4.89	Weak reddish brown medium to coarse grained SANDSTONE
	7.81 – 7.90	
	8.58 – 8.63	
	9.90 – 10.00	Weak reddish brown fine grained SANDSTONE
	10.94 – 11.00	Very weak reddish brown medium to coarse grained SANDSTONE
	11.16 – 11.20	
	11.50 – 11.55	
	12.82 – 13.00	Medium strong reddish brown fine to medium grained SANDSTONE
	13.80 – 13.89	
	15.22 – 15.28	
	17.21 – 17.29	
	17.50 – 17.56	
	18.47 – 18.57	Medium strong reddish brown medium to coarse grained SANDSTONE
	20.44 – 20.50	
	23.81 – 24.00	
	24.82 – 25.00	Medium strong reddish brown medium to coarse grained SANDSTONE with occasional subrounded to rounded coarse gravel.
	25.00 – 25.17	
	26.96 – 27.00	
	33.39 – 35.50	
	34.19 – 34.33	
	41.20 – 41.23	Medium strong reddish brown medium to coarse grained SANDSTONE.
	44.10 – 44.16	
	47.13 – 47.20	
RBH102	3.50 – 3.59	Extremely weak reddish brown medium to coarse grained SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts.
	5.00 – 5.09	
	9.40 – 9.50	Weak reddish brown fine to medium grained SANDSTONE.
	9.97 – 10.03	
	17.95 – 17.97	Medium strong reddish brown medium grained micaceous SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts
	27.20 – 27.30	Medium strong reddish brown medium to coarse grained SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts.

Exploratory Hole ID	Depth (m bgl)	Stratum Description
	32.10 – 32.23	Medium strong reddish brown medium to coarse grained SANDSTONE.
	34.40 – 34.43	
	35.46 – 35.51	
	38.09 – 38.15	Medium strong reddish brown medium to coarse grained SANDSTONE with rare subangular to subrounded fine to medium gravel clasts
	40.77 – 40.90	
	47.54 – 47.56	Strong reddish brown medium to coarse grained SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts.
	48.89 – 48.91	
RBH103	5.00 – 5.09	Very weak reddish brown medium to coarse grained SANDSTONE
	5.30 – 5.38	
	8.00 – 8.12	Extremely weak reddish brown medium to coarse grained SANDSTONE
	14.09 – 14.38	Very weak reddish brown medium to coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts
	15.50 – 15.60	
	16.29 – 16.35	
	31.28 – 31.32	Medium strong reddish brown medium to coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts.
	38.00 – 38.07	Weak reddish brown medium to coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts
	38.42 – 38.50	
	43.00 – 43.11	Weak reddish brown fine to medium grained SANDSTONE
	43.23 – 43.30	Weak reddish brown fine to medium grained SANDSTONE
	46.02 – 46.15	Strong reddish brown medium to coarse grained SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts

6.3.1 Sandstone

Rock Quality Designation (RQD) recorded in cored samples ranged from 0 to 100% (averaging 69%) which classifies it as of very poor to excellent mass quality. Total Core Recovery (TCR) and Solid Core Recovery (SCR) vary between core runs, with no general trend, as shown in *Figure 6.3.1a* and *Figure 6.3.1b* below.

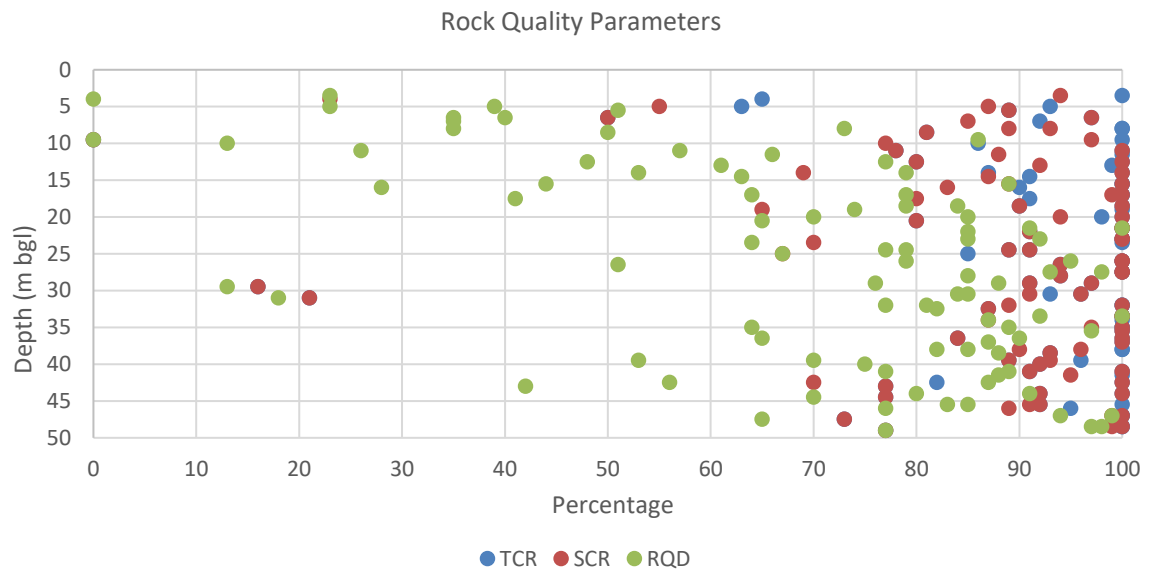


Figure 6.3.1a – Summary of Rock Quality Parameters vs Depth

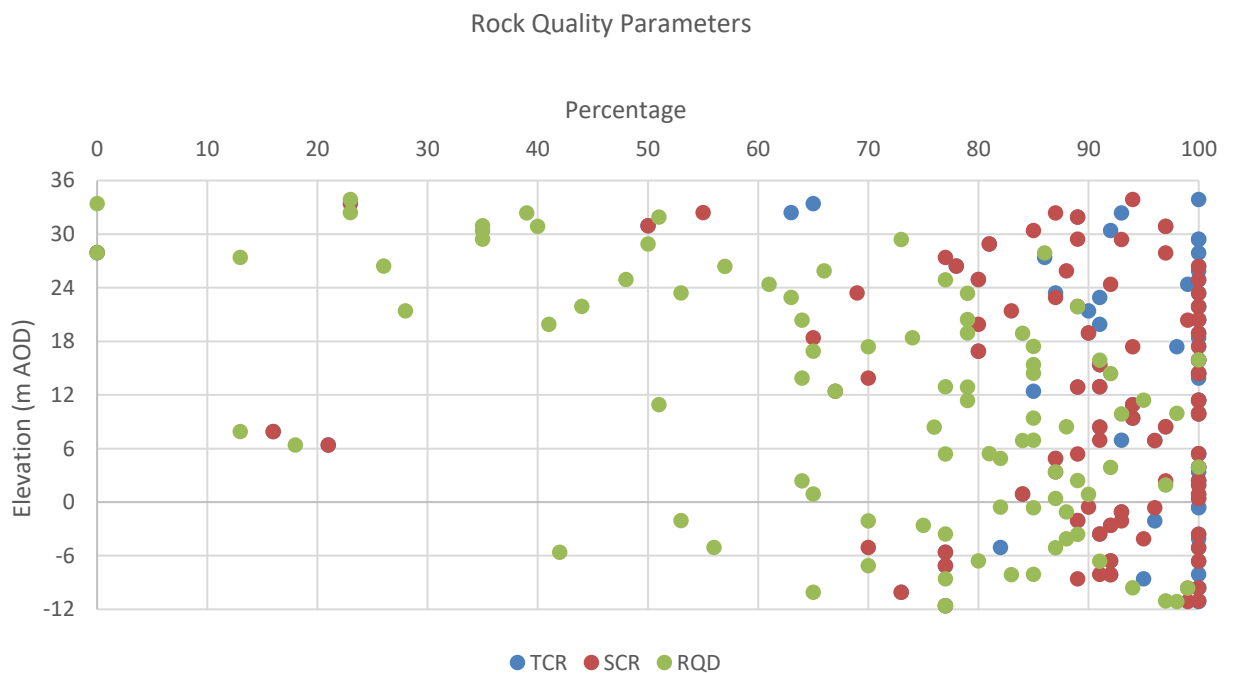


Figure 6.3.1b – Summary of Rock Quality Parameters vs Elevation

A summary of the geotechnical testing results for the Sandstone bedrock are presented in *Table 6.3.1*. Full details of the geotechnical results are included in *Appendix D*.

Table 6.3.1 – Summary of Geotechnical Test Results

Parameter			No. of Tests	Summary of Results
Laboratory Test Results	Point Load Indices (Is50)	Axial Plane	51	Min: 0.13 Max: 0.84 Average: 0.34
		Diametral Plane	52	Min: 0.04 Max: 0.52 Average: 0.24
		Irregular Plane	1	0.15
	Unconfined Compressive Strength, UCS (MPa)		44	Min: 6.90 Max: 24.40 Average: 16.77
	Young's Modulus (Gpa)	10% failure load	3	Min: 0.753 Max: 1.46 Average: 1.121
		50% failure load	3	Min: 1.95 Max: 2.55 Average: 2.21
	Poisson's Ratio	10% failure load	3	Min: 0.02 Max: 0.58 Average: 0.25
		50% failure load	3	Min: 0.14 Max: 0.25 Average: 0.2
	pH Value		1	9.36
	Water Soluble Sulphate (mg/l)		1	30
Derived Parameters	Estimated UCS from Point Load Indices	Axial Plane	51	Min: 3.12 Max: 20.16 Average: 8.26
		Diametral Plane	52	Min: 0.96 Max: 12.48 Average: 5.66
		Irregular Plane	1	3.60

Overall, 51 No. axial, 52 No. diametral and 1 No. irregular Point Load Tests (PLT) were undertaken on selected samples of Sandstone from rotary cores located across the site. Axial plane PLT (Is(50)) results ranged between 0.13MPa and 0.84MPa, diametral plane PLT (Is(50)) test results ranged between 0.04MPa and 0.52MPa and the irregular plane PLT (Is(50)) test result is 0.15MPa.

An approximation of the unconfined compressive strength (UCS) of the rock may be derived from the following relationship, described in Equation 5:

$$UCS = PLT\ Is(50) \times f_1$$

Equation 5 (Tomlinson, 1999)

Where f_1 is derived from correlation between PLT $Is(50)$ and UCS results

However, due to the variability in the results, a published correlation factor of 24 has been used for Sandstone (Ref. 14). Based on this relationship, estimated UCS values for bedrock range between 3.12MPa and 20.16MPa for axial tests, 0.96MPa and 12.48MPa for diametral tests and 3.60MPa for the irregular test, indicating the rock tested has strength index of extremely weak to weak in accordance with BS5930:2015. These findings generally show lower strengths indicated during the field descriptions, typically recorded as extremely weak to medium strong. This is likely due to localised areas of lower strength sandstone chosen for laboratory analysis.

The estimated UCS results are generally lower than the UCS testing results which range between 6.90MPa and 24.40MPa. The reason for termination was due to multiple shear, single shear, axial cleavage and fragmentation. The results indicate that the intact rock is weak to medium strong in accordance with BS5930:2015. This is generally consistent with strength described in the field.

All results of the above are shown in *Figure 6.3.1c* and *Figure 6.3.1d*.

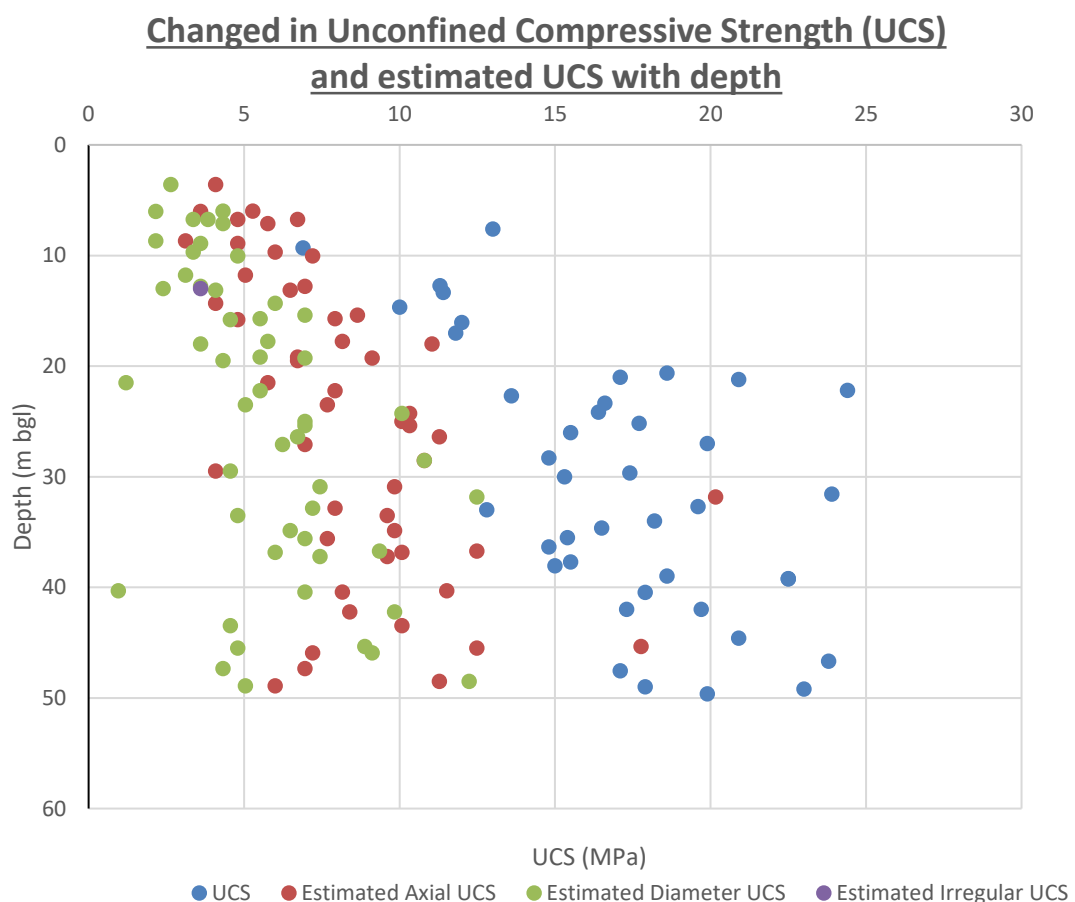


Figure 6.3.1c – Variation of UCS Test and Estimated UCS Results with Depth

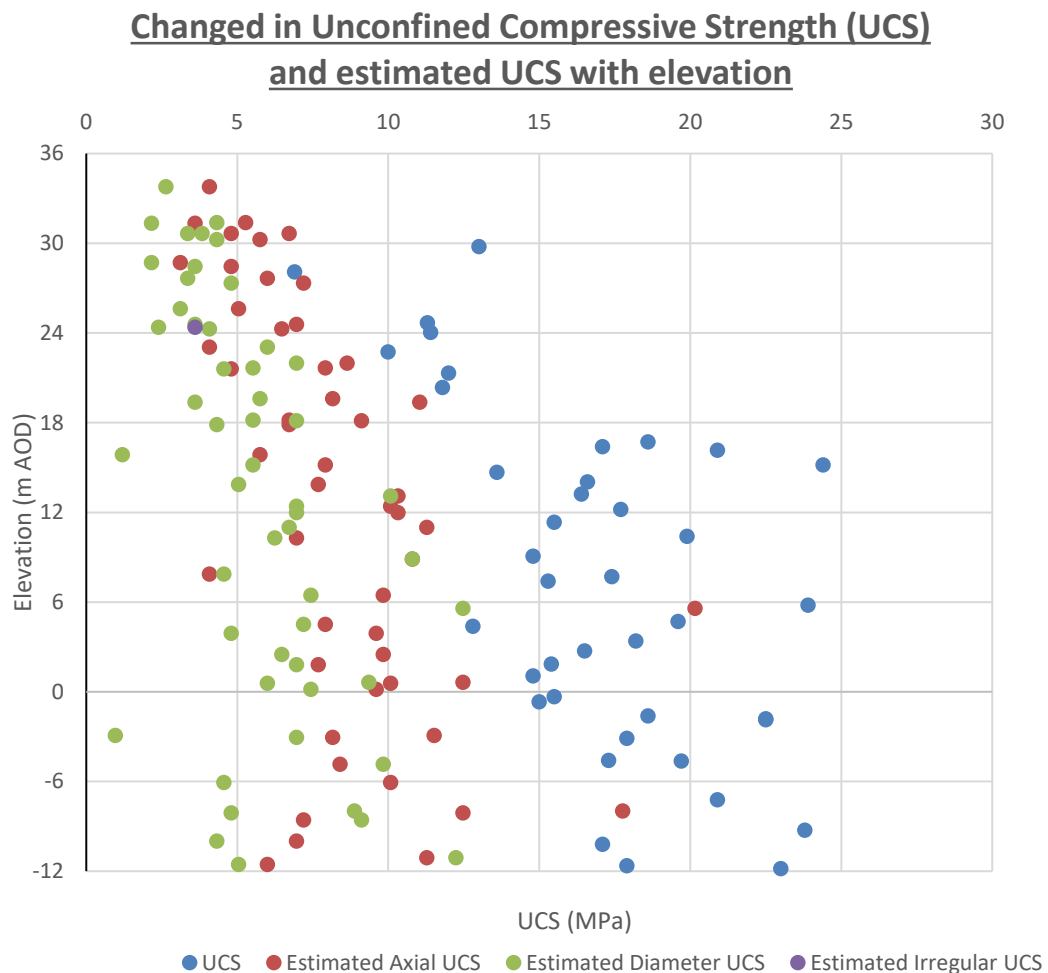


Figure 6.3.1d – Variation of UCS Test and Estimated UCS Results with Elevation

6.4 Aggressive Ground Conditions

The classification of the site in terms of concrete in aggressive ground is based on the guidance provided in Table C2 of the Building Research Establishment (BRE) Special Digest 1, 3rd edition of 2005 (Ref. 19). A summary of the results obtained as a part of the ground investigation are summarised in Table 6.4a below.

Table 6.4a –Aggressive Chemical Environment for Concrete (ACEC) Site Classification

Stratum	Test Type	Range
Made Ground	pH	7.57 – 11.80
	Water Soluble Sulphate (mg/l)	50 - 390
Cohesive Glacial Till	pH	No testing undertaken

Stratum	Test Type	Range
	Water Soluble Sulphate (mg/l)	
Granular Glacial Till	pH	8.75 – 11.99
	Water Soluble Sulphate (mg/l)	20 - 40
Chester Formation	pH	9.36
	Water Soluble Sulphate (mg/l)	30

Table 6.4b –Aggressive Chemical Environment for Concrete (ACEC) Site Classification

Stratum	Design Sulphate Class	ACEC Class ⁽¹⁾
Made Ground	DS-1	AC-1
Granular Glacial Till	DS-1	AC-1
Chester Formation	DS-1	AC-1 ⁽²⁾

(1) ACEC assessment was based on the *mobile* groundwater condition for a *brownfield* scheme area.

(2) Based on one value.

In these conditions, and as a preliminary assessment, it is considered that deterioration of buried concrete due to sulphate or acid attack is unlikely to occur. The preliminary design of buried concrete, based on the Curtins ground investigation, according to Table C2 of BRE Special Digest 1:2005 should be in accordance with Class DS-1 (AC-1) conditions assuming mobile groundwater for the Made Ground, granular Glacial Till and Chester Formation bedrock.

7.0 Ground and Groundwater Contamination Assessment

This section of the report includes the assessment of the potential contamination, solid, liquid and gas, identified on the subject site which may present a risk to the proposed end-users, associated utilities and the wider environment.

In guidance published by the Environment Agency, the risk to human health or controlled waters is determined through an assessment of pollutant linkages between a source of contamination (within the ground or groundwater either on or off site) and a sensitive receptor such as end-users of the site, building materials, edible plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship. The same model is applied to the assessment of risk arising from ground gases as detailed within BS8576:2013 (Ref. 20).

These models have a common approach, which is one of a tiered assessment. At each stage of the assessment further detail can be applied to the conceptual site model to provide a detailed interpretation on a site by site basis. As part of the planning process this approach is adopted to establish either if the site is 'suitable for use' or whether additional work or else remedial work is required for the site to be deemed so.

The sub-sections hereafter therefore incorporate the first tier (Tier 1) of this approach otherwise referred to as the Generic Quantitative Risk Assessment (GQRA). The GQRA builds on the qualitative risk assessment presented in the Phase 1 Desk Study in conjunction with observations made during the ground investigation and is based solely on the results of the chemical and other testing data obtained as part of Curtins ground investigation. The GQRA is used to build/refine the Conceptual Site Model (CSM) for the site as detailed and presented in *Section 9.0* of this report.

The following sections present more detail on the risk assessment methodology rationale for the main receptors.

7.1 Human Health GQRA

The soil results will be screened against the relevant Generic Assessment Criteria (GAC) where available, including:

- i) **Soil Guideline Values (SGVs):** These have been published by the Environment Agency and are trigger values for screening out low risk areas of land contamination. SGV's give an indication of representative average concentrations of chemicals in soil, below which long-term health risks are likely to be minimal. SGVs have been published for several contaminants including arsenic, cadmium, mercury, nickel, selenium, BTEX, phenols and dioxins, furans and dioxin-like PCB substances for land uses including residential, allotments and commercial. The SGVs have been developed for a sandy loam soil with 6% soil organic matter (SOM) content;
- ii) **Supplementary Screening Values (SSVs):** In addition to the SGVs developed by the EA, other third party organisations have derived SSVs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including

those developed by Atkins AtriskSoil™, the LQM/CIEH Suitable for Use Levels (S4UL) and EIC/AGS/CL:AIRE published thresholds;

- iii) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium and lead. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 (Ref. 21) in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). C4SLs are not representative of significant possibility of significant harm (SPoSH) and are low risk levels which, and therefore where the C4SLs are not exceeded, land can be demonstrated to be in Category 4 and cannot be determined as contaminated land.

7.1.1 Adopted Soil Human Health GACs Screening Methodology

Current development proposals for the partial redevelopment of the site include the construction of a new office building and the refurbishment of the existing building on site. Considering this, chemical analysis has been compared against a 'Commercial' end-use scenario.

The assessment has been undertaken against the following GACs, in order of preference:

1. Environment Agency Soil Guideline Values,
2. CL:AIRE, AGS, EIC. Soil Generic Assessment Criteria for Human Health Risk Assessments,
3. LQM/CIEH 2015 S4ULs for Human Health Risk Assessment, and
4. DEFRA Category 4 Screening Levels.

The soil organic matter (SOM) content has an influence on the volatilisation of organic contaminants (i.e. the higher the SOM, the lower the volatilisation rate and therefore inhalation exposure risk). Soil organic matter (SOM) values for soils ranged from 0.4% to 17.2%. The greatest organic matter concentrations were recorded in samples Made Ground nearest the surface.

With consideration for a calculated geometric average, soils from the Made Ground determine a SOM of 1.8% to 17.2%, with a geomean SOM of 4.67%. The natural soils determined a much lower SOM of between 0.4%. As such, a comparison against Generic Assessment Criteria (GAC) thresholds for a conservative SOM of 2.5% and 1.0% for the identified end use thresholds have been adopted for the Made Ground and natural soils, respectively.

The adopted GAC's can be referred to in *Appendix F*.

7.1.2 Generic Assessment Criteria Screening of Soil Laboratory Results – Pre Demolition

The results of the environmental testing can be referred to in *Appendix C*.

With respect to the '*Commercial*' thresholds, no exceedances of contamination GACs were recorded in any of the soil samples tested.

All soil samples tested were also screened for asbestos fibres, with no asbestos being positively identified in the laboratory. No suspected asbestos containing materials (ACMs) were identified within any of the exploratory holes excavated on site.

7.1.3 Generic Assessment Criteria Screening of Soil Laboratory Results – Post Demolition

Following demolition of the pre-existing structure on site, additional sampling and testing was undertaken beneath the footprint of the building.

The results of the environmental testing can be referred to in *Appendix C*.

With respect to the '*Commercial*' thresholds, no exceedances of contamination GACs were recorded in any of the soil samples tested.

No suspected asbestos containing materials (ACMs) were identified within any of the exploratory holes excavated on site. All soil samples tested were also screened for asbestos fibres, with no asbestos being positively identified in the laboratory.

7.2 Controlled Waters GQRA

A model for assessing the potential for pollution of the controlled waters and for deriving a safe concentration in ground and groundwater is the Environment Agency's publication "Remedial Targets Methodology - Hydrogeological Risk Assessment for Land Contamination" (Ref. 22).

In relation to the standards for the water environment, there are currently no generic groundwater standards or surface water standards that are necessarily applicable to all sites.

7.2.1 Adopted Controlled Waters Tier 1 Screening Values and Methodology

The site is underlain by Made Ground soils, to depths of between 0.20m and 1.40m bgl. Natural soils comprise cohesive and granular Glacial Till, underlain by Sandstone bedrock of the Chester Formation which was encountered from 0.20m to 5.00m bgl.

The superficial aquifer is designated as a Secondary Undifferentiated Aquifer, while the underlying bedrock aquifer is designated as a Principal Aquifer.

The nearest surface water feature is the Rochdale Canal, 270m southeast of the site.

Given the presence of relatively impermeable shallow superficial soils, it is considered that the likelihood of shallow groundwater migrating to the canal is unlikely. On this basis, the risk to surface water features is **Very Low**.

Given the presence of a Principal Aquifer underlying the site, the results of laboratory analysis of groundwater have been assessed against UK Drinking Water Standards, UK DWS, (Ref. 23). Where these are not available for review, WHO guidelines (Ref. 24) have been adopted as screening thresholds.

This assessment is to be undertaken to determine the risk to groundwater.

The adopted Tier 1 Screening Values are listed in *Appendix F*.

7.2.2 Tier 1 Screening of Groundwater Laboratory Results

The results of the environmental testing can be referred to in *Appendix C*.

With respect to the proposed receptor (the underlying Principal Aquifer), one determinant was recorded at a concentration greater than the relevant UK DWS thresholds, as detailed below.

Table 7.2.2a – Groundwater UK DWS Exceedances

Determinant	UK DWS threshold (mg/l)	Samples > Tier 1 Value
Sulphate	250	RBH101 (14.29m) – 309 mg/l

Marginally elevated concentrations of sulphate were recorded in RBH101 at 14.29m bgl. There is no indication that the elevated concentrations recorded are a result of high concentrations in soils leaching to the underlying aquifer based on the chemical soil analysis from the Made Ground and Glacial Till above. The marginally elevated concentrations are attributed background concentrations within the sandstone bedrock. On this basis, the risk to groundwater features is **Low** requiring no further action.

8.0 Ground Gas Assessment

The assessment of risk presented by ground gases is assessed with reference to guidance published by CIRIA Assessing Risks Posed by Hazardous Ground Gases to Buildings, C665 (Ref. 25), BSI Publication code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2019 (Ref. 26) and other broadly accepted references such as the Ground Gas Handbook 2009 (Ref. 27).

The gas risk assessment adopts a tiered approach. In the first instance this involves a re-evaluation of the Conceptual Site Model described within the Phase 1 Desk Study (Ref. 1) and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

8.1 Ground Gas Monitoring Results

To characterise the site's ground gas regime and validate the qualitative assessment of ground gas risk, standpipe installations were incorporated within all three rotary boreholes (RBH101, RBH102 and RBH103) and one window sample borehole (WS104) as detailed in *Section 3.2*.

An initial programme of six gas monitoring visits over twelve weeks was proposed. Six gas monitoring visits have been undertaken between 17th August 2021 and 5th November 2021, with barometric pressure recorded between 1005 mb and 1031 mb. Rising barometric pressure was recorded on the first (17/09), fourth (29/09) and fifth (21/10) visits, falling barometric pressure was recorded on the second (02/09) and sixth (05/11) monitoring visit and steady barometric pressure was recorded on the third monitoring visit (16/09).

The results log sheets are contained within *Appendix E* and summarised in *Table 8.1*.

Table 8.1 – Summary of Ground Gas Monitoring Results

Exploratory Hole ID	Maximum Methane Concentration (%)	Maximum Steady Carbon Dioxide Concentration (%)	Minimum Steady Oxygen Concentration (%)	Maximum Peak Gas Flow (l/hr)	Maximum Steady State Gas Flow (l/hr)
RBH101	<0.1	0.2 (Visit 3)	19.1	-0.2 (Visit 3)	-0.1 (Visit 3)
RBH102	<0.1	0.2 (Visits 2, 3 & 5)	19.6	25.9 (Visit 5)	22.6 (Visit 5)
RBH103	<0.1	0.7 (Visit 4)	18.9	-1.3 (Visit 5)	-1.3 (Visit 5)
WS104	<0.1	0.1 (Visit 2)	20.2	-1.0 (Visit 5)	-0.9 (Visit 5)

The maximum recorded concentration of carbon dioxide of 0.70% v/v was recorded in RBH103 on the fourth monitoring visit.

Methane (CH_4) was recorded below the limit of detection of the monitoring instrument throughout the monitoring period.

The maximum recorded concentration of hydrogen sulphide of 2 ppm was recorded in RBH101 and RBH102 on the second monitoring visit.

The maximum recorded concentration of carbon monoxide of 6 ppm was recorded in RBH101 and RBH102 on the second monitoring visit.

Gas flow was recorded at a maximum peak flow rate of 25.9 l/hr in RBH102 on the fifth monitoring visit.

Exploratory hole WS105's monitoring installation response zone was flooded following bouts of heavy rain on the first, second and fifth monitoring visit. The variation in well head space caused by rising and falling groundwater levels in the unslotted section of the pipe is the likely cause of the positive and negative air flow rates recorded.

8.2 Ground Gas Assessment

The Conceptual Site Model presented in *Section 2.7* highlighted potential Made Ground and natural soils containing organic / putrescible content as a potential source of ground gas generation

Noxious and asphyxiate gases were attributed to include, but not limited to, carbon dioxide, carbon monoxide, methane and hydrogen sulphide.

The ground investigation revealed a ground model generally consistent with the preliminary conceptual site model. Ground conditions pertaining to the development site comprise a Made Ground to maximum depths of 2.40m bgl, overlying cohesive and granular Glacial Till deposits, overlying Sandstone bedrock of the Chester Formation. A groundwater table was recorded in the Cohesive Glacial Till between 37m and 36m AOD, as well as a deeper groundwater table within the bedrock between 26m and 23m AOD.

In accordance with BS8485:2015+A1:2019 (Ref. 26), consideration of the recorded soil gas flow rates, presented below, enables hazardous gas flow rates (Q_{hg}) to be evaluated. Q_{hg} can be derived for both 'borehole' and 'worst case' scenarios and a comparison made in support of an appropriate assessment of ground gas risk. For a 'borehole' scenario (highest hazardous gas flow rate identified a single borehole) steady state flow rates and maximum gas concentrations are adopted, whilst for a 'worst case' scenario (highest Q_{hg} across the entire dataset irrespective of location and discrete monitoring events) peak flows and gas concentrations are adopted.

As methane was not detected above the instruments limit of detection throughout the monitoring period, the risk to site end users from methane is considered **Low** and is therefore not considered further.

RBH102 recorded a significantly elevated peak flow rate of 25.9 l/hr. From a review of groundwater level monitoring (*Table 5.7*) and the response zones of the monitoring wells (*Table 3.2*) it can be seen that the response zone was flooded during the monitoring period. It is considered that high flow rates in these boreholes is likely to be linked to rising groundwater in the solid section of the well installation

causing an increase in internal pressure within the pipework, which is released and subsequently equalised, when the valve tap is open resulting in the high observed peak flow preceding lower steady flow. The effect is detailed within BS8485:2015 (Ref. 26), CL:AIRE Research Bulletin 17 'A Pragmatic Approach to ground gas risk assessments for the 21st century'.

Considering the above, and using professional judgement, the elevated peak flow readings from RBH102 have been omitted for the calculations used in the assessment of gas risk on site, with remaining flow and carbon dioxide readings considered to give a more representative.

Evaluation of the 'representative borehole' scenario (highest hazardous gas flow rate identified a single borehole) records a maximum Q_{hg} of 0.0039 l/hr for carbon dioxide where for the fifth visit the maximum steady state gas flow reading is -1.3 l/hr, and a maximum gas concentration is 0.30% v/v.

Evaluation of the 'worst case' scenario (highest Q_{hg} across the entire dataset irrespective of location and discrete monitoring events) recorded a maximum Q_{hg} of 0.0091 l/hr for carbon dioxide with the highest steady state flow rate of -1.3 l/hr and a maximum gas concentration of 0.70% v/v.

Considering the above, it is recommended that the site is characterised with CS1 classification, with no gas protection measures required for the proposed development.

The potential risks from ground gases to the excavations are to be dealt with by the Contractor, in accordance with the Confined Space Regulations, during construction. Appropriate ground gas monitoring and safety measures should be in place during the works, as the potential presence of ground gases could pose a risk in any confined spaces of deep excavations.

9.0 Revised Conceptual Site Model

The Preliminary Conceptual Site Model (PCSM) presented *Section 2.8* and discussed in *Section 2.0* of this report has been revised following the GQRA in *Sections 7.0* and *8.0* above. The Revised Conceptual Site Model (CSM) is summarised in the table overleaf.

The CSM details the source-pathway-receptor linkages or potential pollutant linkages (PPL) that have been identified as relevant for the site. The GQRA details the associated level of risk relating to these potential pollutant linkages.

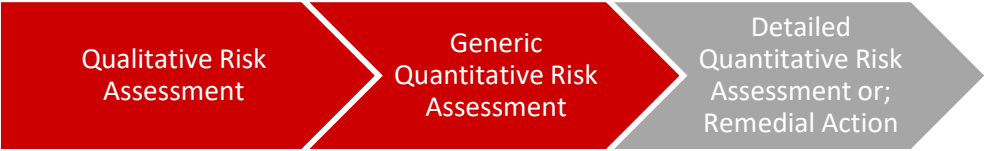
The CSM follows the framework outlined within CIRIA C552 (Ref. 28) which is summarised within *Appendix G*.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage or PPL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

Risks presented by Unexploded Ordnance is discussed and assessed in *Section 2.5*.

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 (Ref. 29) which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk.

It has been assumed that any future construction works on site will be undertaken in compliance with these requirements. This assumption is factored into the conceptual site model. Reference should be given to the environmental testing results discussed within *Section 6.0* and presented within *Appendix C*.



- The table below represents the Second stage in the land quality risk assessment process; the Revised Conceptual Site Model following the Quantitative Risk Assessment.
- For a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e. low to very low risk. The purpose of each stage of risk assessment is ultimately to establish if there is a requirement for additional levels of assessment to be made to have sufficient confidence to support a risk characterisation or management decision, e.g. remedial action.
- In the absence of specific site data, a Generic Quantitative Risk Assessment is invariably recommended.

Conceptual Site Model			Generic Qualitative Risk Assessment			Comments	Action
Identified Source	Pathway(s)	Receptor(s)	Consequence	Likelihood of Occurrence	Risk Rating		
Limited potential sources of contamination identified on site, related to Made Ground of an unknown composition. Marginally elevated concentrations of sulphate in RBH101 at 14.29m bgl of 309mg/l.	Direct contact and dermal uptake, soil and dust ingestion, dust and migration inhalation (indoor & outdoor air)	Site End Users (Office staff)	Medium Human Health Risk	Unlikely	Low	No exceedances identified in any of the soil samples tested above 'Commercial' GAC. No suspected asbestos containing materials (ACMs) were identified within any of the exploratory hole logs or laboratory screening.	No further action required.
		Adjacent Residents					
		Construction and maintenance workers					
	Vertical and horizontal migration of soluble phase contamination through groundwater.	Controlled Waters (Surface Water) Nearest surface water feature is the Rochdale Canal 270m southeast of site.	Mild	Unlikely	Very Low	No gross contamination identified during ground investigation or subsequent monitoring to raise risk level identified in Phase 1 Preliminary Risk Assessment. One exceedance noted in the groundwater sample from RBH101, however no chemical exceedances were noted in the soils in the overlying Made Ground or Glacial Till.	No further action required.
	Vertical and horizontal migration of soluble phase contamination through superficial deposits and bedrock.	Controlled Waters (Groundwater) Superficial Soils: Glacial Till (Secondary Undifferentiated Aquifer) Bedrock: Chester Formation (Principal Aquifer) The site is not within a designated Source Protection Zone.	Medium	Unlikely	Low		
Ground gas generating sources, including Made Ground on site.	Ground gas & vapour migration and inhalation. Vertical and horizontal migration through existing service corridors and the underlying superficial deposits.	Site End Users (Office staff)	Medium Human Health Risk	Unlikely	Low	Elevated concentrations of carbon dioxide (>5% v/v) was recorded in RBH102 on the fifth monitoring visit. However, based on the response zones and groundwater levels recorded, the borehole was noted as flooded and therefore this reading discounted from GSV calculations. Methane (CH4) was recorded below the limit of detection on all monitoring visits. Considering the low flow and low gas concentrations, the Characteristic Gas Situation is assessed as CS1 with no gas protection measures required in accordance with BS8485.	No further action required.

9.1 Summary of Significant Pollutant Linkages

A **Low** risk rating is identified to site end-users and construction workers, from soils and dust from inhalation and ingestion, in areas of proposed hardstanding and building footprint. No further action is required.

A **Very Low** and **Low** risk rating is identified to controlled waters (Groundwater and Surface Waters) following the ground investigation, where no major sources of contamination were identified other than one exceedance noted in the RBH101 groundwater sample.

A **Low** risk rating is identified to site end users from ground gases arising from site soils, migrating into buildings and subsequent inhalation by on-site staff. This corresponds to a Characteristic Gas Situation assessed as CS1, therefore no gas protection measures are required.

10.0 Geotechnical Assessment and Recommendations

10.1 Introduction

This section will discuss the ground and groundwater conditions encountered across the site and assess the associated risks for the proposed scope of works. Development proposals for the redevelopment of the site include the construction of a new office building and the refurbishment of the existing building on site.

Any changes in the development of designs beyond the issue of this Ground Investigation Report to the client, should be considered by the Construction Designer.

10.2 Key Geotechnical Considerations

10.2.1 Site Preparation

The Principal Designer and Principal Contractor should be informed of the site conditions and risk assessment undertaken to comply with the Construction Design Management (CDM) regulations. Site personnel are to be made aware of the site conditions prior to commencement on site.

10.2.2 Presence of Existing Services

The presence of existing services may require detailed geotechnical design, capping and/or diversion associated with the development, which should be managed through the appropriate utility suppliers during the construction phase. The Principal Contractor should ensure that appropriate mitigation measures are put in place during the construction phase (i.e. during excavation of foundations) and designers must ensure that suitable geotechnical design is considered to avoid damage caused by issues such as settlement during both construction phase and design life of the proposed infrastructures.

10.2.3 Obstructions and Relict Foundations

Where demolition works are to be undertaken of the existing structures, it should be ensured that all obstructions within influencing depth of the proposed development are removed as required. Existing foundations should be removed to avoid forming hard spots and backfilled in accordance with an engineering specification to avoid soft spots.

Consideration should be given, in liaison with the Principal Contractor, for re-use of any former foundations/concrete obstructions via crushing, appropriate testing (environmental and geotechnical), screening and re-use on site as capping or fill to structures in accordance with Series 600 of the Specification for Highways Works (SHW) to reduce export/import costs.

10.2.4 Variable Superficial Deposits

The depth to competent granular strata and potential presence of soft cohesive deposits would need to be considered in the design of shallow foundations. Should softer deposits be encountered at formation layer upon excavation, it is recommended to over-excavate until competent cohesive or granular material is encountered (complimented by in-situ strength testing) and fill to formation level with competent fill material to ensure a consistent foundation stratum; foundations should not be formed or spread across mixed cohesive and granular soils. Bearing resistances and foundation settlements provided below will be subject to detailed design.

10.3 Foundation Design

It is understood that the proposed development comprises the construction of a new office building.

The existing made ground and natural soils are unlikely to be able to support conventional pad foundations due to the high building loads involved in the development and therefore raft/pile foundations are discussed in this study.

Raft Foundation

It is understood that a raft foundation is the preferred option for the new development. Current design proposals indicate the construction of the raft basement floor level at approximately 28.80m AOD, 30.80m AOD and 33.35m AOD.

A maximum allowable bearing capacity of 250kN/m² has been calculated at the 3 different levels within the weathered Chester Sandstone Formation. On inspection of the exploratory hole information the sandstone in this area appears to be almost completely weathered at these various levels and acting (geotechnically) as a granular soil and guidance from Meyerhof, 1956 & Tomlinson, 2001 has been used to calculate the capacity. More intact bedrock appears to be present from around 25m AOD.

The modelling assumes the raft will be constructed on approx. 500mm of imported crushed concrete (Class 6N/6P) to create a level finished floor level. The imported stone will need to be mechanically compacted to a suitable earthworks specification with appropriate validation testing to confirm geotechnical parameters.

Using the raft and sub-base thickness described above and loadings provided internally by Curtins the following preliminary (maximum) settlements have been calculated for the proposed development levels using geotechnical software PDISP licensed from Oasys:

- 28.80m AOD: 15-20mm (drained, long term)
- 30.80m AOD: 25-30mm (drained, long term)
- 33.35m AOD: <5mm (drained, long term)

Settlements related to the existing buildings on the site have been analysed with the findings from this study detailed in Curtins Technical Note Reference 078847-CUR-00-XX-RP-GE-002 dated November 2021.

Despite these analyses a full raft design will be required to evaluate the proposed raft foundation performance under gravity loading once frozen layouts are provided. It should be checked that the Uniformly Distributed Load (UDL) in kN/m² arising from the raft does not exceed the bearing capacities provided.

It is considered that the costs for the removal of the existing soil and import of the 500mm crushed concrete and construction of a 1.50m raft need to be considered by the client and cost consultant relative to costs for piles socketed into competent rock as detailed below.

Piled foundations

In the event that the use of raft foundations proves either impracticable or uneconomical due to the size and depth of foundation required, then a piled foundation will be required.

Due to the presence of these obstructions and locally shallow bedrock, driven piles are considered likely to refuse at unsuitably shallow depths and consequently are considered unsuitable for use on site as a piling method associated with the proposed development.

The ground conditions on site are considered to potentially be amenable to CFA or bored piles, taking into account the below comments.

CFA piles are generally limited to 25m for smaller diameter piles (<400mm) and 30m for larger diameter piles (>600mm), which should be taken into account when determining the number of piles under heavily loaded areas. CFA piles require good workmanship to ensure they are adequately constructed and may struggle to penetrate the obstructions encountered on site (subject to rig utilised).

Bored piles should be able to penetrate rock bands and bedrock encountered on site.

The presence of shallow and variable groundwater levels should be considered during pile design.

The use of casing or bentonite slurry or other suitable support fluid may be required to support the pile bore through the Made Ground and Superficial Deposits and potentially any significantly weathered water bearing granular bedrock materials. It should be noted that the possibility of groundwater strikes additional to those encountered during the ground investigation works cannot be ruled out.

The risk of over-flighting should be considered during pile construction due to the presence of loose / soft soils atop of intact rock bands / bedrock.

If adopted, it is important that the piling contractor has experience piling in similar ground conditions and it is advised that early engagement with the suitability qualified and experienced piling contractor is considered.

10.4 Ground Floor Slabs

Proposals indicate the construction of a two-level raft foundation. The floor slab may be constructed via a raft foundation formed on the weathered bedrock encountered as outlined in Section 10.3.

10.5 Chemical Attack on Buried Concrete

The site has been classified in accordance with BRE Special Digest 1 (Ref. 19) and laboratory testing undertaken accordingly in *Section 7.0*. Based on the laboratory test results obtained during the Curtins ground investigation, it is considered that a Design Sulphate Class may be undertaken as DS-1 with an ACEC class of AC-1 for made ground, glacial till and Chester Formation bedrock.

10.6 Excavation and Support

Observation during the intrusive works indicates no groundwater strikes or perched water was encountered during the ground investigation works. However, it should be noted water flush drilling techniques were used which may have masked water strikes.

It is noted that the groundwater readings are recorded below the proposed raft foundation therefore groundwater management techniques are unlikely to be required during the construction works. Despite this ongoing groundwater monitoring is recommended so seasonal changes can be factored into the final raft design.

Any excavations where the water table is encountered, and in accordance with Health and Safety Regulations, side support for safety purposes should be provided to all excavations which appear unstable, including where groundwater is encountered, and those more than 1.20m deep. Excavations shallower than 1.20m deep, requiring personnel access, will require closed side support.

The chosen contractor should provide details on how they intend to ensure the safety and stability of proposed excavations.

11.0 Conclusions & Recommendations

11.1 Conclusions

11.1.1 Ground and Groundwater Contamination

The environmental chemistry soil results have been compared with the Generic Assessment Criteria (GAC) for soils with respect to human health against the conservative '*Commercial*' threshold.

No exceedances have been noted with respect to the '*Commercial*' GAC threshold. No suspected asbestos containing materials (ACMs) were identified within any of the exploratory hole logs or during laboratory screening.

A **Low** risk rating is identified to site end-users, adjacent site users and construction workers, from soils and dust from inhalation and ingestion, in areas of proposed hardstanding and building footprints. No further action is required.

A **Very Low** and **Low** risk rating is identified to controlled waters (Groundwater and Surface Waters) following the ground investigation and groundwater sampling. No gross contamination was identified during the ground investigation and subsequent monitoring.

11.1.2 Ground Gas Assessment

Using 'representative borehole' scenario, due to the results across various atmospheric pressures and weather conditions, the calculated Q_{hg} for the site was of 0.0039l/hr for carbon dioxide.

Exploratory hole RBH102 monitoring installation response zone was flooded throughout the monitoring period. The variation in well head space caused by rising and falling groundwater levels in the unslotted section of the pipe is the likely cause of elevated air flow rates recorded.

Considering the above, a Characteristic Gas Situation is assessed as CS1, with no requirement for ground gas protection measures.

A **Low** risk rating is identified to site end users from ground gases arising from site soils, migrating into buildings and subsequent inhalation by end-users. This corresponds to a Characteristic Gas Situation 1.

The site is located within a Lower Probability Radon Area (1-3% of homes are estimated to be at or above the Action Level).

11.1.3 Geotechnical Assessment

The proposed development is to comprise the construction of a new office building. Due to the risk associated with shallow ground conditions, it is unlikely that the made ground or glacial till will provide a suitable bearing stratum.

It is understood that a raft foundation is the preferred option for the new development and further recommendations for consideration of this solution is presented in this document.

In the event the raft foundation does not provide suitable bearing capacities for the proposed structures, piled foundations may be adopted socketed into the Chester Formation.

The site has been classified in accordance with BRE Special Digest 1 and it is considered that a Design Sulphate Class may be taken as DS-1 with an ACEC class of AC-1 for the made ground, glacial till and bedrock.

11.2 Recommendations

Based on the findings of the ground investigation, the following recommendations are made:

- 1) It is recommended that construction workers are provided with appropriate PPE and sanitary facilities, with reference to the environmental testing results presented herein and within *Appendix C*.
- 2) Should unexpected contamination be observed during construction advice should be obtained from a Geo-environmental Engineer.
- 3) A full raft design will be required to evaluate the proposed raft foundation performance under gravity loading once frozen layouts are provided. The recommendations in this report can then be re-assessed.
- 4) It is noted that the groundwater readings are recorded below the proposed raft foundation therefore groundwater management techniques are unlikely to be required during the construction works. Despite this ongoing groundwater monitoring is recommended so seasonal changes can be factored into the final raft design.
- 5) If a piled foundation solution is adopted for the proposed structures, consultation with piling contractors with experience in piling in similar ground conditions should be considered.

12.0 References

1. WSP (2016) Jackson's Row Phase 1 Preliminary Geo-Environmental Risk Assessment, ref. 70010925/001/10465
2. British Geological Survey (BGS) 1:50,000 (Solid and Drift Edition, Sheet No. 085, 2011) for Manchester
3. Coal Authority Interactive Map Viewer [online], <http://mapapps2.bgs.ac.uk/coalauthority/home.html> (accessed October 2021).
4. CIRIA (2009) Unexploded Ordnance: A Guide for the Construction Industry (report no. C681).
5. Zetica Regional Unexploded Bomb Risk, Risk Map, <https://zeticauxo.com/downloads-and-resources/risk-maps/> (accessed July 2021).
6. WSP (2017) Jackson's Row Ground Investigation Report ref. 070028727_20160109
7. WSP (2015) Jackson's Row Preliminary Geotechnical and Environmental Assessment Report ref. 070010925/002/10482
8. IFA (2020) St Michael's Project, Manchester Factual Report on Ground Investigation, Report ref. 2230167
9. Ramboll (2021) St Michaels Ground Contamination Assessment, Report ref. 1620005916
10. Ramboll (2021) St Michaels Remedial Statement, report ref. 1620005916
11. Environmental Agency (2020) Land Contamination Risk Management (LCRM)
12. British Standards Institution (2011) Investigation of Potentially Contaminated Sites: Code of Practice (report no. BS10175:2011+A2:2017).
13. British Standards Institution BSI (2015+2000) Code of Practice for Site Investigations (report no. BS5930).
14. British Standards Institution (2006) Eurocode 7: Geotechnical Design (report no. BSEN1997).
15. British Standard (2016) Methods of test for soils for civil engineering purposes. General requirements and sample preparation (report no. BS1377-1).
16. ISRM (2014) The ISRM Suggested Methods for Rock Characterisation, Testing and Monitoring 2007-2014
17. British Standard (2015) Code of Practice for Retaining Structures (report no. BS8002:2015)
18. Peck et al (1967) Soil Mechanics in Engineering Practice
19. Building Research Establishment (2005) Concrete in Aggressive Ground (Special Digest 1).
20. British Standards Institution. (2013) Guidance on Investigations for Ground Gas, Permanent Gas and Volatile Organic Compounds (VOCs) (report no. BS8576:2013).
21. Department of Environment Food and Rural Affairs (DEFRA) (2012) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (report no. PB13735).
22. Environment Agency (2006) Remedial Targets Methodology – Hydrogeological Risk Assessment for Land Contamination

23. Department of the Environment (1996) The Surface Waters (Abstraction for Drinking Water) Classification Regulations (no. 3001)
24. World Health Organisation (2017) Guidelines for Drinking Water Quality (4th Edition)
25. CIRIA (2007) Assessing Risks Posed by Hazardous Ground Gases to Buildings (report no. C665).
26. British Standards Institution (2015) Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (report no.BS8485:2015 +A1:2019).
27. S Wilson, G Card, S Haines (2009) Ground Gas Handbook Cathness, Scotland, Whittles Publishing.
28. CIRIA (2001) Contaminated Land Risk Assessment. A guide to good practice (report no. C552).
29. CITB (2015) Construction (Design and Management) Regulations.

Appendix A – Drawings

- Curtins Borehole Plan
- Development Drawings



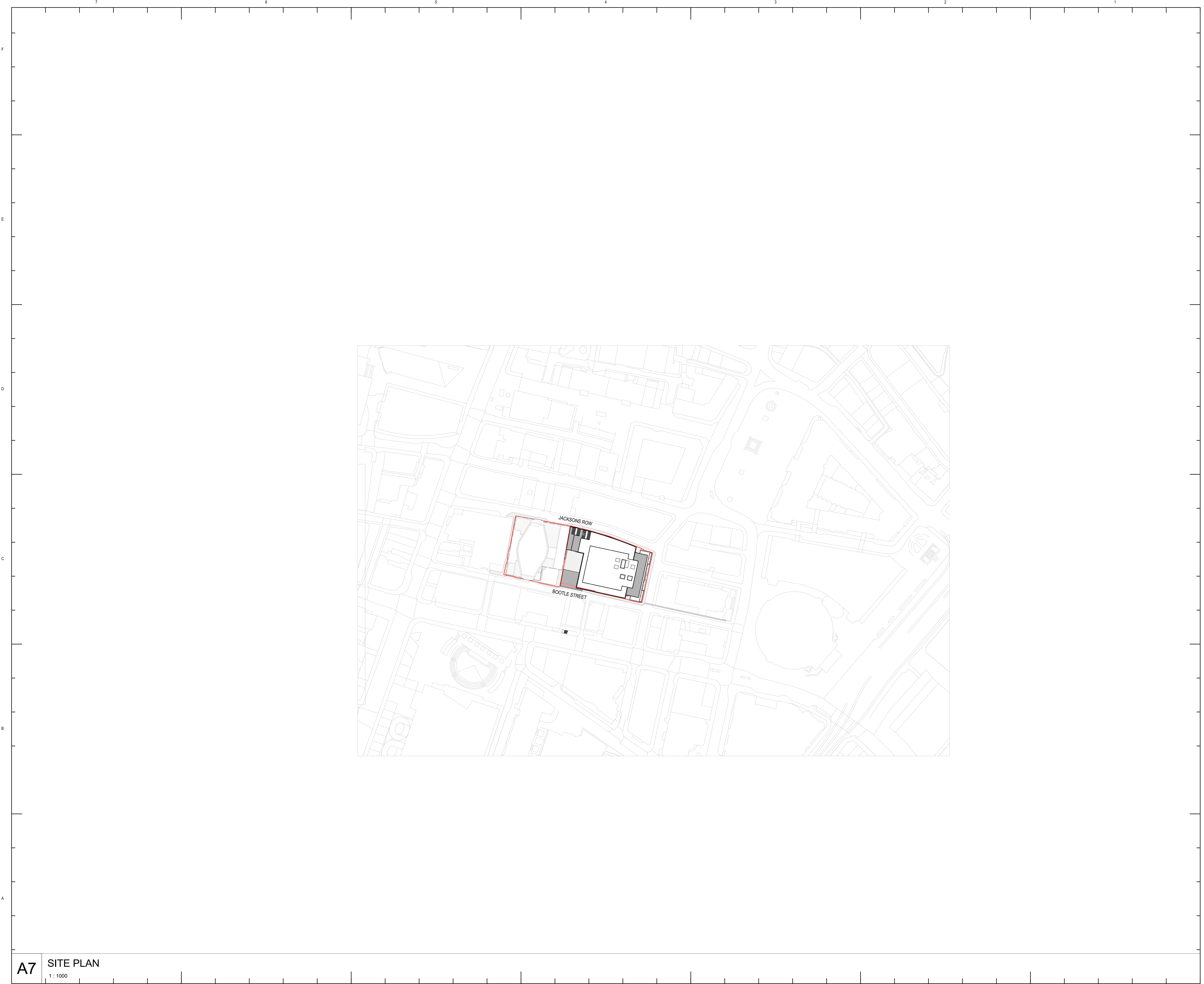
Key:				
	Window Sample Borehole Internal			
	Window Sample with Rotary Cored Follow on to 50.00mbgl			
	Window Sample Borehole External			
	Machine Excavated Trial Pit			
GENERAL NOTES:	Rev:	Description:	Date:	By:

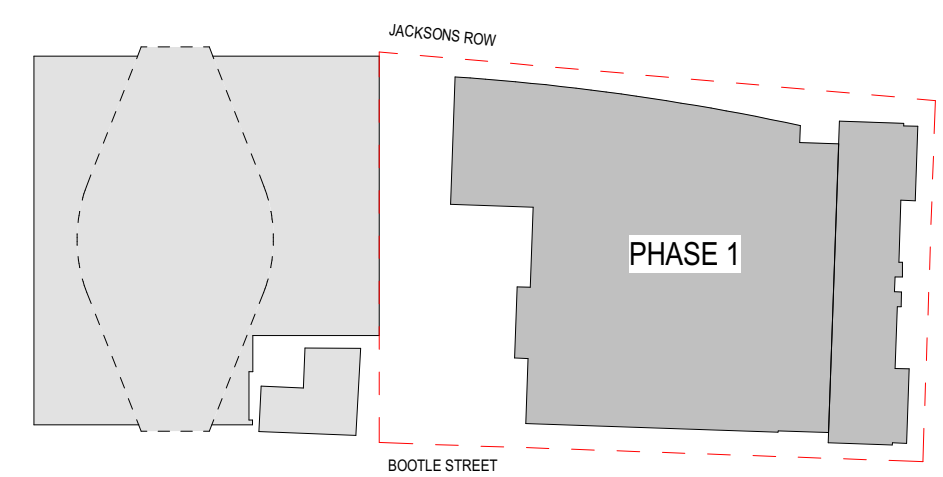


Merchant Exchange
 17-19 Whitworth Street West
 Manchester
 M1 5WG
 t: 0161 234 8509
 e: manchester@curtins.com
 w: www.curtins.com

Civils & Structures • Transport Planning • Environmental • Infrastructure • Geotechnical • Conservation & Heritage • Principal Designer
 Birmingham • Bristol • Cambridge • Cardiff • Douglas • Dublin • Edinburgh • Glasgow • Kendal • Leeds • Liverpool • London • Manchester • Nottingham

Project: St Michaels, Manchester		Status: DRAFT	
Drawing Title: Post Demo Exploratory Hole Location Plan		Drawn By: JL	Checked By: NF
		Designed By: JL	Date: 02/09/2022
		Scale: NTS	
Project No: Originator: Zone: Level: Type: Discipline: Category/Number: Rev:			
078874-CUR-00-XX-DR-GE-003-V02			





GENERAL NOTES:

1. FOR ABBREVIATIONS, SYMBOLS, LEGENDS, GENERAL NOTES AND MATERIAL CODE LIST, REFER TO A-0-002

P01	17.09.2021	Stage 2	
NO:	DATE:	ISSUE:	

Status

FOR INFORMATION

Civil Engineer



Services Engineer



Fire Engineer



Design Consultant



Client



Landscape Designer



Project Manager



Architect / Structural Engineer



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

Project Name

ST. MICHAELS DEVELOPMENT,
MANCHESTER

Drawing Title

SITE PLAN

Designed by	Designer	Drawn by	Author	Checked by	Checker	Approved by	Approver
-------------	----------	----------	--------	------------	---------	-------------	----------

Protocol Drawing No	STM-SOM-ZZ-ZZ-DR-A-0011		
Project No	218739	SOM Drawing No	Revision
Scale @ A0	1 : 1000	A-011	P01

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

Appendix B – Exploratory Hole Logs

- Window Sample Borehole Logs, WS104 – WS110
- Rotary Core Logs RBH101 – RBH103



Rotary Core Log

Borehole No.

RBH101

Sheet 1 of 6

Project Name: St Michael's

Project No.
078847

Co-ords: 383693.50 - 398018.32

Hole Type
RC

Location: Manchester

Level: 37.38

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 02/08/2021

Logged By
PN

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		0.35	ES				0.19	37.19		MADE GROUND: CONCRETE	
										MADE GROUND: Brown sandy gravelly clay with frequent intact bricks. Sand is fine to coarse. Gravel is angular to subangular fine to coarse including brick, ceramic and coal.	1
		2.00	D				1.40	35.98		Very dense reddish brown gravelly medium to coarse SAND.	2
											3
											4
		4.00 - 5.50	NI	65	23	0	4.60	32.78		Weak reddish brown medium to coarse grained SANDSTONE.	5
			NR							4.60 to 4.67m 0 - 10 degrees closely spaced planar rough From 4.67 to 4.89m recovered as non-intact core of angular cobbles. 4.89 to 4.98m 0 - 10 degrees closely spaced planar rough From 4.98 to 5.50m no recovery From 5.50 to 5.55m recovered as non-intact core of angular to subangular fine to coarse gravel. 5.55 to 6.82m 0 - 10 degrees very closely spaced to closely spaced planar rough.	6
		5.50 - 7.00	11	89	89	51					7
			NR							From 6.82 to 7.00m no recovery 7.00 to 7.81 10 - 45 degrees very closely spaced to closely spaced planar rough.	8
		7.00 - 8.50	12	92	85	35				From 7.81 to 7.90m recovered as non-intact core of angular cobbles. 7.90 to 8.37 0 - 10 degrees very closely spaced to closely spaced planar rough. From 8.37 to 8.58m no recovery From 8.58 to 8.63m recovered as non-intact core of angular cobbles. 8.63 to 9.90m 0 - 15 degrees very closely spaced to closely spaced planar rough.	9
		8.50 - 10.00	10	81	81	50	9.43	27.95		Weak reddish brown fine grained SANDSTONE. From 9.59 to 9.63m sand infill	10
			NI				10.00	27.38		Continued on next sheet	

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH101

Sheet 2 of 6

Project Name: St Michael's

Project No.
078847

Co-ords: 383693.50 - 398018.32

Hole Type
RC

Location: Manchester

Level: 37.38

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 02/08/2021

Logged By
PN

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description		
				TCR	SCR	RQD						
		10.00 - 11.50	23	86	77	13	11.68	25.70		From 9.90 to 10.00m recovered as non-intact core of angular to subangular fine to coarse gravel.	11	
			NI							Very weak reddish brown medium to coarse grained SANDSTONE.		
			13							10.00 to 10.94m 0 - 10 degrees extremely closely spaced and closely spaced planar rough.		
			NI							From 10.94 to 11.00m recovered as non-intact core of sandy angular to subangular fine to coarse gravel.		
		NR	11.00 to 11.16m 0 -10 degrees very closely spaced planar rough.									
		11.50 - 13.00	9	100	88	66				From 11.16 to 11.20 recovered as non-intact core of sandy angular to subangular fine to coarse gravel.		
			NI							From 11.27 to 11.50mn no recovery.		
			NI							From 11.50 to 11.55m recovered as non-intact core of sandy angular to subangular fine to coarse gravel.		
			NR							11.55 to 12.82m 0 - 15 degrees very closely spaced to medium spaced planar rough.		
		13.00 - 14.50	<25	99	92	61				Medium strong reddish brown fine to medium grained SANDSTONE.		
			NI							11.85 to 11.93m 1 No. discontinuity incipient fracture 90 degrees planar rough.		
			12							From 12.82 to 13.00m recovered as non-intact core of stiff reddish brown clay		
			NR							13.00 to 13.80m 0 - 20 degrees very closely spaced to medium spaced planar rough.		
		14.50 - 16.00	8	91	87	63				From 13.80 to 13.89m recovered as non-intact core of angular cobbles.		
			NI							13.89 to 14.50m 10 - 45 degrees very closely spaced to medium spaced planar rough.		
			11							From 14.50 to 14.58m no recovery.		
			NR							14.58 to 15.22m 0 - 10 degrees closely spaced to medium spaced planar rough.		
		16.00 - 17.50	11	90	83	28				From 15.22 to 15.28m recovered as non-intact core of sandy angular to subangular fine to coarse gravel.		
			NI							15.28 to 16.49m 0 - 10 degrees very closely to medium spaced planar rough.		
			NR							From 16.49 to 16.87m weak		
			17							From 17.21 to 17.29m recovered as non-intact core of sandy angular to subangular fine to coarse gravel.		
		17.50 - 19.00	11	91	80	41				17.29 to 17.35m 0 - 10 degrees closely spaced planar rough.		
			NI							From 17.35 to 17.50m no recovery.		
			<25							From 17.50 to 17.56m recovered as non-intact core of sandy angular to subangular fine to coarse gravel.		
			NR				17.56 to 18.7m 0 - 10 degrees very closely spaced to medium spaced planar rough.					
		19.00 - 20.50	9	100	95	74	From 17.68 to 17.72m clay infill.					
			NI				From 18.47 to 18.57m recovered as non-intact core of angular cobbles.					
			<25				18.57 to 18.92m 10 - 30 degrees very closely spaced to closely spaced planar rough.					
			NR				From 18.92 to 19.00m no recovery.					
											Medium strong reddish brown medium to coarse grained SANDSTONE.	19
											19.00 to 20.44m 0 - 10 degrees very closely spaced to medium spaced planar rough.	20
											Continued on next sheet	

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH101

Sheet 3 of 6

Project Name: St Michael's

Project No.
078847

Co-ords: 383693.50 - 398018.32

Hole Type
RC

Location: Manchester

Level: 37.38

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 02/08/2021

Logged By
PN

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
			NE				20.71	16.67		From 20.44 to 20.50m recovered as non-intact core of angular cobbles.	21
			14							20.50 to 20.71m 0 - 10 degrees very closely spaced to closely spaced planar rough.	
		20.50 - 22.00	4	80	80	65	22.00	15.38		Medium strong reddish brown fine grained SANDSTONE. 20.71 to 21.70m 0 - 10 degrees closely spaced to medium spaced planar rough.	
										From 21.70 to 22.00m no recovery.	
		22.00 - 23.50	5	91	91	85				Medium strong reddish brown medium to coarse grained SANDSTONE with occasional subrounded to rounded coarse gravel. 22.00 to 23.32m 0 - 30 degrees closely spaced and medium spaced planar rough.	22
			NR								23
			3							From 23.32 to 23.50m no recovery.	
			NI							23.50 to 23.81m 0 degrees medium spaced planar rough.	
		23.50 - 25.00	5	100	70	64				From 23.81 to 24.00m recovered as non-intact core of angular cobbles. 24.00 to 24.82m 10 - 30 degrees closely spaced and medium spaced planar rough.	24
			NI								
			NI							From 24.82 to 25.00m recovered as non-intact core of sandy angular to subangular fine to coarse gravel and angular cobbles.	
		25.00 - 26.50	4	85	67	67				From 25.00 to 25.17m recovered as non-intact core of angular cobbles. 25.17 to 26.29m 0 - 10 degrees closely spaced to medium spaced planar rough. 25.57 - 25.68m 1 No. Discontinuity incipient fracture 90 degrees planar rough.	25
			NR								26
			9							From 26.29 to 26.50m no recovery.	
										26.50 to 29.96m 0 - 10 degrees very closely spaced to closely spaced planar rough.	
		26.50 - 28.00	4	94	94	51				From 26.96 to 27.00m recovered as non-intact core of sandy angular to subangular fine to coarse gravel. 27.00 to 27.91m 0 - 10 degrees closely spaced locally very closely planar rough.	27
			NR								28
		28.00 - 29.50	6	94	94	85					29
			NR							From 29.32 to 29.35m clay infill	
			9							From 29.42 to 29.50m no recovery. 29.50 to 29.73m 0 - 10 degrees very closely spaced to closely spaced planar rough.	
										From 29.73 to 31.00m no recovery.	30

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH101

Sheet 4 of 6

Project Name: St Michael's

Project No.
078847

Co-ords: 383693.50 - 398018.32

Hole Type
RC

Location: Manchester

Level: 37.38

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 02/08/2021

Logged By
PN

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		29.50 - 31.00	NR	16	16	13	35.50	1.88			
		31.00 - 32.50	6	21	21	18				31	31.00 to 31.33m 0 - 10 degrees very closely spaced to closely spaced planar rough.
			NR							32	From 31.33 to 32.50m no recovery.
		32.50 - 34.00	8	87	87	82				33	32.50 to 33.39m 0 - 10 degrees closely spaced to medium spaced locally very closely spaced planar rough.
			NI								
			6							34	From 33.39 to 33.50m recovered as non-intact as sandy angular to subangular fine to coarse gravel. 33.50 to 34.00m 0 - 10 degrees closely spaced to medium spaced planar rough.
		34.00 - 35.50	11	100	87	87				35	From 33.94 to 34.00m no recovery. 34.00 to 34.19m 0 - 10 degrees closely spaced to medium spaced planar rough. From 34.19 to 34.33m recovered as non-intact core of sandy angular to subangular fine to coarse gravel. 34.33 to 38.44m 0 - 10 degrees closely spaced to medium spaced locally very closely spaced planar rough. 34.33 to 34.48 1 No. Discontinuity incipient fracture 90 degrees planar rough.
			NI								
			6							36	Medium strong reddish brown fine to medium grained SANDSTONE.
		35.50 - 37.00	6	100	100	97				37	
		37.00 - 38.50		100	100	87				38	
		NR									
		38.50 - 40.00	5	93	93	88				39	From 38.44 to 38.50m no recovery. 38.50 to 39.90 0 - 10 degrees medium spaced locally very closely spaced planar rough.
		NR					40	Continued on next sheet			

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH101

Sheet 5 of 6

Project Name: St Michael's

Project No.
078847

Co-ords: 383693.50 - 398018.32

Hole Type
RC

Location: Manchester

Level: 37.38

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 02/08/2021

Logged By
PN

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description																																																																																																																																																																																																																																																																																																																																																																																																																																																									
				TCR	SCR	RQD																																																																																																																																																																																																																																																																																																																																																																																																																																																													
		40.00 - 41.50	7	92	92	75				From 39.90 to 40.00m no recovery. Medium strong reddish brown medium to coarse grained SANDSTONE. 40.00 to 41.58m 0 - 10 degrees closely spaced to medium spaced planar rough.	41																																																																																																																																																																																																																																																																																																																																																																																																																																																								
			NR	100	95	88				From 41.20 to 41.23m recovered as non-intact core of rounded fine to coarse gravel. From 41.38 to 41.50m no recovery. 41.50 to 44.10m 10 -30 degrees closely spaced to medium spaced locally very closely spaced planar rough.		42																																																																																																																																																																																																																																																																																																																																																																																																																																																							
		41.50 - 43.00	7							77	77		42	From 42.54 to 42.63m clay infill	43																																																																																																																																																																																																																																																																																																																																																																																																																																																				
				43.00 - 44.50	NR	77						77				42	From 44.10 to 44.16m recovered as non-intact core of angular cobbles. From 44.16 to 44.50m no recovery. 44.50 to 45.66m 0 - 10 degrees closely spaced to medium spaced planar rough.	44																																																																																																																																																																																																																																																																																																																																																																																																																																																	
		44.50 - 46.00	8							77	77		70	From 45.66 to 46.00m no recovery.	45																																																																																																																																																																																																																																																																																																																																																																																																																																																				
				46.00 - 47.50	6	95						89				77	46.00 to 47.13m 0 - 10 degrees closely spaced locally very closely spaced planar rough.	46																																																																																																																																																																																																																																																																																																																																																																																																																																																	
		47.50 - 49.00	5							73	73		65	From 47.13 to 47.20m recovered as non-intact core of angulars cobbles. 47.20 to 47.42m 0 - 10 degrees closely spaced planar rough. From 47.42 to 47.50m no recovery. 47.50 to 48.61m 0 - 10 degrees closely spaced to medium spaced locally very closely spaced planar rough.	47																																																																																																																																																																																																																																																																																																																																																																																																																																																				
				49.00 - 50.50	5	77						77				77	From 48.61 to 49.00m no recovery. 49.00 to 50.16m 0 - 10 degrees closely spaced to medium spaced planar rough.	48																																																																																																																																																																																																																																																																																																																																																																																																																																																	

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH101

Sheet 6 of 6

Project Name: St Michael's

Project No.
078847

Co-ords: 383693.50 - 398018.32

Hole Type
RC

Location: Manchester

Level: 37.38

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 02/08/2021

Logged By
PN

Well	Water Strikes	Depth (m)	Type / Fl	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
							50.50	-13.12		From 50.16 to 50.50m no recovery.	
										End of borehole at 50.50 m	
											51
											52
											53
											54
											55
											56
											57
											58
											59
											60

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.







Rotary Core Log

Borehole No.

RBH102

Sheet 2 of 5

Project Name: St Michael's

Project No.
078847

Co-ords: 383708.81 - 398005.21

Hole Type
RC

Location: Manchester

Level: 37.37

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 13/08/2021

Logged By
TW

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
1		9.50 - 11.00	7	100	97	86	14.93	22.44		<i>spaced locally medium spaced, planar rough</i> <i>From 9.61 to 9.70m locally extremely weak.</i> <i>From 9.97 to 10.03m recovered as non-intact core of sandy subangular coarse gravel.</i> <i>10.03 to 11.50m 5 - 10 degrees closely spaced to medium spaced locally very closely spaced, planar rough.</i>	11
		11.00 - 12.50	13	100	100	57				<i>11.5 to 12.50m 5 - 15 degrees very closely spaced to closely spaced, planar and stepped and locally undulating rough.</i>	12
		12.50 - 14.00	9	100	100	77				<i>From 12.39 to 12.50m locally weak.</i> <i>12.50 to 14.00m 0 - 15 degrees closely spaced to medium spaced locally extremely closely spaced, planar rough</i> <i>From 13.09 to 13.15m mudstone band.</i> <i>From 13.46 to 13.50m sandy clay band.</i>	13
		14.00 - 15.50	7	100	100	79				<i>14.00 to 15.50m 5 - 15 degrees closely spaced to medium spaced, locally very closely spaced, planar locally stepped rough.</i>	14
		15.50 - 17.00	6	100	100	89				<i>Weak, reddish brown medium to coarse grained SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts.</i> <i>15.5 to 17.5m 5 - 10 degrees closely spaced to medium spaced locally extremely closely spaced, planar and undulating rough.</i> <i>From 16.05 to 16.10m locally very weak.</i>	15
		17.00 - 18.50	18	100	99	64				<i>Medium strong reddish brown medium grained micaceous SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts.</i> <i>17.50 to 17.95m 0 - 5 degrees closely spaced to medium spaced, planar smooth locally rough and 1 No. discontinuity 75 - 80 degrees planar rough.</i> <i>From 17.95 to 17.97m recovered as non-intact core of sandy subangular fine to coarse gravel.</i> <i>17.97 to 18.50m 0 - 5 degrees closely spaced to medium spaced, planar rough.</i>	17
		18.50 - 20.00	7	100	100	84				<i>18.50 to 20.00m 0 - 15 degrees closely spaced to medium spaced locally very closely spaced, planar and undulating rough.</i> <i>From 19.155 to 19.35m mudstone band.</i>	19
							19.87	17.50			20
										Continued on next sheet	

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH102

Sheet 3 of 5

Project Name: St Michael's

Project No.
078847

Co-ords: 383708.81 - 398005.21

Hole Type
RC

Location: Manchester

Level: 37.37

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 13/08/2021

Logged By
TW

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		20.00 - 21.50	15	98	94	70	21.50	15.87		Medium strong reddish brown fine grained micaceous SANDSTONE. 20.00 to 20.48m 5 - 10 degrees closely spaced to medium spaced, planar rough and 1 No. discontinuity 80 - 85 degrees, planar smooth. From 20.46 to 20.462m highly micaceous lamination. From 20.50 to 20.64m locally coarse grained and very weak. 20.64 to 21.47m 5 - 15 degrees closely spaced to medium spaced locally very closely spaced, planar rough.	21
			NI								
			7								
		21.50 - 23.00	6	100	100	91	23.22	14.15		From 21.47 to 21.50m no recovery. Medium strong reddish brown medium to coarse grained SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts. 21.50 to 24.50m 0 - 10 degrees closely spaced to medium spaced locally very closely spaced, planar and undulating rough locally smooth. From 21.60 to 21.70m subangular to subrounded coarse gravel bed.	22
		23.00 - 24.50		100	100	92				Medium strong reddish brown fine grained SANDSTONE.	24
		24.50 - 26.00	4	89	100	79	24.90	12.47		24.50 to 25.86m 5 - 20 degrees closely spaced to medium spaced locally very closely, planar rough.	
		26.00 - 27.50	NR	100	100	79				Medium strong reddish brown medium to coarse grained SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts.	25
			8								
		26.00 - 27.50	8	100	100	79				From 25.84 to 26.00m no recovery. 26.00 to 27.20m 5 - 10 degrees very closely spaced to closely spaced locally extremely closely, planar and undulating rough.	26
										NI	
		10									
27.50 - 29.00	7	100	100	93		From 27.20 to 27.30m recovered as non-intact core of sandy subangular medium to coarse gravel. 27.20 to 27.50m 5 - 15 degrees closely spaced, undulating rough. 27.50 to 29.00m 0 - 10 degrees closely spaced to medium spaced, planar and undulating rough.	27				
27.50 - 29.00	7	100	100	93					28		
29.00 - 30.50	5	91	91	76		29.00 to 30.37m 0 - 5 degrees closely spaced to medium spaced locally very closely spaced, planar and locally undulating rough.	29				
								Continued on next sheet	30		

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH102

Sheet 4 of 5

Project Name: St Michael's

Project No.
078847

Co-ords: 383708.81 - 398005.21

Hole Type
RC

Location: Manchester

Level: 37.37

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 13/08/2021

Logged By
TW

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
			NR								
		30.50 - 32.00	5	96	96	84	31.52	5.85		From 30.37 to 30.50m no recovery. 30.50 to 31.94m 0 - 5 degrees closely spaced to medium spaced locally very closely spaced, planar smooth and 1 No. discontinuity 40 - 45 degrees, planar smooth.	31
			NR							Medium strong reddish brown fine grained SANDSTONE.	
			NR				32.00	5.37		From 31.94 to 32.00m no recovery.	32
		32.00 - 33.50	7	100	89	77				Medium strong reddish brown medium to coarse grained SANDSTONE with rare subangular to subrounded fine to medium gravel clasts. 32.00 to 32.10m 1 No. discontinuity 85 - 90 degrees, planar rough. From 32.10 to 32.23m recovered as non-intact core of subangular gravelly cobbles. 32.23 to 34.40m 5 - 20 degrees closely spaced to medium spaced locally very closely spaced, planar and locally undulating rough.	33
		33.50 - 35.00	7	100	100	92				From 34.40 to 34.43m recovered as non-intact core of sandy gravel. 34.43 to 35.46m 0 - 10 degrees closely spaced to medium spaced locally very closely spaced, planar and undulating rough.	34
			7								35
		35.00 - 36.50	5	100	97	64	35.90	1.47		From 35.46 to 35.51m recovered as non-intact core of sandy subangular medium to coarse gravel. 35.51 to 36.50m 0 - 10 degrees closely spaced to medium spaced locally very closely spaced, planar and undulating rough.	36
			5				36.45	0.92		Medium strong reddish brown fine grained SANDSTONE. From 36.27 to 36.32m mudstone band.	37
		36.50 - 38.00	6	100	100	90				Medium strong reddish brown medium to coarse grained SANDSTONE with rare subangular to subrounded fine to medium gravel clasts. 36.50 to 38.09m 0 - 5 degrees closely spaced to medium spaced locally extremely closely spaced, planar and locally undulating rough and 1 No. discontinuity 70 - 75 degrees, planar smooth.	38
			6								39
		38.00 - 39.50	6	100	96	85				From 38.09 to 38.15m recovered as non-intact core of clayey sandy subangular fine to coarse gravel. 38.15 to 40.77m 10 - 20 degrees closely spaced to medium spaced locally very closely spaced, planar rough.	40
			6							From 38.97 to 39.01m mudstone band.	
										Continued on next sheet	

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH102

Sheet 5 of 5

Project Name: St Michael's

Project No.
078847

Co-ords: 383708.81 - 398005.21

Hole Type
RC

Location: Manchester

Level: 37.37

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 13/08/2021

Logged By
TW

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description				
				TCR	SCR	RQD								
		39.50 - 41.00		96	93	70	42.17	-4.80		From 40.77 to 40.90m recovered as non-intact core of sandy subangular medium to coarse gravel. 40.90 to 40.94m 1 No. discontinuity 0 - 5 degrees very closely spaced, planar rough. From 40.94 to 41.00m no recovery. 41.00 to 42.50m 5 - 10 degrees closely spaced to medium spaced locally very closely spaced, planar and locally stepped rough and 1 No. discontinuity 40 -45 degrees, planar rough.	41			
			NI											42
			NR											
		41.00 - 42.50	6	100	100	89					43			
												42.50 - 44.00	5	100
		44.00 - 45.50		100	100	91					45			
												45.50 - 47.00	13	92
		47.00 - 48.50	6	100	99	99					47			
												48.50 - 50.00	4	100
			5								49			
										50				

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH103

Sheet 1 of 5

Project Name: St Michael's

Project No.
078847

Co-ords: 383717.15 - 398018.23

Hole Type
RC

Location: Manchester

Level: 37.41

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 10/08/2021

Logged By
TW

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		0.45	ES				0.21	37.20		MADE GROUND: CONCRETE	
							1.00	36.40		MADE GROUND: Reddish brown gravelly fine to coarse sand with frequent intact bricks. Gravel is angular to subrounded fine to coarse including coal and brick.	1
							1.35	36.06		Firm reddish brown slightly gravelly CLAY. Gravel is subrounded fine to coarse including sandstone.	
										Very dense reddish brown slightly gravelly medium to coarse SAND. Gravel is subrounded to well rounded fine to coarse including sandstone.	2
											3
											4
							5.00	32.40		Very weak reddish brown medium to coarse grained SANDSTONE. <i>From 5.00 to 5.09m recovered as non-intact core of fine to medium sand.</i> <i>5.04 to 5.30m 0 - 10 degrees closely spaced locally extremely closely spaced, planar rough and 1 No. discontinuity 80 - 90 degrees planar rough.</i> <i>From 5.30 to 5.38m recovered as non-intact core of sandy subangular fine to medium gravel.</i> <i>From 5.38 to 5.47m locally extremely weak.</i> <i>5.38 to 5.95m 0 - 20 degrees very closely spaced to closely spaced, planar rough.</i> <i>From 5.95 to 6.50m no recovery.</i> <i>6.50 to 7.25m 0 - 10 degrees closely spaced, planar rough.</i>	5
		5.00 - 6.50	15 NI 12	63	55	23					6
		6.50 - 8.00	12 NR	50	50	35					7
		8.00 - 9.50	NI 10 25 25 15	100	89	35	8.00	29.40		Extremely weak reddish brown medium to coarse grained SANDSTONE. <i>From 8.00 to 8.12m recovered as non-intact core of clayey medium to coarse sand.</i> <i>8.12 to 8.20m 1 No. discontinuity 5 - 10 degrees, undulating rough</i> <i>From 8.20 to 8.25m recovered as non-intact core of sandy subangular coarse gravel.</i> <i>From 8.25 to 8.75m highly fractured.</i>	8
							8.75	28.66		Very weak reddish brown medium to coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts. <i>8.75 to 9.50m 0 - 15 degrees very closely spaced to closely spaced, planar rough</i>	9
											10

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH103

Sheet 2 of 5

Project Name: St Michael's

Project No.
078847

Co-ords: 383717.15 - 398018.23

Hole Type
RC

Location: Manchester

Level: 37.41

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 10/08/2021

Logged By
TW

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description				
				TCR	SCR	RQD								
		9.50 - 11.00	NR	0	0	0	16.83	20.58		From 9.00 to 11.00m no recovery.				
		11.00 - 12.50	>25	78	78	26				11.00 to 11.53m 0 - 10 degrees extremely closely spaced to very closely spaced locally closely spaced, planar and undulating rough.				
			10							From 11.40 to 11.53m locally extremely weak.				
			NR							11.53 to 12.17m 10 - 30 degrees closely spaced, planar and undulating rough.				
		12.50 - 14.00	17	80	80	48				From 12.17 to 12.50m no recovery.				
			NR							12.50 to 13.20m 0 - 10 degrees very closely spaced to closely spaced, planar rough				
		14.00 - 15.50	11	87	69	53				From 13.20 to 14.00m no recovery.				
			NI							14.00 to 14.09m 1 No. discontinuity 5 - 10 degrees, planar rough.				
			6							From 14.09 to 14.38m recovered as non-intact core of subangular cobbles.				
			NR							14.36 to 15.30m 0 - 10 degrees closely spaced to medium spaced locally very closely spaced, planar rough.				
		15.50 - 17.00	12	100	89	44				From 15.30 to 15.50m no recovery.				
			NI							From 15.50 to 15.60m recovered as non-intact core of sandy subangular coarse gravel and cobbles.				
			10							15.60 to 16.29m 0 - 5 degrees very closely spaced to closely spaced, planar rough and 1 No. discontinuity from 15.00 to 16.00m 85 - 90 degrees, planar rough.				
		17.00 - 18.50	9	100	100	79				From 16.29 to 16.35m recovered as non-intact core of very sandy subangular coarse gravel.				
			NR							16.35 to 16.83m 5 - 10 degrees closely spaced to medium spaced locally very closely spaced, planar rough and 1 No. discontinuity 80 - 90 degrees, planar rough.				
			5							Medium strong reddish brown fine grained SANDSTONE.				
		18.50 - 20.00	5	90	90	79				16.83 to 18.85m 0 - 10 degrees closely spaced to medium spaced locally very closely spaced, planar smooth.				
			NR							Weak reddish brown medium to coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts.				
		18.50 - 20.00	5	90	90	79				18.85 to 19.85m 5 - 10 degrees very closely spaced to closely spaced, planar rough.				
			NR							From 19.85 to 20.00m no recovery.				
									Continued on next sheet	20				

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH103

Sheet 3 of 5

Project Name: St Michael's

Project No.
078847

Co-ords: 383717.15 - 398018.23

Hole Type
RC

Location: Manchester

Level: 37.41

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 10/08/2021

Logged By
TW

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD					
		20.00 - 21.50	5	100	100	85	26.85	10.56		20.00 to 23.00m 0 - 10 degrees closely spaced to medium spaced, planar locally stepped rough.	21
		21.50 - 23.00		100	100	100					22
		23.00 - 24.50	6	100	100	85				23.00 to 25.87m 0 - 10 degrees closely spaced to medium spaced locally very closely spaced, planar and undulating rough and 1 No. discontinuity from 23.92 to 24.00m 85 - 90 degrees, planar rough.	23
		24.50 - 26.00		91	91	77					24
			NR							From 25.87 to 26.00m no recovery.	25
		26.00 - 27.50	6	100	100	95				26.00 to 26.85m 0 - 5 degrees closely spaced to medium spaced locally very closely spaced, planar rough.	26
			7							Medium strong reddish brown fine grained SANDSTONE. 26.85 to 29.00m 5 - 10 degrees closely spaced to medium spaced locally very closely spaced, planar rough locally smooth.	27
		27.50 - 29.00		100	100	98				From 27.5 to 27.53m mudstone band.	28
		29.00 - 30.50	7	97	97	88				29.00 to 30.45m 0 - 10 degrees very closely spaced to medium spaced, planar rough.	29
										Continued on next sheet	30

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Rotary Core Log

Borehole No.

RBH103

Sheet 5 of 5

Project Name: St Michael's

Project No.
078847

Co-ords: 383717.15 - 398018.23

Hole Type
RC

Location: Manchester

Level: 37.41

Scale
1:50

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 10/08/2021

Logged By
TW

Well	Water Strikes	Depth (m)	Type / FI	Coring			Depth (m)	Level (m)	Legend	Stratum Description				
				TCR	SCR	RQD								
		39.50 - 41.00		89	89	53	41.77	-4.36		40.19 to 40.83m 0 - 5 degrees very closely spaced to medium spaced, planar rough.	41			
			23											
			NR											
		41.00 - 42.50	7	91	91	77			41.77	-4.36			41.00 to 42.36m 5 - 10 degrees closely spaced to medium spaced locally extremely closely spaced, planar and undulating rough.	42
													NR	
		42.50 - 44.00	4	82	70	56			42.94	-5.54			Medium strong reddish brown coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts.	43
							NI							
							17							
							NI							
							16							
		NR												
		44.00 - 45.50	7	92	92	80	44.00	-6.60		Weak reddish brown fine to medium grained SANDSTONE.	44			
		45.50 - 47.00	6	100	91	85	46.02	-8.62		From 43.00 to 43.11m recovered as non-intact core of sandy subangular medium to coarse gravel.	45			
										NI				
47.00 - 48.50	4	100	100	94	46.02	-8.62				From 43.11 to 43.23m 0 - 5 degrees closely spaced, planar rough.		46		
48.50 - 50.00	4	100	100	97	46.02	-8.62				From 43.23 to 43.30m recovered as non-intact core of sandy subangular cobbles.		47		
48.50 - 50.00	4	100	100	97	46.02	-8.62		From 43.30m to 44m no recovery.	48					
48.50 - 50.00	4	100	100	97	46.02	-8.62		From 43.73 to 44m no recovery.	49					
48.50 - 50.00	4	100	100	97	46.02	-8.62		Medium strong reddish brown medium to coarse grained SANDSTONE with occasional subangular fine to medium gravel clasts.	50					
48.50 - 50.00	4	100	100	97	46.02	-8.62		44.00 to 45.38m 0 - 5 degrees closely spaced to medium spaced, planar rough.	50					
48.50 - 50.00	4	100	100	97	46.02	-8.62		45.38 to 45.50m no recovery.	50					
48.50 - 50.00	4	100	100	97	46.02	-8.62		45.50 to 46.02m 5 - 10 degrees closely spaced to medium spaced, planar and undulating rough.	50					
48.50 - 50.00	4	100	100	97	46.02	-8.62		Strong reddish brown medium to coarse grained SANDSTONE with occasional subangular to subrounded fine to medium gravel clasts.	50					
48.50 - 50.00	4	100	100	97	46.02	-8.62		From 46.02 to 46.15m recovered as non-intact core of sandy subangular cobbles.	50					
48.50 - 50.00	4	100	100	97	46.02	-8.62		46.15 to 50.00m 5 - 20 degrees closely spaced to medium spaced locally very closely spaced, planar rough.	50					
48.50 - 50.00	4	100	100	97	46.02	-8.62		End of borehole at 50.00 m	50					

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered due to water flush.





Borehole Log

Borehole No.

WS104

Sheet 1 of 1

Project Name: St Michael's

Project No.
078847

Co-ords: 383699.78 - 398028.48

Hole Type
WS

Location: Manchester

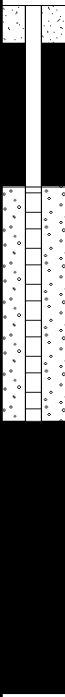
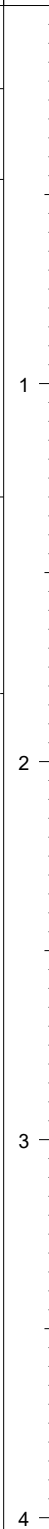
Level: 37.41

Scale
1:20

Client: Bowmer & Kirkland

Dates: 27/07/2021 - 27/07/2021

Logged By
PN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.25	ES		0.22	37.19		MADE GROUND: CONCRETE	
					0.46	36.95		Light brown fine to coarse slightly gravelly SAND. Gravel is subangular to well rounded fine to coarse including sandstone.	
		1.20 1.20 - 1.35	D	N=61 (3,3/6,12,18,25)	1.30	36.11		Very stiff reddish brown mottled grey CLAY with frequent rounded cobbles of sandstone and mudstone.	
		1.56		50 (7,20/50 for 80mm)	1.82	35.59		Very dense reddish brown medium to coarse SAND.	
								End of borehole at 1.82 m	

Remarks

Service inspection pit hand excavated from GL to 1.20m. No groundwater encountered. Terminated at 1.82m due to SPT refusal.



Borehole Log

Borehole No.

WS105

Sheet 1 of 1

Project Name: St Michael's

Project No.
078847

Co-ords: 383723.84 - 398028.79

Hole Type	WS
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
27	27
28	28
29	29
30	30
31	31
32	32
33	33
34	34
35	35
36	36
37	37
38	38
39	39
40	40
41	41
42	42
43	43
44	44
45	45
46	46
47	47
48	48
49	49
50	50
51	51
52	52
53	53
54	54
55	55
56	56
57	57
58	58
59	59
60	60
61	61
62	62
63	63
64	64
65	65
66	66
67	67
68	68
69	69
70	70
71	71
72	72
73	73
74	74
75	75
76	76
77	77
78	78
79	79
80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

Location: Manchester

Level:	34.31
--------	-------

Scale
1:20

Client: Bowmer & Kirkland

Dates: 28/07/2021 - 28/07/2021

Logged By
PN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.28 - 0.35	D		0.20	34.11		MADE GROUND: CONCRETE	1 2 3 4
					0.28	34.03		MADE GROUND: Brown sandy gravel. Sand is fine to coarse. Gravel is angular to subangular fine to coarse including concrete, brick and bitumen. Brown slightly gravelly coarse SAND. Gravel is subrounded fine to coarse of sandstone and quartz. Reddish brown SANDSTONE. End of borehole at 0.37 m	
					0.35	33.96			
					0.37	33.94			

Remarks

Hand excavated pit to 0.37m bgl in sandstone bedrock.



Borehole Log

Borehole No.

WS106

Sheet 1 of 1

Project Name: St Michael's

Project No.
078847

Co-ords: 383709.88 - 398035.35

Hole Type	WS
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
27	27
28	28
29	29
30	30
31	31
32	32
33	33
34	34
35	35
36	36
37	37
38	38
39	39
40	40
41	41
42	42
43	43
44	44
45	45
46	46
47	47
48	48
49	49
50	50
51	51
52	52
53	53
54	54
55	55
56	56
57	57
58	58
59	59
60	60
61	61
62	62
63	63
64	64
65	65
66	66
67	67
68	68
69	69
70	70
71	71
72	72
73	73
74	74
75	75
76	76
77	77
78	78
79	79
80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

Location: Manchester

Level:	34.30
--------	-------

Scale
1:20

Client: Bowmer & Kirkland

Dates: 28/07/2021 - 28/07/2021

Logged By
PN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.15	34.15		MADE GROUND: CONCRETE	1 2 3 4
					0.25	34.05		MADE GROUND: Brown sandy gravel. Sand is fine to coarse. Gravel is angular to subangular fine to coarse including concrete, brick and bitumen. Brown slightly gravelly coarse SAND. Gravel is subrounded fine to coarse of sandstone and quartz. Reddish brown SANDSTONE. End of borehole at 0.32 m	
					0.30	34.00			
					0.32	33.98			

Remarks

Hand excavated pit to 0.32m bgl in sandstone bedrock.





Borehole Log

Borehole No.

WS107

Sheet 1 of 1

Project Name: St Michael's

Project No.
078847

Co-ords: 383684.61 - 398040.17

Hole Type
WS

Location: Manchester

Level: 33.53

Scale
1:20

Client: Bowmer & Kirkland

Dates: 28/07/2021 - 28/07/2021

Logged By
PN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.33 - 0.36	D		0.33 0.36 0.40 0.42	33.20 33.16 33.12 33.10		MADE GROUND: CONCRETE	
								Greyish brown slightly gravelly coarse SAND. Gravel is subrounded fine of quartz.	
								Brown slightly gravelly coarse SAND. Gravel is subrounded fine to coarse of sandstone and quartz.	
								Reddish brown SANDSTONE.	
								End of borehole at 0.42 m	

1

2

3

4

Remarks

Hand excavated pit to 0.42m bgl in sandstone bedrock.



Borehole Log

Borehole No.

WS108

Sheet 1 of 1

Project Name: St Michael's

Project No.
078847

Co-ords: 383673.96 - 398010.14

Hole Type	WS
1	1
2	2
3	3
4	4
5	5
6	6
7	7
8	8
9	9
10	10
11	11
12	12
13	13
14	14
15	15
16	16
17	17
18	18
19	19
20	20
21	21
22	22
23	23
24	24
25	25
26	26
27	27
28	28
29	29
30	30
31	31
32	32
33	33
34	34
35	35
36	36
37	37
38	38
39	39
40	40
41	41
42	42
43	43
44	44
45	45
46	46
47	47
48	48
49	49
50	50
51	51
52	52
53	53
54	54
55	55
56	56
57	57
58	58
59	59
60	60
61	61
62	62
63	63
64	64
65	65
66	66
67	67
68	68
69	69
70	70
71	71
72	72
73	73
74	74
75	75
76	76
77	77
78	78
79	79
80	80
81	81
82	82
83	83
84	84
85	85
86	86
87	87
88	88
89	89
90	90
91	91
92	92
93	93
94	94
95	95
96	96
97	97
98	98
99	99
100	100

Location: Manchester

Level: 34.39

Scale
1:20

Client: Bowmer & Kirkland

Dates: 28/07/2021 - 28/07/2021

Logged By
PN

[illegible]

Remarks				
Hand exavated pit to 0.30m bgl in bedrock.				





Borehole Log

Borehole No.

WS109

Sheet 1 of 1

Project Name: St Michael's

Project No.
078847

Co-ords: 383701.15 - 397998.97

Hole Type
WS

Location: Manchester

Level: 34.33

Scale
1:20

Client: Bowmer & Kirkland

Dates: 28/07/2021 - 28/07/2021

Logged By
PN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20 - 0.30	D		0.10 0.12 0.20 0.30 0.32	34.23 34.21 34.13 34.03 34.01	  	MADE GROUND: CONCRETE MADE GROUND: Bitumen MADE GROUND: Intact bricks Brown slightly gravelly coarse SAND. Gravel is subrounded fine to coarse of sandstone and quartz. Reddish brown SANDSTONE. End of borehole at 0.31 m	1 2 3 4

Remarks

Hand excavated pit to 0.32m bgl in sandstone bedrock.





Borehole Log

Borehole No.

WS110

Sheet 1 of 1

Project Name: St Michael's

Project No.
078847

Co-ords: 383717.32 - 397995.59

Hole Type
WS

Location: Manchester

Level: 34.34

Scale
1:20

Client: Bowmer & Kirkland

Dates: 28/07/2021 - 28/07/2021

Logged By
PN

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		0.20 - 0.30	D		0.10	34.24		MADE GROUND: CONCRETE	1 2 3 4
					0.12	34.22		MADE GROUND: Bitumen	
					0.20	34.14		MADE GROUND: Intact bricks	
					0.30	34.04		Brown slightly gravelly coarse SAND. Gravel is subrounded fine to coarse of sandstone and quartz.	
					0.32	34.02		Reddish brown SANDSTONE.	

End of borehole at 0.32 m

Remarks

Hand excavated pit to 0.32m bgl in sandstone bedrock.



Appendix C – Chemical Laboratory Testing Results

- Envirolab, Environmental Chemistry Analysis Results, Soils
- Envirolab, Environmental Chemistry Analysis Results, Waters

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 21/08243
Issue Number: 1
Date: 03 August, 2021

Client: Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: EBMA/Philippa Neesham/Rob Allen
Project Name: St Michael's
Project Ref: 078847
Order No: n/a
Date Samples Received: 28/07/21
Date Instructions Received: 28/07/21
Date Analysis Completed: 03/08/21

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 21/08243

Client Project Name: St Michael's

Client Project Ref: 078847

Lab Sample ID	21/08243/1	21/08243/2	21/08243/3	21/08243/4				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS104	WS101	WS102	WS103						
Depth to Top	0.25	0.35	0.4	0.45						
Depth To Bottom										
Date Sampled	27-Jul-21	27-Jul-21	27-Jul-21	27-Jul-21						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	1A	6A	6A	1A						
% Stones >10mm _A	8.5	13.3	0.9	8.3				% w/w	0.1	A-T-044
pH _D ^{M#}	8.75	8.55	7.57	8.99				pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.02	0.06	0.39	0.17				g/l	0.01	A-T-026s
Cyanide (total) _A ^{M#}	<1	<1	<1	<1				mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	<0.2	<0.2	<0.2				mg/kg	0.2	A-T-050s
Organic matter _D ^{M#}	0.4	17.2	3.3	1.8				% w/w	0.1	A-T-032 OM
Arsenic _D ^{M#}	2	39	16	2				mg/kg	1	A-T-024s
Boron (water soluble) _D	<1.0	2.0	1.1	1.0				mg/kg	1	A-T-027s
Cadmium _D ^{M#}	<0.5	1.0	0.9	<0.5				mg/kg	0.5	A-T-024s
Copper _D ^{M#}	7	127	30	12				mg/kg	1	A-T-024s
Chromium _D ^{M#}	11	18	25	6				mg/kg	1	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1				mg/kg	1	A-T-040s
Lead _D ^{M#}	6	157	45	57				mg/kg	1	A-T-024s
Mercury _D	<0.17	0.48	<0.17	<0.17				mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	16	49	30	9				mg/kg	1	A-T-024s
Selenium _D ^{M#}	<1	<1	<1	<1				mg/kg	1	A-T-024s
Zinc _D ^{M#}	30	113	59	36				mg/kg	5	A-T-024s

Envirolab Job Number: 21/08243

Client Project Name: St Michael's

Client Project Ref: 078847

Lab Sample ID	21/08243/1	21/08243/2	21/08243/3	21/08243/4				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS104	WS101	WS102	WS103						
Depth to Top	0.25	0.35	0.4	0.45						
Depth To Bottom										
Date Sampled	27-Jul-21	27-Jul-21	27-Jul-21	27-Jul-21						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	1A	6A	6A	1A						
Asbestos in Soil (inc. matrix)										
Asbestos in soil [#]	NAD	NAD	NAD	NAD						A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	N/A	N/A	N/A						A-T-045

Envirolab Job Number: 21/08243

Client Project Name: St Michael's

Client Project Ref: 078847

Lab Sample ID	21/08243/1	21/08243/2	21/08243/3	21/08243/4				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS104	WS101	WS102	WS103						
Depth to Top	0.25	0.35	0.4	0.45						
Depth To Bottom										
Date Sampled	27-Jul-21	27-Jul-21	27-Jul-21	27-Jul-21						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	1A	6A	6A	1A						
PAH-16MS										
Acenaphthene _A ^{M#}	<0.01	<0.01	<0.01	0.06				mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	<0.02	<0.02	<0.02	0.17				mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	<0.04	<0.04	<0.04	0.41				mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	<0.04	<0.04	<0.04	0.30				mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	<0.05	<0.05	<0.05	0.28				mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	<0.05	<0.05	0.15				mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	<0.07	<0.07	0.09				mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	<0.06	<0.06	<0.06	0.50				mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04				mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	<0.08	<0.08	<0.08	0.89				mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	<0.01	<0.01	<0.01	0.05				mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	<0.03	<0.03	<0.03	0.13				mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	<0.03	<0.03	<0.03	0.07				mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	<0.03	<0.03	<0.03	0.89				mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	<0.07	<0.07	<0.07	0.79				mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	<0.08	<0.08	<0.08	4.78				mg/kg	0.01	A-T-019s

Envirolab Job Number: 21/08243

Client Project Name: St Michael's

Client Project Ref: 078847

Lab Sample ID	21/08243/1	21/08243/2	21/08243/3	21/08243/4				Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS104	WS101	WS102	WS103						
Depth to Top	0.25	0.35	0.4	0.45						
Depth To Bottom										
Date Sampled	27-Jul-21	27-Jul-21	27-Jul-21	27-Jul-21						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	1A	6A	6A	1A						
TPH CWG										
Ali >C5-C6 _A [#]	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Ali >C8-C10 _A	<1	<1	<1	<1				mg/kg	1	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	<1	<1	<1				mg/kg	1	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	1	<1	<1				mg/kg	1	A-T-055s
Ali >C16-C21 _A ^{M#}	<1	1	<1	1				mg/kg	1	A-T-055s
Ali >C21-C35 _A ^{M#}	<1	5	<1	9				mg/kg	1	A-T-055s
Total Aliphatics _A	<1	7	<1	11				mg/kg	1	A-T-055s
Aro >C5-C7 _A [#]	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
Aro >C8-C10 _A	<1	<1	<1	1				mg/kg	1	A-T-055s
Aro >C10-C12 _A	<1	<1	<1	5				mg/kg	1	A-T-055s
Aro >C12-C16 _A	<1	2	<1	7				mg/kg	1	A-T-055s
Aro >C16-C21 _A ^{M#}	<1	2	<1	33				mg/kg	1	A-T-055s
Aro >C21-C35 _A ^{M#}	<1	14	<1	111				mg/kg	1	A-T-055s
Total Aromatics _A	<1	18	<1	157				mg/kg	1	A-T-055s
TPH (Ali & Aro >C5-C35) _A	<1	25	<1	168				mg/kg	1	A-T-055s
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01	<0.01				mg/kg	0.01	A-T-022s

REPORT NOTES

General

This report shall not be reproduced, except in full, without written approval from Envirolab.

The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG	Project No:	21/08243
Project:	St Michael's	Date Received:	28/07/2021 (am)
Clients Project No:	078847	Cool Box Temperatures (°C):	14.7

NO DEVIATIONS IDENTIFIED with respect to sampling dates or containers received.

Note: If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3 (for water samples $5 \pm 3^{\circ}\text{C}$), ISO 18400-120:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	21/08243/1	21/08243/2	21/08243/3	21/08243/4
Client Sample No				
Client Sample ID/Depth	WS104 0.25m	WS101 0.35m	WS102 0.4m	WS103 0.45m
Date Sampled	27/07/21	27/07/21	27/07/21	27/07/21
A-T-019s	03/08/2021	03/08/2021	03/08/2021	03/08/2021
A-T-022s	02/08/2021	02/08/2021	02/08/2021	02/08/2021
A-T-024s	03/08/2021	03/08/2021	03/08/2021	03/08/2021
A-T-026s	02/08/2021	02/08/2021	02/08/2021	02/08/2021
A-T-027s	03/08/2021	03/08/2021	03/08/2021	03/08/2021
A-T-031s	02/08/2021	02/08/2021	02/08/2021	02/08/2021
A-T-032 OM	30/07/2021	30/07/2021	30/07/2021	30/07/2021
A-T-040s	02/08/2021	02/08/2021	02/08/2021	02/08/2021
A-T-042sTCN	02/08/2021	02/08/2021	02/08/2021	02/08/2021
A-T-044	02/08/2021	02/08/2021	02/08/2021	02/08/2021
A-T-045	30/07/2021	30/07/2021	30/07/2021	30/07/2021
A-T-050s	02/08/2021	02/08/2021	02/08/2021	02/08/2021
A-T-055s	03/08/2021	03/08/2021	03/08/2021	03/08/2021

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 21/09569
Issue Number: 1

Date: 10 September, 2021

Client: Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: EBMA/Philippa Neesham/Rob Allen/Tommy Walker
Project Name: St. Michaels
Project Ref: B078847
Order No: EBMA3042
Date Samples Received: 03/09/21
Date Instructions Received: 03/09/21
Date Analysis Completed: 10/09/21

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Sophie France
Client Service Manager

Envirolab Job Number: 21/09569

Client Project Name: St. Michaels

Client Project Ref: B078847

Lab Sample ID	21/09569/1	21/09569/2	21/09569/3					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH101	RBH102	RBH103							
Depth to Top	14.29	13.48	13.02							
Depth To Bottom	14.30	13.49	13.03							
Date Sampled	02-Sep-21	02-Sep-21	02-Sep-21							
Sample Type	Water - EW	Water - EW	Water - EW							
Sample Matrix Code	N/A	N/A	N/A							
pH (w) _A [#]	7.26	7.77	7.54					pH	0.01	A-T-031w
Hardness Total _A [#]	842	270	215					mg/l Ca CO ₃	2	A-T-049w
Sulphate (w) _A [#]	309	84	60					mg/l	1	A-T-026w
Cyanide (total) (w) _A [#]	<0.005	0.005	<0.005					mg/l	0.005	A-T-042wTCN
Phenols - Total by HPLC (w) _A	<0.01	<0.01	<0.01					mg/l	0.01	A-T-050w
Sulphide (w) _A	<0.1	<0.1	<0.1					mg/l	0.1	A-T-S2-w
DOC (w) _A [#]	3.2	4.0	4.2					mg/l	0.2	A-T-032w
Arsenic (dissolved) _A [#]	<1	<1	<1					µg/l	1	A-T-025w
Boron (dissolved) _A [#]	49	95	123					µg/l	10	A-T-025w
Cadmium (dissolved) _A [#]	<0.2	<0.2	<0.2					µg/l	0.2	A-T-025w
Calcium (dissolved) _A [#]	185	56	46					mg/l	1	A-T-049w
Copper (dissolved) _A [#]	1	3	4					µg/l	1	A-T-025w
Chromium (dissolved) _A [#]	<1	2	4					µg/l	1	A-T-025w
Lead (dissolved) _A [#]	<1	<1	1					µg/l	1	A-T-025w
Mercury (dissolved) _A [#]	<0.1	<0.1	<0.1					µg/l	0.1	A-T-025w
Nickel (dissolved) _A [#]	2	<1	2					µg/l	1	A-T-025w
Selenium (dissolved) _A [#]	3	2	<1					µg/l	1	A-T-025w
Zinc (dissolved) _A [#]	4	5	16					µg/l	1	A-T-025w

Envirolab Job Number: 21/09569

Client Project Name: St. Michaels

Client Project Ref: B078847

Lab Sample ID	21/09569/1	21/09569/2	21/09569/3					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH101	RBH102	RBH103							
Depth to Top	14.29	13.48	13.02							
Depth To Bottom	14.30	13.49	13.03							
Date Sampled	02-Sep-21	02-Sep-21	02-Sep-21							
Sample Type	Water - EW	Water - EW	Water - EW							
Sample Matrix Code	N/A	N/A	N/A							
PAH 16MS (w)										
Acenaphthene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Acenaphthylene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Anthracene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Benzo(a)anthracene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Benzo(a)pyrene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Benzo(b)fluoranthene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Benzo(ghi)perylene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Benzo(k)fluoranthene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Chrysene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Dibenzo(ah)anthracene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Fluoranthene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Fluorene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Indeno(123-cd)pyrene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Naphthalene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Phenanthrene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Pyrene (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w
Total PAH 16MS (w) _A [#]	<0.01	<0.01	<0.01					µg/l	0.01	A-T-019w

Envirolab Job Number: 21/09569

Client Project Name: St. Michaels

Client Project Ref: B078847

Lab Sample ID	21/09569/1	21/09569/2	21/09569/3					Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH101	RBH102	RBH103							
Depth to Top	14.29	13.48	13.02							
Depth To Bottom	14.30	13.49	13.03							
Date Sampled	02-Sep-21	02-Sep-21	02-Sep-21							
Sample Type	Water - EW	Water - EW	Water - EW							
Sample Matrix Code	N/A	N/A	N/A							
TPH CWG (w)										
Ali >C5-C6 (w) _A [#]	<1	<1	<1					µg/l	1	A-T-022w
Ali >C6-C8 (w) _A [#]	<1	<1	<1					µg/l	1	A-T-022w
Ali >C8-C10 (w) _A [#]	<5	<5	<5					µg/l	5	A-T-055w
Ali >C10-C12 (w) _A [#]	<5	<5	<5					µg/l	5	A-T-055w
Ali >C12-C16 (w) _A [#]	<5	<5	<5					µg/l	5	A-T-055w
Ali >C16-C21 (w) _A [#]	<5	<5	<5					µg/l	5	A-T-055w
Ali >C21-C35 (w) _A [#]	<5	<5	<5					µg/l	5	A-T-055w
Total Aliphatics (w) _A [#]	<5	<5	<5					µg/l	5	A-T-055w
Aro >C5-C7 (w) _A [#]	<1	<1	<1					µg/l	1	A-T-022w
Aro >C7-C8 (w) _A [#]	<1	<1	<1					µg/l	1	A-T-022w
Aro >C8-C10 (w) _A	<5	<5	<5					µg/l	5	A-T-055w
Aro >C10-C12 (w) _A [#]	<5	<5	<5					µg/l	5	A-T-055w
Aro >C12-C16 (w) _A [#]	<5	<5	<5					µg/l	5	A-T-055w
Aro >C16-C21 (w) _A [#]	<5	<5	<5					µg/l	5	A-T-055w
Aro >C21-C35 (w) _A [#]	<10	<10	<10					µg/l	10	A-T-055w
Total Aromatics (w) _A	<10	<10	<10					µg/l	10	A-T-055w
TPH (Ali & Aro >C5-C35) (w) _A	<10	<10	<10					µg/l	10	A-T-055w
BTEX - Benzene (w) _A [#]	<1	<1	<1					µg/l	1	A-T-022w
BTEX - Toluene (w) _A [#]	<1	<1	<1					µg/l	1	A-T-022w
BTEX - Ethyl Benzene (w) _A [#]	<1	<1	<1					µg/l	1	A-T-022w
BTEX - m & p Xylene (w) _A [#]	<1	<1	<1					µg/l	1	A-T-022w
BTEX - o Xylene (w) _A [#]	<1	<1	<1					µg/l	1	A-T-022w
MTBE (w) _A [#]	<1	<1	<1					µg/l	1	A-T-022w

REPORT NOTES

General

This report shall not be reproduced, except in full, without written approval from Envirolab.

The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample, 9 = INCINERATOR ASH.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG	Project No:	21/09569
Project:	St. Michaels	Date Received:	03/09/2021 (am)
Clients Project No:	B078847	Cool Box Temperatures (°C):	16.0

NO DEVIATIONS IDENTIFIED with respect to sampling dates or containers received.

Note: If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3 (for water samples $5 \pm 3^{\circ}\text{C}$), ISO 18400-105:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	21/09569/1	21/09569/2	21/09569/3
Client Sample No			
Client Sample ID/Depth	RBH101 14.29-14.30m	RBH102 13.48-13.49m	RBH103 13.02-13.03m
Date Sampled	02/09/21	02/09/21	02/09/21
A-T-019w	09/09/2021	09/09/2021	09/09/2021
A-T-022w	08/09/2021	08/09/2021	08/09/2021
A-T-025w	10/09/2021	10/09/2021	10/09/2021
A-T-026w	09/09/2021	09/09/2021	09/09/2021
A-T-031w	08/09/2021	08/09/2021	08/09/2021
A-T-032w	08/09/2021	08/09/2021	08/09/2021
A-T-042wTCN	08/09/2021	08/09/2021	08/09/2021
A-T-049w	09/09/2021	09/09/2021	09/09/2021
A-T-050w	09/09/2021	09/09/2021	09/09/2021
A-T-055w	08/09/2021	08/09/2021	08/09/2021
A-T-S2-w	08/09/2021	08/09/2021	08/09/2021

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 22/08376
Issue Number: 1

Date: 07 September, 2022

Client: Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: EBMA/Jonathan Lord
Project Name: St Michaels
Project Ref: 78847
Order No: EBMA 3517
Date Samples Received: 25/08/22
Date Instructions Received: 26/08/22
Date Analysis Completed: 07/09/22

Approved by:



Richard Wong
Client Manager

Envirolab Job Number: 22/08376

Client Project Name: St Michaels

Client Project Ref: 78847

Lab Sample ID	22/08376/1	22/08376/2	22/08376/3	22/08376/4	22/08376/5	22/08376/6		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP01	TP02	TP03	TP04	TP05	TP06				
Depth to Top	0.4	0.5	0.8	0.4	0.4	0.3				
Depth To Bottom										
Date Sampled	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4AB	4A	4AB	4AB	4AB	4A				
% Stones >10mm _A	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		% w/w	0.1	A-T-044
pH _D ^{M#}	10.87	10.15	10.80	11.94	9.52	11.43		pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	1.36	1.50	1.48	1.14	1.34	1.35		g/l	0.01	A-T-026s
Cyanide (total) _A ^{M#}	<1	<1	<1	<1	<1	<1		mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC _A	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		mg/kg	0.2	A-T-050s
Organic Matter _D ^{M#}	0.7	0.3	0.3	0.7	1.3	0.8		% w/w	0.1	A-T-032 OM
Arsenic _D ^{M#}	2	3	3	2	4	3		mg/kg	1	A-T-024s
Boron (water soluble) _D	1.1	1.2	<1.0	<1.0	<1.0	<1.0		mg/kg	1	A-T-027s
Cadmium _D ^{M#}	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5		mg/kg	0.5	A-T-024s
Copper _D ^{M#}	7	7	9	8	8	8		mg/kg	1	A-T-024s
Chromium _D ^{M#}	13	14	15	18	17	18		mg/kg	1	A-T-024s
Chromium (hexavalent) _D	<1	<1	<1	<1	<1	<1		mg/kg	1	A-T-040s
Lead _D ^{M#}	30	35	33	39	22	32		mg/kg	1	A-T-024s
Mercury _D	<0.17	<0.17	<0.17	<0.17	<0.17	<0.17		mg/kg	0.17	A-T-024s
Nickel _D ^{M#}	9	9	11	12	14	13		mg/kg	1	A-T-024s
Selenium _D ^{M#}	<1	<1	<1	<1	<1	<1		mg/kg	1	A-T-024s
Zinc _D ^{M#}	149	156	147	212	92	154		mg/kg	5	A-T-024s

Envirolab Job Number: 22/08376

Client Project Name: St Michaels

Client Project Ref: 78847

Lab Sample ID	22/08376/1	22/08376/2	22/08376/3	22/08376/4	22/08376/5	22/08376/6		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP01	TP02	TP03	TP04	TP05	TP06				
Depth to Top	0.4	0.5	0.8	0.4	0.4	0.3				
Depth To Bottom										
Date Sampled	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4AB	4A	4AB	4AB	4AB	4A				
Asbestos in Soil (inc. matrix)										
Asbestos in soil _D [#]	NAD	NAD	NAD	NAD	NAD	NAD				A-T-045
Asbestos Matrix (visual) _D	-	-	-	-	-	-				A-T-045
Asbestos Matrix (microscope) _D	-	-	-	-	-	-				A-T-045
Asbestos ACM - Suitable for Water Absorption Test? _D	N/A	N/A	N/A	N/A	N/A	N/A				A-T-045

Envirolab Job Number: 22/08376

Client Project Name: St Michaels

Client Project Ref: 78847

Lab Sample ID	22/08376/1	22/08376/2	22/08376/3	22/08376/4	22/08376/5	22/08376/6		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP01	TP02	TP03	TP04	TP05	TP06				
Depth to Top	0.4	0.5	0.8	0.4	0.4	0.3				
Depth To Bottom										
Date Sampled	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4AB	4A	4AB	4AB	4AB	4A				
PAH-16MS										
Acenaphthene _A ^{M#}	0.04	0.12	0.06	0.13	<0.01	0.08		mg/kg	0.01	A-T-019s
Acenaphthylene _A ^{M#}	<0.01	<0.01	<0.01	0.04	<0.01	<0.01		mg/kg	0.01	A-T-019s
Anthracene _A ^{M#}	0.06	0.15	0.08	0.22	<0.02	0.11		mg/kg	0.02	A-T-019s
Benzo(a)anthracene _A ^{M#}	0.17	0.28	0.20	0.28	<0.04	0.21		mg/kg	0.04	A-T-019s
Benzo(a)pyrene _A ^{M#}	0.11	0.19	0.14	0.17	<0.04	0.11		mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene _A ^{M#}	0.13	0.21	0.17	0.19	<0.05	0.14		mg/kg	0.05	A-T-019s
Benzo(ghi)perylene _A ^{M#}	<0.05	0.08	0.07	0.08	<0.05	<0.05		mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene _A ^{M#}	<0.07	0.08	<0.07	<0.07	<0.07	<0.07		mg/kg	0.07	A-T-019s
Chrysene _A ^{M#}	0.20	0.32	0.24	0.31	<0.06	0.22		mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene _A ^{M#}	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		mg/kg	0.04	A-T-019s
Fluoranthene _A ^{M#}	0.82	1.10	0.81	1.11	<0.08	0.90		mg/kg	0.08	A-T-019s
Fluorene _A ^{M#}	0.02	0.05	0.03	0.19	<0.01	0.04		mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene _A ^{M#}	0.06	0.09	0.08	0.08	<0.03	0.06		mg/kg	0.03	A-T-019s
Naphthalene _A ^{M#}	<0.03	0.09	<0.03	1.24	<0.03	<0.03		mg/kg	0.03	A-T-019s
Phenanthrene _A ^{M#}	0.37	0.81	0.47	1.16	<0.03	0.56		mg/kg	0.03	A-T-019s
Pyrene _A ^{M#}	0.58	0.82	0.63	0.88	<0.07	0.66		mg/kg	0.07	A-T-019s
Total PAH-16MS _A ^{M#}	2.56	4.39	2.98	6.08	<0.08	3.09		mg/kg	0.01	A-T-019s

Envirolab Job Number: 22/08376

Client Project Name: St Michaels

Client Project Ref: 78847

Lab Sample ID	22/08376/1	22/08376/2	22/08376/3	22/08376/4	22/08376/5	22/08376/6		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP01	TP02	TP03	TP04	TP05	TP06				
Depth to Top	0.4	0.5	0.8	0.4	0.4	0.3				
Depth To Bottom										
Date Sampled	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4AB	4A	4AB	4AB	4AB	4A				
Speciated PCB-WHO12										
PCB BZ 81 _A ^{M#}	0.006	<0.005	<0.005	<0.005	<0.005	<0.005		mg/kg	0.005	A-T-004s
PCB BZ 105 _A ^{M#}	0.114	<0.005	<0.005	<0.005	<0.005	<0.005		mg/kg	0.005	A-T-004s
PCB BZ 114 _A ^{M#}	0.012	<0.005	<0.005	<0.005	<0.005	<0.005		mg/kg	0.005	A-T-004s
PCB BZ 118 _A ^{M#}	0.145	<0.007	<0.007	<0.007	<0.007	<0.007		mg/kg	0.007	A-T-004s
PCB BZ 123 _A ^{M#}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		mg/kg	0.005	A-T-004s
PCB BZ 126 _A ^{M#}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		mg/kg	0.005	A-T-004s
PCB BZ 156 _A ^{M#}	0.008	<0.005	<0.005	<0.005	<0.005	<0.005		mg/kg	0.005	A-T-004s
PCB BZ 157 _A ^{M#}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		mg/kg	0.005	A-T-004s
PCB BZ 167 _A ^{M#}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		mg/kg	0.005	A-T-004s
PCB BZ 169 _A ^{M#}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		mg/kg	0.005	A-T-004s
PCB BZ 189 _A ^{M#}	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		mg/kg	0.005	A-T-004s
PCB BZ 77 _A ^{M#}	0.181	<0.005	<0.005	<0.005	<0.005	<0.005		mg/kg	0.005	A-T-004s
Total Speciated PCB-WHO12 _A ^{M#}	0.466	<0.007	<0.007	<0.007	<0.007	<0.007		mg/kg	0.005	A-T-004s

Envirolab Job Number: 22/08376

Client Project Name: St Michaels

Client Project Ref: 78847

Lab Sample ID	22/08376/1	22/08376/2	22/08376/3	22/08376/4	22/08376/5	22/08376/6		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	TP01	TP02	TP03	TP04	TP05	TP06				
Depth to Top	0.4	0.5	0.8	0.4	0.4	0.3				
Depth To Bottom										
Date Sampled	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22	24-Aug-22				
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES				
Sample Matrix Code	4AB	4A	4AB	4AB	4AB	4A				
TPH CWG with Clean Up										
Ali >C5-C6 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
Ali >C6-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
Ali >C8-C10 _A	<1	<1	1	<1	<1	<1		mg/kg	1	A-T-055s
Ali >C10-C12 _A ^{M#}	<1	<1	<1	<1	<1	<1		mg/kg	1	A-T-055s
Ali >C12-C16 _A ^{M#}	<1	<1	<1	<1	<1	<1		mg/kg	1	A-T-055s
Ali >C16-C21 _A ^{M#}	3	3	2	4	<1	3		mg/kg	1	A-T-055s
Ali >C21-C35 _A ^{M#}	77	79	73	90	10	83		mg/kg	1	A-T-055s
Total Aliphatics _A	72	73	68	85	9	78		mg/kg	1	Calc-As Recd
Aro >C5-C7 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
Aro >C7-C8 _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
Aro >C8-C10 _A	<3	<3	<3	<3	<3	<3		mg/kg	1	A-T-055s
Aro >C10-C12 _A	<1	<1	1	<1	<1	<1		mg/kg	1	A-T-055s
Aro >C12-C16 _A	3	3	3	3	<1	3		mg/kg	1	A-T-055s
Aro >C16-C21 _A ^{M#}	11	10	11	10	2	11		mg/kg	1	A-T-055s
Aro >C21-C35 _A ^{M#}	24	18	21	21	3	20		mg/kg	1	A-T-055s
Total Aromatics _A	35	28	33	31	5	31		mg/kg	1	Calc-As Recd
TPH (Ali & Aro >C5-C35) _A	107	101	101	116	14	109		mg/kg	1	Calc-As Recd
BTEX - Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
BTEX - Toluene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
BTEX - m & p Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
BTEX - o Xylene _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s
MTBE _A [#]	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01		mg/kg	0.01	A-T-022s

REPORT NOTES

General

This report shall not be reproduced, except in full, without written approval from Envirolab.

The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample, 9 = INCINERATOR ASH.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Subscript ""^" indicates analysis has dependant options against results. Testing dependant on results appear in the comments area of your sample receipt.

EPH CWG results have humics mathematically subtracted through instrument calculation

TPH results "with Cleanup" indicates results cleaned up with Silica during extraction

EPH CWG GCxGC ID from TPH CWG

Where we have identified humic substances in any ID's from TPH CWG with Clean Up please note that the concentration of these

humic substances is not included in the quantified results and are included in the ID for information.

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG	Project No:	22/08376
Project:	St Michaels	Date Received:	26/08/2022 (am)
Clients Project No:	78847	Cool Box Temperatures (°C):	14.2

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	22/08376/1	22/08376/2	22/08376/3	22/08376/4	22/08376/5	22/08376/6
Client Sample No						
Client Sample ID/Depth	TP01 0.4m	TP02 0.5m	TP03 0.8m	TP04 0.4m	TP05 0.4m	TP06 0.3m
Date Sampled	24/08/22	24/08/22	24/08/22	24/08/22	24/08/22	24/08/22
A-T-004s	05/09/2022	05/09/2022	05/09/2022	05/09/2022	07/09/2022	07/09/2022
A-T-019s	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022
A-T-022s	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022
A-T-024s	05/09/2022	05/09/2022	05/09/2022	05/09/2022	05/09/2022	05/09/2022
A-T-026s	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022
A-T-027s	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022
A-T-031s	02/09/2022	05/09/2022	05/09/2022	05/09/2022	05/09/2022	05/09/2022
A-T-032 OM	01/09/2022	01/09/2022	01/09/2022	01/09/2022	01/09/2022	01/09/2022
A-T-040s	06/09/2022	06/09/2022	06/09/2022	06/09/2022	06/09/2022	06/09/2022
A-T-042sTCN	01/09/2022	01/09/2022	01/09/2022	01/09/2022	01/09/2022	01/09/2022
A-T-044	01/09/2022	01/09/2022	01/09/2022	01/09/2022	01/09/2022	01/09/2022
A-T-045	31/08/2022	31/08/2022	31/08/2022	31/08/2022	31/08/2022	31/08/2022
A-T-050s	01/09/2022	01/09/2022	01/09/2022	01/09/2022	01/09/2022	01/09/2022
A-T-055s	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022
Calc-As Recd	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022	02/09/2022

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

Appendix D – Geotechnical Analysis Results

- Envirolab, Environmental Geotechnical Analysis Results
- IFA, Geotechnical Analysis Results

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 21/08989
Issue Number: 1
Date: 25 August, 2021

Client: Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: EBMA/Philippa Neesham/Rob Allen/Tommy Walker
Project Name: St Michaels
Project Ref: B078847
Order No: EBMA3026
Date Samples Received: 09/08/21
Date Instructions Received: 19/08/21
Date Analysis Completed: 25/08/21

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Holly Neary-King
Client Services Supervisor

Envirolab Job Number: 21/08989

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/08989/1	21/08989/2	21/08989/3	21/08989/4	21/08989/5			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	WS105	WS107	WS108	WS109	WS110					
Depth to Top	0.28	0.33	0.2	0.2	0.2					
Depth To Bottom	0.35	0.36	0.30		0.30					
Date Sampled	27-Jul-21	27-Jul-21	27-Jul-21	27-Jul-21	27-Jul-21					
Sample Type	Soil - C	Soil - C	Solid	Soil - C	Soil - C					
Sample Matrix Code	4AB	4A	7	4A	4A					
% Stones >10mm _A	7.7	18.1	<0.1	6.7	16.9			% w/w	0.1	A-T-044
pH _D ^{M#}	11.36	10.79	9.36	11.80	11.99			pH	0.01	A-T-031s
Sulphate (water sol 2:1) _D ^{M#}	0.04	0.03	0.03	0.05	0.04			g/l	0.01	A-T-026s

REPORT NOTES

General

This report shall not be reproduced, except in full, without written approval from Envirolab.

The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts.

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample, 9 = INCINERATOR ASH.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG	Project No:	21/08989
Project:	St Michaels	Date Received:	19/08/2021 (am)
Clients Project No:	B078847	Cool Box Temperatures (°C):	14.4

NO DEVIATIONS IDENTIFIED with respect to sampling dates or containers received.

Note: If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3 (for water samples $5 \pm 3^{\circ}\text{C}$), ISO 18400-105:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	21/08989/1	21/08989/2	21/08989/3	21/08989/4	21/08989/5
Client Sample No					
Client Sample ID/Depth	WS105 0.28-0.35m	WS107 0.33-0.36m	WS108 0.2-0.30m	WS109 0.2m	WS110 0.2-0.30m
Date Sampled	27/07/21	27/07/21	27/07/21	27/07/21	27/07/21
A-T-026s	23/08/2021	23/08/2021	23/08/2021	23/08/2021	23/08/2021
A-T-031s	25/08/2021	25/08/2021	25/08/2021	25/08/2021	25/08/2021
A-T-044	24/08/2021	24/08/2021	24/08/2021	24/08/2021	24/08/2021

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 21/09714
Issue Number: 1
Date: 04 October, 2021

Client: Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: EBMA/Philippa Neesham/Rob Allen
Project Name: St Michaels
Project Ref: B078847
Order No: EBMA3022
Date Samples Received: Not specified
Date Instructions Received: 07/09/21
Date Analysis Completed: 04/10/21

Prepared by:


Melanie Marshall
Laboratory Coordinator

Approved by:


Richard Wong
Client Manager

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/1	21/09714/2	21/09714/3	21/09714/4	21/09714/5	21/09714/6	21/09714/8	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH102	RBH102	RBH102	RBH102	RBH102	RBH102	RBH102			
Depth to Top	3.59	6.02	7.12	7.82	8.92	10.03	12.18			
Depth To Bottom	3.71	6.12	7.26	7.95	9.06	10.18	12.29			
Date Sampled	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	Appended	Appended	Appended	-	Appended	Appended	Appended			Subcon IFA
Natural Water Content (Rock) _A	-	-	-	Appended	-	-	-			Subcon IFA
Dry Density (Rock)	-	-	-	Appended	-	-	-			

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/9	21/09714/10	21/09714/11	21/09714/13	21/09714/15	21/09714/16	21/09714/17	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH102	RBH102	RBH102	RBH102	RBH102	RBH102	RBH102			
Depth to Top	13.5	14.32	15.39	16.05	17.76	18.8	19.5			
Depth To Bottom	13.82	14.53	15.50	16.39	17.89	18.94	19.63			
Date Sampled	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	-	Appended	Appended	-	Appended	-	Appended			Subcon IFA
UCS (Rock) ISRM 2007 _A	-	-	-	Appended	-	-	-			Subcon IFA
Natural Water Content (Rock) _A	-	-	-	-	-	Appended	-			Subcon IFA
Dry Density (Rock)	-	-	-	-	-	Appended	-			
UCS with youngs modulus and poisons ratio (up to 3 cycles) _A	Appended	-	-	Appended	-	-	-			Subcon IFA

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/18	21/09714/20	21/09714/21	21/09714/23	21/09714/24	21/09714/26	21/09714/27	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH102	RBH102	RBH102	RBH102	RBH102	RBH102	RBH102			
Depth to Top	20.64	21.5	22.69	25.37	26.02	27.08	27.5			
Depth To Bottom	20.96	21.61	23.00	25.50	26.31	27.20	27.68			
Date Sampled	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	-	Appended	-	Appended	-	Appended	-			Subcon IFA
UCS (Rock) ISRM 2007 _A	Appended	-	Appended	-	Appended	-	-			Subcon IFA
Natural Water Content (Rock) _A	-	-	-	-	-	-	Appended			Subcon IFA
Dry Density (Rock)	-	-	-	-	-	-	Appended			

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/29	21/09714/31	21/09714/32	21/09714/34	21/09714/36	21/09714/37	21/09714/38	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH102	RBH102	RBH102	RBH102	RBH102	RBH102	RBH102			
Depth to Top	29.67	30.9	31.57	32.85	34.86	35.5	37.21			
Depth To Bottom	29.98	31.05	31.94	33.02	35.00	35.90	37.41			
Date Sampled	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	-	Appended	-	Appended	Appended	-	Appended			Subcon IFA
UCS (Rock) ISRM 2007 _A	Appended	-	Appended	-	-	Appended	-			Subcon IFA

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/39	21/09714/40	21/09714/42	21/09714/44	21/09714/47	21/09714/48	21/09714/50	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH102	RBH102	RBH102	RBH102	RBH102	RBH102	RBH102			
Depth to Top	38.15	38.97	40.47	42.22	44.59	45.94	47.56			
Depth To Bottom	38.26	39.39	40.77	42.35	45.08	46.09	47.94			
Date Sampled	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	-	-	-	Appended	-	Appended	-			Subcon IFA
UCS (Rock) ISRM 2007 _A	-	Appended	Appended	-	Appended	-	Appended			Subcon IFA
Natural Water Content (Rock) _A	Appended	-	-	-	-	-	-			Subcon IFA
Dry Density (Rock)	Appended	-	-	-	-	-	-			

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/51	21/09714/52	21/09714/53	21/09714/54	21/09714/55	21/09714/56	21/09714/57	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH102	RBH102	RBH102	RBH103	RBH103	RBH103	RBH103			
Depth to Top	48.14	48.91	49.19	5.58	6.74	9.32	11.78			
Depth To Bottom	48.27	49.08	49.66	5.73	6.86	9.50	11.93			
Date Sampled	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	-	Appended	-	-	Appended	-	Appended			Subcon IFA
UCS (Rock) ISRM 2007 _A	-	-	Appended	-	-	Appended	-			Subcon IFA
Natural Water Content (Rock) _A	Appended	-	-	Appended	-	-	-			Subcon IFA
Dry Density (Rock)	Appended	-	-	Appended	-	-	-			

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/58	21/09714/59	21/09714/60	21/09714/61	21/09714/62	21/09714/63	21/09714/65	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH103	RBH103	RBH103	RBH103	RBH103	RBH103	RBH103			
Depth to Top	12.72	13	14.67	15.81	16.83	17.54	19.27			
Depth To Bottom	12.89	13.14	14.85	15.95	16.99	17.82	19.50			
Date Sampled	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	-	Appended	-	Appended	-	-	Appended			Subcon IFA
UCS (Rock) ISRM 2007 _A	Appended	-	Appended	-	-	-	-			Subcon IFA
Natural Water Content (Rock) _A	-	-	-	-	Appended	-	-			Subcon IFA
Dry Density (Rock)	-	-	-	-	Appended	-	-			
UCS with youngs modulus and poisons ratio (up to 3 cycles) _A	-	-	-	-	-	Appended	-			Subcon IFA

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/67	21/09714/68	21/09714/69	21/09714/70	21/09714/71	21/09714/72	21/09714/73	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH103	RBH103	RBH103	RBH103	RBH103	RBH103	RBH103			
Depth to Top	21	22.24	23.36	24.18	25	26.4	27			
Depth To Bottom	21.34	22.39	23.68	24.54	25.15	26.60	27.39			
Date Sampled	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	-	Appended	-	-	Appended	Appended	-			Subcon IFA
UCS (Rock) ISRM 2007 _A	Appended	-	Appended	Appended	-	-	Appended			Subcon IFA
UCS with youngs modulus and poissons ratio (up to 3 cycles) _A	Appended	-	-	-	-	-	-			Subcon IFA

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/74	21/09714/75	21/09714/76	21/09714/77	21/09714/79	21/09714/80	21/09714/81	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH103	RBH103	RBH103	RBH103	RBH103	RBH103	RBH103			
Depth to Top	28.53	29.65	30	31.83	32.71	33.5	34			
Depth To Bottom	28.68	29.80	30.36	32.00	33.08	33.64	34.33			
Date Sampled	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	Appended	-	-	Appended	-	Appended	-			Subcon IFA
UCS (Rock) ISRM 2007 _A	-	-	Appended	-	Appended	-	Appended			Subcon IFA
Natural Water Content (Rock) _A	-	Appended	-	-	-	-	-			Subcon IFA
Dry Density (Rock)	-	Appended	-	-	-	-	-			

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/82	21/09714/83	21/09714/84	21/09714/85	21/09714/86	21/09714/88	21/09714/89	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH103	RBH103	RBH103	RBH103	RBH103	RBH103	RBH103			
Depth to Top	34.81	35.6	36.34	36.84	38.07	39.21	40.32			
Depth To Bottom	35.00	35.75	36.66	36.97	38.42	39.60	40.43			
Date Sampled	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	13-Aug-21	12-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	-	Appended	-	Appended	-	-	Appended			Subcon IFA
UCS (Rock) ISRM 2007 _A	-	-	Appended	-	Appended	Appended	-			Subcon IFA
Natural Water Content (Rock) _A	Appended	-	-	-	-	-	-			Subcon IFA
Dry Density (Rock)	Appended	-	-	-	-	-	-			

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/91	21/09714/92	21/09714/93	21/09714/95	21/09714/97	21/09714/99	21/09714/101	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH103	RBH103	RBH103	RBH103	RBH103	RBH103	RBH103			
Depth to Top	42	42.5	43.46	45.5	46.67	48.5	49.62			
Depth To Bottom	42.36	42.73	43.64	45.64	47.00	48.77	50.00			
Date Sampled	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21	12-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	-	-	Appended	Appended	-	Appended	-			Subcon IFA
UCS (Rock) ISRM 2007 _A	Appended	-	-	-	Appended	-	Appended			Subcon IFA
Natural Water Content (Rock) _A	-	Appended	-	-	-	-	-			Subcon IFA
Dry Density (Rock)	-	Appended	-	-	-	-	-			

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/102	21/09714/103	21/09714/104	21/09714/105	21/09714/106	21/09714/107	21/09714/108	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH101	RBH101	RBH101	RBH101	RBH101	RBH101	RBH101			
Depth to Top	6	6.73	7.6	8.67	9.71	12	12.34			
Depth To Bottom	6.18	6.83	7.81	8.82	9.84	12.15	12.63			
Date Sampled	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	Appended	Appended	-	Appended	Appended	-	-			Subcon IFA
UCS (Rock) ISRM 2007 _A	-	-	Appended	-	-	-	-			Subcon IFA
Natural Water Content (Rock) _A	-	-	-	-	-	Appended	-			Subcon IFA
Dry Density (Rock)	-	-	-	-	-	Appended	-			
UCS with youngs modulus and poisons ratio (up to 3 cycles) _A	-	-	-	-	-	Appended	Appended			Subcon IFA

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/109	21/09714/110	21/09714/112	21/09714/113	21/09714/114	21/09714/115	21/09714/117	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH101	RBH101	RBH101	RBH101	RBH101	RBH101	RBH101			
Depth to Top	13	13.34	15.71	17.02	18	19.2	21.22			
Depth To Bottom	13.16	13.68	15.89	17.22	18.18	19.40	21.60			
Date Sampled	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	Appended	-	Appended	-	Appended	Appended	-			Subcon IFA
UCS (Rock) ISRM 2007 _A	-	Appended	-	Appended	-	-	Appended			Subcon IFA
UCS with youngs modulus and poissons ratio (up to 3 cycles) _A	-	-	-	Appended	-	-	-			Subcon IFA

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/118	21/09714/119	21/09714/120	21/09714/121	21/09714/122	21/09714/124	21/09714/126	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH101	RBH101	RBH101	RBH101	RBH101	RBH101	RBH101			
Depth to Top	22.19	23.28	24.28	25.17	26.5	28.3	29.5			
Depth To Bottom	22.54	23.44	24.43	25.58	26.68	28.70	29.73			
Date Sampled	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	-	-	Appended	-	Appended	-	Appended			Subcon IFA
UCS (Rock) ISRM 2007 _A	Appended	-	-	Appended	-	Appended	-			Subcon IFA
Natural Water Content (Rock) _A	-	Appended	-	-	-	-	-			Subcon IFA
Dry Density (Rock)	-	Appended	-	-	-	-	-			

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/127	21/09714/128	21/09714/129	21/09714/131	21/09714/132	21/09714/134	21/09714/135	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH101	RBH101	RBH101	RBH101	RBH101	RBH101	RBH101			
Depth to Top	33	33.8	34.63	36.74	37.7	39.24	40.42			
Depth To Bottom	33.30	33.94	35.00	37.00	38.00	39.64	40.61			
Date Sampled	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21			
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid	Solid			
Sample Matrix Code	7	7	7	7	7	7	7			
Point Load (Single) ISRM 2007 _A	-	-	-	Appended	-	-	Appended			Subcon IFA
UCS (Rock) ISRM 2007 _A	Appended	-	Appended	-	Appended	Appended	-			Subcon IFA
Natural Water Content (Rock) _A	-	Appended	-	-	-	-	-			Subcon IFA
Dry Density (Rock)	-	Appended	-	-	-	-	-			

Envirolab Job Number: 21/09714

Client Project Name: St Michaels

Client Project Ref: B078847

Lab Sample ID	21/09714/137	21/09714/139	21/09714/140	21/09714/141	21/09714/143	21/09714/145		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	RBH101	RBH101	RBH101	RBH101	RBH101	RBH101				
Depth to Top	42	44.57	45.35	47.36	49	50.09				
Depth To Bottom	42.39	44.80	45.51	47.50	49.40	50.20				
Date Sampled	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21	04-Aug-21				
Sample Type	Solid	Solid	Solid	Solid	Solid	Solid				
Sample Matrix Code	7	7	7	7	7	7				
Point Load (Single) ISRM 2007 _A	-	-	Appended	Appended	-	-				Subcon IFA
UCS (Rock) ISRM 2007 _A	Appended	-	-	-	Appended	-				Subcon IFA
Natural Water Content (Rock) _A	-	Appended	-	-	-	Appended				Subcon IFA
Dry Density (Rock)	-	Appended	-	-	-	Appended				

REPORT NOTES

General

This report shall not be reproduced, except in full, without written approval from Envirolab.

The results reported herein relate only to the material supplied to the laboratory.

The residue of any samples contained within this report, and any received with the same delivery, will be disposed of six weeks after initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of six months after the initial Asbestos testing is completed.

Analytical results reflect the quality of the sample at the time of analysis only.

Opinions and interpretations expressed are outside the scope of our accreditation.

If results are in italic font they are associated with an AQC failure, these are not accredited and are unreliable.

A deviating samples report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

The Client Sample No, Client Sample ID, Depth to Top, Depth to Bottom and Date Sampled were all provided by the client.

Soil chemical analysis:

All results are reported as dry weight (<40°C).

For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.

For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts

All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH analysis of water by method A-T-007:

Free and visible oils are excluded from the sample used for analysis so that the reported result represents the dissolved phase only.

Electrical Conductivity of water by Method A-T-037:

Results greater than 12900µS/cm @ 25°C / 11550µS/cm @ 20°C fall outside the calibration range and as such are unaccredited.

Asbestos:

Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.

Stones etc. are not removed from the sample prior to analysis.

Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Predominant Matrix Codes:

1 = SAND, 2 = LOAM, 3 = CLAY, 4 = LOAM/SAND, 5 = SAND/CLAY, 6 = CLAY/LOAM, 7 = OTHER, 8 = Asbestos bulk ID sample, 9 = INCINERATOR ASH.

Samples with Matrix Code 7 & 8 are not predominantly a SAND/LOAM/CLAY mix and are not covered by our BSEN 17025 or MCERTS accreditations, with the exception of bulk asbestos which are BSEN 17025 accredited.

Secondary Matrix Codes:

A = contains stones, B = contains construction rubble, C = contains visible hydrocarbons, D = contains glass/metal,

E = contains roots/twigs.

Key:

IS indicates Insufficient Sample for analysis.

US indicates Unsuitable Sample for analysis.

NDP indicates No Determination Possible.

NAD indicates No Asbestos Detected.

N/A indicates Not Applicable.

Superscript # indicates method accredited to ISO 17025.

Superscript "M" indicates method accredited to MCERTS.

Subscript "A" indicates analysis performed on the sample as received.

Subscript "D" indicates analysis performed on the dried sample, crushed to pass a 2mm sieve

Please contact us if you need any further information.

Envirolab Deviating Samples Report

Units 7&8 Sandpits Business Park, Mottram Road, Hyde, SK14 3AR
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client:	Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG	Project No:	21/09714
Project:	St Michaels	Date Received:	07/09/2021 (am)
Clients Project No:	B078847	Cool Box Temperatures (°C):	16.3

NO DEVIATIONS IDENTIFIED with respect to sampling dates or containers received.

Note: If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3 (for water samples $5 \pm 3^{\circ}\text{C}$), ISO 18400-105:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	21/09714/1	21/09714/2	21/09714/3	21/09714/4	21/09714/5	21/09714/6	21/09714/8	21/09714/9	21/09714/10	21/09714/11	21/09714/13
Client Sample No											
Client Sample ID/Depth	RBH102 3.59-3.71m	RBH102 6.02-6.12m	RBH102 7.12-7.26m	RBH102 7.82-7.95m	RBH102 8.92-9.06m	RBH102 10.03- 10.18m	RBH102 12.18- 12.29m	RBH102 13.5- 13.82m	RBH102 14.32- 14.53m	RBH102 15.39- 15.50m	RBH102 16.05- 16.39m
Date Sampled	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21

Lab Sample ID	21/09714/15	21/09714/16	21/09714/17	21/09714/18	21/09714/20	21/09714/21	21/09714/23	21/09714/24	21/09714/26	21/09714/27
Client Sample No										
Client Sample ID/Depth	RBH102 17.76-17.89m	RBH102 18.8-18.94m	RBH102 19.5-19.63m	RBH102 20.64-20.96m	RBH102 21.5-21.61m	RBH102 22.69-23.00m	RBH102 25.37-25.50m	RBH102 26.02-26.31m	RBH102 27.08-27.20m	RBH102 27.5-27.68m
Date Sampled	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21

Lab Sample ID	21/09714/29	21/09714/31	21/09714/32	21/09714/34	21/09714/36	21/09714/37	21/09714/38	21/09714/39	21/09714/40	21/09714/42
Client Sample No										
Client Sample ID/Depth	RBH102 29.67-29.98m	RBH102 30.9-31.05m	RBH102 31.57-31.94m	RBH102 32.85-33.02m	RBH102 34.86-35.00m	RBH102 35.5-35.90m	RBH102 37.21-37.41m	RBH102 38.15-38.26m	RBH102 38.97-39.39m	RBH102 40.47-40.77m
Date Sampled	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21

Lab Sample ID	21/09714/44	21/09714/47	21/09714/48	21/09714/50	21/09714/51	21/09714/52	21/09714/53	21/09714/54	21/09714/55	21/09714/56
Client Sample No										
Client Sample ID/Depth	RBH102 42.22-42.35m	RBH102 44.59-45.08m	RBH102 45.94-46.09m	RBH102 47.56-47.94m	RBH102 48.14-48.27m	RBH102 48.91-49.08m	RBH102 49.19-49.66m	RBH103 5.58-5.73m	RBH103 6.74-6.86m	RBH103 9.32-9.50m
Date Sampled	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21

Lab Sample ID	21/09714/57	21/09714/58	21/09714/59	21/09714/60	21/09714/61	21/09714/62	21/09714/63	21/09714/65	21/09714/67	21/09714/68
Client Sample No										
Client Sample ID/Depth	RBH103 11.78-11.93m	RBH103 12.72-12.89m	RBH103 13-13.14m	RBH103 14.67-14.85m	RBH103 15.81-15.95m	RBH103 16.83-16.99m	RBH103 17.54-17.82m	RBH103 19.27-19.50m	RBH103 21-21.34m	RBH103 22.24-22.39m
Date Sampled	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21

Lab Sample ID	21/09714/69	21/09714/70	21/09714/71	21/09714/72	21/09714/73	21/09714/74	21/09714/75	21/09714/76	21/09714/77	21/09714/79	21/09714/80
Client Sample No											
Client Sample ID/Depth	RBH103 23.36-23.68m	RBH103 24.18-24.54m	RBH103 25-25.15m	RBH103 26.4-26.60m	RBH103 27-27.39m	RBH103 28.53-28.68m	RBH103 29.65-29.80m	RBH103 30-30.36m	RBH103 31.83-32.00m	RBH103 32.71-33.08m	RBH103 33.5-33.64m
Date Sampled	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21

Lab Sample ID	21/09714/81	21/09714/82	21/09714/83	21/09714/84	21/09714/85	21/09714/86	21/09714/88	21/09714/89	21/09714/91	21/09714/92
Client Sample No										
Client Sample ID/Depth	RBH103 34-34.33m	RBH103 34.81-35.00m	RBH103 35.6-35.75m	RBH103 36.34-36.66m	RBH103 36.84-36.97m	RBH103 38.07-38.42m	RBH103 39.21-39.60m	RBH103 40.32-40.43m	RBH103 42-42.36m	RBH103 42.5-42.73m
Date Sampled	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	13/08/21	12/08/21	12/08/21	12/08/21

Lab Sample ID	21/09714/93	21/09714/95	21/09714/97	21/09714/99	21/09714/101	21/09714/102	21/09714/103	21/09714/104	21/09714/105	21/09714/106	21/09714/107
Client Sample No											
Client Sample ID/Depth	RBH103 43.46-43.64m	RBH103 45.5-45.64m	RBH103 46.67-47.00m	RBH103 48.5-48.77m	RBH103 49.62-50.00m	RBH101 6-6.18m	RBH101 6.73-6.83m	RBH101 7.6-7.81m	RBH101 8.67-8.82m	RBH101 9.71-9.84m	RBH101 12-12.15m
Date Sampled	12/08/21	12/08/21	12/08/21	12/08/21	12/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21

Lab Sample ID	21/09714/108	21/09714/109	21/09714/110	21/09714/112	21/09714/113	21/09714/114	21/09714/115	21/09714/117	21/09714/118	21/09714/119
Client Sample No										
Client Sample ID/Depth	RBH101 12.34-12.63m	RBH101 13-13.16m	RBH101 13.34-13.68m	RBH101 15.71-15.89m	RBH101 17.02-17.22m	RBH101 18-18.18m	RBH101 19.2-19.40m	RBH101 21.22-21.60m	RBH101 22.19-22.54m	RBH101 23.28-23.44m
Date Sampled	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21

Lab Sample ID	21/09714/120	21/09714/121	21/09714/122	21/09714/124	21/09714/126	21/09714/127	21/09714/128	21/09714/129	21/09714/131	21/09714/132
Client Sample No										
Client Sample ID/Depth	RBH101 24.28-24.43m	RBH101 25.17-25.58m	RBH101 26.5-26.68m	RBH101 28.3-28.70m	RBH101 29.5-29.73m	RBH101 33-33.30m	RBH101 33.8-33.94m	RBH101 34.63-35.00m	RBH101 36.74-37.00m	RBH101 37.7-38.00m
Date Sampled	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21

Lab Sample ID	21/09714/134	21/09714/135	21/09714/137	21/09714/139	21/09714/140	21/09714/141	21/09714/143	21/09714/145
Client Sample No								
Client Sample ID/Depth	RBH101 39.24-39.64m	RBH101 40.42-40.61m	RBH101 42-42.39m	RBH101 44.57-44.80m	RBH101 45.35-45.51m	RBH101 47.36-47.50m	RBH101 49-49.40m	RBH101 50.09-50.20m
Date Sampled	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21	04/08/21

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

F.A.O.

Final Test Report - 2280730 / 3

Site: St Michaels
Job Number: 2280730
Originating Client: Envirolab
Originating Reference: 21/09714
Date Sampled: Not Given
Date Scheduled: 09/09/2021
Date Testing Started: 20/09/2021
Date Testing Finished: 28/09/2021

Previous Reports		Amendments	Date Issued
1	Interim		24/09/2021
2	Interim	14x Point Loads and Water Content/Density results added	27/09/2021

Amendments: Rock UCS results added

Authorised By:



Tim Robinson
Quality Supervisor

Report Issue Date: 29/09/2021



Site: St Michaels

Job Number: 2280730

Client: Envirolab

Page: 2

ROCK INDEX TESTS - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock description / Rock type	Natural Water Content ¹ %	Caliper ²		Buoyancy ³		Natural Bulk density Mg/m ³	Remarks
					Dry density Mg/m ³	Porosity %	Dry density Mg/m ³	Porosity %		
RBH101	12.00	C	Brown SANDSTONE	11.3						
RBH101	23.28	C	Brown SANDSTONE	9.3						
RBH101	33.80	C	Brown SANDSTONE	11.2						
RBH101	44.57	C	Brown SANDSTONE	11.0						
RBH101	50.09	C	Brown SANDSTONE	10.7						
RBH102	7.82	C	Brown SANDSTONE	10.5						
RBH102	18.80	C	Brown SANDSTONE	10.2						
RBH102	27.50	C	Brown SANDSTONE	11.3						
RBH102	38.15	C	Brown SANDSTONE	11.1						
RBH102	48.14	C	Brown SANDSTONE	5.8						
RBH103	5.58	C	Brown SANDSTONE	11.0						
RBH103	16.83	C	Brown SANDSTONE	10.4						
RBH103	29.65	C	Brown SANDSTONE	9.5						
RBH103	34.81	C	Brown SANDSTONE	10.2						
RBH103	42.50	C	Brown SANDSTONE	12.4						

Notes 1. ISRM p87 test 1, water content at 105 ± 3 oC, specimen as received at the laboratory 3. ISRM p88 test 3, Porosity/density determination using saturation and buoyancy
2. ISRM p87 test 2, Porosity/density determination using saturation and caliper 2/3. pore volume determined by water saturation

Method of Preparation: International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007.
Part 1.1 Suggested method for determination of the water content of a rock sample

Method of Test: International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007.
Part 1.1 Suggested method for determination of the water content of a rock sample

Results reported relate only to the samples tested.

**Site:** St Michaels**Job Number:** 2280730**Client:** Envirolab**Page:** 3**UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS**

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions ²			Bulk Density ² Mg/m ³	Water Content 1 %	Uniaxial Compression ³				Remarks
				Dia. mm	Length mm	H/D			Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
RBH101	7.60	C	Brown SANDSTONE	99.3	248.0	2.5	2.26	16.2	as received	0.5077	MS	13.0	
RBH101	13.34	C	Brown SANDSTONE	97.7	250.9	2.6	2.28	12.4	as received	0.5238	MS	11.4	
RBH101	17.02	C	Brown SANDSTONE	96.6	130.4	*1.4	2.34	7.7	as received	0.4943	MS	11.8	
RBH101	21.22	C	Brown SANDSTONE	99.2	251.8	2.5	2.21	10.3	as received	0.5082	S	20.9	
RBH101	22.19	C	Brown SANDSTONE	99.3	251.1	2.5	2.23	9.2	as received	0.5076	S	24.4	
RBH101	25.17	C	Brown SANDSTONE	99.4	250.7	2.5	2.22	9.8	as received	0.5064	MS	17.7	
RBH101	28.30	C	Brown SANDSTONE	99.6	248.7	2.5	2.25	7.1	as received	0.5042	S	14.8	
RBH101	33.00	C	Brown SANDSTONE	99.3	235.0	*2.4	2.21	11.4	as received	0.5073	MS	12.8	
RBH101	34.63	C	Brown SANDSTONE	99.2	249.8	2.5	2.19	8.6	as received	0.5083	MS	16.5	
RBH101	37.70	C	Brown SANDSTONE	98.4	250.3	2.5	2.27	7.7	as received	0.5166	MS	15.5	
RBH101	39.24	C	Brown SANDSTONE	99.4	249.8	2.5	2.25	8.2	as received	0.5060	S	22.5	
RBH101	42.00	C	Brown SANDSTONE	98.8	169.9	*1.7	2.23	8.8	as received	0.5125	MS	19.7	
RBH101	49.00	C	Brown SANDSTONE	98.7	203.9	*2.1	2.27	10.1	as received	0.4930	MS	17.9	
RBH102	16.05	C	Brown SANDSTONE	99.6	245.7	2.5	2.22	11.7	as received	0.5046	MS	12.0	
RBH102	20.64	C	Brown SANDSTONE	99.3	248.5	2.5	2.25	11.6	as received	0.5073	S	18.6	
RBH102	22.69	C	Brown SANDSTONE	100.0	245.1	*2.4	2.16	11.9	as received	0.4999	MS	13.6	
RBH102	26.02	C	Brown SANDSTONE	99.4	249.0	2.5	2.20	12.8	as received	0.5062	S	15.5	
RBH102	29.67	C	Brown SANDSTONE	99.0	251.3	2.5	2.20	11.3	as received	0.5102	MS	17.4	
RBH102	31.57	C	Brown SANDSTONE	99.7	248.7	2.5	2.31	9.0	as received	0.5032	S	23.9	
RBH102	35.50	C	Brown SANDSTONE	99.6	248.7	2.5	2.22	9.3	as received	0.5042	MS	15.4	
RBH102	38.97	C	Brown SANDSTONE	99.4	248.5	2.5	2.20	10.8	as received	0.5060	MS	18.6	
RBH102	40.47	C	Brown SANDSTONE	99.5	244.5	2.5	2.25	8.3	as received	0.5056	S	17.9	
RBH102	44.59	C	Brown SANDSTONE	99.9	247.3	2.5	2.26	8.3	as received	0.5014	MS	20.9	

Notes 1 ISRM p87 test 1, water content at 105 ± 3 °C, specimen as tested for UCS

*Denotes length diameter ratio outside ISRM specification

2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density

Mode of failure :

3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials

S - Single shear MS - multiple shear

above notes apply unless annotated otherwise in the remarks

AC - Axial cleavage F - Fragmented

Method of Preparation: International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007**Method of Test:** International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007**Results reported relate only to the samples tested.**

**Site:** St Michaels**Job Number:** 2280730**Client:** Envirolab**Page:** 4**UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS**

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions ²			Bulk Density ² Mg/m ³	Water Content ¹ %	Uniaxial Compression ³				Remarks
				Dia. mm	Length mm	H/D			Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
RBH102	47.56	C	Brown SANDSTONE	99.3	249.5	2.5	2.19	10.1	as received	0.5079	S	17.1	
RBH102	49.19	C	Brown SANDSTONE	99.7	251.2	2.5	2.34	12.1	as received	0.5029	MS	23.0	
RBH103	9.32	C	Brown SANDSTONE	97.7	119.4	*1.2	2.11	9.5	as received	0.5033	MS	6.9	
RBH103	12.72	C	Brown SANDSTONE	98.5	148.2	*1.5	2.15	11.4	as received	0.4946	MS	11.3	
RBH103	14.67	C	Brown SANDSTONE	99.7	162.1	*1.6	2.17	12.1	as received	0.5034	MS	10.0	
RBH103	21.00	C	Brown SANDSTONE	98.4	251.5	2.6	2.20	13.9	as received	0.4955	MS	17.1	
RBH103	23.36	C	Brown SANDSTONE	100.2	251.5	2.5	2.19	10.5	as received	0.4986	S	16.6	
RBH103	24.18	C	Brown SANDSTONE	100.0	253.9	2.5	2.24	10.5	as received	0.5003	MS	16.4	
RBH103	27.00	C	Brown SANDSTONE	99.6	252.0	2.5	2.27	8.8	as received	0.5045	MS	19.9	
RBH103	30.00	C	Brown SANDSTONE	99.9	247.6	2.5	2.27	9.0	as received	0.5013	S	15.3	
RBH103	32.71	C	Brown SANDSTONE	99.6	246.7	2.5	2.25	5.9	as received	0.5047	MS	19.6	
RBH103	34.00	C	Brown SANDSTONE	99.4	250.2	2.5	2.22	11.0	as received	0.5061	S	18.2	
RBH103	36.34	C	Brown SANDSTONE	98.3	253.1	2.6	2.24	10.2	as received	0.4971	F	14.8	
RBH103	38.07	C	Brown SANDSTONE	97.2	246.5	2.5	2.32	8.2	as received	0.5292	AC	15.0	
RBH103	39.21	C	Brown SANDSTONE	99.1	255.2	2.6	2.27	9.7	as received	0.5098	MS	22.5	
RBH103	42.00	C	Brown SANDSTONE	99.4	247.0	2.5	2.19	10.6	as received	0.5067	MS	17.3	
RBH103	46.67	C	Brown SANDSTONE	99.3	251.0	2.5	2.36	10.3	as received	0.5070	MS	23.8	
RBH103	49.62	C	Brown SANDSTONE	99.3	253.8	2.6	2.28	10.3	as received	0.5071	S	19.9	

Notes ¹ ISRM p87 test 1, water content at 105 ± 3 °C, specimen as tested for UCS

*Denotes length diameter ratio outside ISRM specification

² ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density

Mode of failure :

³ ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials

S - Single shear MS - multiple shear

above notes apply unless annotated otherwise in the remarks

AC - Axial cleavage F - Fragmented

Method of Preparation: International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007**Method of Test:** International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007**Results reported relate only to the samples tested.**

Site: St Michaels

Job Number: 2280730

Client: Envirolab

Page: 5

Point Load Strength Index Tests Summary of Results

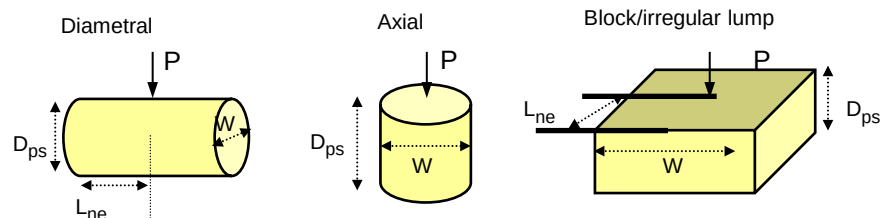
Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
				Type (D, A, I, B)	Direction (PL, PD or U)		Lne mm	W mm	Dps mm	Dps' mm			Is MPa	Is (50) MPa	
RBH101	6	C	Brown MUDSTONE As received	D	PL	YES	93.2	96.8	96.8	93.8	1.2	96.8	0.13	0.18	
RBH101	6	C	Brown MUDSTONE As received	A	PD	YES		98.0	69.0	66.0	1.4	92.8	0.17	0.22	
RBH101	6.73	C	Brown MUDSTONE As received	D	PL	YES	56.1	98.1	98.1	96.1	1.1	98.1	0.11	0.16	
RBH101	6.73	C	Brown MUDSTONE As received	A	PD	YES		98.6	73.3	68.3	1.3	95.9	0.15	0.20	
RBH101	8.67	C	Brown MUDSTONE As received	D	PL	YES	85.2	95.0	95.0	93.0	0.6	95.0	0.07	0.09	
RBH101	8.67	C	Brown MUDSTONE As received	A	PD	YES		94.5	81.6	57.6	0.9	99.1	0.10	0.13	
RBH101	9.71	C	Brown SANDSTONE As received	D	PL	YES	68.1	96.8	96.8	94.8	1.0	96.8	0.10	0.14	
RBH101	9.71	C	Brown SANDSTONE As received	A	PD	YES		96.1	68.2	61.2	1.6	91.4	0.19	0.25	
RBH101	13	C	Brown SANDSTONE As received	D	PL	YES	92.3	100.9	100.9	95.9	0.7	100.9	0.07	0.10	
RBH101	13	C	Brown SANDSTONE As received	I	PD	YES	48.2	97.14 51.30	42.1	39.1	0.5	63.1	0.14	0.15	
RBH101	15.71	C	Brown SANDSTONE As received	D	PL	YES	91.1	97.5	97.5	95.5	1.6	97.5	0.17	0.23	
RBH101	15.71	C	Brown SANDSTONE As received	A	PD	YES		96.5	85.4	76.4	2.5	102.5	0.24	0.33	
RBH101	18	C	Brown SANDSTONE As received	D	PL	YES	90.1	97.3	97.3	95.3	1.1	97.3	0.11	0.15	
RBH101	18	C	Brown SANDSTONE As received	A	PD	YES		99.0	83.1	61.1	3.5	102.3	0.33	0.46	
RBH101	19.2	C	Brown SANDSTONE As received	D	PL	YES	105.7	95.7	95.7	95.7	1.5	95.7	0.17	0.23	
RBH101	19.2	C	Brown SANDSTONE As received	A	PD	YES		96.1	105.5	94.5	2.5	113.6	0.19	0.28	
RBH101	24.28	C	Brown SANDSTONE As received	D	PL	YES	87.2	100.0	100.0	83.0	3.1	100.0	0.31	0.42	
RBH101	24.28	C	Brown SANDSTONE As received	A	PD	YES		100.0	101.8	92.8	3.9	113.9	0.30	0.43	
RBH101	26.5	C	Brown SANDSTONE As received	D	PL	YES	85.3	94.0	94.0	82.0	1.4	94.0	0.15	0.21	
RBH101	26.5	C	Brown SANDSTONE As received	A	PD	YES		94.9	87.2	72.2	2.5	102.7	0.23	0.32	

Test Type
D - Diametral, A - Axial, I - Irregular Lump, B - Block

Direction
PL - Parallel to planes of weakness
PD - Perpendicular to planes of weakness
U - Unknown or random

Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure (see ISRM note 6)
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P
Size factor, F = (De/50)0.45 for all tests.

Detailed legend for test and dimensions, based on ISRM



Method of Preparation: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Method of Test: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Results reported relate only to the samples tested.



Site: St Michaels

Job Number: 2280730

Client: Envirolab

Page: 6

Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
				Type (D, A, I, B)	Direction (PL, PD or U)		Lne mm	W mm	Dps mm	Dps' mm			Is MPa	Is (50) MPa	
RBH101	29.5	C	Brown MUDSTONE As received	D	PL	YES	97.0	99.0	99.0	97.0	1.3	99.0	0.14	0.19	
RBH101	29.5	C	Brown MUDSTONE As received	A	PD	YES		98.9	98.2	64.2	1.5	111.2	0.12	0.17	
RBH101	36.74	C	Brown SANDSTONE As received	D	PL	YES	107.3	99.9	99.9	97.9	2.8	99.9	0.29	0.39	
RBH101	36.74	C	Brown SANDSTONE As received	A	PD	YES		99.6	41.0	39.0	2.3	72.1	0.44	0.52	
RBH101	40.42	C	Brown SANDSTONE As received	D	PL	YES	90.9	96.9	96.9	95.9	2.0	96.9	0.21	0.29	
RBH101	40.42	C	Brown SANDSTONE As received	A	PD	YES		98.5	103.2	92.2	3.0	113.8	0.23	0.34	
RBH101	45.35	C	Brown SANDSTONE As received	D	PL	YES	75.0	99.9	99.9	97.9	2.7	99.9	0.27	0.37	
RBH101	45.35	C	Brown SANDSTONE As received	A	PD	YES		98.2	82.0	69.0	5.5	101.3	0.54	0.74	
RBH101	47.36	C	Brown SANDSTONE As received	D	PL	YES	72.1	96.2	96.2	94.2	1.3	96.2	0.14	0.18	
RBH101	47.36	C	Brown SANDSTONE As received	A	PD	YES		98.0	79.0	73.0	2.1	99.3	0.21	0.29	
RBH102	3.59	C	Brown SANDSTONE As received	D	PL	YES	68.0	95.7	95.7	93.7	0.7	95.7	0.08	0.11	
RBH102	3.59	C	Brown SANDSTONE As received	A	PD	YES		100.0	76.1	61.1	1.2	98.4	0.13	0.17	
RBH102	6.02	C	Brown SANDSTONE As received	D	PL	YES	50.1	95.2	95.2	91.2	0.6	95.2	0.07	0.09	
RBH102	6.02	C	Brown SANDSTONE As received	A	PD	YES		97.9	54.2	49.2	0.8	82.2	0.12	0.15	
RBH102	7.12	C	Brown SANDSTONE As received	D	PL	YES	70.5	97.9	97.9	94.9	1.3	97.9	0.13	0.18	
RBH102	7.12	C	Brown SANDSTONE As received	A	PD	YES		98.0	68.9	61.9	1.6	92.7	0.18	0.24	
RBH102	8.92	C	Brown SANDSTONE As received	D	PL	YES	64.0	98.0	98.0	95.0	1.0	98.0	0.11	0.15	
RBH102	8.92	C	Brown SANDSTONE As received	A	PD	YES		98.2	68.9	61.9	1.3	92.8	0.15	0.20	
RBH102	10.03	C	Brown SANDSTONE As received	D	PL	YES	74.5	99.0	99.0	96.0	1.4	99.0	0.14	0.20	
RBH102	10.03	C	Brown SANDSTONE As received	A	PD	YES		96.8	71.0	59.0	2.0	93.6	0.23	0.30	

Test Type

D - Diametral, A - Axial, I - Irregular Lump, B - Block

Direction

PL - Parallel to planes of weakness

PD - Perpendicular to planes of weakness

U - Unknown or random

Dimensions

Dps - Distance between platens (platen separation)

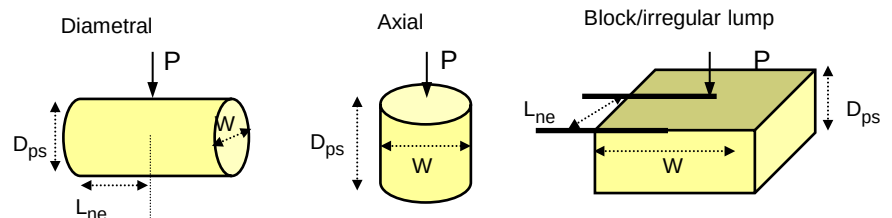
Dps' - at failure (see ISRM note 6)

Lne - Length from platens to nearest free end

W - Width of shortest dimension perpendicular to load, P

Size factor, F = (De/50)0.45 for all tests.

Detailed legend for test and dimensions, based on ISRM



Method of Preparation: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Method of Test: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Results reported relate only to the samples tested.

Site: St Michaels

Job Number: 2280730

Client: Envirolab

Page: 7

Point Load Strength Index Tests Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
				Type (D, A, I, B)	Direction (PL, PD or U)		Lne mm	W mm	Dps mm	Dps' mm			Is MPa	Is (50) MPa	
RBH102	12.18	C	Brown SANDSTONE As received	D	PL	YES	57.9	98.0	98.0	95.0	1.1	98.0	0.11	0.15	
RBH102	12.18	C	Brown SANDSTONE As received	A	PD	YES		99.6	61.0	54.0	1.7	87.9	0.23	0.29	
RBH102	14.32	C	Brown SANDSTONE As received	D	PL	YES	90.5	94.8	94.8	92.8	1.7	94.8	0.19	0.25	
RBH102	14.32	C	Brown SANDSTONE As received	A	PD	YES		97.0	95.2	77.2	1.4	108.5	0.12	0.17	
RBH102	15.39	C	Brown SANDSTONE As received	D	PL	YES	60.1	97.2	97.2	94.2	2.0	97.2	0.22	0.29	
RBH102	15.39	C	Brown SANDSTONE As received	A	PD	YES		98.3	67.8	57.8	2.3	92.1	0.28	0.36	
RBH102	17.76	C	Brown SANDSTONE As received	D	PL	YES	75.5	97.0	97.0	93.0	1.7	97.0	0.18	0.24	
RBH102	17.76	C	Brown SANDSTONE As received	A	PD	YES		93.5	70.3	65.3	2.2	91.5	0.26	0.34	
RBH102	19.5	C	Brown SANDSTONE As received	D	PL	YES	64.8	98.2	98.2	95.2	1.3	98.2	0.13	0.18	
RBH102	19.5	C	Brown SANDSTONE As received	A	PD	YES		98.2	55.2	50.2	1.5	83.1	0.22	0.28	
RBH102	21.5	C	Brown SANDSTONE As received	D	PL	YES	49.5	92.6	92.6	90.6	0.3	92.6	0.04	0.05	
RBH102	21.5	C	Brown SANDSTONE As received	A	PD	YES		97.1	57.7	46.7	1.3	84.5	0.19	0.24	
RBH102	25.37	C	Brown SANDSTONE As received	D	PL	YES	62.5	100.0	100.0	98.0	2.1	100.0	0.21	0.29	
RBH102	25.37	C	Brown SANDSTONE As received	A	PD	YES		98.6	72.0	64.0	2.9	95.1	0.32	0.43	
RBH102	27.08	C	Brown SANDSTONE As received	D	PL	YES	63.3	97.8	97.8	92.8	1.8	97.8	0.19	0.26	
RBH102	27.08	C	Brown SANDSTONE As received	A	PD	YES		98.2	61.7	56.7	1.7	87.8	0.22	0.29	
RBH102	30.9	C	Brown SANDSTONE As received	D	PL	YES	80.5	97.2	97.2	93.2	2.2	97.2	0.23	0.31	
RBH102	30.9	C	Brown SANDSTONE As received	A	PD	YES		100.2	79.5	71.5	3.0	100.7	0.30	0.41	
RBH102	32.85	C	Brown SANDSTONE As received	D	PL	YES	97.5	98.9	98.9	93.9	2.2	98.9	0.22	0.30	
RBH102	32.85	C	Brown SANDSTONE As received	A	PD	YES		98.9	81.9	73.9	2.5	101.6	0.24	0.33	

Test Type

D - Diametral, A - Axial, I - Irregular Lump, B - Block

Direction

PL - Parallel to planes of weakness

PD - Perpendicular to planes of weakness

U - Unknown or random

Dimensions

Dps - Distance between platens (platen separation)

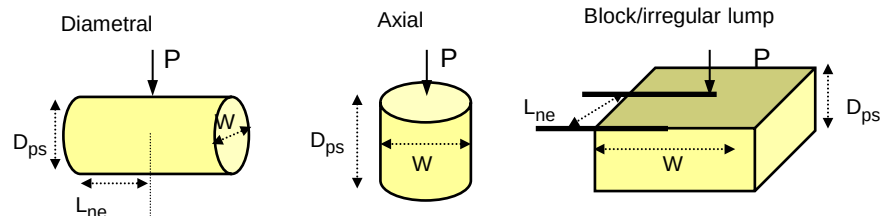
Dps' - at failure (see ISRM note 6)

Lne - Length from platens to nearest free end

W - Width of shortest dimension perpendicular to load, P

Size factor, F = (De/50)0.45 for all tests.

Detailed legend for test and dimensions, based on ISRM


Method of Preparation: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Method of Test: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Results reported relate only to the samples tested.



Site: St Michaels

Job Number: 2280730

Client: Envirolab

Page: 8

Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
				Type (D, A, I, B)	Direction (PL, PD or U)		Lne mm	W mm	Dps mm	Dps' mm			Is MPa	Is (50) MPa	
RBH102	34.86	C	Brown SANDSTONE As received	D	PL	YES	74.5	99.0	99.0	94.0	1.9	99.0	0.20	0.27	
RBH102	34.86	C	Brown SANDSTONE As received	A	PD	YES		98.7	75.8	66.8	2.9	97.6	0.31	0.41	
RBH102	37.21	C	Brown SANDSTONE As received	D	PL	YES	104.6	92.3	92.3	87.3	2.0	92.3	0.24	0.31	
RBH102	37.21	C	Brown SANDSTONE As received	A	PD	YES		99.6	104.2	74.2	3.7	115.0	0.28	0.40	
RBH102	42.22	C	Brown SANDSTONE As received	D	PL	YES	68.6	99.9	99.9	94.9	3.0	99.9	0.30	0.41	
RBH102	42.22	C	Brown SANDSTONE As received	A	PD	YES		101.0	41.8	40.8	1.6	73.3	0.30	0.35	
RBH102	45.94	C	Brown SANDSTONE As received	D	PL	YES	64.1	96.1	96.1	95.1	2.6	96.1	0.28	0.38	
RBH102	45.94	C	Brown SANDSTONE As received	A	PD	YES		95.5	83.1	71.1	2.2	100.5	0.22	0.30	
RBH102	48.91	C	Brown SANDSTONE As received	D	PL	YES	81.5	97.1	97.1	93.1	1.5	97.1	0.16	0.21	
RBH102	48.91	C	Brown SANDSTONE As received	A	PD	YES		96.6	86.2	80.2	2.0	103.0	0.18	0.25	
RBH103	6.74	C	Brown SANDSTONE As received	D	PL	YES	53.5	99.1	99.1	96.1	1.0	99.1	0.10	0.14	
RBH103	6.74	C	Brown SANDSTONE As received	A	PD	YES		98.0	60.3	52.3	1.7	86.8	0.22	0.28	
RBH103	11.78	C	Brown SANDSTONE As received	D	PL	YES	62.5	98.6	98.6	96.6	0.9	98.6	0.10	0.13	
RBH103	11.78	C	Brown SANDSTONE As received	A	PD	YES		99.1	75.0	67.0	1.5	97.3	0.16	0.21	
RBH103	13.14	C	Brown SANDSTONE As received	D	PL	YES	69.6	93.2	93.2	91.2	1.2	93.2	0.14	0.19	
RBH103	13.14	C	Brown SANDSTONE As received	A	PD	YES		96.0	78.8	72.8	1.9	98.1	0.20	0.27	
RBH103	15.81	C	Brown SANDSTONE As received	D	PL	YES	76.5	97.5	97.5	95.5	1.3	97.5	0.14	0.19	
RBH103	15.81	C	Brown SANDSTONE As received	A	PD	YES		97.1	84.5	76.5	1.5	102.2	0.15	0.20	
RBH103	19.27	C	Brown MUDSTONE As received	D	PL	YES	68.9	99.8	99.8	95.8	1.9	99.8	0.19	0.26	
RBH103	19.27	C	Brown MUDSTONE As received	A	PD	YES		99.2	74.3	66.3	2.6	96.9	0.28	0.38	

Test Type

D - Diametral, A - Axial, I - Irregular Lump, B - Block

Direction

PL - Parallel to planes of weakness

PD - Perpendicular to planes of weakness

U - Unknown or random

Dimensions

Dps - Distance between platens (platen separation)

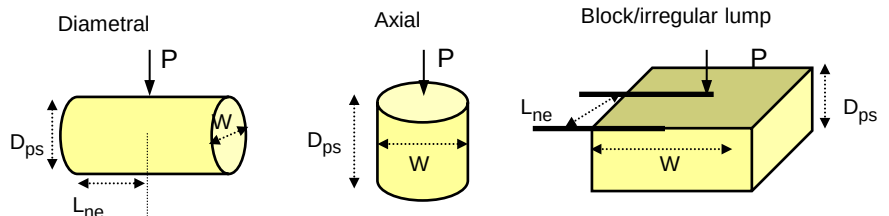
Dps' - at failure (see ISRM note 6)

Lne - Length from platens to nearest free end

W - Width of shortest dimension perpendicular to load, P

Size factor, F = (De/50)0.45 for all tests.

Detailed legend for test and dimensions, based on ISRM



Method of Preparation: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Method of Test: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Results reported relate only to the samples tested.

Site: St Michaels

Job Number: 2280730

Client: Envirolab

Page: 9

Point Load Strength Index Tests Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
				Type (D, A, I, B)	Direction (PL, PD or U)		Lne mm	W mm	Dps mm	Dps' mm			Is MPa	Is (50) MPa	
RBH103	22.24	C	Brown MUDSTONE As received	D	PL	YES	76.5	99.0	99.0	97.0	1.6	99.0	0.17	0.23	
RBH103	22.24	C	Brown MUDSTONE As received	A	PD	YES		98.9	74.5	65.5	2.3	96.9	0.24	0.33	
RBH103	25	C	Brown MUDSTONE As received	D	PL	YES	81.5	95.8	95.8	91.8	2.0	95.8	0.21	0.29	
RBH103	25	C	Brown MUDSTONE As received	A	PD	YES		96.1	84.5	75.5	3.2	101.7	0.31	0.42	
RBH103	26.4	C	Brown MUDSTONE As received	D	PL	YES	46.5	94.7	94.7	92.7	1.9	94.7	0.21	0.28	
RBH103	26.4	C	Brown MUDSTONE As received	A	PD	YES		94.3	41.0	36.0	2.0	70.2	0.40	0.47	
RBH103	28.53	C	Brown MUDSTONE As received	D	PL	YES	72.5	99.5	99.5	97.5	3.3	99.5	0.33	0.45	
RBH103	28.53	C	Brown MUDSTONE As received	A	PD	YES		99.2	83.2	78.2	3.4	102.5	0.33	0.45	
RBH103	31.83	C	Brown SANDSTONE As received	D	PL	YES	84.7	97.8	97.8	95.8	3.7	97.8	0.38	0.52	
RBH103	31.83	C	Brown SANDSTONE As received	A	PD	YES		98.2	83.6	68.6	6.4	102.2	0.61	0.84	
RBH103	33.5	C	Brown SANDSTONE As received	D	PL	YES	92.5	97.6	97.6	93.6	1.4	97.6	0.15	0.20	
RBH103	33.5	C	Brown SANDSTONE As received	A	PD	YES		98.0	93.3	86.3	3.3	107.9	0.28	0.40	
RBH103	35.6	C	Brown SANDSTONE As received	D	PL	YES	79.9	96.2	96.2	93.2	2.0	96.2	0.22	0.29	
RBH103	35.6	C	Brown SANDSTONE As received	A	PD	YES		96.6	65.3	60.3	2.0	89.6	0.25	0.32	
RBH103	36.84	C	Brown SANDSTONE As received	D	PL	YES	71.5	98.0	98.0	94.0	1.8	98.0	0.19	0.25	
RBH103	36.84	C	Brown SANDSTONE As received	A	PD	YES		97.6	54.7	43.7	2.3	82.4	0.33	0.42	
RBH103	40.32	C	Brown SANDSTONE As received	D	PL	YES	52.3	97.2	97.2	95.2	0.3	97.2	0.03	0.04	
RBH103	40.32	C	Brown SANDSTONE As received	A	PD	YES		99.1	54.3	49.3	2.6	82.7	0.39	0.48	
RBH103	43.46	C	Brown SANDSTONE As received	D	PL	YES	45.1	98.0	98.0	95.0	1.4	98.0	0.14	0.19	
RBH103	43.46	C	Brown SANDSTONE As received	A	PD	YES		97.5	42.4	37.4	1.9	72.5	0.35	0.42	

Test Type
D - Diametral, A - Axial, I - Irregular Lump, B - Block

Direction
PL - Parallel to planes of weakness
PD - Perpendicular to planes of weakness
U - Unknown or random

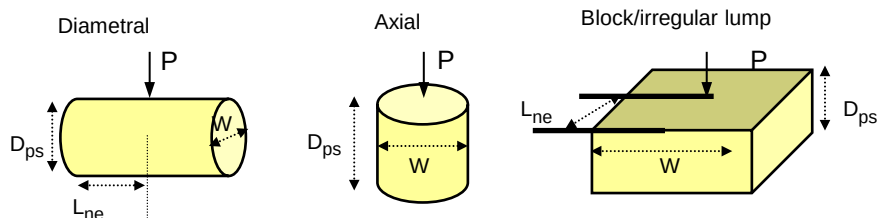
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure (see ISRM note 6)

Lne - Length from platens to nearest free end

W - Width of shortest dimension perpendicular to load, P

Size factor, F = (De/50)0.45 for all tests.

Detailed legend for test and dimensions, based on ISRM



Method of Preparation: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Method of Test: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Results reported relate only to the samples tested.



Site: St Michaels

Job Number: 2280730

Client: Envirolab

Page: 10

Point Load Strength Index Tests Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
				Type (D, A, I, B)	Direction (PL, PD or U)		Lne mm	W mm	Dps mm	Dps' mm			Is MPa	Is (50) MPa	
RBH103	45.5	C	Brown SANDSTONE As received	D	PL	YES	64.4	95.7	95.7	92.7	1.4	95.7	0.15	0.20	
RBH103	45.5	C	Brown SANDSTONE As received	A	PD	YES		91.0	53.5	48.5	2.6	78.7	0.43	0.52	
RBH103	48.5	C	Brown SANDSTONE As received	D	PL	YES	133.8	93.7	93.7	88.7	3.4	93.7	0.38	0.51	
RBH103	48.5	C	Brown SANDSTONE As received	A	PD	YES		99.8	115.2	98.2	4.6	121.0	0.32	0.47	

Test Type

D - Diametral, A - Axial, I - Irregular Lump, B - Block

Direction

PL - Parallel to planes of weakness

PD - Perpendicular to planes of weakness

U - Unknown or random

Dimensions

Dps - Distance between platens (platen separation)

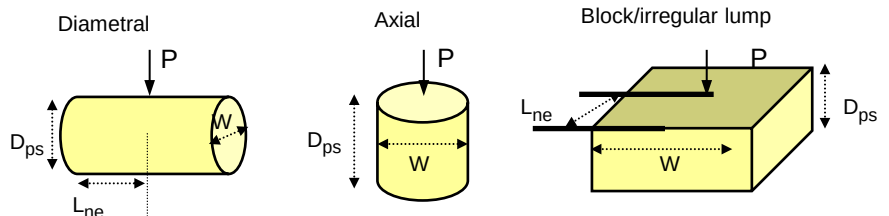
Dps' - at failure (see ISRM note 6)

Lne - Length from platens to nearest free end

W - Width of shortest dimension perpendicular to load, P

Size factor, F = (De/50)0.45 for all tests.

Detailed legend for test and dimensions, based on ISRM



Method of Preparation: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Method of Test: ISRM 2007 Suggested method for point load strength index (pages 125 - 132)

Results reported relate only to the samples tested.



Site: St Michaels

Job Number: 2280730

Client: Envirolab

Page: 11

Dry Density of Rock - Summary of Results

Borehole / Trial Pit	Depth (m)	Sample	Soil description	Sample Type and Dimensions	Dry Mass of Sample g	Dry density Mg/m3	Remarks
RBH101	12.00	C	Brown SANDSTONE	Core Sample Av. Len. : 126.43mm Av. Diam. : 99.02mm	1943.20	2.00	
RBH101	23.28	C	Brown SANDSTONE	Core Sample Av. Len. : 93.66mm Av. Diam. : 99.2mm	1442.50	1.99	
RBH101	33.80	C	Brown SANDSTONE	Core Sample Av. Len. : 104.68mm Av. Diam. : 99.38mm	1601.40	1.97	
RBH101	44.57	C	Brown SANDSTONE	Core Sample Av. Len. : 174.43mm Av. Diam. : 98.49mm	2674.20	2.01	
RBH101	50.09	C	Brown SANDSTONE	Core Sample Av. Len. : 67.06mm Av. Diam. : 98.52mm	1016.00	1.99	
RBH102	7.82	C	Brown SANDSTONE	Core Sample Av. Len. : 117.16mm Av. Diam. : 98.38mm	1734.70	1.95	
RBH102	18.80	C	Brown SANDSTONE	Core Sample Av. Len. : 117.57mm Av. Diam. : 99.94mm	1907.90	2.07	
RBH102	27.50	C	Brown SANDSTONE	Core Sample Av. Len. : 141.7mm Av. Diam. : 99.22mm	2189.30	2.00	
RBH102	38.15	C	Brown SANDSTONE	Core Sample Av. Len. : 96.68mm Av. Diam. : 99.2mm	1479.90	1.98	
RBH102	48.14	C	Brown SANDSTONE	Core Sample Av. Len. : 83.28mm Av. Diam. : 100.23mm	1480.90	2.25	
RBH103	5.58	C	Brown SANDSTONE	Core Sample Av. Len. : 32.7mm Av. Diam. : 98.73mm	459.50	1.84	
RBH103	16.83	C	Brown SANDSTONE	Core Sample Av. Len. : 105.06mm Av. Diam. : 99.49mm	1699.40	2.08	
RBH103	29.65	C	Brown SANDSTONE	Core Sample Av. Len. : 130.22mm Av. Diam. : 100.09mm	2061.90	2.01	
RBH103	34.81	C	Brown SANDSTONE	Core Sample Av. Len. : 138.66mm Av. Diam. : 99.18mm	2137.00	1.99	
RBH103	42.50	C	Brown SANDSTONE	Core Sample Av. Len. : 184.72mm Av. Diam. : 100.08mm	2846.50	1.96	

Method of Preparation: ISRM suggested methods for rock characterisation : Dry Density of Rock

Method of Test: ISRM suggested methods for rock characterisation : Dry Density of Rock

Results reported relate only to the samples tested.



Final Test Report - 2280730 / 3

Site: St Michaels

Job Number: 2280730

Originating Client: Envirolab

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

This test report shall not be reproduced, except in full and only with the written permission of Ian Farmer Associates Ltd.

Samples will be retained for 28 days from date of issue of the final test report before being disposed of, unless we receive written instruction to the contrary.

Report Issue Date: 29/09/2021

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK MATERIALS

Sample details						Density		Uniaxial Compression Test (LF0879C (1000kN) compression frame used)							
Borehole Ref.	Sample Ref.	Depth (m)	Description	MC (%)	Degree of Saturation (%)	Bulk (Mg/m³)	Dry (Mg/m³)	Mean after prep.		H/D Ratio	Load at Failure (kN)	UCS (MPa) 3 sig. fig.	Failure Sketch	D. Tested	Remarks
								Diameter (mm)	Height (mm)						
RBH101		12.00	Weak reddish brown fine to medium grained SANDSTONE. Highly weathered	10.0	76.8	2.32	2.11	54.00	112.20	2.1	30.5	13.3		30/09/21	Sample recored
RBH102		13.50	Weak reddish brown fine to medium grained SANDSTONE. Highly weathered	10	70.6	2.25	2.04	54.00	115.30	2.1	35.2	15.4		30/09/21	Sample recored
RBH103		17.54	Weak reddish brown fine to medium grained SANDSTONE. Highly weathered	7.0	52.6	2.24	2.09	99.60	204.50	2.1	92.6	11.9		30/09/21	

Note: The dimensional requirements of flatness (<0.02 mm), perpendicularity (<0.05 / 50 mm) and straightness (0.3 mm deviation) are all met. Specific Gravity used for Degree of Saturation is assumed unless specified by the client.

Checked and Approved by  C Clergeaud (Snr. Geologist) Date: 01/10/2021	Project Number: GEO / 34025 Project Name: ST MICHAELS 2280730	 
--	--	--

UNCONFINED COMPRESSIVE STRENGTH WITH YOUNG'S MODULUS AND POISSON'S RATIO

Borehole Ref.: RBH101
Sample Ref.: -
Depth (m): 12.00

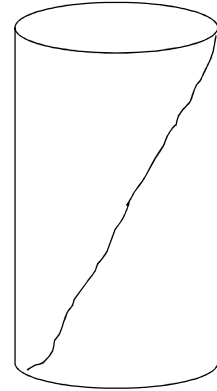
Description:
Weak reddish brown fine to medium grained SANDSTONE. Highly weathered

Diameter	54.00 mm
Height	112.20 mm
Bulk Density	2.32 Mg/m ³
Dry Density	2.11 Mg/m ³
Water Content	10.0 %
Degree of Saturation: 76.8 %	Specific Gravity: 2.9 Mg/m ³ (Assumed)

LF0879C (1000kN) compression frame used

Failure Sketch

Mode of failure: Diagonal shearing



Solid lines for material failures.
Dashed lines for apparent weakness failure.

Angle of foliation/Horizontal: n/a
Angle of shear plane/Horizontal: n/a

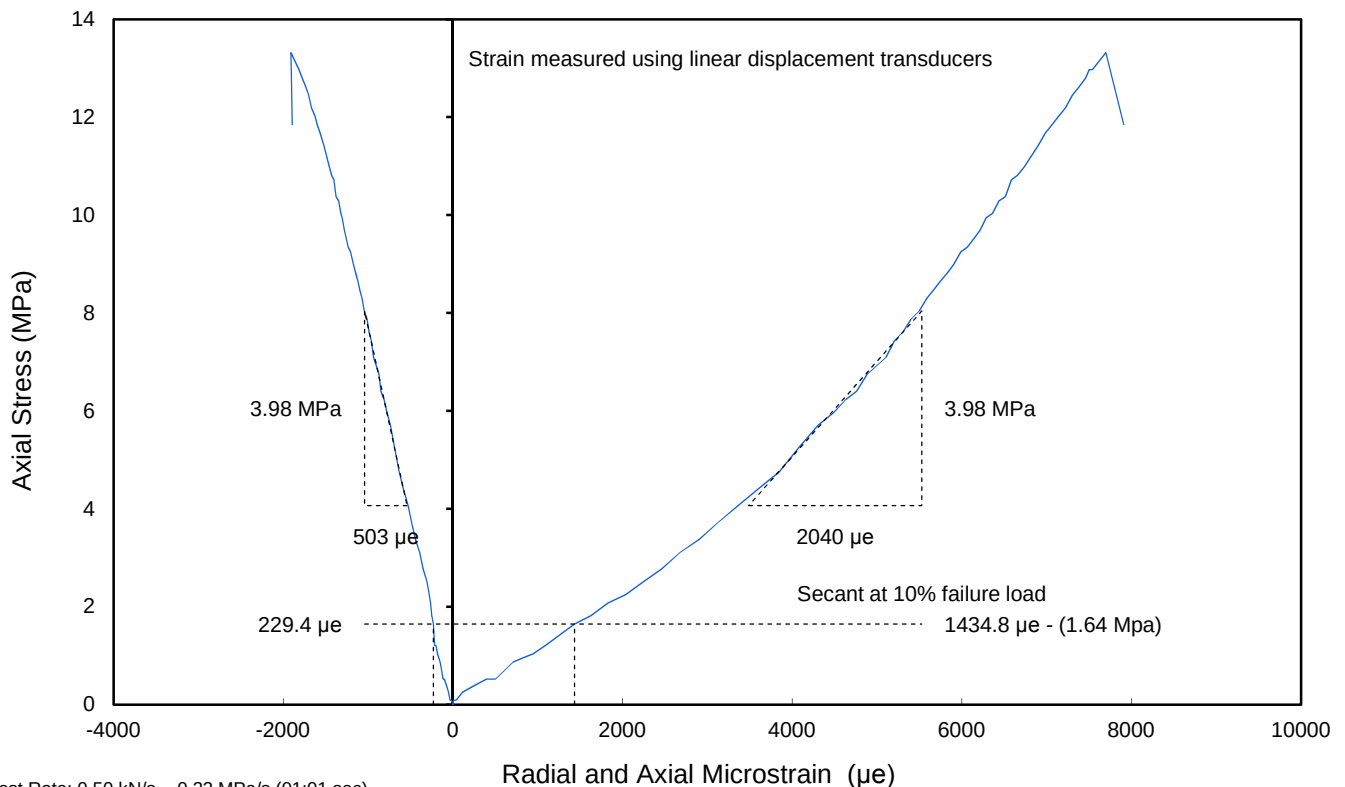
Date tested: 30/09/2021

Test results

Unconfined Compressive Strength	13.3 MPa
Young's Modulus (tangential at 50% failure load)	1.95 GPa
Poisson's Ratio (tangential at 50% failure load)	0.25
Young's Modulus (secant at 10% failure load)	1.15 GPa
Poisson's Ratio (secant at 10% failure load)	0.16

Sample type

C



Test Rate: 0.50 kN/s - 0.22 MPa/s (01:01 sec)

Remarks: Sample recorded

Note: The dimensional requirements of Flatness (<0.02 mm), Perpendicularity (<0.05 / 50 mm) and Straightness (0.3 mm deviation) are all met.

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 01/10/2021

Project Number:

GEO / 34025

Project Name:

ST MICHAELS
2280730

GEOLABS®

UNCONFINED COMPRESSIVE STRENGTH WITH YOUNG'S MODULUS AND POISSON'S RATIO

Borehole Ref.: RBH102
Sample Ref.: -
Depth (m): 13.50

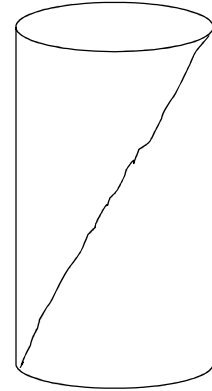
Description:
Weak reddish brown fine to medium grained SANDSTONE. Highly weathered

Diameter	54.00 mm
Height	115.30 mm
Bulk Density	2.25 Mg/m ³
Dry Density	2.04 Mg/m ³
Water Content	10 %
Degree of Saturation: 70.6 %	Specific Gravity: 2.9 Mg/m ³ (Assumed)

LF0879C (1000kN) compression frame used

Failure Sketch

Mode of failure: Diagonal shearing



Solid lines for material failures.
Dashed lines for apparent weakness failure.

Angle of foliation/Horizontal: n/a
Angle of shear plane/Horizontal: n/a

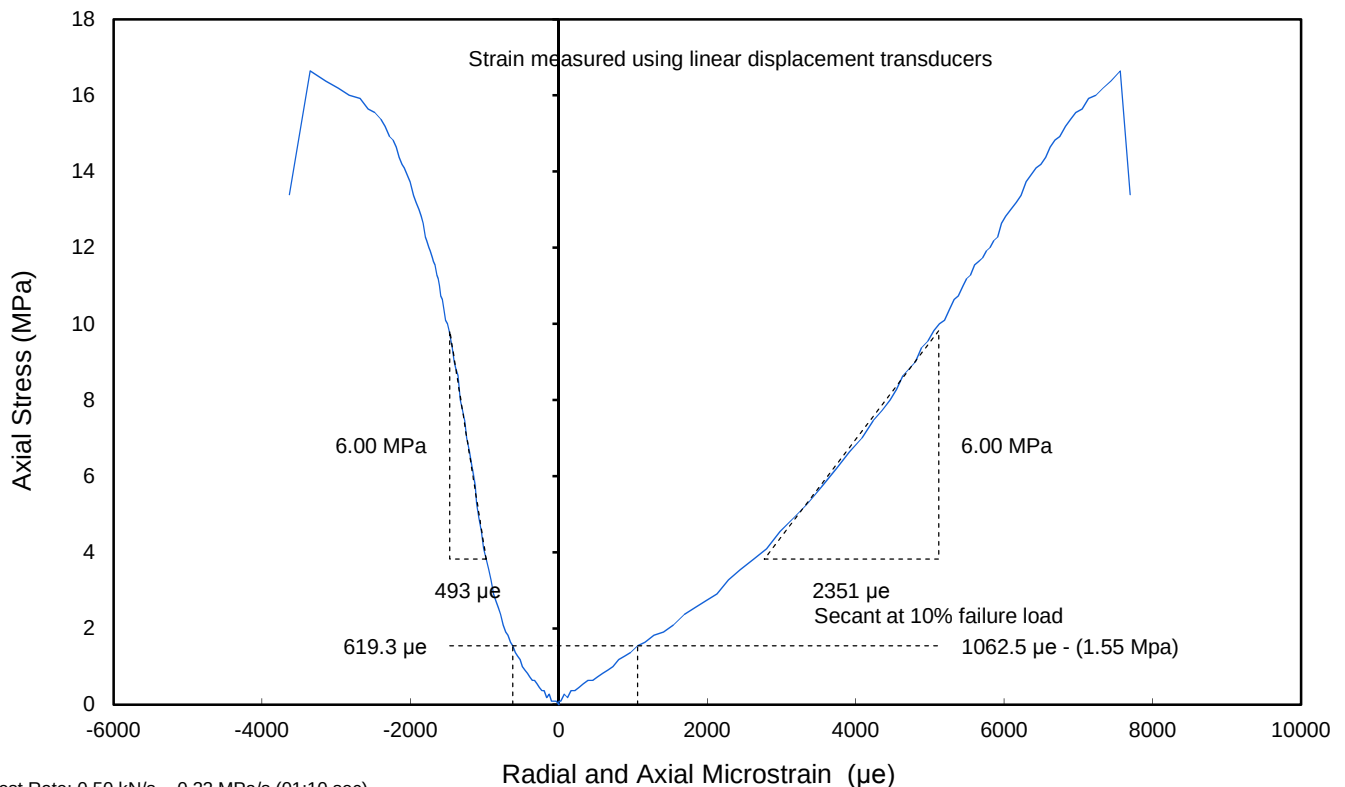
Date tested: 30/09/2021

Test results

Unconfined Compressive Strength	15.4 MPa
Young's Modulus (tangential at 50% failure load)	2.55 GPa
Poisson's Ratio (tangential at 50% failure load)	0.21
Young's Modulus (secant at 10% failure load)	1.46 GPa
Poisson's Ratio (secant at 10% failure load)	0.58

Sample type

C



Test Rate: 0.50 kN/s - 0.22 MPa/s (01:10 sec)

Remarks: Sample recorded

Note: The dimensional requirements of Flatness (<0.02 mm), Perpendicularity (<0.05 / 50 mm) and Straightness (0.3 mm deviation) are all met.

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 01/10/2021

Project Number:

GEO / 34025

Project Name:

ST MICHAELS
2280730

GEOLABS®

UNCONFINED COMPRESSIVE STRENGTH WITH YOUNG'S MODULUS AND POISSON'S RATIO

Borehole Ref.: RBH103
Sample Ref.: -
Depth (m): 17.54

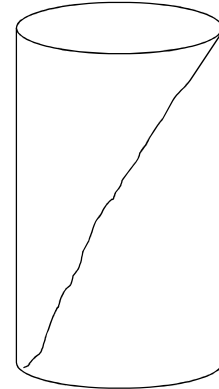
Description:
Weak reddish brown fine to medium grained SANDSTONE. Highly weathered

Diameter	99.60 mm
Height	204.50 mm
Bulk Density	2.24 Mg/m ³
Dry Density	2.09 Mg/m ³
Water Content	7.0 %
Degree of Saturation: 52.6 %	Specific Gravity: 2.9 Mg/m ³ (Assumed)

LF0879C (1000kN) compression frame used

Failure Sketch

Mode of failure: Diagonal shearing



Solid lines for material failures.
Dashed lines for apparent weakness failure.

Angle of foliation/Horizontal: n/a
Angle of shear plane/Horizontal: n/a

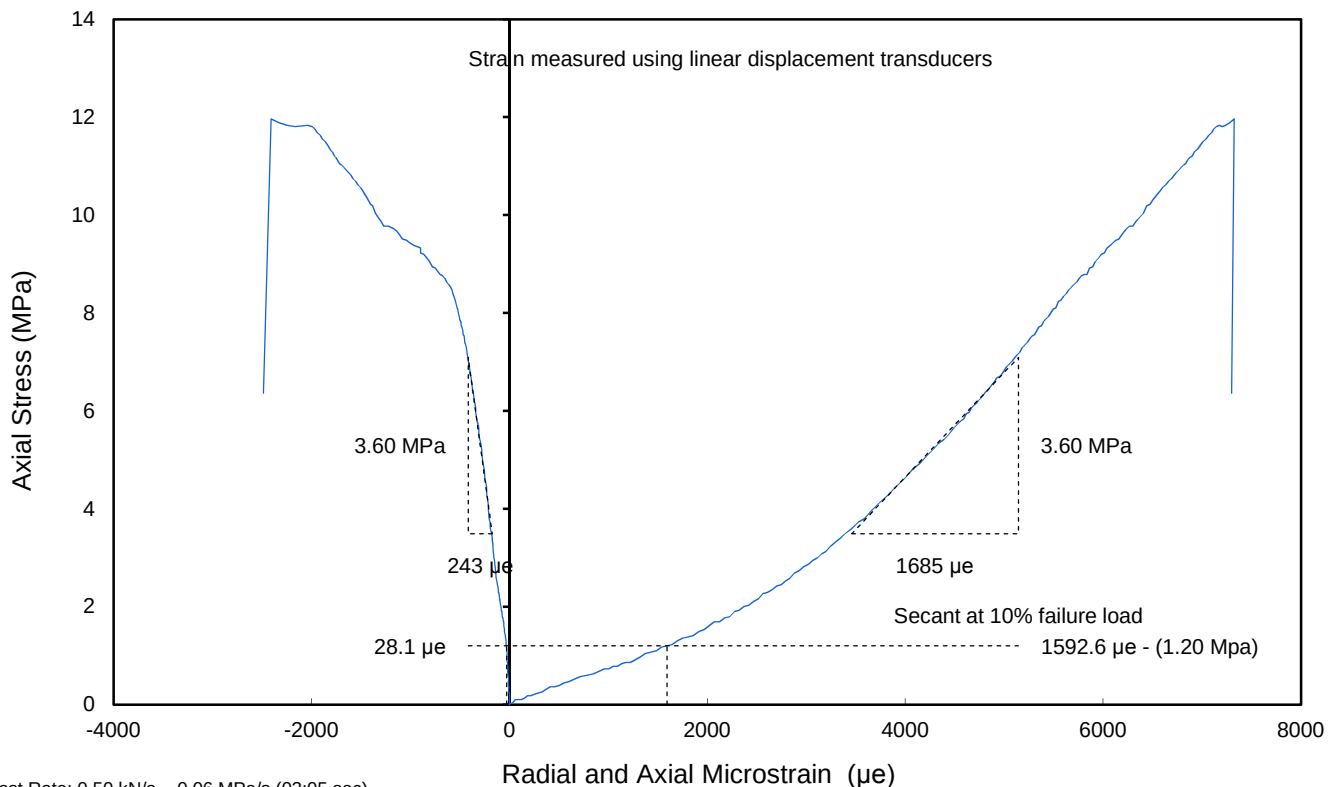
Date tested: 30/09/2021

Test results

Unconfined Compressive Strength	11.9 MPa
Young's Modulus (tangential at 50% failure load)	2.13 GPa
Poisson's Ratio (tangential at 50% failure load)	0.14
Young's Modulus (secant at 10% failure load)	0.753 GPa
Poisson's Ratio (secant at 10% failure load)	0.02

Sample type

C



Test Rate: 0.50 kN/s - 0.06 MPa/s (03:05 sec)

Note: The dimensional requirements of Flatness (<0.02 mm), Perpendicularity (<0.05 / 50 mm) and Straightness (0.3 mm deviation) are all met.

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 01/10/2021

Project Number:

GEO / 34025

Project Name:

ST MICHAELS
2280730

GEOLABS®

Appendix E – Ground Gas and Groundwater Monitoring Results

- Curtins Gas Monitoring Results Visits 1 – 6

Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

Tel: 0161 236 2394

Fax: 0161 228 7902



GAS MONITORING LOG SHEET

Project:	St Michaels	Date:	17/08/2021
Job Number:	B078847	Visit:	1
Client:	Bowmer Kirkland	Weather:	Dry
Barometric State:	Rising	Ground Conditions:	Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
RBH101	1005	-	-	0.0	0.0	0.0	0.0	20.5	0	0	13.83	48.94	3
RBH102	1005	-	-	-	-	-	-	-	-	-	-	-	1
RBH103	1005	-0.9	-0.8	0.0	0.0	0.1	0.1	20.3	0	0	11.45	19.98	
WS104	1005	-	-	-	-	-	-	-	-	-	-	-	2

Notes

- 1 Flush cover submerged underwater
- 2 Unable to open well
- 3 Bung submerged underwater - unable to measure flow

Logged by

PN

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

Project:	St Michaels	Date:	02/09/2021
Job Number:	B078847	Visit:	2
Client:	Bowmer Kirkland	Weather:	Cloudy
Barometric State:	Falling	Ground Conditions:	Dry

Borehole Reference	Barometric Pressure mb	Flow		Methane		Carbon Dioxide		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		l/hr		%		%							
		Max	SS	Max	SS	Max	SS						
RBH101	1031	0.0	0.0	0.0	0.0	0.1	0.0	19.1	2	6	13.93	48.53	1
RBH102	1031	0.0	0.0	0.0	0.0	0.5	0.2	20.0	2	6	13.03	35.04	1
RBH103	1031	-0.1	0.0	0.0	0.0	0.5	0.5	19.2	1	0	12.88	19.88	1
WS104	1031	0.0	0.0	0.0	0.0	0.2	0.1	20.6	1	2	Dry	1.59	

1 Boreholes sampled for groundwater.

TW

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

GAS MONITORING LOG SHEET

Project:	St Michaels	Date:	16/09/2021
Job Number:	B078847	Visit:	3
Client:	Bowmer Kirkland	Weather:	Cloudy
Barometric State:	Steady	Ground Conditions:	Sunny

Borehole Reference	Barometric Pressure mb	Flow		Methane		Carbon Dioxide		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		l/hr		%		%							
		Max	SS	Max	SS	Max	SS						
RBH101	1017	-0.2	-0.1	0.0	0.0	0.6	0.2	19.1	1	2	13.94	48.53	
RBH102	1017	-0.1	-0.1	0.0	0.0	0.2	0.2	20.0	0	0	13.24	35.04	
RBH103	1017	0.0	0.0	0.0	0.0	0.0	0.0	20.6	1	0	12.93	19.88	
WS104	1017	0.0	0.0	0.0	0.0	0.0	0.0	20.4	1	0	Dry	1.59	

Notes

Logged by

TW

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

Tel: 0161 236 2394

Fax: 0161 228 7902



GAS MONITORING LOG SHEET

Project:	St Michaels	Date:	29/09/2021
Job Number:	B078847	Visit:	4
Client:	Bowmer Kirkland	Weather:	Cloudy
Barometric State:	Rising	Ground Conditions:	Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
RBH101	-	-	-	-	-	-	-	-	-	-	-	-	1
RBH102	1013	-1.2	-0.3	-	-	-	-	-	-	-	13.28	35.70	2
RBH103	1013	-0.6	-0.5	0.0	0.0	0.7	0.7	18.9	0	4	13.04	19.95	
WS104	1016	0.0	0.0	0.0	0.0	0.1	0.0	20.9	0	0	1.18	1.60	

Notes

- 1 Flush cover submerged in water - unable to reach down to bung
- 2 Bung submerged in water - no gas readings taken

Logged by

ZH

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

Tel: 0161 236 2394

Fax: 0161 228 7902



GAS MONITORING LOG SHEET

Project:	St Michaels	Date:	21/10/2021
Job Number:	B078847	Visit:	5
Client:	Bowmer Kirkland	Weather:	Sunny, cold
Barometric State:	Rising	Ground Conditions:	Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
RBH101	-	-	-	-	-	-	-	-	-	-	-	-	1
RBH102	1006	25.9	22.6	0.0	0.0	0.2	0.2	19.6	0	0	13.12	-	2
RBH103	1007	-1.3	-1.3	0.0	0.0	0.3	0.3	20.2	0	0	12.94	1.00	2
WS104	1007	-1.0	-0.9	0.0	0.0	0.0	0.0	20.2	0	0	0.33	1.60	

Notes

- | | |
|---|---|
| 1 | Flush cover submerged in water - unable to reach down to bung |
| 2 | Unable to record depth of installed borehole |

Logged by

SH

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

Curtins

Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG

Tel: 0161 236 2394

Fax: 0161 228 7902



GAS MONITORING LOG SHEET

Project:	St Michaels	Date:	05/11/2021
Job Number:	B078847	Visit:	6
Client:	Bowmer Kirkland	Weather:	Drizzle
Barometric State:	Falling	Ground Conditions:	Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
RBH101	-	-	-	-	-	-	-	-	-	-	-	-	1
RBH102	1016	-1.3	-1.2	0.0	0.0	0.2	0.2	19.6	0	0	13.12	35.10	
RBH103	1016	-0.7	-0.8	0.0	0.0	0.3	0.3	20.2	0	0	12.94	19.90	
WS104	1016	-0.9	-0.8	0.0	0.0	0.0	0.0	20.2	0	0	1.17	1.60	

Notes

- 1 Flush cover submerged in water - unable to reach down to bung
- 2 Unable to record depth of installed borehole

Logged by

PN

1% gas volume = 10,000 ppm

Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.

All other gases recorded at 'steady state' unless otherwise stated

Appendix F – GAC Screening Thresholds

- Curtins GAC Thresholds for 1.0% SOM.
- Curtins GAC Thresholds for 2.5% SOM.

Adopted Soil Generic Assessment Criteria
Sandy loam with 6% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	230 410	120 220	560 880
Chromium III	910	910	18,000	8,600	1,500	33,000
Chromium VI	6 21	6 21	1.8 170	33 49	7.7 21	220 250
Lead	200	310	80	2,300	630	1,300
Mercury (<i>elemental</i>)	1	1	26	26	16	26⁽⁸⁾ [30]
Mercury (<i>inorganic</i>)	170	240	80	3600	120	240
Nickel	130⁽¹⁰⁾	180⁽¹⁰⁾	53⁽¹¹⁾	980⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	640⁽¹²⁾ 640	79 79	170 170
Antimony		550		7500	1500	3300
Selenium	350	600	120	13000	1100	1800
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
<i>Aliphatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₆	160	160	3900	12000	600000	180000
EC ₅₋₆ - EC ₈	530	530	13000	40000	620000	320000
EC ₅₋₈ - EC ₁₀	150	150	1700	11000	13000	21000
EC ₁₀₋₁₀ - EC ₁₂	760	770	7300	47000	13000	24000
EC ₁₂₋₁₂ - EC ₁₆	4300	4400	13000	90000	13000	26000
EC ₅₋₁₆ - EC ₃₅	110000	110000	270000	1800000	250000	490000
EC ₃₅₋₃₅ - EC ₄₄	110000	110000	270000	1800000	250000	490000
<i>Aromatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₇	300	1400	57	86000	56000	92000
EC ₅₋₇ - EC ₈	660	3900	120	180000	56000	100000
EC ₅₋₈ - EC ₁₀	190	270	51	17000	5000	9300
EC ₁₀₋₁₀ - EC ₁₂	380	1200	74	34000	5000	10000
EC ₁₂₋₁₂ - EC ₁₆	660	2500	130	38000	5000	10000
EC ₅₋₁₆ - EC ₂₁	930	1900	260	28000	3800	7800
EC ₂₁₋₂₁ - EC ₃₅	1700	1900	1600	28000	3800	7900
EC ₃₅₋₃₅ - EC ₄₄	1700	1900	1600	28000	3800	7900
Aliph + Arom EC >44-70	1900	1900	3000	28000	3800	7900
Aromatic						
Benzene	0.33 0.87	1.0 3.3	0.07 0.18	95 98	73 140	110 230
Ethyl benzene	350	840	90	2800⁽⁸⁾ [66000]	2800⁽⁸⁾ [25000]	2800⁽⁸⁾ [27000]
Toluene	610	2700	120	4400⁽⁸⁾ [190000]	4400⁽⁸⁾ [56000]	4400⁽⁸⁾ [100000]
Xylene ⁽⁹⁾	230	290	160	2600⁽⁸⁾ [32000]	2600⁽⁸⁾ [43000]	2600⁽⁸⁾ [31000]
Phenol	420	520	280	3200⁽¹⁴⁾ (38000)	3200⁽¹⁴⁾ (10000)	3200⁽¹⁴⁾ (9300)
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	13	13	24	1100	4900	3000
Acenaphthylene	920	6000	160	100000	15000	30000
Acenaphthene	1100	6000	200	100000	15000	30000
Fluorene	860	4500	160	71000	9900	20000
Phenanthrene	440	1500	90	23000	3100	6300
Anthracene	11000	37000	2200	540000	74000	150000
Fluoranthene	890	1600	290	23000	3100	6400
Pyrene	2000	3800	620	54000	7400	15000
Benz(a)anthracene	13	15	13	180	29	62
Chrysene	27	32	19	350	57	120
Benzo(b)fluoranthene	3.7	4.0	3.9	45	7.2	16.0
Benzo(k)fluoranthene	100	110	130	1200	190	440
Benzo(a)pyrene	3.0 5.0	3.2 5.3	3.5 5.7	36 77	5.7 10	13 21
Indeno(123cd)pyrene	41	46	39	510	82	180
Dibenzo(ah)anthracene	0.3	0.32	0.43	3.6	0.58	1.4
Benzo(ghi)perylene	350	360	640	4000	640	1600
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.0014	0.0015	0.0018	0.12	3.5	5.4
Trichloroethene (TCE)	0.075	0.08	0.21	5.7	120	120
1,1,1,2 Tetrachlorethane	6.4	8.2	4.4	560	1400	2100
Tetrachlorethane (PCE)	0.90	0.92	3.6	95	1400	1500
1,1,1 Trichlorethane	39	40	240	3000	140000	100000

Notes

- All values above are in mg/kg
- Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters, numbers in italics are S4ULs, numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters and underlined numbers are C4SLs**
- Soil organic matter (SOM) is assumed to be 6% - DEFAULT VALUE
- Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
- For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
- For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
- Based on vapour saturation limit as suggested by EA / [] model value
- Lowest of o-, m- and p-xylene
- Based on comparison of inhalation exposure with inhalation TDI
- Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
- Based on a comparison of oral and dermal soil exposure with oral Index Dose only
- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 2.5% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	230 410	120 220	560 880
Chromium III	910	910	18,000	8,600	1,500	33,000
Chromium VI	6 <u>21</u>	6 <u>21</u>	1.8 <u>170</u>	33 <u>49</u>	7.7 <u>21</u>	220 <u>250</u>
Lead	<u>200</u>	<u>310</u>	<u>80</u>	<u>2,300</u>	<u>630</u>	<u>1,300</u>
Mercury (elemental)	1	1	26	26	16	26 ⁽⁸⁾ [30]
Mercury (inorganic)	170	240	80	3600	120	240
Nickel	130 ⁽¹⁰⁾	180 ⁽¹⁰⁾	53 ⁽¹¹⁾	980 ⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	640⁽¹²⁾ 640	79 <u>79</u>	170 <u>170</u>
Antimony		550		7500	1500	3300
Selenium	350	600	120	13000	1100	1800
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
<i>Aliphatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅ - EC ₆	78	78	1700	5900	590000	130000
EC ₆ - EC ₈	230	230	5600	17000	610000	220000
EC ₈ - EC ₁₀	65	65	770	4800	13000	18000
EC ₁₀ - EC ₁₂	330	330	4400	23000	13000	23000
EC ₁₂ - EC ₁₆	2400	2400	13000	82000	13000	25000
EC ₁₆ - EC ₃₅	92000	92000	270000	1700000	250000	480000
EC ₃₅ - EC ₄₄	92000	92000	270000	1700000	250000	480000
<i>Aromatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅ - EC ₇	140	690	27	46000	56000	84000
EC ₇ - EC ₈	290	1800	51	110000	56000	95000
EC ₈ - EC ₁₀	83	110	21	8100	5000	8500
EC ₁₀ - EC ₁₂	180	590	31	28000	5000	9700
EC ₁₂ - EC ₁₆	330	2300	57	37000	5100	10000
EC ₁₆ - EC ₂₁	540	1900	110	28000	3800	7700
EC ₂₁ - EC ₃₅	1500	1900	820	28000	3800	7800
EC ₃₅ - EC ₄₄	1500	1900	820	28000	3800	7800
Aliph + Arom EC >44-70	1800	1900	2100	28000	3800	7800
<i>Aromatic</i>						
Benzene	0.16	0.49	0.035	50	72	100
Ethyl benzene	150	380	39	1200⁽⁸⁾ [35000]	1200⁽⁸⁾ [24000]	1200⁽⁸⁾ [22000]
Toluene	270	1300	51	1900⁽⁸⁾ [110000]	1900⁽⁸⁾ [56000]	1900⁽⁸⁾ [95000]
Xylene ⁽⁹⁾	98	120	70	1200⁽⁸⁾ [14000]	1200⁽⁸⁾ [42000]	1200⁽⁸⁾ [23000]
Phenol	290	420	140	1500⁽¹⁴⁾ (35000)	1500⁽¹⁴⁾ (10000)	1500⁽¹⁴⁾ (8300)
<i>Polycyclic Aromatic Hydrocarbons (PAH)</i>						
Naphthalene	5.6	5.6	10	460	4900	1900
Acenaphthylene	420	4600	69	97000	15000	30000
Acenaphthene	510	4700	85	97000	15000	30000
Fluorene	400	3800	67	68000	9900	20000
Phenanthrene	220	1500	38	22000	3100	6200
Anthracene	5400	35000	950	540000	74000	150000
Fluoranthene	560	1600	130	23000	3100	6300
Pyrene	1200	3800	270	54000	7400	15000
Benz(a)anthracene	11	14	6.5	170	29	56
Chrysene	22	31	9.4	350	57	110
Benzo(b)fluoranthene	3.3	4.0	2.1	44	7.2	15
Benzo(k)fluoranthene	93	110	75	1200	190	410
Benzo(a)pyrene	2.7	3.2	2	35	5.7	12
Indeno(123cd)pyrene	36	46	21	510	82	170
Dibenzo(ah)anthracene	0.28	0.32	0.27	3.6	0.57	1.3
Benzo(ghi)perylene	340	360	470	4000	640	1500
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.00087	0.001	0.001	0.077	3.5	5
Trichloroethene (TCE)	0.034	0.036	0.091	2.6	120	91
1,1,1,2 Tetrachlorethane	2.8	3.5	1.9	250	1400	1800
Tetrachlorethane (PCE)	0.39	0.4	1.5	42	1400	1100
1,1,1 Trichlorethane	18	18	110	1300	140000	76000

Notes

- All values above are in mg/kg
- Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters, numbers in italics are S4ULs, numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters and underlined numbers are C4SLs
- Soil organic matter (SOM) is assumed to be 2.5% - DEFAULT VALUE
- Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
- For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
- For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
- Based on vapour saturation limit as suggested by EA / [] model value
- Lowest of o-, m- and p-xylene
- Based on comparison of inhalation exposure with inhalation TDI
- Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
- Based on a comparison of oral and dermal soil exposure with oral Index Dose only
- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	230 410	120 220	560 880
Chromium III	910	910	18,000	8,600	1,500	33,000
Chromium VI	6 <u>21</u>	6 <u>21</u>	1.8 <u>170</u>	33 <u>49</u>	7.7 <u>21</u>	220 <u>250</u>
Lead	<u>200</u>	<u>310</u>	80	<u>2,300</u>	630	<u>1,300</u>
Mercury (<i>elemental</i>)	1	1	26	26	16	26⁽⁸⁾ [30]
Mercury (<i>inorganic</i>)	170	240	80	3600	120	240
Nickel	130 ⁽¹⁰⁾	180 ⁽¹⁰⁾	53 ⁽¹¹⁾	980 ⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	640⁽¹²⁾ 640	79 <u>79</u>	170 <u>170</u>
Antimony		550		7500	1500	3300
Selenium	350	600	120	13000	1100	1800
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
<i>Aliphatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₆	42	42	730	3200	570000	95000
EC ₆₋₆ - EC ₈	100	100	2300	7800	600000	150000
EC ₈₋₈ - EC ₁₀	27	27	320	2000	13000	14000
EC ₁₀₋₁₀ - EC ₁₂	130	130	2200	9700	13000	21000
EC ₁₂₋₁₂ - EC ₁₆	1100	1100	11000	59000	13000	25000
EC ₁₆₋₁₆ - EC ₃₅	65000	65000	260000	1600000	250000	450000
EC ₃₅₋₃₅ - EC ₄₄	65000	65000	260000	1600000	250000	450000
<i>Aromatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₇	70	370	13	26000	56000	76000
EC ₇₋₇ - EC ₈	130	860	22	56000	56000	87000
EC ₈₋₈ - EC ₁₀	34	47	8.6	3500	5000	7200
EC ₁₀₋₁₀ - EC ₁₂	74	250	13	16000	5000	9200
EC ₁₂₋₁₂ - EC ₁₆	140	1800	23	36000	5100	10000
EC ₁₆₋₁₆ - EC ₂₁	260	1900	46	28000	3800	7600
EC ₂₁₋₂₁ - EC ₃₅	1100	1900	370	28000	3800	7800
EC ₃₅₋₃₅ - EC ₄₄	1100	1900	370	28000	3800	7800
Aliph + Arom EC >44-70	1600	1900	1200	28000	3800	7800
Aromatic						
Benzene	0.08	0.3	0.017	28	72	90
Ethyl benzene	65	170	16	520⁽⁸⁾ [17000]	520⁽⁸⁾ [24000]	520⁽⁸⁾ [17000]
Toluene	120	610	22	860⁽⁸⁾ [59000]	860⁽⁸⁾ [56000]	860⁽⁸⁾ [87000]
Xylene ⁽⁹⁾	41	53	28	480⁽⁸⁾ [69000]	480⁽⁸⁾ [41000]	480⁽⁸⁾ [17000]
Phenol	180	310	66	760⁽¹⁴⁾ (31000)	760⁽¹⁴⁾ (10000)	760⁽¹⁴⁾ (7600)
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	2.3	2.3	4.1	190	4900	1200
Acenaphthylene	170	2900	28	83000	15000	29000
Acenaphthene	210	3000	34	84000	15000	29000
Fluorene	170	2800	27	63000	9900	20000
Phenanthrene	95	1300	15	22000	3100	6200
Anthracene	2400	31000	380	520000	74000	150000
Fluoranthene	280	1500	52	23000	3100	6300
Pyrene	620	3700	110	54000	7400	15000
Benz(a)anthracene	7.2	11	2.9	170	29	49
Chrysene	15	30	4.1	350	57	93
Benzo(b)fluoranthene	2.6	3.9	0.99	44	7.1	13
Benzo(k)fluoranthene	77	110	37	1200	190	370
Benzo(a)pyrene	2.2	3.2	0.97	35	5.7	11
Indeno(123cd)pyrene	27	45	9.5	500	82	150
Dibenzo(ah)anthracene	0.24	0.31	0.14	3.5	0.57	1.1
Benzo(ghi)perylene	320	360	290	3900	640	1400
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.00064	0.00077	0.00055	0.059	3.5	4.8
Trichloroethene (TCE)	0.016	0.017	0.041	1.2	120	70
1,1,1,2 Tetrachlorethane	1.2	1.5	0.79	110	1400	1500
Tetrachlorethane (PCE)	0.18	0.18	0.65	19	1400	810
1,1,1 Trichlorethane	8.8	9	48	660	140000	57000

Notes

- All values above are in mg/kg
- Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters, numbers in italics are S4ULs, numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters and underlined numbers are C4SLs**
- Soil organic matter (SOM) is assumed to be 1% - DEFAULT VALUE
- Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
- For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
- For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
- Based on vapour saturation limit as suggested by EA / [] model value
- Lowest of o-, m- and p-xylene
- Based on comparison of inhalation exposure with inhalation TDI
- Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
- Based on a comparison of oral and dermal soil exposure with oral Index Dose only
- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

Appendix G – Risk Assessment Methodology

The site-specific risk assessment, presented in this report, follows the principle of establishing whether there is a viable linkage between a contaminant source to a potential receptor, via an exposure pathway.

The risk assessment corresponds with the total site area and incorporates both descriptive (qualitative) and, where available, numerical (quantitative) lines of evidence.

Risk assessment is the process of collating known information on a hazard or set of hazards to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem or future construction materials. Receptors can be connected to the source by one or several exposure pathways such as direct contact for example. Risks are generally managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway and receptor there can be no risk. Therefore, the presence of contaminant source on a site does not necessarily mean there is a risk.

The risk assessment considers the likelihood of an event taking place (accounting for the presence of the source and receptor and the viability of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment, the consequence of the hazard has been classified as severe or medium or mild or minor and the probability (likelihood) of the circumstances occurring classified as high likelihood or likely or low likelihood or unlikely.

The consequences and probabilities are subsequently cross-correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

		Consequence			
		Severe	Medium	Mild	Minor
Probability (Likelihood)	High Likelihood	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

Phase 2 Ground Investigation

In accordance with DoE guidance, the following categorisation of **consequence** has been developed.

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to an ecosystem or organisation forming part of such ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in an ecosystem or organism forming part of such ecosystem.	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a Principal or Secondary A aquifer. Death of a species within a designated nature reserve. Lesser toxic and asphyxiate effects
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures and services. Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater (inc. Secondary B aquifers). Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

Phase 2 Ground Investigation

In accordance with DoE guidance, the following categorisation of **probability** has been developed.

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution linkage and all the elements are present and in the right place, which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short term and likely over the long term.
Low Likelihood	There is a pollution linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place, and is less likely in the shorter term.
Unlikely	There is a pollution linkage but circumstances are such that it is improbable that an event would occur even in the very long term.

In accordance with DoE guidance, the following categorisation of **risk** has been developed.

Classification	Definition
Very High Risk	There is a <i>high probability</i> that <i>severe harm</i> could arise to a designated receptor from an identified hazard at the site without appropriate further action.
High Risk	<i>Harm is likely to arise</i> to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	<i>It is possible</i> that without appropriate further action <i>harm could arise</i> to a designated receptor. It is relatively <i>unlikely</i> that any such harm would be <i>severe</i> , and if any harm were to occur it is <i>more likely</i> that such harm would be <i>relatively mild</i> .
Low Risk	<i>It is possible</i> that <i>harm could arise</i> to a designated receptor from an identified hazard. It is <i>likely</i> that, at worst, if any harm was realised any effects would be <i>mild</i> .
Very Low Risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

The term 'risk' in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation.

Our Locations

Birmingham

2 The Wharf
Bridge Street
Birmingham
B1 2JS
T. 0121 643 4694
birmingham@curtins.com

Bristol

Quayside
40-58 Hotwell Road
Bristol
BS8 4UQ
T. 0117 302 7560
bristol@curtins.com

Cambridge

50 Cambridge Place
Cambridge
CB2 1NS
T. 01223 631 799
cambridge@curtins.com

Cardiff

3 Cwrt-y-Parc
Earlswood Road
Cardiff
CF14 5GH
T. 029 2068 0900
cardiff@curtins.com

Douglas

Varley House
29-31 Duke Street
Douglas
Isle of Man
IM1 2AZ
T. 01624 624 585
douglas@curtins.com

Dublin

11 Pembroke Lane
Dublin 2
D02 CX82
Ireland
T. +353 1 507 9447
dublin@curtins.com

Edinburgh

1a Belford Road
Edinburgh
EH4 3BL
T. 0131 225 2175
edinburgh@curtins.com

Glasgow

Queens House
29 St Vincent Place
Glasgow
G1 2DT
T. 0141 319 8777
glasgow@curtins.com

Kendal

Units 24 & 25 Riverside Place
K Village
Lound Road
Kendal
LA9 7FH
T. 01539 724 823
kendal@curtins.com

Leeds

Ground Floor
Rose Wharf
78-80 East Street
Leeds
LS9 8EE
T. 0113 274 8509
leeds@curtins.com

Liverpool

51-55 Tithebarn Street
Liverpool
L2 2SB
T. 0151 726 2000
liverpool@curtins.com

London

40 Compton Street
London
EC1V 0BD
T. 020 7324 2240
london@curtins.com

Manchester

Merchant Exchange
17-19 Whitworth Street West
Manchester
M1 5WG
T. 0161 236 2394
manchester@curtins.com

Nottingham

56 The Ropewalk
Nottingham
NG1 5DW
T. 0115 941 5551
nottingham@curtins.com