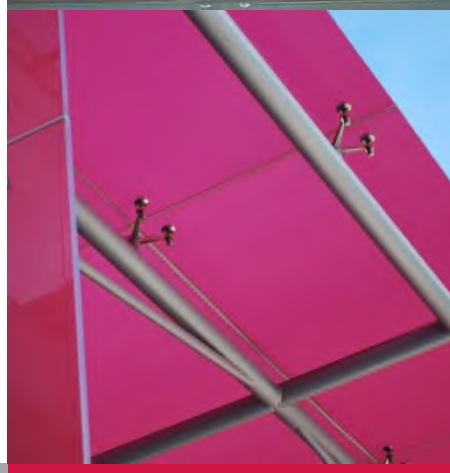








St. John’s, Manchester

Phase 2 Site Investigation

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Client Name: Manchester Quays Limited

Client Address: 2nd Floor, 2 Atherton Street, Manchester, M3 3GS

Site Address: Quay Street, Manchester, M3 4PR

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

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V02	*Groundwater assessment*	MH	JJ	20 September 2018
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Author	Signature	Date
M Holroyd BSc (Hons) MSc Geo-Environmental Engineer		20 September 2018
J Bailey BSc (Hons) MSc Geo-Environmental Engineer		05 March 2019

Reviewed	Signature	Date
S Nevitt BSc (Hons) MSc DIC CGeol FGS Principal Geotechnical Engineer		05 March 2019
J James BSc GC EnvMgt Principal Engineer		05 March 2019

Authorised	Signature	Date
J James BSc GC EnvMgt Principal Engineer		05 March 2019

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Executive Summary

Appointment	In February 2018, Curtins were instructed by Manchester Quays Ltd to undertake a Phase 2 Intrusive Investigation at the St. John's development site in Manchester city centre. The site is approximately centred on NGR 383110, 398029, and covers an area of approximately 5.4ha. This investigation addresses recommendations as presented in previous Phase 1 reports, with the aim of the Phase 2 works to characterise geo-environmental conditions prior to redevelopment as generally high rise (up to 35-storeys) buildings comprising residential apartments on upper floors with retail, leisure and commercial spaces with a dual storey basement.
Current Site Status	The development site is in Manchester City Centre, in the Spinningfields area of the city. The site is currently occupied by the Old Granada Studios (central) with hardstanding external surfaces currently used for car parking. Beyond Quay Street at the north of the site, a small disused warehouse and hardstanding surfacing, is boarded by fencing, beyond which is a small area of soft landscaping directly south of New Quay Street. The site is currently undergoing demolition.
Summary of Phase 1	The relatively flat and level site is currently occupied by the Old Granada Studios (Central) a disused warehouse (north) and recently demolished buildings (south) with hardstanding surfaces. The site was historically used for a range of commercial and industrial buildings and warehouses, with a former railway line in the south of the site. The site is underlain by Alluvium (west) and the Chester Pebble Beds Formation, with associated Secondary A and Principal Aquifer designations respectively. Two groundwater abstractions are located within 250m of the site, to the northeast, though neither are used for potable water supplies. The River Irwell is located approximately 60m west of the site, flowing from northeast to southwest. Seven discharge consents are located between the site and the River Irwell, all relating to storm water/storm sewage overflows. UXO Mitigation measures are required for all intrusive investigation works. Primary potential risks to be investigated during the Phase 2, as well as establishing ground conditions for geotechnical design, included; risks to human health and controlled waters, and potential for ground gas.
Fieldworks Undertaken	Fieldworks were undertaken in multiple stages; Stage Ia between the 3rd April and 6th April, Stage Ib between 23rd June and 13th July, and Stage II between 10th October and 21st November 2018. It comprised eight windowless sample boreholes to maximum depth of 4.31m bgl, ten machine excavated trial pits to a maximum depth of 4.00m bgl, and four cable percussive boreholes and twenty-two rotary open hole boreholes each with rotary cored follow-on to maximum depth of 55.00m bgl. Ground gas and groundwater monitoring standpipes or piezometers were installed in selected boreholes. Selected soil and rock samples were scheduled for chemical and geotechnical analysis. Eight return ground gas monitoring visits have been undertaken. Groundwater samples have been scheduled to be obtained to allow for chemical assessment.
Encountered Ground Conditions	Made Ground deposits were encountered in all exploratory holes across the site, from ground level to depths of 0.60m to 6.25m bgl, though typically reached a maximum thickness of 3.40m. Deposits comprise a thin layer of Asphalt or Concrete, underlain by black, brown, red and grey, clayey, gravelly, fine to coarse Sand with occasional cobbles and boulders and soft to firm brown, grey or black sandy slightly gravelly Clay. Anthropogenic fragments included concrete, plastic, brick, metal, glass, coal, clinker, ash, slag and bitumen. A strong diesel odour was noted within WS03 (0.10-0.20m bgl) and a strong odour was noted within RBH12A (0.30-0.45m bgl). The Made Ground is underlain by up to 5.70m thick superficial soils comprising firm, brown, sandy, gravelly Clay, stiff, light brown, clayey Silt, and loose to dense, brown, gravelly, fine to coarse Sand and subangular to subrounded, fine to coarse Gravel. Within RBH03 at 2.00m bgl black spongey Peat (0.20m thick) was identified. Bedrock (Chester Pebble Beds Formation) was encountered at depths between 3.05m to 7.70m bgl and comprised extremely weak to very strong, reddish-brown with yellow banding, fine and medium grained Sandstone. Top of strata weathered, recovered as sandy coarse gravel. Rare interbedded mudstone and siltstone. Groundwater strikes were not recorded in shallow window sample or cable percussive boreholes. Due to the use of water flush in rotary cored boreholes, groundwater strikes were unable to be recorded in deep cored boreholes. During monitoring, groundwater was encountered (within granular superficial deposits) in WS10 only. Groundwater levels within the bedrock deposits typically rose above the monitoring installation response zone, to depths of between 1.97m – 4.44m bgl.
Environmental Laboratory Testing and Ground Gas Monitoring Results	Several exceedances were identified with respect to Lead, PAHs, TPHs and SVOCs against adopted *Commercial* GACs. Chrysotile fibres (<0.001%) within TT1 at 3.00m and 5.00m bgl and asbestos boarding was identified in archaeological trenches undertaken simultaneously with this investigation. Groundwater chemical analysis identified exceedances of heavy metals and PAH concentrations when compared with EU DWS and WFD WQS thresholds.

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	During ground gas monitoring, a maximum representative concentration of 4.2% v/v carbon dioxide (CO_2), and a maximum positive steady state flow rate of 1.0l/hr. Concentrations of methane (CH_4) carbon monoxide (CO) and hydrogen sulphide (H_2S) have been recorded below the instruments limit of detection. Maximum concentration of carbon monoxide (CO) recorded was 20ppm. The adopted Gas Screening Values (GSV) for the site are 0.042 l/hr for carbon dioxide.
Ground Contamination and Ground Gas Assessment	Risks to human health have been assessed as **Low** on the basis that all Made Ground soils are to be removed from site to facilitate the construction of a dual storey basement. Risks to controlled waters (groundwater and surface water) have been assessed as **Low** on the basis that all Made Ground soils are to be removed from site to facilitate the construction of a dual storey basement. Elevated concentrations identified in groundwater samples may be representative of background conditions. With reference to CIRIA C665 and BS8485:2015, the maximum carbon dioxide concentrations and respective gas screening values indicate a Gas Characterisation Situation 1 (CS1) gas regime, requiring no gas protection measures for the proposed new development. The risk to site end users from ground gases is therefore considered to be **Low**. Due to the proposed basement features, the advice of a specialist radon assessor should be obtained.
Preliminary Material Classification and Soils Reuse	If soil arisings are required to be disposed offsite, an initial assessment of shallow soils was carried out using a proprietary waste characterisation assessment tool. Results of thirty-seven Made Ground soil samples identified that thirty-two samples indicated to be non-hazardous for offsite disposal. Five samples indicated to be hazardous owing to the concentrations of copper, zinc, benzo(a)anthracene, diesel, lead and pH. In addition, Chrysotile fibres (<0.001%) within TT1 and asbestos boarding were identified, which should be appropriately managed and disposed by an appropriately licensed contractor. The initial assessment of the seven natural soil samples tested may be considered non-hazardous waste for offsite disposal. Where natural soils are being considered for offsite disposal as inert waste, Waste Acceptance Criteria (WAC) testing should first be undertaken with confirmation of acceptability from the receiving landfill. The Contractors should satisfy themselves regarding the classification of any waste arisings. Confirmation of acceptability should be sought from the receiving landfill or treatment facility via the issue of laboratory chemical testing results.
Geotechnical Assessment	The Made Ground and the superficial deposits are not considered to be suitable founding stratums due to the likely significant loadings for a high-rise building and it is considered that a piled foundation solution is adopted designed as end bearing in the sandstone bedrock. However, pad foundations for the low-rise buildings may be suitable founding in the superficial deposits /completely weathered sandstone. Square pad foundations maybe suitable for the low-rise buildings with a presumed bearing resistance of approximately 400-600kN/m2 founding at 4.5m bgl in the weathered Sandstone increasing to approximately 600 - 1000 kN/m2 at 8.0m bgl founding in the partially weathered sandstone. For the high-rise buildings it is considered that a piled foundation be adopted to accommodate the significant loads. Initial estimates in accordance with Eurocode 7 indicate that a bored pile of 750mm diameter and 16m length would provide a total design resistance of 11,025kN for combination 1 and 6228kN for combination 2. Increasing to 14,502kN combination 1 and 8110kN combination 2 for a 900mm diameter bored pile of 16m length. Due to the likely presence of groundwater into excavations once rockhead is penetrated a contiguous pile or secant piled foundation should be considered to reduce groundwater flow into excavations to enable basements to be constructed. It is recommended that all ground slabs should be suspended to account for the high structural loads and any potential hydrostatic uplift. Basement slabs should be developed to span between foundations to resist buoyancy. The potential risk of floatation should be considered in the temporary condition during construction. Excavation through layers of Made Ground and superficial deposits should be feasible using conventional site plant. An allowance should be made for breaking out and removing any encountered concrete obstructions associated with existing foundations. Temporary earthworks support is envisaged to allow the proposed construction within the Made Ground outside the permanent basement wall, which may be in the form of sheet piled walls, subject to design by a temporary works engineer.
Recommendations	Based on the findings of the ground investigation, the following recommendations are made: 1) It is anticipated that all Made Ground soils are to be removed from site to facilitate the construction of a dual storey basement. It is considered unlikely that a remediation strategy will be required for this development; 2) Further numerical analysis be undertaken to model the pile interaction with the sandstone to obtain a greater understanding of the pile carrying capacity and settlement; and 3) Notwithstanding, appropriate PPE should be supplied to and worn by all groundwork and construction personnel during the basement excavation, and other groundwork and construction activities, with reference to the environmental testing results presented herein and within Appendix C.

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Appendix D - Geotechnical Laboratory Testing Results
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1.0 Introduction

1.1 Project Background

In February 2018 Curtins were instructed by Manchester Quays Limited to undertake a Phase 2 Intrusive Investigation at the St. John's site in Manchester city centre. The site is approximately centred on NGR 383110, 398029, and covers an area of approximately 5.4ha. A site location plan is presented as *Figure 2.1*.

1.2 Scope of Services

This investigation addresses recommendations as presented in previous Curtins Phase 1 reports (Refs. 1-4), with the aim of the Phase 2 works to characterise geo-environmental conditions prior to redevelopment as generally high rise (up to 35-storeys) buildings comprising residential apartments on upper floors with retail, leisure and commercial spaces with a dual storey basement.

Specifically, the Phase 2 report is intended to determine:

a) If there is a risk of the proposed end user being adversely impacted upon by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use;
b) If there is a risk of groundwater and/or surface water being adversely impacted upon by potential contamination that may be present on the site due to its known current, recent and historical use;
c) If there is a risk to the end user from soil gases including methane, carbon dioxide, carbon monoxide and hydrogen sulphide;
d) Preliminary recommendations for the design of basement walls and foundation design; and
e) Recommendations for the specification of sub-structure concrete and water supply pipes.

Consideration of detailed flood risk, ecology and archaeological issues are outside of the scope of this report.

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2.0 Phase 1 Preliminary Site Assessment Summary

This section presents a summary of the current site setting, history, geology and hydrogeology/hydrology, as presented in the following Phase 1 Reports:

- Curtins Phase 1 Preliminary Site Assessment for Bonded Warehouse and Energy Centre (Report ref. B049241/JJ/6744) dated 24th May 2018 (Ref.1);
- Curtins Phase 1 Preliminary Site Assessment for St. John's Place, Manchester (Report ref. B049228/JJ/6743) dated 24th May 2018 (Ref.2);
- Curtins Phase 1 Preliminary Site Assessment for Central Village, Manchester (Report ref. B061604.010)/JJ/6923) dated 12th July 2016 (Ref.3); and
- Curtins Phase 1 Preliminary Site Assessment for Old Granada Studios, Manchester (Report ref. B049242/JJ/6736 Rev. A) dated 19th June 2017 (Ref.4).

It is not the intention of this report to duplicate the information within the above documentation, rather the information below providing the background information to support the revised post Phase 2 siteworks Conceptual Site Model (CSM), as presented in *Section 8.0*.

2.1 Current Setting

The development site is in Manchester City Centre, located off Quay Street in the Spinningfields area of the city. *Figure 2.1*, overleaf, outlines the location of the proposed development.

Surface cover across the site is predominantly tarmac roads and hardstanding surfaces, with concrete surfaces within existing buildings. The site is currently occupied by the following:

Table 2.1 – *Summary of the Existing Land Use Onsite*

Location	Description
North (New Quay Street to Quay Street)	Disused warehouse and low-rise office building Small area of soft landscaping directly south of New Quay Street.
Central Portion (south of Quay Street, east of Water Street)	Old Granada TV Film Studios and hardstanding surfaces for car parking. Studios comprise warehouses and office facilities
South (Grape Street)	Two existing buildings with hardstanding external surfaces. Demolition works currently being undertaken.
West (west of Water Street)	Vacant Land

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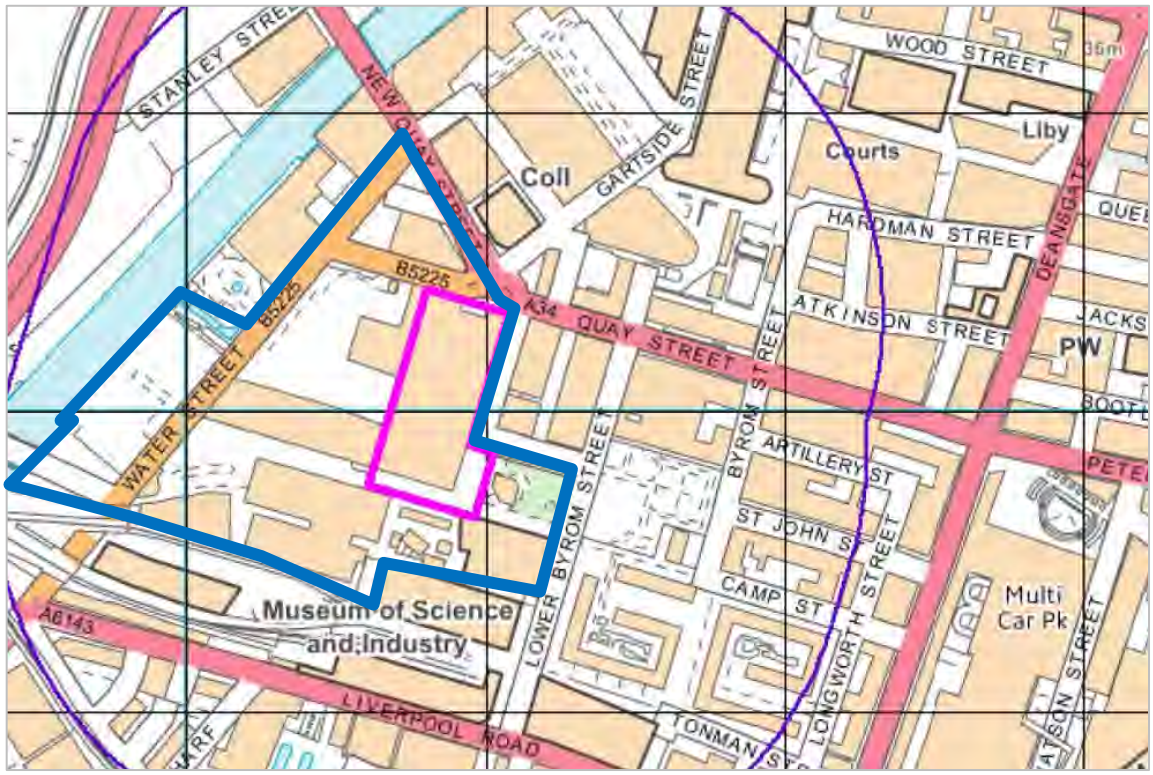


Figure 2.1 – *Site Location Plan, approximate site boundary shown in blue. Crown Copyright. License Number 100020245*

2.2 Previous Site Use

A review of the available historical mapping information for the site as presented within the previous Curtins Phase 1 reports (Refs.1-4) has been undertaken with specific reference to potential sources of contamination. *Table 2.2* summarises the findings.

Table 2.2 – *Summary of onsite historical land use.*

Date	Description
1848	**North:** The site was occupied by commercial/industrial land comprising multiple warehouses including dye house, cotton and wool mills and timber yards. **Central:** Mixed use residential and commercial including timber yard and gasometer. Site intersected by canal associated with dry dock. **South:** Commercial/industrial land use including timber yard, crane, cotton storage and railway sidings. Railway to the south of the site.
1891-1908	**North/Central:** Demolition of previous structures and construction of newer commercial/industrial **South:** Numerous railway lines build onsite as part of the Liverpool Road & Salford Goods Station
1940s	Major construction across northern and central areas of the site following WWII. Potential for UXO from Luftwaffe bombing. **North:** Construction of an automobile and electrical engineering workshop. **Central:** Construction of an engineering works in the west and eastern boundary of the site. Warehouses and compound works also identified.

Date	Description
1950s	**Central:** Additional construction at west and central portion. Tank noted at the western boundary associated with engineering works.
1960 – 70s	**Central:** Construction of the Granada Television Centre with associated car parking centrally within the site. **South:** Liverpool Road goods Depot railway line noted as being disused. Railway lines no longer shown onsite by 1990.
1992	**North:** Demolition of Albert Shed Warehouse and subsequent conversion to a car park (now disused)
1999	**South:** New structure build at the south of the site in area previously occupied by railway lines.

2.3 Published Geology

A study of the Envirocheck, BGS borehole records and BGS 1:50,000 mapping (Solid and Superficial Editions) for Manchester (Sheet 085) indicates the following geological succession underlying the site:

- Alluvium of *Flandrian Age*; and
- Chester Pebble Beds Formation of *Early Triassic Age*.

2.3.1 Made Ground Deposits

Made Ground deposits are not indicated to be present on the site. However, given the substantial historical development that has occurred on the site, and suspected infilled canal in the west of the site, it is anticipated that Made Ground deposits, of unknown composition, may be encountered during the investigation.

2.3.2 Superficial Deposits

Alluvium deposits comprising clay, silt, sand and gravel are identified at the west of the site. Elsewhere onsite, superficial deposits are not recorded to be present.

2.3.3 Bedrock Deposits

Bedrock deposits are present as Chester Pebble Beds Formation of *Early Triassic Age,* comprising sandstone.

There are three BGS fault lines located within 1 kilometre (km) of the site, with the closest being approximately 100m to the northwest, orientated northwest to southeast.

2.3.4 Mining and Quarrying

The previous reports did not identify evidence of historic mining activities in historic mapping within or in the area immediately adjacent to the site. The Coal Authority's online interactive mapping confirms that the site is located within a coal mining referral area.

It is considered unlikely that relic mining features are present onsite and as such, have not been considered any further.

2.3.5 Other Pertinent Geological Existing Geological Records

The previous reports identified a low risk to no hazard from the following ground stability hazards on and around the site; running sands, collapsible ground, landslides, shrinking or swelling cl\ay, compressible ground and ground dissolution.

UK Radon Mapping confirms the site is situated in an area where less than 1% of homes are above the radon action level. The new development incorporates a basement and so the advice of a specialist Radon assessor must be obtained.

2.4 Hydrogeology and Hydrology

Environment Agency data indicates that the site, corresponding with the underlying bedrock geology, overlies a Principal Aquifer. These are;

> *Layers of rock or drift deposits that have high intergranular and/or fracture permeability meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, Principal Aquifers are aquifers previously designated as Major Aquifers.*

Where Alluvium superficial soils are recorded, it is identified as a Secondary A Aquifer. These are;

> *Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers.*

The site is not situated within a designated Source Protection Zone (SPZ). The Groundwater Vulnerability Map presented in the Envirocheck Report indicates a highly permeable principal aquifer underlies the site, with high vulnerability.

There are two groundwater abstractions within 250m of the site, both at Gartside Street, Manchester, and are operated by Bovis Lend Lease Ltd. The Envirocheck Report identifies the groundwater abstraction for non-evaporative cooling purposes.

The nearest surface water feature is the River Irwell directly west of site, which flows from N to S. No water quality data is available for this feature. There are no surface water abstractions within 1000 m of the site.

There are seven discharge consents directly west of the site into the River Irwell, all relating to storm water/storm sewage overflows.

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2.5 Landfill

There are no licensed landfills located within 250 m of the site.

The nearest identified historical landfill (Wilburn Street) is located approximately 200m west of the site.

2.6 Unexploded Ordnance (UXO) Risk Assessment

The site of interest is in Manchester City Centre. Risk mapping for UXOs has placed the site within a High-risk area. High-risk regions are those that show a bomb density of >50 bombs per 1000 acres and abundant potential WWII targets.

A review of historical maps (Ref.5) indicate bomb ruins within the south-eastern corner of the site, with damaged and demolished buildings in the vicinity to the east, north and south. Several fire bombs and high explosives were dropped near the site. *Figure 2.6* shows the impacted land during WWII.



Figure 2.6 – *Historic Records showing bombing incidents during WWII. Site boundary marked in* ***blue****.* ***Red*** *circles indicate fire bombs,* ***blue*** *circles indicate high explosives, pink shading indicates damaged buildings,* ***red*** *shading indicates demolished buildings.*

An Explosive Ordnance Threat Assessment (Ref.6) was undertaken by Planit in March 2016 (for the larger overall St. John's development area) and concluded the threat level with portions of the Site are

at Medium threat levels and therefore a UXO Threat Mitigation Strategy is required prior to intrusive engineering works. Details of the mitigation strategy can be found within the assessment.

2.7 Summary of Phase 1 PCSM

A summary of potential pollutant linkages at the development site identified in the previous Phase 1 reports referenced in *Section 2.0* is presented in *Table 2.7*, were identified as requiring further investigation to enable the safe redevelopment of the site.

Table 2.7 – *Preliminary Conceptual Site Model*

Source	Pathway	Receptor	Risk
Made Ground of unknown composition from: • Historic development on, and near the site; • Leaks and spills of petrol and diesel from plant/engineering activities, car parking and depot vehicles, and warehouse/factory processes; • Potential use of asbestos containing materials in historic buildings; • Adjacent railway tracks and stations near historic engineering works; • Manufacturing/Treatment processes associated with historic timber yard; • Dock and motor repair works and electrical substation adjacent to the site;	Direct contact/ ingestion and inhalation	**Future site-users** (Commercial Development)	**Moderate**
	Horizontal and vertical migration of contaminants through superficial soils	**Groundwater** (Principal Aquifer)	**Low**
		Groundwater (Secondary A Aquifer)	**Low**
		Surface Water (River Irwell)	**Low**
Production of ground generating gases from: • Made Ground deposits containing organic/ putrescible content; • Infilling of canal basin directly beneath the site; • Historic St. Johns Church Graveyard.	Vertical and horizontal migration through existing service corridors and the underlying superficial deposits	**Future site-users**	**High**

Potential contaminants of concern associated with any Made Ground present include, amongst others; broad range aliphatic and aromatic hydrocarbons present within any fuel oils; semi-volatile and volatile organic contamination; polycyclic aromatic hydrocarbons (PAHs); inorganic compounds including heavy metals; and asbestos present in discarded building materials.

The qualitative risk assessment determined the above risks associated with the proposed development of the site warrant further investigation.

It was recommended that a ground investigation is conducted to both confirm this assessment and provide data in support of the structural and civil engineering design. The scope of the investigation undertaken in detailed in *Section 3.0*.

3.0 Phase 2 Investigation Scope of Works

Site investigation works were undertaken in multiple stages; Stage Ia between the 3rd April and 6th April, Stage Ib between 23rd June and 13th July, and Stage II between 10th October and 21st November 2018.

The scope of the ground investigation was designed in general accordance with current UK guidance including CLR11 (Ref.7), British Standard (BS) 10175 (Ref.8), BS5930:2015 (Ref.9), and BSEN1997: Part 2:2007 Eurocode 7 (Ref.10). A summary of the scope and rationale are summarised in *Table 3.0* below.

Table 3.0 – *Scope and Rationale of Fieldwork Undertaken*

Stage	Exploratory Hole Type	Exploratory Hole Ref.	Exploratory Hole Depth (m bgl)	Rationale
Stage I	**Windowless Sample Boreholes**	**WS02 WS03 WS04 – WS06 WS08 WS10 – WS11**	**0.80 1.20 3.30 – 3.41 3.38 4.30 – 4.31**	Confirm ground conditions. Collect soil and water samples for chemical and geotechnical analysis. Undertake in-situ testing. Gas and groundwater monitoring. Determine geotechnical parameters.
	Cable Percussive with Rotary Core (follow-on) Boreholes	**BH02 – BH04B**	**25.10 – 25.20**	Confirm shallow and deep ground conditions. Collect soil, rock and water samples for chemical and geotechnical analysis. Undertake in-situ testing. Gas and groundwater monitoring. Determine geotechnical parameters.
	Dynamic Sampler with Rotary Core (follow-on) Boreholes	**RBH02 – RBH06**	**40.00 – 55.00**	
Stage II	**Cable Percussive with Rotary Core (follow-on) Boreholes**	**BH06**	**25.00**	
	Rotary Open Hole with Core (follow-on) Boreholes	**RBH07 – RBH22 RBH23**	**36.00 – 41.00 8.50**	
	Machine Excavated Trial Trenches	**TT1 – TT6 & TT02A**	**3.30 – 4.00**	Confirm shallow ground conditions. Expose and confirm existing foundations and subsurface features.

Exploratory hole locations were surveyed on completion. Curtins drawing ref. SJQ-099-CUR-XX-XX-DR-S-20071 records the locations of the exploratory holes undertaken (a copy of which is contained within *Appendix A*).

3.1 Soil Logging and Sampling

Exploratory holes were logged onsite by a qualified Engineer. All exploratory holes were logged in accordance with the requirements of BS5930 (Ref.9), including recording observed visual and olfactory indications of contamination. Exploratory hole logs are provided in *Appendix B*.

3.2 Monitoring Well Installations

Stage I

Ground gas and groundwater monitoring installations (50mm diameter) were installed within six window sample borehole locations and four rotary cored borehole locations. A bentonite seal was placed above and below the screened section of the borehole to minimise the potential for downward migration of contaminants, and the creation of a preferential migratory pathway. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of pipe.

The 50 mm diameter monitoring wells were primarily designed to assess the potential for ground gas and strata likely to have the highest permeability and as such the screened section focussed on granular superficial strata, or the underlying bedrock.

Piezometers (19mm) were installed within four rotary cored borehole locations. A gravel and sand surround were installed in the annulus between the sides of the borehole, and approximately +/- 1m above and below the resting point of the piezometer.

These were installed at 2.00m below the vertical extent of the proposed basement floor to assess the potential ingress of water from fractures below the basement.

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

Table 3.2a – *Monitoring Well Response Zones – Stage I*

Borehole Ref.	Response Zone(s) (m bgl)	Standpipe/ Piezometer	Strata Description(s)
WS04	2.00 – 3.00	Standpipe (50mm)	CLAY and SAND
WS05	2.00 – 3.00	Standpipe (50mm)	SAND
WS06	2.00 – 3.00	Standpipe (50mm)	SAND
WS08	2.00 – 3.00	Standpipe (50mm)	SAND
WS10	2.00 – 4.00	Standpipe (50mm)	SAND
WS11	1.50 – 3.50	Standpipe (50mm)	SAND
BH02	5.00 – 20.00	Standpipe (50mm)	SANDSTONE, Mudstone and Siltstone
BH03	8.80 – 10.00	Piezometer (19mm)	SANDSTONE
BH04B	5.00 – 20.00	Standpipe (50mm)	SANDSTONE
RBH02	6.30 – 20.00	Standpipe (50mm)	SANDSTONE and Mudstone
RBH03	14.50 – 16.50	Piezometer (19mm)	SANDSTONE

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Borehole Ref.	Response Zone(s) (m bgl)	Standpipe/ Piezometer	Strata Description(s)
RBH04	9.20 – 10.20	Piezometer (19mm)	SANDSTONE
RBH05	5.00 – 20.00	Standpipe (50mm)	SANDSTONE
RBH06	10.20 – 10.50	Piezometer (19mm)	SANDSTONE

Copies of borehole logs can be referred to in *Appendix B* of this report.

Stage II

Ground gas and groundwater monitoring installations (50mm diameter) were installed within five borehole locations. A bentonite seal was placed above and below the screened section of the borehole to minimise the potential for downward migration of contaminants, and the creation of a preferential migratory pathway. A gravel surround was installed in the annulus between the sides of the borehole and the slotted sections of pipe.

The 50mm diameter monitoring wells were primarily designed to assess the potential for ground gas and strata likely to have the highest permeability and as such the screened section focussed on Made Ground, granular superficial strata or the underlying bedrock.

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

Table 3.2b – *Monitoring Well Response Zones – Stage II*

Borehole Ref.	Response Zone(s) (m bgl)	Strata Description(s)
BH06	2.50 – 7.50	SANDSTONE, Sand & Gravel, and Made Ground
RBH09	2.50 – 7.50	SAND & GRAVEL, Sandstone and Made Ground
RBH14	9.00 – 15.00	SANDSTONE
RBH18A	8.50 – 14.50	SANDSTONE
RBH22	2.50 – 7.20	SANDSTONE and Sand

Copies of borehole logs can be referred to in *Appendix B* of this report.

3.3 Post-Investigation Monitoring

3.3.1 Ground Gas Monitoring

Stage I

An initial programme of six gas monitoring visits over three months was proposed to assess ground gas conditions as identified in the Preliminary Conceptual Site Model.

Stage II

An initial programme of six gas monitoring visits over three months was proposed to assess ground gas conditions as identified in the Preliminary Conceptual Site Model. Only two visits were able to be undertaken due to restricted access to the boreholes.

3.3.2 Groundwater Sampling

Groundwater samples from rotary boreholes RBH02, BH02 and BH04B, and window sample borehole WS10 during Stage I. No groundwater sampling was undertaken during Stage II.

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4.0 Laboratory Analysis

Representative soil samples were selected for laboratory chemical analysis, based on field observations and to provide a characterisation of the Made Ground and natural strata encountered. Selected 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 analysis of soil and groundwater samples was Envirolab, a UKAS and MCERTS accredited laboratory.

Given the potential site wide source of contamination (Made Ground) the sampling positions (boreholes) were generally located in a non-targeted, systematic array to give adequate and representative coverage of the site accounting for the historical site use, proposed end use and the immediate environmental setting.

4.1 Soil Analysis

The contaminants of concern potentially present on the site was considered to include, amongst others; organic matter, ash and fill, hydrocarbons (e.g. fuel/oils), heavy metals, volatile and semi-volatile organic compounds and asbestos, the extent of which is captured by the broad environmental testing suite listed in *Table 4.1* below.

Table 4.1 *– Environmental Chemistry Analysis Suite: Soils*

Suite Ref.	Analyte	LOD
Soils Suite A	Asbestos Screen, pH and Soil Organic Matter (SOM)	-
	Arsenic, Chromium, Chromium VI, Copper, Lead, Selenium, Zinc, Nickel	1 - 5 mg/kg
	Boron (water soluble)	1 mg/kg
	Cadmium	0.5 mg/kg
	Mercury	0.17 mg/kg
	Cyanide (total)	1 mg/kg
	Phenols (screen)	0.2 mg/kg
	PAHs (USEPA 16)	0.1 mg/kg
	TPH (Aro/Ali Split)	0.01 to 0.1 mg/kg
SVOCs	SVOC Suite (Excluding PAH-16)	100 – 500 µg/kg
VOCs	VOC Suite	1 – 10 µg/kg

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

Stage I

Nineteen soil samples were taken from Made Ground soils across the site and tested for Soils Suite A. Additionally, seven soil samples were taken from within natural soils and tested for Soils Suite A.

Nine Made Ground soil samples and a single natural soil sample were tested for SVOCs, and one Made Ground soil sample was tested for VOCs.

Stage II

Eighteen soil samples were taken from Made Ground soils across the site and tested for Soils Suite A.

4.2 Groundwater Analysis

The contaminants of concern potentially present on the site was considered to include, amongst others; organic matter, ash and fill, hydrocarbons (e.g. fuel/oils), volatile organic compounds, and heavy metals the extent of which is captured by the broad environmental testing suite listed in *Table 4.2* below.

***Table 4.2** – Environmental Chemistry Analysis Suite: Waters*

Suite Ref.	Analyte	LOD
Water Suite A	pH	-
	Total Hardness	2 mg/l
	Arsenic, Lead, Nickel, Selenium, Zinc	1 µg/l
	Boron (water soluble), Chromium, Copper, Mercury, Phenols (screen)	0.01 - 10 µg/l
	Cadmium	0.2 µg/l
	Cyanide, Sulphide	0.005 – 0.1 mg/l
	Sulphate	1 mg/l
	PAHs (USEPA16)	0.01 µg/l
	TPH (Aro/Ali Split)	1 – 5 µg/l
VOCs	VOC Suite (Excluding PAH-16)	1 – 10 µg/l
SVOCs	SVOC Suite	1 – 10 µg/l

Water samples were taken from rotary boreholes RBH02, BH02 and BH04B, and window sample borehole WS10 during Stage I. No groundwater sampling was undertaken during Stage II. Copies of the environmental chemistry testing certificates are presented in *Appendix C*.

4.3 Quality Assurance and Quality Control

Soil and water chemical and geotechnical analysis were conducted by Envirolab, a MCERTS and UKAS accredited laboratory. All samples were delivered in appropriate containers for the suites tested and analysed within the recommended holding times. No deviations were recorded at the time of analysis. The Envirolab Deviating Samples Reports no. 18-05180-1, 18-05735-1, 18-08489-1, 18-09025-1 and 18-09265-1 did not record any deviations.

The following Envirolab Deviating Samples Reports reported deviations:

- No. 18-02606-1 – with respect to Sulphide for RBH03 (0.40m);
- No. 18-05337-1 – with respect to PAH-16MS for RBH02 (0.50m);
- No. 18-05734-1 – with respect to Cyanide for RBH06 (0.40m & 0.80m), WS02 (0.30m) and WS03 (0.30m & 1.00m), and with respect to VPH-CWG for WS02 (0.30m);
- No. 18-08489-1 – separate container not supplied for VPH/BTEX analysis for TT1-3.00m (1.00m); and
- No. 18-08762-1 – with respect to Cyanide for TT4 (2.00m), TT5 (3.50m) and TT6 (1.00m).

The sample results which deviated are comparable with the other results and therefore it is not considered that the samples have been compromised. All analysis reports are enclosed within *Appendix C*.

4.4 Geotechnical Analysis

Rock samples for geotechnical testing were prepared and tested in accordance with ISRM Suggested Methods (Ref.11). Copies of the geotechnical testing certificates are presented in *Appendix D*. The following tests were carried out:

- 245 No. Point Load Index Test (PLT) – Axial Plane;
- 209 No. PLT – Diametral Plane;
- 135 No. Uniaxial Compressive Strength (UCS);
- 204 No. Bulk Density;
- 70 No. Dry Density;
- 70 No. Natural Rock Water Content;
- 70 No. Rock Porosity Density;
- 14 No. Brazilian Tests;
- 16 No. Sound Velocity Tests (P and S Wave);
- 12 No. Hoek Triaxial Compression Tests; and
- 12 No. Hoek Shear Box Tests.

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5.0 Encountered Ground Conditions

5.1 General

A summary of the ground conditions encountered during the site investigation works is presented below, with detailed information presented in the exploratory hole logs included in *Appendix B* and a summary of each strata presented in subsequent sections.

Table 5.1 – *Summary of Ground Conditions Encountered*

Stratum	Depth to top of strata, m bgl (mAOD)	Thickness (m)		Description
		Min	Max	
MADE GROUND	0.00 (25.36 – 27.35)	0.60	6.25	ASPHALT, CONCRETE and sub-base *underlain by* black, brown, red and grey, clayey, gravelly, fine to coarse SAND with occasional cobbles and boulders *and* soft to firm brown, grey or black sandy slightly gravelly CLAY. Anthropogenic fragments included concrete, plastic, brick, metal, glass, coal, clinker, ash, slag and bitumen.
SUPERFICIAL DEPOSITS[1]	0.60 – 6.25 (22.47 – 26.67)	0.25*	5.70	Firm, brown, sandy, gravelly CLAY. Stiff, light brown, clayey SILT. Loose to dense, brown, gravelly, fine to coarse SAND and subangular to subrounded, fine to coarse GRAVEL. Spongey peat (RBH03 2.00–2.20m bgl).
BEDROCK (Chester Pebble Beds Formation)	3.05 – 7.70 (17.66 – 23.53)	**	**	Extremely weak to very strong, reddish-brown with yellow banding, fine and medium grained SANDSTONE. Top of strata weathered, recovered as sandy coarse gravel. Rare interbedded mudstone and siltstone.

1 BGS geological mapping does not record the presence of superficial soils beneath the site
* Where encountered
** Thickness not proved

5.2 Made Ground

Made Ground deposits were encountered in all exploratory holes, to depths of between 0.60m bgl and 6.25m bgl. The deepest Made Ground was encountered in RBH02, where deposits comprise a red brick wall, underlain by well bonded brick and concrete. It is likely that the wall is associated with a historic canal which historically underlies the site. Elsewhere, a maximum thickness of 4.00m was recorded in RBH11 and RBH18A.

Deposits typically comprise a surface cover of a limited thickness of Asphalt, often with sub-base or Concrete. BH02, RBH05 and RBH13 recorded up to 0.30m of topsoil, with frequent rootlets.

The surface cover is typically underlain by granular deposits comprising black, brown, red and grey, clayey, gravelly, fine to coarse Sand with occasional cobbles and boulders. Anthropogenic fragments within these soils included: brick, concrete, slag, slate, tile, glass, asphalt, plastic, porcelain, metal, coal, clinker, ash, bitumen and wood fragments, in addition to mixed lithologies of sandstone, mudstone and limestone. Thicknesses of the granular Made Ground strata are variable across the site, ranging between 0.17m (RBH06) – 4.00m (RBH11, RBH18A). A strong diesel odour was noted within WS03 and a strong odour was noted within RBH12A.

The granular deposits are underlain by cohesive soils in WS03 – WS06, WS08, WS10, WS11, TT02A, TT03, BH06, RBH06 and RBH19, to a maximum depth of 4.00m bgl (TT03), though typically to between 1.20m – 1.70m bgl). Deposits within WS04, WS05, WS10, WS11, TT02A, TT03, BH06 and RBH06 comprised very soft to firm, grey and brown with black mottling (WS05, WS10, TT02A and BH06), sandy, gravelly Clay. Soft, black, sandy Clay was encountered in WS06 between 0.80m – 1.30m, and WS03 recorded very soft greenish grey sandy, gravelly clay with low cobble content, where a hydrocarbon odour was noted. Anthropogenic fragments included: concrete, sandstone, brick, slag, tile, ash, coal, mudstone and limestone.

5.3 Superficial Deposits

BGS geological mapping does not record the presence of superficial soils beneath the development area. This investigation encountered superficial soils all exploratory holes, except for RBH02 which recorded extensive Made Ground soils to 6.25m bgl, and generally comprised granular soils, though limited thicknesses of cohesive soil were also encountered.

5.3.1 Granular Soils

Granular superficial soils were encountered in all exploratory holes except for RBH02, with a maximum recorded thickness of 5.32m.

Deposits typically comprised loose to very dense, yellowish, reddish or orangish brown, gravelly, fine to coarse Sand and subangular to subrounded, fine to coarse Gravel. Gravels are fine to coarse, sub-angular to rounded of mixed lithologies of sandstone, mudstone, siltstone, limestone, quartzite and rare coal. Rarely, deposits are slightly clayey, and clay bands are identified within shallow sand deposits. An organic odour was recorded in BH04B at 3.40m – 3.65m bgl, within grey sandy gravel deposits.

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A summary of the geotechnical test results levels recorded within the granular superficial deposits are presented in *Table 5.3.1*. Full details of the geotechnical results recorded are presented on the exploratory hole logs in *Appendix B* and test result certificates in *Appendix D*.

Table 5.3.1 – *Summary of geotechnical test results – granular superficial deposits*

Parameter	No. of tests	Minimum	Maximum	Average
pH	6	7.27	7.91	7.50
Water Soluble Sulphate (mg/l)	6	20	70	38
SPT 'N' Value (full penetration)	20	8	47	23
Organic Content (%)	6	0.2	1.5	0.82

Twenty SPT 'N' Values were recorded to full penetration with values ranging between 8 – 47, generally increasing with depth, illustrated in *Figure 5.3.1*; indicating loose to dense granular soils.

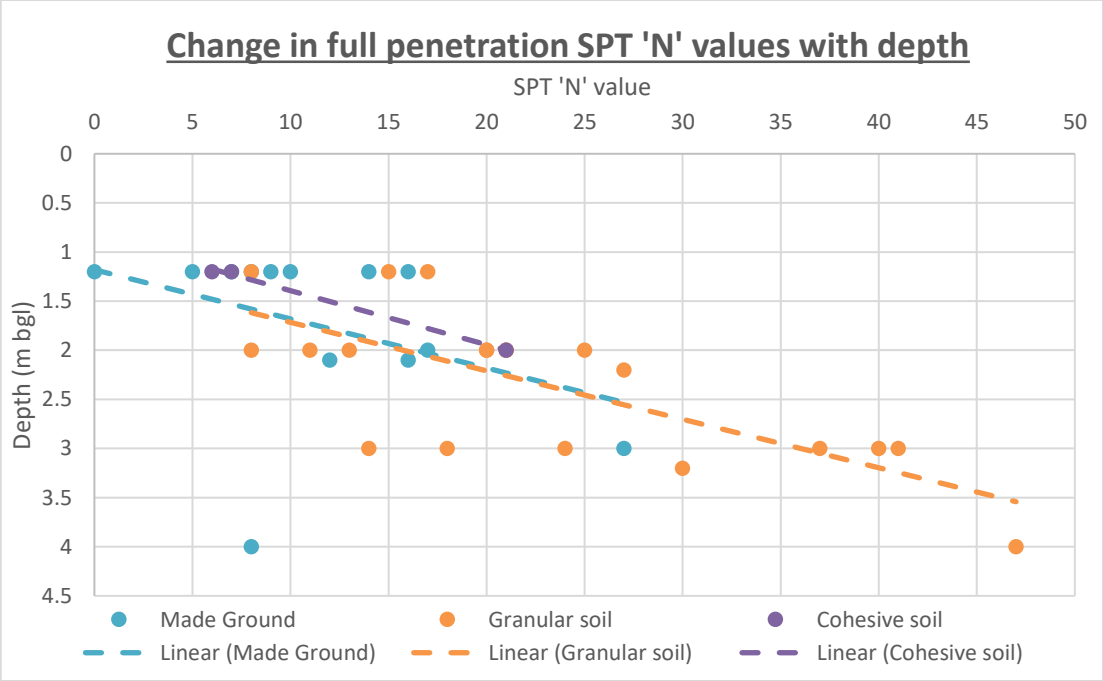


Figure 5.3.1 – Full penetration SPT 'N' Values vs Depth.

5.3.2 Cohesive Soils

Cohesive soils were encountered in twelve of the exploratory holes (WS04, WS06, WS08, TT02A, RBH04, RBH08, RBH09, RBH12A, RBH14, RBH20, RBH21 and RBH23), ranging in thicknesses between 0.10m – 4.40m.

The clay recorded in comprise soft to firm, light, dark, yellowish and greenish brown with occasional mottling, gravelly, sandy Clay with occasional sand lenses. Gravel is sub-angular to

rounded, fine to medium of sandstone and limestone. The deeper clay identified in RBH04 (5.70 – 5.80m bgl) recorded reddish-brown, slightly sandy, very gravelly Clay with gravels of sub-rounded to rounded granite and sandstone.

Stiff, light brown, clayey Silt was encountered within RBH12A at 1.04m to 1.20m bgl.

RBH03 recorded 0.20m of black, spongey peat at 2.00m bgl.

A summary of the geotechnical test results levels recorded within the cohesive superficial deposits are presented in *Table 5.3.2*. Full details of the geotechnical results recorded are presented on the exploratory hole logs in *Appendix B* and test result certificates in *Appendix D*.

Table 5.3.2 – *Summary of geotechnical test results – cohesive superficial deposits*

Parameter	No. of tests	Minimum	Maximum	Average
pH	1	4.46		
Water Soluble Sulphate (mg/l)	1	200		
SPT 'N' Value (full penetration)	3	6	21	11
Organic Content (%)	1	0.3		

Three SPT 'N' Values were recorded to full penetration with values ranging between 6 – 21, generally increasing with depth, illustrated in *Figure 5.3.1* above; indicating soft to stiff cohesive soils.

5.4 Bedrock Deposits

Bedrock was encountered in all progressed cable percussive and rotary boreholes, in addition to WS04, from depths of 3.05m bgl (WS04) to 7.70m bgl (RBH23), to a maximum recorded depth of >55.00m bgl.

Generally, deposits comprise extremely weak to very strong, thinly laminated to thickly bedded, reddish-brown with yellow banding, fine and medium grained occasionally coarse grained Sandstone, with rare interbedded mudstone and siltstone. Heavily fractured with very closely spaced, undulating and rough sand and gravel infilled fractures. The top of the strata is generally highly weathered and was recovered as sand and gravel in several locations, occasionally with clay lenses.

The base of the sandstone strata was not encountered during this investigation. The boreholes were terminated at depths of between 8.50m – 55.00m bgl.

The total core recovery (TCR) in the top 5m of rock (<10m bgl) averaged 67%; 10% lower than the average TCR between 10–15m bgl (77%). This corresponded with average Rock Quality Designations (RQD) of 21% at depths <10m bgl and 42% between 10m–15m bgl. The average TCR and RQD for rock at depths >15m were calculated to be 88% and 59%, respectively. The above indicates that the rock at depths of <10m bgl is generally very poor to poor rock mass quality, increasing to generally poor

to fair at 10–15m bgl, and at depths of >15m bgl the rock is generally fair to good rock mass quality. Generally, the TCR, SCR and RQD increase with depth, as shown in *Figure 5.4.1a* and *Figure 5.4.1b* below.

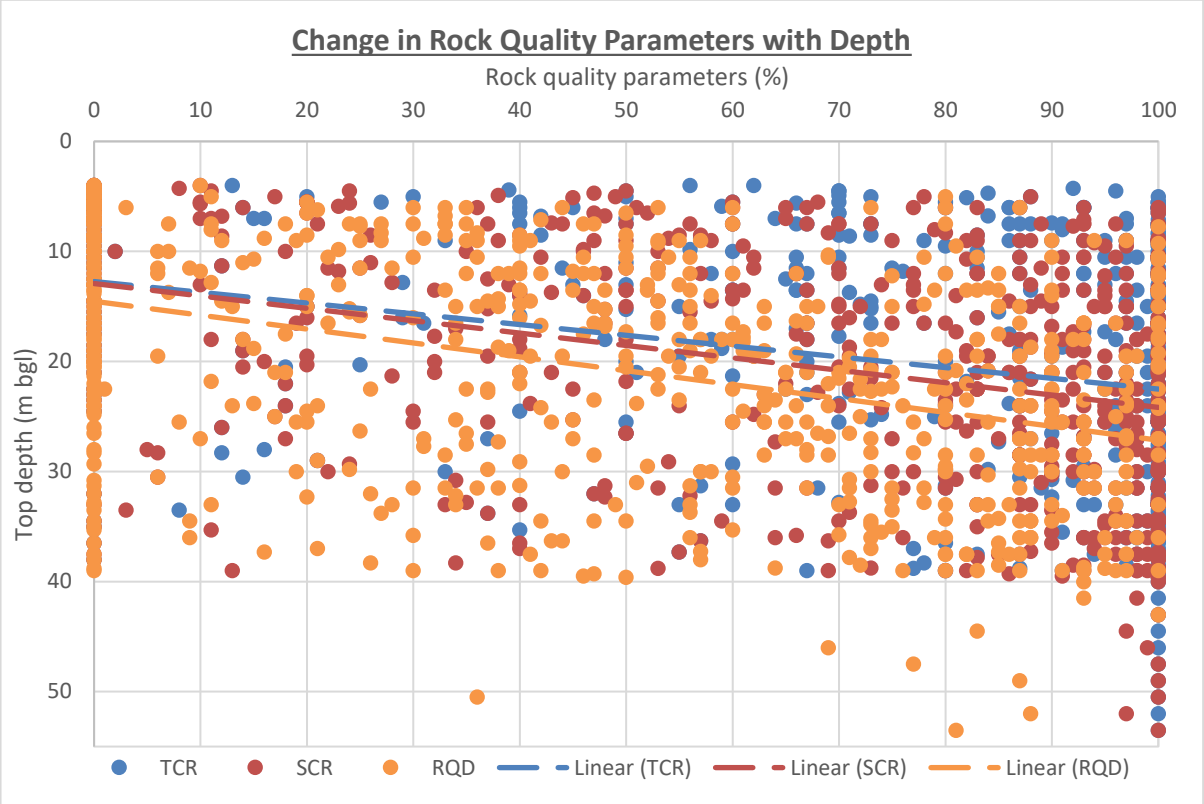


Figure 5.4.1a – Change in rock quality parameters with depth

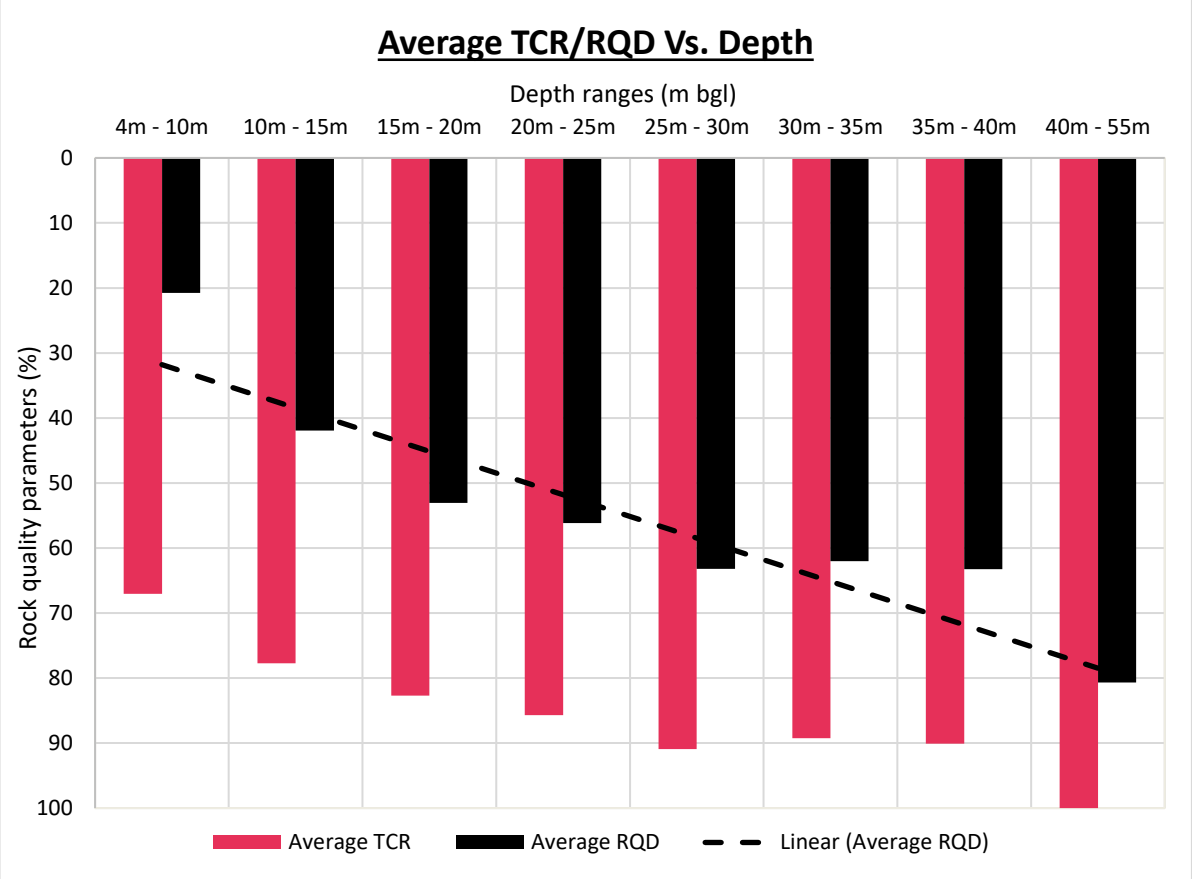


Figure 5.4.1b – Change in average TCR and RQD with depth

A summary of the geotechnical test results recorded within the bedrock is presented in *Table 5.4b*, below. Full details of the geotechnical test results recorded are presented in the exploratory borehole logs, in *Appendix B*, and test result certificates in *Appendix D*.

Table 5.4b – *Summary of Rock Testing Results*

Parameter		No. of tests	Minimum	Maximum	Average
Point Load Test (PLT) Is50 (MPa)	Axial	245	0.01	1.76	0.21
	Diametral	209	0.01	0.40	0.10
	All Tests	454	0.01	1.76	0.16
Estimated Unconfined Compressive Strength from PLT Is(50) Results (MPa)	Axial	245	0.20	35.20	4.22
	Diametral	208	0.20	8.00	1.95
	All Tests	453	0.20	35.20	3.18
Unconfined Compressive Strength (UCS) (MPa)		135	0.30	35.6	9.72
Bulk Density of Sandstone (Mg/m^3)		205	0.22	2.84	2.24

Parameter			No. of tests	Minimum	Maximum	Average
Dry Density of Sandstone (Mg/m^3)			70	1.65	2.28	2.02
Natural Water Content (%)			70	3.9	14.8	10.9
Porosity (%)			70	14.9	31.1	23.5
Tensile Strength by Brazilian Test (MPa)			14	0.23	1.10	0.54
Hoek Shear Box Test	Angle of shearing resistance φ' (°)	Peak	12	8.5	45	23.7
		Residual		4.5	40	18.1
	Apparent cohesion, c' (MPa)	Peak		16	533	213.2
		Residual		8	354	181
Hoek Triaxial Compression Test	Internal friction angle, φ (°)		12	20.5	44.0	36.2
	Apparent cohesion, c' (MPa)			1.0	7.0	4.0
Sound Velocity Test	P Wave Travel Time (µs)		16	37.5	126.5	72.7
	P Wave Compression (m/s)			1161	2151	1730
	S Wave Travel Time (µs)			69.6	219.4	130.2
	S Wave Compression (m/s)			642	1210	963.6

Overall 454 Point Load Tests (PLT) were carried out on samples of sandstone bedrock from rotary cores. PLT Is(50) values ranged between 0.01MPa to 1.76MPa. Comparison between the axial and diametral PLT tests indicates that, generally, the rock strength is greater when pressures are applied axially than diametrically, with average PLT Is(50) values of 1.76MPa and 0.40MPa recorded for axial and diametral tests respectively. The average PLT Is(50) value for axial and diametral tests identifies a similar trend, with values of 0.21MPa and 0.10MPa respectively.

An approximation of the unconfined compressive strength (UCS) of the rock may be derived from the following relationship:

PLT Is(50) x 20 = UCS.

In principle the correlation between point load test indices and UCS should be developed on a site-specific basis. Published literature indicates that a factor between 10 and 60 is possible; although a value of 20 – 25 is typical. The available dataset is not suitable to support a site-specific correlation because of the overall quantity of samples, and because of the unavoidable preferential sample selection across the available core. Consequently, a general factor of 20 has been applied (Hoek and Bray, 1981).

Using the above relationship, estimated UCS values with an overall range of between 0.20MPa to 35.2MPa may be derived, indicating the rock tested is extremely weak to medium-strong.

UCS testing was undertaken on 135 No. Rock samples, with UCS values ranging between 0.30MPa to 35.6MPa, indicating the sandstone samples are extremely weak to medium-strong.

Estimates of characteristic compressive strength from PLT Is(50) values are significantly weaker than those recorded by direct UCS testing. This is likely to be due to the preferential selection of samples for the UCS testing, which given their more intact nature, are inherently stronger than those selected for point load tests. The combined dataset should provide a reasonable characterisation of the range of rock strengths encountered within the undertaken boreholes. Some variation beyond the findings of this investigation should be anticipated.

Figure 5.4.2, below, indicates that, generally, the UCS, and estimated UCS, of the sandstone bedrock rock increases with depth.

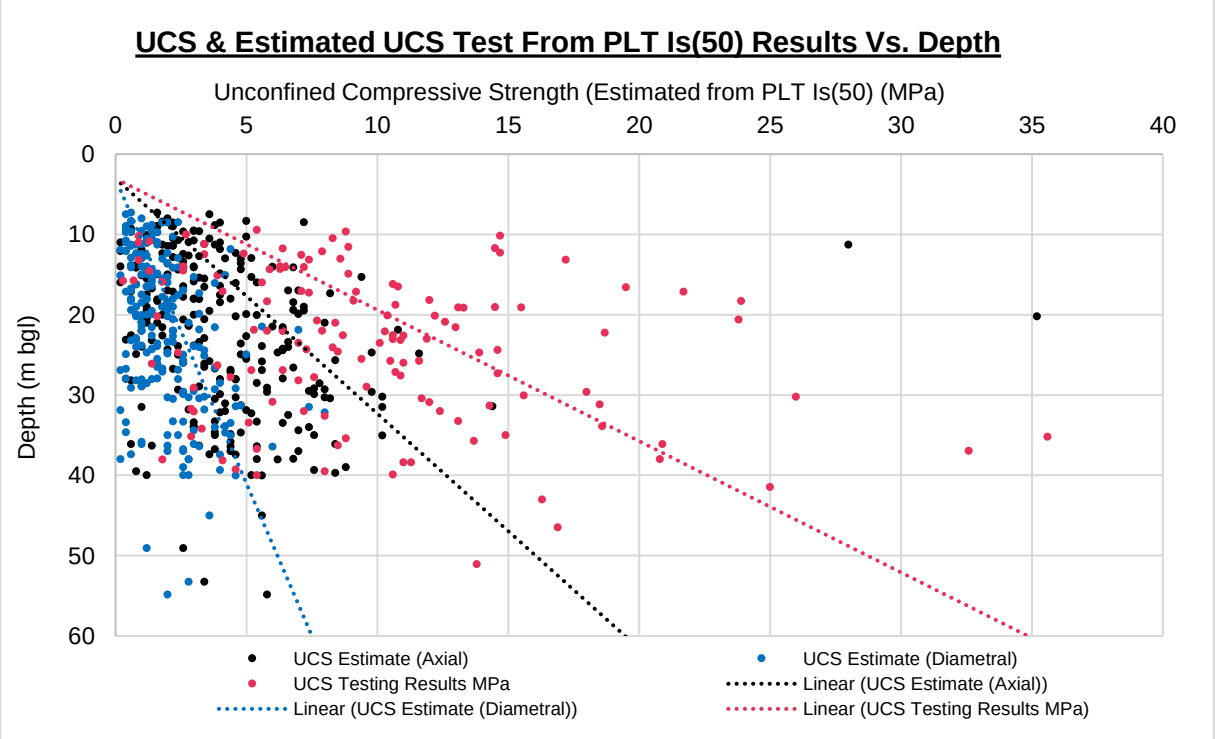


Figure 5.4.2 – Variation of UCS Test and Estimated UCS Results with Depth

Twelve Hoek Triaxial Compression Tests were undertaken in sandstone bedrock at depths between 11.00m – 21.86m bgl. Test results indicate and internal angle of friction of between 20.5^{o} -44.0^{o} with an apparent cohesion of between 1MPa and 7MPa.

It should be noted that the in-situ strength characteristics of the rock will be affected by the aperture and spacing of discontinuities, in addition to the strength of the rock itself, particularly where the discontinuities are very closely spaced.

The indirect tensile strength of sandstone bedrock was assessed by undertaking fourteen Brazil tests. The tensile strength of the rock was recorded at values between 0.23MPa to 1.10MPa, accounting for rock samples obtained at depths of between 9.82m to 21.89m bgl. The average tensile strength of

sandstone within this depth range was 0.54MPa. Eleven samples failed by axial split, two samples failed by curved split, and one sample fractured by wedge fracture.

5.5 Observed Potential Contamination

A hydrocarbon odour was identified in WS03 at depths of between 0.10m – 1.20m bgl. This was also identified in the chemical testing results. The source of the odour was not identified in this investigation.

A strong odour was noted within RBH12A at 0.30m – 0.45m bgl. The type or source of the odour was not identified in this investigation.

An organic odour was identified in BH04B between 3.40m – 3.65m bgl within dark grey sandy gravel deposits.

5.6 Obstructions Encountered

The following potential obstructions were encountered during this investigation, as detailed in *Table 5.6* below.

Table 5.6 – *Obstructions Identified*

Exploratory Hole Ref.	Depth (m bgl)	Obstructions Encountered
WS02	0.80	Dense soils (could not be penetrated further using hand excavation methods).
BH04/A	0.45	Concrete slab.

5.7 Groundwater

Table 5.7a summarises the groundwater levels recorded during drilling. Full details of the recorded groundwater strikes during the investigation are presented in the borehole logs in A*ppendix B*.

Table 5.7a – *Groundwater Noted During Drilling*

Exploratory Hole Ref.	Strike Depth (m bgl)	Rose to Depth (m bgl)	Strike Level (mAOD)	Strata
RBH08	4.70	4.30*		SANDSTONE
RBH09	4.00	3.70*		SAND & GRAVEL
RBH10	8.00	0.00**		SANDSTONE
RBH18A	4.00	3.70*		SAND & GRAVEL
RBH20	3.70	–	22.88	CLAY
RBH23	4.00	–	21.36	CLAY

* After 20 minutes.
** Immediately.

Groundwater strikes were not recorded in shallow window sample or cable percussive boreholes. Due to the use of water flush in rotary cored boreholes, it was not possible to determine water strikes within bedrock during the investigation.

Table 5.7b summarises the groundwater levels recorded during post investigation monitoring. Full details of the response zones within window sample borehole locations and rotary cored borehole locations are included in *Appendix B*. Full details of the recorded water levels during post investigation monitoring visits are presented in *Appendix E*.

Table 5.7b – *Groundwater Noted During Post Investigation Monitoring Visits*

Stage	Exploratory Hole Ref.	Installation Strata	Response Zone (m bgl)	Depth (m bgl)	Depth (mAOD)
Stage I	WS04	CLAY and SAND	2.00 – 3.00	Dry	–
	WS05	SAND	2.00 – 3.00	Dry	–
	WS06	SAND	2.00 – 3.00	Dry	–
	WS08	SAND	2.00 – 3.00	Dry	–
	WS10	SAND	2.00 – 4.00	3.44 – 3.45	–
	WS11	SAND	1.50 – 3.50	Dry	–
	BH02	SANDSTONE (Bands of mudstone and siltstone)	5.00 – 20.00	4.25 – 4.26	23.01 – 23.02
	BH03	SANDSTONE	8.80 – 10.00	1.97 – 3.93	22.66 – 24.62
	BH04B	SANDSTONE	5.00 – 20.00	3.12 – 3.18	23.37 – 23.43
	RBH02	SANDSTONE (Bands of mudstone)	6.30 – 20.00	3.38 – 3.63	22.79 – 23.04
	RBH03	SANDSTONE	14.50 – 16.50	*	*
	RBH04	SANDSTONE	9.20 – 10.20	4.06 – 4.44	22.06 – 22.44
	RBH05	SANDSTONE	5.00 – 20.00	4.18	23.09
	RBH06	SANDSTONE	10.20 – 10.50	3.90	–
Stage II	BH06	SANDSTONE (Bands of mudstone)	6.30 – 20.00	3.40	–
	RBH09	SANDSTONE	14.50 – 16.50	*	*
	RBH14	SANDSTONE	9.00 – 15.00	3.66 – 3.67	23.05 – 23.06
	RBH18A	SANDSTONE	8.50 – 14.50	3.28	–
	RBH22	SANDSTONE and Sand	2.50 – 7.20	3.91 – 4.00	21.97 – 22.06

* Unable to access.

During monitoring, groundwater was encountered (within granular superficial deposits) in WS10 only. Each of the remaining installations within the window sample boreholes were recorded as dry during post investigation monitoring visits.

Groundwater levels within the bedrock deposits typically rose above the monitoring installation response zone, to depths of between 1.97m – 4.44m bgl.

5.8 Aggressive Ground Conditions

It is anticipated that Made Ground and superficial soils are to be removed from site as part of the development plans. As such, the Design Sulphate and AC classifications have not been assigned for these strata.

The Chester Pebble Beds Formation is not recorded in Box C6 of the Building Research Establishment (BRE) Special Digest 1, 3rd edition of 2005 (Ref.12), which describes the UK Geological Formations known to contain Pyrite. The ground investigation identified ground conditions which are unlikely to present a significant risk of degradation of concrete from chemical attack. Although no samples were obtained from the rock, an absence of evidence to show the site will be impacted by the presence of elevated sulphate concentrations, or low pH values, would suggest a Design Sulphate Classification, and ACEC classification of DS-1 and AC1 respectively. Considering the mobile groundwater condition for the scheme area.

Pile designers should satisfy themselves that the concrete used within the adopted piled foundation solution, and basement construction, is suitable for the ground conditions identified onsite.

6.0 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.13).

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 8.0* of this report.

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

6.1 Human Health GQRA

Detailed guidance on human health risk assessment is available within several documents, published by both the Environment Agency and Defra. Guidance includes Contaminated Land Exposure Assessment (CLEA) v1.071 model (Ref.14), Science Report 2 (Ref.15) and Science Report 3 (Ref.16).

A generic quantitative risk assessment (GQRA) has been carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against 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.17) 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.

6.1.1 Adopted Soil Human Health GACs Screening Methodology

The use of the site, noted as generally high rise (up to 35-storeys) buildings comprising residential apartments on upper floors with retail, leisure and commercial spaces with a dual storey basement; is most analogous with a *'Commercial'* end-use scenario and so 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 the site soils ranged significantly from 0.2% w/w to 21.4% w/w. the greatest concentrations of soil organic matter were encountered in WS02 at 0.20m, WS03 at 0.30m, WS05 at 0.80m and WS10 at 0.50m (21.4%, 14.9%, 11.2% and 17.5% w/w respectively). Soils where, or directly above where, these samples were obtained from, except for WS02 recorded the presence of slag, and or wood fragments, and the high concentrations are attributed to these features. A strong diesel odour was recorded in WS03.

With consideration for a calculated geometric average, Made Ground features determine an SOM of 3.37% w/w while natural soils maintain a lower valuation of 0.56% w/w. As such, a comparison against Tier 1 thresholds for a conservative SOM of 2.5% for *'Commercial'* end-use

has been adopted for Made Ground, and a SOM of 1.0% for *'Commercial'* end-use has been adopted natural soil features. The adopted GAC's are listed in *Appendix F*.

6.1.2 Generic Assessment Criteria Screening of Soil Laboratory Results

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

With respect to the proposed end use of the site, several exceedances are noted within recovered Made Ground soil samples, as outlined in *Table 6.1.2* below. No exceedances were noted within recovered naturals soil samples.

Table 6.1.2 – *Made Ground Soil GAC Exceedances for a Commercial End-Use*

Exploratory Hole Ref.	Depth (m bgl)	Determinant	Concentration
RBH03	0.40	Lead	970 mg/kg
RBH06	0.40	Lead Perylene	698 mg/kg 276 µg/kg
WS02	0.30	Dibenzofuran Carbazole* 2-Methylanphthalene Perylene	644 µg/kg 683 µg/kg 751 µg/kg 1120 µg/kg
WS03	0.30	Lead Benzo(a)pyrene Benzo(b)fluoranthene Dibenzo(ah)anthracene TPH Aromatic >C16-C21 TPH Aromatic >C21-C35 Dibenzofuran Carbazole* 2,4-Dinitrotoluene 1,4-Dichlorobenzene 1,2-Dichlorobenzene 2-Methylnaphthalene Perylene	2010 mg/kg 17.8 mg/kg 23.1 mg/kg 2.54 mg/kg 4080 mg/kg 6040 mg/kg 6150 µg/kg 3680 µg/kg 1190 µg/kg 1400 µg/kg 9190 µg/kg 2280 µg/kg 4490 µg/kg
	1.00	Dibenzo(ah)anthracene Dibenzofuran Carbazole* 2,4-Dinitrotoluene 2,4-dimethylphenol 1,4-Dichlorobenzene 1,2-Dichlorobenzene 2-Methylnaphthalene Perylene	0.94 mg/kg 2710 µg/kg 1110 µg/kg 1230 µg/kg 1320 µg/kg 1350 µg/kg 7440 µg/kg 3460 µg/kg 2760 µg/kg
WS10	0.50	Lead	921 mg/kg
WS11	0.40	Lead	751 mg/kg
TT4	2.00	Benzo(a)pyrene Benzo(b)fluoranthene Dibenzo(ah)anthracene	5.95 mg/kg 7.42 mg/kg 1.06 mg/kg

Selected soil samples were screened for asbestos. No suspected asbestos containing materials (ACMs) were identified in the exploratory hole logs however laboratory screening identified Chrysotile fibres (<0.001%) within TT1 at 3.00m and 5.00m bgl soil samples.

On 17th July 2018, asbestos boarding was identified during trial trenches undertaken as part of an archaeological investigation, running simultaneously with this intrusive investigation. A sample was not obtained for screening.

6.2 Controlled Waters GQRA

A model for assessing the potential for pollution of 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.18).

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

However, dependant on the receptor identified as being at risk, see *Section 6.2.1*, the EU Drinking Water Standards (Ref.19), Surface Water (Abstraction for Drinking Water (Ref.20) and/or Water Framework Directive Water Quality Standards (WFD WQS) (Ref.21)) can be utilised as primary screening values in a Level 1 assessment. These can also be supplemented by World Health Organisation (WHO) guidelines (Ref.22), where WFD or DWS water quality standards (WQS) do not exist.

In addition to surface and groundwater samples a soil leaching test can be undertaken to provide a preliminary, conservative, assessment of the potential for contaminants in the soil to pollute ground or surface water. Leachate test results are screened in the same way as for groundwater above.

6.2.1 Adopted Controlled Waters Tier 1 Screening Values and Methodology

The results of laboratory analysis of groundwater have been assessed against water framework directive (WFD) WQS, due to the proximity of the River Irwell to the north of the site. The site is underlain by a Principal Aquifer, associated with the Chester Pebble Beds Formation, and so groundwater chemical testing results have also been assessed against UK Drinking Water Standards.

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

6.2.2 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 end use of the site, several exceedances are noted within recovered soil samples as detailed below.

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Table 6.2.2 – *Exceedances Recorded in Groundwater Chemical Testing Results*

Determinant	Tier 1 Value (µg/l)	Min Conc. (µg/l)	Max Conc. (µg/l)	Samples > Tier 1 Value
Copper	**1**[1] *2000*	<1	**3**	**RBH02 (3 µg/l)**
Chromium	**4.7** *50*	1	**13**	**RBH02 (10 µg/l)** **BH04B (13 µg/l)** **BH02 (7 µg/l)**
Nickel	**4**[1] *20*	<1	**6**	**BH02 (6 µg/l)**
Selenium	**-** *10*	<1	*27*	*RBH02 (27 µg/l)*
Zinc	**10.9**[1] *5000*	1	**13**	**BH02 (13 µg/l)**
Anthracene	**0.1** -	<0.01	**0.74**	**RBH02 (0.74 µg/l)** **BH02 (0.69 µg/l)**
Benzo(a)pyrene	**0.00017** *0.01*	<0.01	***3.06***	***RBH02 (3.06 µg/l)*** ***BH04B (0.02 µg/l)*** ***BH02 (2.01 µg/l)***
Sum of 4 PAHs[2]	**-** *0.1*	<0.01	*7.60*	*RBH02 (7.60 µg/l)* *BH02 (5.78 µg/l)*
Fluoranthene	**0.0063**	**0.01**	**5.94**	**WS10 (0.01 µg/l)** **RBH02 (5.94 µg/l)** **BH04B (0.03 µg/l)** **BH02 (4.71 µg/l)**

Note: **EQS (Freshwater)** screening values in bold, *EU DWS* thresholds are in italics.
1. Bioavailable fraction.
2. Benzo(b)fluoranthene, Benzo(ghi)perylene, Benzo(k)fluoranthene and Indeno(1,2,3-c,d)pyrene.

The chemical testing results identified exceedances, with respect to Water Quality Standards, of numerous heavy metals and PAHs, primarily within RBH02, centrally located within the site, and BH02, at the north of the site. Slightly elevated chromium concentrations were also identified in BH04B at the east of the site.

With respect to EU DWS, limited exceedances of selenium (RBH02) were recorded, in addition to PAH concentration exceedances in RBH02 and BH02, and a very minor exceedance of benzo(a)pyrene in BH04B.

The site is in Manchester city centre, which historically was heavily industrialised throughout the surrounding area. Although it is considered likely that the exceedances recorded in *Table 6.2.2*, above, are associated with downward migration of contaminants from onsite Made Ground soils, leaching into bedrock, it is likely that the contaminants are also indicative of the wider historic, industrial, land use of the city centre. It is noted that due to the construction of the double storey basement, all potential sources of contamination within Made Ground will be removed from the site.

6.3 Water Supply Pipe Assessment

It is anticipated that Made Ground soils and superficial soils are to be excavated and removed from site to facilitate the construction of a basement. As such, it is likely that PE/PVC pipes may be used however the exact requirements are to be confirmed with the relevant utility supplier.

6.4 Materials Management

6.4.1 Re-use of Site Soils

Based on the geochemical testing results presented as part of this investigation it is considered that there is no specific requirement to remove soils from site because of them presenting an unacceptable risk to human health or the environment.

The re-use of site-won soils may therefore be undertaken if the following principles are met: i) the geotechnical suitability of the material needs to be confirmed; ii) the re-use of the material needs to be covered as part of the planning approval, e.g. site levels maintained within agreed limits; iii) the volume of the material being re-used needs to be confirmed and traceable and iv) regulatory approval from the relevant authorities has been sought. These principles are outlined within the CL;AIRE Definition of Waste Code of Practice (v2) (Ref.23) and if and where the re-use of site-won soils is proposed as part of the development works it is recommended that a Materials Management Plan is produced in line with the Definition of Waste Code of Practice to detail and document the process.

6.4.2 Material Classification

It is envisaged that significant volumes of material are to be removed from site to facilitate the construction of a dual storey basement.

Where any site soils are to be disposed of offsite guidance on the disposal of contaminated soils is provided within the following document published by the Environment Agency, the Guidance on the classification and Assessment of Waste Technical Guidance WM3 (1st Edition 2015) (Ref.24).

Guidance states that the principal contractor (or any other sub-contractor undertaking excavations) should, in conjunction with the proposed disposal facility, use where possible the relevant environmental chemistry analyses results to classify any surplus material identified for offsite disposal. However, it should be noted that this information is for guidance only and material identified for disposal should be tested and assessed in accordance with WM3 to enable classification during the works.

An initial assessment for the waste classification of the shallow and deeper Made Ground soils encountered onsite has been carried out through a comparison of the soil testing results against the Tier 1 Thresholds and using the Waste Soils Characterisation Assessment Tool, Cat-WasteSoil, developed by McArdle and Atkins. This online tool gives a rapid assessment of contaminated soils and their classification as either hazardous or non-hazardous (stable non-reactive hazardous waste) waste, it should be noted that this tool does not classify inert waste. Persistent Organic Pollutants (POP's) were not tested for as part of the investigation, however based on the Conceptual Site Model the risk of these being present on the site is considered Low.

The initial assessment revealed that of the thirty-seven Made Ground soils tested, thirty-two soil samples have indicated to be non-hazardous with respect to Environment Agency waste classes, using the guidance given in WM3. However, five samples have indicated to be hazardous waste for offsite disposal owing to the concentrations of copper and zinc (RBH06 at 0.40m and WS03 at 0.30m bgl), benzo(a)anthracene, diesel and lead (WS03 at 0.30m bgl), and pH (RBH21 at 0.50m bgl, RBH22 at 0.50m bgl and TT1 at 3.00m bgl). A strong diesel odour was identified in WS03 during the service clearance pit, thought to be associated with a historic diesel spill.

In addition to the samples tested, chrysotile board was identified in archaeological trenches undertaken simultaneously with this investigation. A sample of the material was not tested. It is considered likely that more asbestos will be present in locations not tested during this investigation. Chrysotile asbestos fibres (<0.001%) were identified within TT1 at 3.00m and 5.00m bgl. Additional testing should be undertaken during the excavation phase to confirm the hazardous waste classification of material prior to removal from site.

The initial assessment of the seven natural soil samples tested may be considered non-hazardous waste for offsite disposal. Where natural soils are being considered for offsite disposal as inert waste, Waste Acceptance Criteria (WAC) testing should first be undertaken with confirmation of acceptability from the receiving landfill.

As discussed, preliminary waste classification is undertaken to offer indicative advice with respect to disposal requirements. Landfill operators are not obliged to accept waste and, if they were to do so, may have specific requirements beyond those outlined above prior to acceptance. Landfill operators should be contacted to confirm the above classifications or otherwise.

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7.0 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 BS8485:2015 (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 Preliminary Site Assessment (desk study) and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

7.1 Ground Gas Monitoring Results

Stage I

To characterise the site's ground gas regime and validate the qualitative assessment of ground gas risk 50mm standpipe installations were incorporated within the six window sample borehole locations and four rotary cored borehole locations. 19mm piezometers were within four rotary cored borehole locations. The details of the response zone of each monitoring installation are outlined in *Section 3.2*.

During Stage I, an initial programme of six gas monitoring visits over three months was proposed. Six gas monitoring visits have been undertaken between 26th July and 16th October 2018, with barometric pressure recorded between 1009mb and 1026mb and the monitoring period included one monitoring visit following precipitation.

Stage II

To characterise the site's ground gas regime and validate the qualitative assessment of ground gas risk 50mm standpipe installations were incorporated within five rotary cored borehole locations. The details of the response zone of each monitoring installation are outlined in *Section 3.2*.

During Stage II, an initial programme of six gas monitoring visits over three months was proposed. However, only two visits were able to be undertaken due to restricted access to the boreholes. These gas monitoring visits were undertaken on 14th and 22nd November 2018, with barometric pressure recorded as 1015mb.

A summary of the ground gas monitoring from Stage I & II are detailed below. The results log sheets are contained within *Appendix E* and summarised in *Table 7.1*.

Table 7.1 – *Summary of Ground Gas Monitoring Results*

Stage	Exploratory Hole Ref.	Maximum CH_4 Concentration (%)	Maximum CO_2 Concentration (%)	Minimum Steady O_2 Concentration (%)	Maximum gas flow (l/hr)	
					Peak	Steady State
Stage I	WS04	<0.1	5.2	12.2	*	0.1
	WS05	<0.1	3.4	16.0	*	<0.1
	WS06	<0.1	1.8	19.0	*	0.1
	WS08	<0.1	0.4	14.3	*	-0.1
	WS10	<0.1	7.1	13.6	*	<0.1
	BH02	<0.1	4.2	1.4	*	-0.1
	BH03	<0.1	0.9	18.1	*	<0.1
	BH04B	<0.1	0.2	20.5	*	<0.1
	RBH02	<0.1	0.3	19.0	-7.0	-2.3/1.0
	RBH04	<0.1	2.1	15.4	*	-0.1
	RBH05	<0.1	0.7	17.2	16.1	0.3
	RBH06	<0.1	0.2	19.7	*	<0.1
Stage II	BH06	<0.1	1.9	16.3	*	0.1
	RBH14	<0.1	0.2	19.0	*	-0.7
	RBH18A	<0.1	0.1	20.8	*	0.1
	RBH22	<0.1	2.3	16.4	*	0.1

Note: WS11, RBH03 and RBH09 are located within a demolition exclusion zone or buried. These wells could not be monitored.
* Peak flow rate not recorded.

Methane (CH_4) and hydrogen sulphide (H_2S) concentrations were recorded below the monitoring instrument's limit of detection within all the monitoring wells throughout the monitoring period. Maximum concentration of carbon monoxide (CO) recorded was 20ppm.

Carbon dioxide (CO_2) was recorded in peak concentrations between 0.2% and 7.1%. The greatest concentrations were recorded in WS04, WS05, WS10 and BH02.

Maximum, peak, gas flow was recorded between -7.0 and 16.1 litres per hour (l/hr), returning to steady state flow rates of between -2.3 and 1.0 l/hr. Peak flow rates in RBH02 of -7.0 l/hr were recorded, returning to a steady state flow rates of between -2.3 and -1.4 l/hr after 5 minutes on the first monitoring visit.

The highest concentrations of carbon dioxide were consistently recorded from WS04 and WS10, centrally within the site, with carbon dioxide concentrations of between 5.2% v/v to 7.1% v/v recorded.

7.2 Ground Gas Assessment

The Preliminary Site Model presented in *Section 2.8* identified possible Made Ground deposits as a potential source of Ground Gas generation, both onsite and offsite, resulting from historical development and land use.

A review of geological mapping suggests no records of organic rich drift deposits (e.g. peat) being present. A historic infilled canal is present at orientated northwest to southeast across the centre of the development site, and south to north beneath the existing Old Granada Studios building. This could act as a source of ground gas. Coal deposits are noted to not underlie the site.

Noxious and asphyxiate gases were attributed to include, but not limited to, carbon dioxide, carbon monoxide, methane and hydrogen sulphide. The consequence was evaluated as Moderate risk.

Made Ground soils were encountered to depths of between 0.60m to 6.25m bgl with limited putrescible content generally. Soils within WS02 (0.20m), WS03 (0.30m), WS05 (0.80m) and WS10 (0.50m) identified soil organic matter concentrations of >10% w/w.

The ground investigation revealed a ground model generally consistent with the preliminary conceptual site model. Natural deposits were generally sand and clay with no significant putrescible/organic content, however one localised band of 'black spongey peat' was recorded at 2.00m – 2.20m bgl in RBH03. Sandstone bedrock was encountered at depths of between 3.05m (WS04) and 7.70m (RBH23) bgl.

To facilitate the construction of the basement, significant volumes of Made Ground and superficial soils are to be removed from the site. The base level of the basement is likely to be constructed within bedrock deposits, some circa 6.00m bgl. Consequently, ground gas results from the window sample boreholes are unlikely to be representative of the ground conditions and have therefore been discounted from the following analysis. *Table 7.2*, below, summarises the results considered to be representative of ground conditions for the proposed development.

Table 7.2 – *Representative Ground Gas Monitoring Results*

Exploratory Hole Ref.	Maximum CH_4 Concentration (%)	Maximum Steady CO_2 Concentration (%)	Minimum Steady O_2 Concentration (%)	Maximum gas flow (l/hr)	
				Peak	Steady State
BH02	<0.1	4.2	1.4	*	-0.1
BH03	<0.1	0.9	18.1	*	<0.1
BH04B	<0.1	0.2	20.5	*	<0.1
RBH02	<0.1	0.3	19.0	-7.0	-2.3/1.0
RBH04	<0.1	2.1	15.4	*	-0.1
RBH05	<0.1	0.7	17.2	16.1	0.3
RBH06	<0.1	0.2	19.7	*	<0.1
BH06	<0.1	1.9	16.3	*	0.1
RBH14	<0.1	0.2	19.0	*	-0.7
RBH18A	<0.1	0.1	20.8	*	0.1
RBH22	<0.1	2.3	16.4	*	0.1

* Peak flow rate not recorded.

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Consideration of the recorded soil gas flow rates, presented above, enables hazardous gas flow rates to be evaluated. Q_{hg} can be derived for both 'representative' and 'worst case' scenarios and a comparison made in support of an appropriate assessment of ground gas risk.

The ground gas monitoring data is representative, given the varying ground conditions, ambient weather conditions and barometric pressures recorded throughout the monitoring period. Therefore, steady state gas flow rates are considered the most appropriate, discounting negative peak flow rates recorded where groundwater levels may have influenced the peak flow rate.

Evaluation of the 'representative' Q_{hg} for carbon dioxide (highest steady state gas flow rate that is realistically possible in a single borehole) records a maximum Q_{hg} of 0.004 l/hr, from RBH02.

Evaluation of the 'worst case' Q_{hg} for carbon dioxide (highest steady state gas flow rate that is realistically possible in any borehole on any occasion) records a maximum Q_{hg} of 0.042 l/hr.

The 'representative' scenario has been adopted as the sites Gas Screening Value (GSV) and in accordance with an assessment by CIRIA C665 the GSV indicates a Characteristic Situation 1 (CS1) gas regime which does not require any gas protection measures.

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.

8.0 Revised Conceptual Site Model

The Preliminary Conceptual Site Model (PCSM) presented in the previous Phase 1 reports and discussed in *Section 3.0* of this report has been revised following the GQRA in *Section 6.0* 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 2.6*.

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 onsite will be undertaken in compliance with these requirements. Reference should be given to the environmental testing results discussed within *Section 8.0* and presented within *Appendix C*.

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- 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 enough 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**		
Made Ground soils derived from historical development and land use as a source of contamination.	Direct contact and dermal uptake, soil and dust ingestion, dust* and migration inhalation (indoor & outdoor air)	Commercial end-users	Medium	**Unlikely**	**Low**	Several exceedances were identified with respect to Lead, PAHs, TPHs and SVOCs against adopted Commercial GACs. It is anticipated that all Made Ground soils will be excavated and removed from the site to facilitate the construction of the basement. This will remove any potential source of contamination from the site, breaking the SPR linkage. Chrysotile fibres (<0.001%) within TT1 at 3.00m and 5.00m bgl. Asbestos boarding was identified in archaeological trenches undertaken simultaneously with this investigation. The material was not quantified. It is considered likely that more asbestos may be present in other locations across the site. As discussed, Made Ground soils are to be removed from site, limiting the likelihood of exposure to site end-users. Construction workers are to be provided with appropriate PPE during all construction activities, to limit the likelihood of exposure to contamination sourced within Made Ground soils.	**Construction and groundworkers to be provided with appropriate PPE.** **No further action required.**
	Direct contact and dermal uptake, soil and dust ingestion, dust* & migration inhalation (outdoor air)	Construction and maintenance workers	Mild (Standard Health & Safety precautions likely to be used by workers)	**Unlikely**	**Very Low**		
	Soil dust and vapour ingestion/inhalation produced during construction (indoor and outdoor air)	Adjacent residents	Medium	**Unlikely**	**Low**	Four soil samples (RBH06 at 0.40m, WS02 at 0.30m and WS03 at 0.30m and 1.00m) recorded the presence of SVOCs. All samples are located within 'Zone 1' at the north of the site. Contaminants are likely to have volatilised prior to exposure to members of the public.	**No further action required**
	Downward vertical migration through superficial soils	Controlled Waters Principal Aquifer (Bedrock) Chester Pebble Beds Formation (Sandstone)	Medium	**Unlikely**	**Low**	Groundwater chemical testing results indicated exceedances of selenium, and several PAHS, when compared against EU DWS. No potable groundwater abstractions are located within 250m of the site, limiting the likelihood of exposure to the relatively minor concentrations identified. It is anticipated that Made Ground soils are to be removed from site to facilitate the construction of a single and dual storey basement. The removal of Made Ground soils will remove the potential source of contamination. As such, no further action to address the elevated concentrations identified in the groundwater samples tested is required.	**No further action required.**
	Vertical and horizontal migration through superficial soils and bedrock	Controlled Waters Surface Water (River Irwell approximately 60m northwest)	Medium	**Unlikely**	**Low**	The chemical testing results identified exceedances, with respect to Water Quality Standards, of numerous heavy metals and PAHs. Contaminants from Made Ground soils may have leached into the underlying aquifer, although it likely that the concentrations identified are indicative of background concentrations associated with historical industrial land use in Manchester city centre. It is anticipated that Made Ground soils are to be removed from site to facilitate the construction of a single and dual storey basement. The removal of Made Ground soils will remove the potential source of contamination. As such, no further action to address the elevated concentrations identified in the groundwater samples tested is required.	**No further action required.**

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Conceptual Site Model			Qualitative Risk Assessment			Comments	Action
Source	**Pathway(s)**	**Receptor(s)**	**Consequence**	**Likelihood of Occurrence**	**Risk Rating**		
Production of ground generating gases from: • Made Ground deposits containing organic/ putrescible content; • Infilling of canal basin directly beneath the site; • Historic St. Johns Church Graveyard.	Ground gas & vapour migration and inhalation	Commercial end-users	**Medium**	**Unlikely**	**Low**	Made Ground soils are to be excavated and removed from the site to facilitate the construction of the basement. As such, any source of ground gas generation will be removed from the site.	**No further action required.** **Should development plans change, this recommendation may be reassessed.**
		Construction and maintenance workers	**Medium**	**Unlikely**	**Low**		
Bedrock deposits as a source of ground gas generation		Commercial end-users	**Medium**	**Unlikely**	**Low**	Ground gas monitoring results recorded a maximum carbon dioxide concentration of 4.2% v/v in BH02. Methane concentrations were recorded below the limit of detection of the monitoring equipment on each visit throughout the monitoring period. A maximum Qhg of 0.042 l/hr for carbon dioxide was calculated, corresponding with a CS1 gas regime, not requiring ground gas protection measures.	**No further action required.**
		Construction and maintenance workers	**Medium**	**Unlikely**	**Low**		

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8.1 Summary of Significant Pollutant Linkages

Several exceedances were identified with respect to Lead, PAHs, TPHs and SVOCs. A **Low** to **Very Low** risk to presented to site end-users and construction workers from Made Ground soils as they are likely to be removed from the site to facilitate the construction of a single and dual storey basement. Construction workers should be provided with appropriate PPE during all earthworks and groundwork activities.

A **Low** risk is presented to site end-users and construction workers from ground gas migration from Made Ground and natural sources. In accordance with an assessment by CIRIA C665, the calculated gas screening value (GSV) indicates a CS1 gas regime, not requiring gas protection measures for the proposed development.

A **Low** risk is presented to controlled waters (Groundwater). Limited exceedances of selenium and PAHs were identified in groundwater samples when compared against EU DWS thresholds. These concentrations may be sourced from Made Ground soils onsite, though are likely to be indicative of background concentrations associated with historical industrial land use in Manchester city centre. Made Ground soils are to be removed from site to facilitate the construction of a single and dual storey basement, and no potable groundwater abstractions are located within 250m of the site.

A **Low** risk is presented to controlled waters (Surface water). Exceedances of heavy metals and PAHs were identified in groundwater samples when compared against WFD EQS thresholds. These concentrations may be sourced from Made Ground soils onsite, though are likely to be indicative of background concentrations associated with historical industrial land use in Manchester city centre. Made Ground soils are to be removed from site to facilitate the construction of a single and dual storey basement, removing a potential source of contamination.

9.0 Engineering Assessment and Recommendations

9.1 Introduction

This section will assess the relevant geotechnical issues for the proposed redevelopment as generally high rise (up to 35-storeys) buildings comprising residential apartments on upper floors with retail, leisure and commercial spaces with a dual storey basement. The engineering assessment considers foundation design, excavations, and ground floor slabs for the site. It should be noted that detail may change in the development of designs beyond the issue of this Phase 2 Report and the Construction designer should satisfy themselves regarding the adequacy of their design and proposed approach to construction by reference to the on-going project design proposals, the site investigation information and their own examination of the site.

9.2 Summary of Ground Conditions

The ground conditions at the site generally comprised Made Ground underlain by superficial and residual soil deposits predominately comprising of Clay, Sand and Gravel underlain by Chester Pebble Beds Sandstone Formation. Groundwater monitoring recorded groundwater to be between 1.97m – 4.44m bgl with potential artesian groundwater conditions.

The geotechnical parameters recommended for use in the design based on the ground conditions encountered are summarised in *Table 9.2* below.

Table 9.2 – *Geotechnical Parameters*

Parameter		Granular superficial deposit/residual soil	Sandstone
Unit Weight, γ (kN/m^3) (1)		18	22
Effective Angle of Shearing Resistance, Φ' (°) (2)		34	38
Estimated unconfined compressive strength based on laboratory testing and logging (MPa)	8m bgl	–	1
	9m – 12m bgl		2
	13m – 16m bgl		6
	17m – 24m bgl		9
	25 - 40m bgl		11
	>40m bgl		15
Drained Modulus of Elasticity, E' (kPa) (3)		15,000	100-150,000

(1) From published sources (BS8002) and laboratory test results.
(2) Estimated from the relationship between SPT 'N' Value and angle of shearing resistance (Peck et al, 1976) laboratory testing and published values (Hoek & Bray 1974).
(3) From published relationships and sources CIRIA R103, R143, R181 and C504).

9.3 Excavation and Support

Based on observations onsite, together with the results of in-situ and laboratory tests, it is considered that excavations to <1.00m bgl should stand unsupported in the short term (1-14 days). Side support for safety purposes should of course be provided to all excavations which appear unstable, and those >1.20m deep, in accordance with Health and Safety Regulations.

Suitable side slope angles excavated in Clay is likely to be in the region of 20-35 degrees when wet, increasing to 35-45 degrees when dry, based on guidance provided by CIRIA report 97 Trenching Practice (Ref.30). Within Sand and Gravel, it is likely to be in the region of 30-40 degrees when dry, decreasing to 10-30 degrees when wet.

Excavation through layers of Made Ground and superficial deposits should be feasible using conventional site plant. However buried obstructions associated with service runs and significant foundations are expected to be present underlying the current buildings. An allowance should be made for breaking out any concrete which may be encountered.

Monitoring recorded groundwater levels within the bedrock deposits typically above the monitoring installation response zone, to depths of between 1.97m – 4.44m bgl. Therefore, groundwater ingress is likely once rockhead is penetrated. This is likely to cause instability to excavations and may hinder construction of the basements and foundations. It is recommended that groundwater monitoring should continue to allow a greater understanding the groundwater regime at the site.

Temporary earthworks support is envisaged to allow the proposed construction which may be in the form of sheet piled walls.

9.4 Foundation Design

The developments range in scale and height from 46m to 140m above ground (9-35 storeys respectively) with both the shortest and tallest buildings in Zone 1, two buildings some 46m and 105m above ground (10 and 31 storeys respectively) are proposed in Zone 6 with one building 114m above ground (35 storey) in Zone 7 proposed. It is understood that the proposed foundations may comprise of a combination of pads, rafts and piles.

The Made Ground and the superficial deposits are not considered to be suitable founding stratums due to the likely significant loadings for a high-rise building and it is considered that a piled foundation solution is adopted designed as end bearing in the sandstone bedrock. However, pad foundations for the low-rise buildings may be suitable founding in the superficial deposits /completely weathered sandstone.

Assuming foundation excavations to approximately 4.50m bgl and founding strata having bearing capacity characteristics not less than those of very dense sand then square pad foundations with may be designed to a bearing resistance of approximately 400-600kN/m^2

If excavations are taken deeper to found in the partially weathered Sandstone at approximately 8.00m bgl, then spread foundations on may be designed using the method of presumed bearing resistance. The method is based on the relationships outlined in BS EN 1997-1:2004. Assessment of the Chester Pebble Beds based on field descriptions, lab test results and discontinuity spacing indicates that the sandstone beneath the upper weathered layer, provides a presumed bearing resistance of approximately 600 - 1000kN/m^2. This assessment assumes square pad foundations bearing onto the weak sandstone for settlements not exceeding 0.5% of the total foundation width. These initial estimates should be reassessed on a plot by plot case and should be undertaken once loadings and configurations are known. If the founding horizon reveals very closely spaced discontinuities, then it would be prudent to adopt a lower presumed bearing resistance. All foundation excavations should be approved by a suitably experienced Geotechnical Engineer.

For the high-rise buildings it is considered that a piled foundation be adopted to accommodate the anticipated significant loads. The load capacity of the piles depends not only on their size and the ground conditions but also on their method of installation. Pile design and installation are continuously evolving processes and state-of-the-art are often employed before they reach the public domain, perhaps several years down the line. Therefore, it is recommended that specialist Piling Contractors be contacted as to the suitability and carrying capacity of their piles in the ground conditions pertaining to the site.

Initial estimates in accordance with Eurocode 7 (Ref.7) indicate that a bored pile of 750mm diameter and 16m length would provide a total design resistance of 11,025kN for combination 1 and 6228kN for combination 2. Increasing to 14,502kN combination 1 and 8110kN combination 2 for a 900mm diameter bored pile of 16m length.

However, this initial estimate should be reassessed on a plot by plot case. This should be undertaken once loadings and configurations are known. It is also recommended that additional analysis be undertaken to model the pile interaction with the sandstone and to obtain a greater understanding of the pile carrying capacity and settlement. From this additional analysis it may become evident that another phase of site investigation and testing may be required to fully validate the detailed design.

Modulus of subgrade reaction values on the weathered Sandstone at 4.5m bgl have been estimated between 7.0MN/m^3 and 13.0MN/m^3 with values between 10.0MN/m^3 and 21.0MN/m^3 at in the partially weathered sandstone at 10.0m bgl, however, this should be reassessed on a plot by plot basis.

Due to the likely presence of groundwater into excavations once rockhead is penetrated a contiguous pile or secant piled foundation should be considered to reduce groundwater flow into excavations to

enable basements to be constructed. Hydrostatic uplift should be considered as part of the detailed design following additional groundwater monitoring to develop the groundwater model at the site.

9.5 Ground Floor Slabs

It is recommended that all ground slabs should be suspended to account for the high structural loads and any potential hydrostatic uplift. Basement slabs should be developed to span between foundations to resist buoyancy. The potential risk of floatation should be considered in the temporary condition during construction.

10.0 Conclusions & Recommendations

10.1 Conclusions

A revised tabulated revised Conceptual Site Model has been derived following the findings on the Generic Quantitative Risk Assessment risk assessment and is presented in *Section 8.0*.

10.1.1 Ground Contamination

The environmental chemistry soil results have been compared with the Tier 1 criteria for soils with respect to human health against '*Commercial*' thresholds. Several exceedances were identified with respect to Lead, PAHs, TPHs and SVOCs. All Made Ground soils are likely to be removed from the site to facilitate the construction of a single and dual storey basement.

Chrysotile fibres (<0.001%) within TT1 at 3.00m and 5.00m bgl. Asbestos boarding was identified in archaeological trenches undertaken simultaneously with this investigation. The material was not quantified. It is considered likely that more asbestos may be present in other locations across the site.

Construction workers should be provided with appropriate PPE during all earthworks and groundwork activities.

10.1.2 Groundwater Contamination

A **Low** risk is presented to controlled waters (groundwater). Limited exceedances of selenium and PAHs were identified in groundwater samples when compared against EU DWS thresholds. These concentrations may be sourced from Made Ground soils onsite, though are likely to be indicative of background concentrations associated with historical industrial land use in Manchester city centre. Made Ground soils are to be removed from site to facilitate the construction of a single and dual storey basement, and no potable groundwater abstractions are located within 250m of the site.

A **Low** risk is presented to controlled waters (surface water). Exceedances of heavy metals and PAHs were identified in groundwater samples when compared against WFD EQS thresholds. These concentrations may be sourced from Made Ground soils onsite, though are likely to be indicative of background concentrations associated with historical industrial land use in Manchester city centre. Made Ground soils are to be removed from site to facilitate the construction of a single and dual storey basement, removing a potential source of contamination.

10.1.3 Ground Gas Assessment

Six gas monitoring visits have been undertaken, with a maximum representative carbon dioxide concentration of 4.2% v/v and a maximum representative steady state flow rate of 1.0 l/hr recorded. Methane concentrations were recorded below the limit of detection of the monitoring instrument throughout the monitoring period. The risk to the end user the development site from ground gas generating sources is therefore considered to be Low. The gas regime for the site is CS1, requiring no gas protection measures.

The BGS Radon Mapping confirms the site is situated in an area where less than 1% of homes are above the radon action level. The new development incorporates a single and dual storey basement, and so the advice of a specialist Radon assessor must be obtained.

10.1.4 Geotechnical Assessment

The proposed development range in in scale and height from 46m to 140m above ground with a dual storey basement. It is understood that the proposed foundations may comprise of a combination of pads, rafts and piles.

The Made Ground and the superficial deposits are not considered to be suitable founding stratums due to the likely significant loadings for a high-rise building and it is considered that a piled foundation solution is adopted designed as end bearing in the sandstone bedrock. However, pad foundations for the low-rise buildings may be suitable founding in the superficial deposits /completely weathered sandstone.

Square pad foundations maybe suitable for the low-rise buildings with a presumed bearing resistance of approximately 400-600kN/m2 founding at 4.5m bgl in the weathered Sandstone increasing to approximately 600 - 1000kN/m2 at 8.0m bgl founding in the partially weathered sandstone.

For the high-rise buildings it is considered that a piled foundation be adopted to accommodate the significant loads. Initial estimates in accordance with Eurocode 7 (Ref.7) indicate that a bored pile of 750mm diameter and 16m length would provide a total design resistance of 11,025kN for combination 1 and 6228kN for combination 2. Increasing to 14,502kN combination 1 and 8110kN combination 2 for a 900mm diameter bored pile of 16m length.

Due to the likely presence of groundwater into excavations once rockhead is penetrated a contiguous pile or secant piled foundation should be considered to reduce groundwater flow into excavations to enable basements to be constructed.

It is recommended that all ground slabs should be suspended to account for the high structural loads and any potential hydrostatic uplift. Basement slabs should be developed to span

between foundations to resist buoyancy. The potential risk of floatation should be considered in the temporary condition during construction.

Excavation through layers of Made Ground and superficial deposits should be feasible using conventional site plant. An allowance should be made for breaking out and removing any encountered concrete obstructions associated with existing foundations. Temporary earthworks support is envisaged to allow the proposed construction within the Made Ground outside the permanent basement wall, which may be in the form of sheet piled walls, subject to design by a temporary works engineer.

10.1.5 Additional Considerations

The site is in Manchester City Centre, which during WWII suffered bomb damage. Records obtained to date indicate that the site may have been struck during bombing raids, and land near the site was impacted by them. However, several recommendations have been made for the implementation of mitigation measures during intrusive works which are detailed within *Section 2.6*.

In the unlikely event that material is revealed on the site of a nature that does not accord with the anticipated ground conditions identified in *Section 5.0* the following procedure is to be complied with:

a) Cease and make safe all excavations in this location and report observations to the Site Manager.

b) The Site Manager is to notify the Engineer.

c) Under guidance of the Engineer take representative samples of the suspect materials and forward to a suitably accredited laboratory for analysis.

d) Await Engineers instructions with respect to re-commencement of the works and or removal from of suspect material to a suitably licensed disposal facility.

e) Manchester City Council and if relevant the Environment Agency are to be kept fully informed of any site such occurrences.

10.2 Recommendations

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

1) It is anticipated that all Made Ground soils are to be removed from site to facilitate the construction of a single and dual storey basement. It is unlikely that a remediation strategy will be required for this development. should development plans change the conclusions of this report should be reassessed;

2) Further numerical analysis be undertaken to model the pile interaction with the sandstone to obtain a greater understanding of the pile carrying capacity and settlement; and

3) Notwithstanding, appropriate PPE should be supplied to and worn by all groundwork and construction personnel during the basement excavation, and other groundwork and construction activities, with reference to the environmental testing results presented herein and within *Appendix C*.

11.0 References

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28. CIRIA (2001) Contaminated Land Risk Assessment. A guide to good practice (report no. C552).
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Appendix A – Drawings

- Curtins, Geotechnical Investigation Stage 1 & 2 Investigation Exploratory Hole Location Plan, drawing ref. SJQ-099-CUR-XX-XX-DR-S-20071 (dated February 2019).

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KEY

- Ex.BH** BOREHOLES TAKEN FROM THE LAND CONSULTANCY LIMITED REPORT FOR CURTINS DATED 26th MAY 2016
- Ex.BH** BOREHOLES TAKEN FROM ESG REPORT UNDERTAKEN FOR BURO HAPPOLD DATED 15th MARCH 2017
- Ex.BH** BOREHOLES TAKEN FROM CCG REPORT UNDERTAKEN FOR NORTHERN HUB ALLIANCE DATED 27th OCTOBER 2015
- RBH** PROPOSED OPEN HOLE ROTARY THROUGH SUPERFICIAL PLUS ROTARY CORED TO BASE THROUGH INTACT ROCK
- BH** PROPOSED CABLE PERCUSSIVE BOREHOLE THROUGH SUPERFICIAL PLUS ROTARY CORED TO BASE THROUGH INTACT ROCK
- TP** PROPOSED TRIAL PITS
- WS** PROPOSED WINDOW SAMPLES

GENERAL NOTES

1. THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECTS AND ENGINEERS DRAWINGS AND SPECIFICATIONS.
2. DO NOT SCALE THIS DRAWING. ANY AMBIGUITIES, OMISSIONS AND ERRORS ON DRAWINGS SHALL BE BROUGHT TO THE ENGINEERS ATTENTION IMMEDIATELY. ALL DIMENSIONS MUST BE CHECKED / VERIFIED ON SITE.
3. ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
4. FOR GENERAL NOTES REFER TO DRAWING.

THIS TECHNICAL MASTERPLAN DRAWING COMPILES DESIGN INFORMATION DRAWN FROM VARIOUS SOURCES AND REMAINS THE RESPONSIBILITY OF THE RELEVANT DESIGN TEAM. THIS DRAWING DOES NOT INFER DESIGN RESPONSIBILITY BUT SIMPLY ADDRESSES PLOT RELATIONSHIPS AND CHALLENGES TO BE RESOLVED BY THE RELEVANT PLOT DESIGNERS.

ZONE	ARCHITECT	CIVIL/STRUCTURAL	M&E	TRANSPORT
1	DOMAXIS	CURTINS	CWC	VECTOS
2	3D REID	CURTINS	CWC	VECTOS
3				
4	CHAPMAN TAYLOR	RoC	CWC	VECTOS
5	ALLIED LONDON	CURTINS	CWC	VECTOS
6	CHAPMAN TAYLOR	CURTINS	CWC	VECTOS
7	DCM	CURTINS	CWC	VECTOS
8	OMA	BURO HAPPOLD	BDP	VECTOS

Rev:	Description:	Date:	By:	Chkd:
P01	ISSUED FOR INFORMATION	01.03.19	AM	JJ

curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
0161 236 2394
manchester@curtins.com
www.curtins.com
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Status: INFORMATION

Project: ST JOHNS MASTERPLAN

Org Title: GEOTECHNICAL INVESTIGATION STAGE 1 & 2 INVESTIGATION

Project No:	Size:	Date:	Drawn By:	Designed By:	Checked By:
065330	A0	FEB 18	AM	JJ	JJ
	Scale: 1 : 500				

Project:	Location:	Originator:	Volume:	Level:	Type:	Discipline:	Category / Number:	Rev:
SJQ	099	CUR -	XX -	XX -	DR -	S -	20071 -	P01

Appendix B – Exploratory Hole Logs

- Borehole logs with photographic record of rock cores.
- Window sample borehole logs.
- Trial trench logs with sketches and photographic record of the trenches.

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IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan	Location ID: **WS02**	
Dates: 09/07/2018	Client: Curtins Consulting	Sheet 1 of 1	
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by: NC / Vertical scale: 1:50 / Project ID: 42206

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
0.30	ES1			0.05 0.15 (0.65) 0.80	MADE GROUND: Dark grey Tarmacadam. MADE GROUND: Light grey concrete. MADE GROUND: Orange brown, sandy, gravelly, angular COBBLE. Gravel is subangular, fine to coarse including brick and concrete. End of Borehole at 0.80m		1 2 3 4 5 6 7 8 9 10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 0.8m. Borehole terminated at 0.80m due to dense material unable to progress further.

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan		Location ID: **WS03**
Dates: 09/07/2018	Client: Curtins Consulting		Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by: NC / Vertical scale: 1:50 / Project ID: 42206

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
0.10 - 0.90	B1			0.10	MADE GROUND: Light grey Tarmacadam.				
0.30 - 0.80	ES2			(0.80)	MADE GROUND: Orange brown, gravelly, fine to coarse SAND with low cobble content. Gravel is subangular to angular, fine to coarse including slag, concrete and brick. Cobbles are subangular including brick.				
0.80	ES3			0.90					
0.90 - 1.20	B4			(0.30)	MADE GROUND: Very soft, greenish grey, gravelly, sandy CLAY with low cobble content. Gravel is subangular including brick and slag. Cobbles are subangular including brick.		1		
				1.20	End of Borehole at 1.20m		2		
							3		
							4		
							5		
							6		
							7		
							8		
							9		
							10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: St John's Masterplan		Location ID: **WS04**
Dates: 24/06/2018	Client: Curtins Consulting		Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by: HD / Vertical scale: 1:50 / Project ID: 42206

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				0.10	MADE GROUND: Tarmacadam.				
0.30	D2			0.20	MADE GROUND: Grey, gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including limestone.				
0.30	ES1				MADE GROUND: Loose, brown, clayey, gravelly, fine to coarse SAND. Gravel is very angular to rounded, fine to coarse including mudstone, brick, slate, tile sandstone and mudstone.				
0.60	D4								
0.60	ES3			(1.10)					
0.70 - 1.20	B5						1		
1.20		SPT(S) N=5 (1,1/1,1,1,2)							
1.20	ES6			1.30					
1.20 - 1.60	B7			(0.40)	MADE GROUND: Firm, brown, slightly gravelly CLAY. Gravel is very angular to rounded, fine to coarse including sandstone, brick, limestone, mudstone and tile.				
1.20 - 1.65	D8			1.70					
				(0.30)	Orangey brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse including sandstone, mudstone, limestone and quartzite.				
2.00		SPT(S) N=21 (5,5/4,3,6,8)		2.00			2		
2.00	D10			2.10					
2.00	ES9				Firm, dark brown, slightly sandy, slightly gravelly CLAY. Gravel is subangular to rounded, fine and medium including sandstone and limestone.				
2.00 - 2.45	D11			(0.95)					
2.70	D12				Medium dense, orangy brown, gravelly, fine to coarse SAND. Gravel is subangular to rounded, fine to coarse including sandstone, limestone, mudstone and quartzite.				
3.00		SPT(S) 50 (8,9/50 for 240mm)		3.05			3		
3.00 - 3.39	D13			(0.34)	Brownish red, fine to coarse grained SANDSTONE.				
				3.39	End of Borehole at 3.39m				
							4		
							5		
							6		
							7		
							8		
							9		
							10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks
1.20	2.00		100	
2.00	3.00		80	
3.00	4.00		20	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	2.00	PLAIN	
2.00	3.00	SLOTTED	

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: St John's Masterplan		Location ID: **WS05**
Dates: 24/06/2018	Client: Curtins Consulting		Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level: / Logged by: HD / Vertical scale: 1:50	Project ID: 42206

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				0.20	MADE GROUND: Tarmacadam.				
0.40	D2			0.35	MADE GROUND: Grey, sandy, very angular to subangular, fine to coarse GRAVEL including granite and sandstone (Type 1).				
0.40	ES1			(0.35)	MADE GROUND: Brownish black, slightly clayey, slightly gravelly, fine to coarse SAND. Gravel is very angular to subrounded, fine to coarse including tile, brick, slag, asphalt, sandstone, mudstone and limestone.				
0.70 - 1.20	B3			0.70					
0.80	D5								
0.80	ES4						1		
1.20		SPT(S) N=10 (2,2/2,3,2,3)		(1.00)	MADE GROUND: Firm, orangy brown mottled black, gravelly, slightly sandy CLAY with some cobbles. Gravel is very angular to subangular, fine to coarse including brick.				
1.20	D7								
1.20	ES6								
1.20 - 1.65	D8			1.70					
1.90	D10				Loose, light brown, fine to coarse SAND.				
1.90	ES9						2		
2.00		SPT(S) N=8 (1,1/2,1,2,3)		(1.00)					
2.00 - 2.45	D12								
2.00 - 2.50	B11								
2.80	D13			2.70					
3.00		SPT(S) 50 (7,12/50 for 150mm)		(0.60)	Dense, orangy brown, gravelly, fine to coarse SAND. Gravel is subangular to rounded including quartzite and sandstone.		3		
3.00 - 3.30	D14			3.30	End of Borehole at 3.30m				
							4		
							5		
							6		
							7		
							8		
							9		
							10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks
1.20	2.00		100	
2.00	3.00		80	
3.00	4.00		10	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	2.00	PLAIN	
2.00	3.00	SLOTTED	

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: St John's Masterplan		Location ID: **WS06**
Dates: 23/06/2018	Client: Curtins Consulting		Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by: RS / Vertical scale: 1:50 / Project ID: 42206

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				0.25	MADE GROUND: CONCRETE.				
0.30	ES1			(0.55)	MADE GROUND: Dark reddish brown/black, gravelly fine to coarse SAND. Gravel is subangular to angular, fine to coarse including concrete, brick and sandstone.				
0.50 - 1.00	B2			0.80					
0.60	D3								
0.80	ES4			(0.50)	MADE GROUND: Soft, black, sandy CLAY.		1		
1.00 - 1.50	B5			1.30					
1.20		SPT(S) N=7 (1,1/1,2,2,2)							
1.20	D6			(0.70)	Firm, light brown, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine and medium including sandstone.				
1.30	ES7								
1.70	D8			2.00			2		
2.00		SPT(S) N=13 (2,3/3,3,3,4)			Medium dense, reddish brown, gravelly, fine to coarse SAND. Gravel is subangular to subrounded fine to coarse including sandstone and coal.				
2.00	D9								
2.20	ES10								
2.50 - 3.00	B11			(1.41)					
2.70	D12				*Below 3m: dense.*		3		
3.00		SPT(S) 53 (2,2/53 for 260mm)							
3.00 - 3.41	D13			3.41	End of Borehole at 3.41m				
							4		
							5		
							6		
							7		
							8		
							9		
							10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	2.00	PLAIN	
2.00	3.00	SLOTTED	

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: St John's Masterplan		Location ID: **WS08**
Dates: 23/06/2018	Client: Curtins Consulting		Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level: / Logged by: RS / Vertical scale: 1:50	Project ID: 42206

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				0.20	MADE GROUND: CONCRETE.				
0.25	ES1			(0.40)	MADE GROUND: Brown, slightly gravelly, fine to coarse SAND. Gravel is subangular to angular, fine to coarse including brick, concrete and roadstone.				
0.50 - 1.00	B2			0.60					
0.60	ES3				MADE GROUND: Soft, dark brown, sandy, slightly gravelly CLAY. Gravel is subangular to angular, fine and medium including brick, sandstone and concrete.				
0.70	D4			(0.60)			1		
1.20		SPT(S) N=6 (1,1/1,1,2,2)		1.20					
1.20	D6			(0.30)	Firm, light brown mottled grey and brown, sandy, slightly gravelly CLAY. Gravel is subangular to subrounded, fine including rounded, sandstone and limestone.				
1.20	ES5			1.50					
1.50	D8				Medium dense, light brown reddish brown, slightly gravelly SAND. Gravel is subangular to subrounded, fine to coarse including sandstone and coal.				
1.50 - 2.00	B7				*Between 2.00m and 2.20m: light green, abundant coal.*				
2.00		SPT(S) N=11 (2,2/2,2,3,4)			*Between 2.20m and 2.80m: reddish brown.*		2		
2.00	D9								
2.10	D10								
2.20	ES11			(1.88)					
2.50 - 3.00	B12								
3.00		SPT(S) 50 (5,5/50 for 235mm)			*Below 3.00m: very dense.*		3		
3.00 - 3.38	D13			3.38					
					End of Borehole at 3.38m				
							4		
							5		
							6		
							7		
							8		
							9		
							10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	2.00	PLAIN	
2.00	3.00	SLOTTED	

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: St John's Masterplan	Location ID: **WS10**	
Dates: 24/06/2018	Client: Curtins Consulting	Sheet 1 of 1	
Dynamic Sample Borehole Log	Location:	Ground level:	Logged by: HD / Vertical scale: 1:50 / Project ID: 42206

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
0.15	D2			0.15	MADE GROUND: Tarmacadam.				
0.15	ES1			0.40	MADE GROUND: Brownish black, slightly clayey, gravelly, fine to coarse SAND. Gravel is very angular to subrounded, fine to coarse including brick, tile, porcelain, mudstone, sandstone, slag, limestone and wood fragments.				
0.50	D4			(0.60)					
0.50	ES3			1.00	MADE GROUND: Brownish black, slightly clayey, gravelly, fine to coarse SAND. Gravel is very angular to subrounded, fine and medium including brick, tile, porcelain, mudstone, sandstone, slag, limestone and wood fragments.		1		
1.20		SPT(S) N=0 (1,0/0,0,0,0)		(0.60)					
1.20	D6				MADE GROUND: Very soft, orangy brown mottled black, gravelly, slightly sandy CLAY. Gravel is angular to rounded, fine to coarse including mudstone, brick, sandstone and limestone (reworked).				
1.20	ES5			1.60					
1.20 - 1.65	D7				Medium dense, orangy brown, slightly clayey, gravelly, fine to coarse SAND. Gravel is angular to rounded, fine to coarse including sandstone, mudstone and limestone.		2		
2.00		SPT(S) N=21 (4,3/4,5,6,6)							
2.00	D9								
2.00	ES8			(1.70)					
3.00		SPT(S) N=37 (5,5/9,8,7,13)			*Below 3.00m: dense.*		3		
				3.30					
3.50	D10			(0.60)	Orangey brown, gravelly, slightly clayey, fine to coarse SAND with lenses of brownish grey, fine to coarse SAND. Gravel is angular to rounded, fine to coarse including sandstone, mudstone and limestone.				
				3.90					
4.00		SPT(S) 50 (6,9/50 for 160mm)		(0.41)	Very dense, brownish red, fine to coarse SAND.		4		
4.00	D11			4.31					
4.00 - 4.31	D12				End of Borehole at 4.31m				
							5		
							6		
							7		
							8		
							9		
							10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks
1.20	2.00		100	
2.00	3.00		100	
3.00	4.00		100	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	2.00	PLAIN	
2.00	4.00	SLOTTED	

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: St John's Masterplan		Location ID: **WS11**
Dates: 23/06/2018	Client: Curtins Consulting		Sheet 1 of 1
Dynamic Sample Borehole Log	Location:	Ground level: / Logged by: RS / Vertical scale: 1:50	Project ID: 42206

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				0.20	MADE GROUND: CONCRETE.				
0.20 - 0.70	B1			0.40	MADE GROUND: Light brown, sandy, fine and medium grained GRAVEL. Gravel is subangular to angular, fine and medium including limestone (Type 1).				
0.25	D3			(0.30)					
0.25	ES2			0.70	MADE GROUND: Dark brown, clayey, slightly gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse including brick, concrete and plastic.				
0.40	ES4						1		
0.50 - 1.00	B5			(0.80)	MADE GROUND: Firm, brown, sandy CLAY.				
0.70	ES6								
0.75	D7			1.50					
1.20		SPT(S) N=14 (1,1/2,2,2,8)			Very dense, dark reddish brown, gravelly, fine to coarse SAND. Gravel is subangular to angular, fine to coarse including sandstone.				
1.20	D8						2		
1.70	D9								
2.00		SPT(S) N=20 (4,5/4,4,5,7)							
2.00	D11								
2.00 - 2.50	B10								
2.70	D12			(2.80)			3		
3.00		SPT() N=14 (6,6/4,4,3,3)							
3.00	D14								
3.00 - 3.50	B13								
3.70	D15								
4.00		SPT(S) 50 (8,10/50 for 150mm)			*Below 4.00m: very dense.*		4		
4.00 - 4.30	D16			4.30	End of Borehole at 4.30m				
							5		
							6		
							7		
							8		
							9		
							10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	1.50	PLAIN	
1.50	3.50	SLOTTED	

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 305	St John's Masterplan	**BH02**
Dates:	**Client:**	Sheet 1 of 3
13/07/2018	Curtins Consulting	

Cable Percussion and Rotary Boring Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
			HD/NC	1:50	42206

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
0.20	ES1			(0.30)	MADE GROUND: Grass over, dark brown, gravelly, fine and medium SAND. Gravel including very angular to rounded, fine to coarse including brick, sandstone, mudstone, frequent rootlets, slate, tile with rare glass (Topsoil).				
0.25	B2			0.30	MADE GROUND: Brownish black, gravelly fine to coarse SAND. Gravel including very angular to rounded, fine and coarse including brick, slate, mudstone, sandstone, tile, rare glass with occasional rootlets.				
0.50	ES3								
1.10	D5						1		
1.10	ES4								
1.20		SPT(S) N=16 (2,3/4,4,4,4)							
1.20 - 1.50	B6			(2.50)					
1.20 - 1.65	D7								
1.60 - 2.60	B8								
1.80	ES9						2		
2.10		SPT(S) N=12 (3,3/3,3,3,3)							
2.10 - 2.55	D10								
2.90	D11			2.80	MADE GROUND: Greyish red, gravelly, fine to coarse SAND. Gravel including subangular to rounded, fine to coarse including tile, brick, sandstone and mudstone.				
3.00		SPT(S) 24 (3,3/24 for 160mm)		3.00	Dark yellowish brown, fine to coarse SAND and subangular to subrounded, fine to coarse GRAVEL including sandstone and mudstone.		3		
3.00 - 3.30	B12								
3.00 - 3.30	D13								
3.20	D14			(1.20)					
3.30 - 3.70	D15								
3.40		SPT(S) 50 (8,8/50 for 235mm)					4		
3.40 - 3.80	D16								
4.30		SPT(S) 20 (25 for 95mm/20 for 70mm)		4.20	Reddish brown SANDSTONE.				
4.30 - 4.40	D17			(0.40)					
4.50	D18	AZCL		4.60	Extremely weak to very weak, thickly laminated, reddish brown, fine and medium grained SANDSTONE. Discontinuities are subhorizontal, 2-4 degrees, very closely spaced, planar to undulating, open and rough.				
	70		4.70m - SPT(S) 50 (25 for 75mm/50 for 70mm)						
4.60 - 5.60	11	NI	4.70m - D19	(1.00)			5		
	0								
				5.60	Weak to medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are subhorizontal, 2-4 degrees, very closely spaced, planar to undulating, open and rough.				
	66	10					6		
5.60 - 7.10	24			(1.40)	*Between 6.20m and 6.23m: weak reddish brown mudstone.*				
	0								
		AZCL		7.00	Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are subhorizontal, 1-3 degrees, closely spaced, planar to undulating, open and rough.		7		
	100								
7.10 - 8.60	93	10		(1.70)			8		
	42								
				8.70	Weak to medium strong, reddish brown, fine and medium grained SANDSTONE with occasional 2-3mm thick brown mudstone laminae. Discontinuities are 1) subhorizontal, 2-6 degrees, very closely spaced, planar to undulating, open, smooth and slightly rough. 2) subvertical 70-80 degrees, medium to widely spaced, planar, open and rough.		9		
	71	NI							
8.60 - 10.00	12								
	0								
		AZCL							
	TCR/SCR/RQD	FI	Samples & Tests		Continued next sheet		10		

Chiselling			
From (m)	To (m)	Time (mins)	Remarks

Borehole Diameter	
Depth (m)	Dia (mm)
4.85	200

Casing Diameter	
Depth (m)	Dia (mm)
4.70	200

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
13/07	16:00	4.60	4.60	Dry
16/07	08:00	4.60	4.60	3.50
16/07	16:30	17.20	4.60	2.10
17/07	08:00	17.50	4.60	7.20

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	5.00	Plain	
5.00	20.00	Slotted	

Checked by:	HH	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 305	Project: St John's Masterplan	Location ID: **BH02**
	Dates: 13/07/2018	Client: Curtins Consulting	Sheet 2 of 3
Rotary Borehole Log	Location:	Ground level:	Logged by: HD/NC / Vertical scale: 1:50 / Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
10.00 - 11.50	60 18 6	9 NI AZCL				Weak to medium strong, reddish brown, fine and medium grained SANDSTONE with occasional 2-3mm thick brown mudstone laminae. Discontinuities are 1) subhorizontal, 2-6 degrees, very closely spaced, planar to undulating, open, smooth and slightly rough. 2) subvertical 70-80 degrees, medium to widely spaced, planar, open and rough. *At 10.00m: medium strong.*		11		
11.50 - 13.00	66 25 6	16 NI 10 AZCL			(5.90)			12		
13.00 - 14.50	100 74 52	9 NI 6						13 14		
14.50 - 16.00	100 86 41	NI 8			14.60 (0.40) 15.00 15.20	*Between 14.50m and 14.60m: weak, greenish brown, medium grained sandstone.* Weak, reddish brown MUDSTONE. Discontinuities are subhorizontal, 6-7 degrees, closely spaced, undulating open and smooth. Medium strong, reddish brown MUDSTONE and pale green SILTSTONE.		15		
16.00 - 17.50	83 83 30	AZCL 13				Medium strong, reddish brown, fine and medium grained SANDSTONE with occasional brown 3-8mm thick clay laminae. Discontinuities are subhorizontal, 1-4 degrees, very closely to closely spaced, planar tight to open and slightly rough.		16 17		
17.50 - 19.00	86 66 46	AZCL NI			(6.95)			18		
19.00 - 20.50	100 93 56							19 20		

Continued next sheet

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)
4.60	25.00	Air mist	80	4.85	200

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
13/07	16:00	4.60	4.60	Dry
16/07	08:00	4.60	4.60	3.50
16/07	16:30	17.20	4.60	2.10
17/07	08:00	17.50	4.60	7.20

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter	
Depth (m)	Dia (mm)
4.70	200

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	5.00	Plain	
5.00	20.00	Slotted	

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 305	Project: St John's Masterplan		Location ID: **BH02**
Dates: 13/07/2018	Client: Curtins Consulting		Sheet 3 of 3
Rotary Borehole Log	Location:	Ground level:	Logged by: HD/NC / Vertical scale: 1:50 / Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Medium strong, reddish brown, fine and medium grained SANDSTONE with occasional brown 3-8mm thick clay laminae. Discontinuities are subhorizontal, 1-4 degrees, very closely to closely spaced, planar tight to open and slightly rough.		21		
20.50 - 22.00	100 100 71							22		
					22.15	Strong, reddish brown, fine grained SANDSTONE with rare off white and black 3-5mm sized quartzite and lignite inclusions. Discontinuities are subhorizontal, 2-5 degrees, widely spaced, planar to undulating, open and slightly rough. *At 22.20m: iron staining along fracture.* *Between 22.20m and 25.00m: occasional brown 10-20mm sized mudstone inclusions.*		23		
22.00 - 23.50	100 97 82	5								
23.50 - 25.00	100 93 78				(2.85)			24		
					25.00	End of Borehole at 25.00m		25		
								26		
								27		
								28		
								29		
								30		

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
17/07	16:30	25.00	4.60	6.80

Remarks:

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Dando 2000/Comacchio 205	Project: St John's Masterplan		Location ID: **BH03**
Dates: 29/06/2018 - 03/07/2018	Client: Curtins Consulting		Sheet 1 of 3
Cable Percussion and Rotary Boring Log	Location:	Ground level:	Logged by: HD / Vertical scale: 1:50 / Project ID: 42206

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
0.20	D2			0.10	MADE GROUND: Tarmacadam			
0.20	ES1			0.30	MADE GROUND: Grey, fine to coarse SAND and very angular to subangular, fine and medium GRAVEL including granite.			
0.50	D4				MADE GROUND: Brownish black, clayey, gravelly, fine to coarse SAND. Gravel is very angular to subrounded, fine to coarse including brick, tile and sandstone.			
0.50	ES3			(0.80)				
				1.10				
1.20		SPT(S) N=15 (1,2/3,3,4,5)			Medium dense, yellowish brown, clayey, fine to coarse SAND and very angular to rounded, fine to coarse GRAVEL including sandstone, mudstone and limestone (possible made ground).			
1.20	D7							
1.20	ES5							
1.20 - 1.65	D8			(1.10)				
1.20 - 2.00	B6							
2.00		SPT(S) N=20 (3,3/3,4,5,8)						
2.20	D9			2.20	Medium dense, brown, clayey, fine to coarse SAND and angular to rounded, fine to coarse GRAVEL including sandstone, mudstone and limestone.			
2.70	B10							
3.00		SPT(S) 50 (5,5/50 for 295mm)		(1.60)	*Below 3.00m: very dense.*			
3.00 - 3.50	B11							
3.00 - 3.50	D12							
3.70		SPT(S) 50 (12,12/50 for 180mm)		3.80				
3.70	D13				Reddish brown SANDSTONE recovered as fine to coarse sand.			
3.70 - 4.15	D14							
4.10		SPT(S) 50 (10,15/50 for 95mm)		(0.90)				
4.10 - 4.35	D15							
		AZCL 0 NI		4.70				
		4.70m - SPT(S) 50 (25 for 75mm/50 for 295mm)						
4.70 - 6.20	84 47 0	18		(1.43)	Very weak to weak, reddish brown, coarse grained SANDSTONE with rare mudstone lenses (<20x20mm). Discontinuities are subhorizontal, very closely spaced, rough undulating, open to moderately wide sand and angular to subangular, fine to coarse gravel fill. Orange staining on fracture surfaces and reduced strength.			
				6.13				
6.20 - 7.70	100 100 21			(3.47)	Medium strong, reddish brown, coarse grained SANDSTONE. Discontinuities are subhorizontal, very closely to closely spaced, rough planar, undulating, open to moderately wide, clean and with sand, gravel and rare clay fill. Orange staining on fracture surfaces.			
7.70 - 9.20	100 92 25	12			*Between 8.26m and 8.33m: subhorizontal fracture with clay and gravel fill.*			
9.20 - 10.70	100 94 53			9.60	Medium strong, reddish brown, coarse grained SANDSTONE with occasional subangular, medium and coarse gravel of mixed			
	TCR/SCR/RQD	FI	Samples & Tests		Continued next sheet			

Chiselling

From (m)	To (m)	Time (mins)	Remarks
3.00	4.70	90	

Borehole Diameter

Depth (m)	Dia (mm)
25.00	107

Casing Diameter

Depth (m)	Dia (mm)
4.70	200

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
03/07	08:00	4.70	4.70	2.10
29/06	16:30	4.70	4.70	Dry
04/07	08:00	25.00		1.90
03/07	16:30	25.00	4.70	1.80

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	8.80	Plain	19
8.80	10.00	Slotted	19

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Checked by:	HH	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Dando 2000/Comacchio 205	Project: St John's Masterplan	Location ID: **BH03**
	Dates: 29/06/2018 - 03/07/2018	Client: Curtins Consulting	Sheet 2 of 3
Rotary Borehole Log	Location:	Ground level: / Logged by: HD / Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Medium strong, reddish brown, coarse grained SANDSTONE with occasional subangular, medium and coarse gravel of mixed lithologies. Discontinuities are subhorizontal, very closely spaced to closely, open to moderately wide, clean and with sand film fill. Reduced strength along fractures.				
10.70 - 12.20	100 82 15				(1.90)	*Between 10.70m and 10.79m: medium and coarse grained sandstone.* *Between 11.13m and 11.15m: coarse grained.*		11		
					11.50	Medium strong to strong, thickly laminated, reddish brown medium and coarse grained SANDSTONE. Discontinuities are subhorizontal, closely spaced to medium spaced, rough, undulating, open to moderately wide with subangular, fine to coarse gravel of sandstone and sand fill and orange brown staining.		12		
12.20 - 13.70	100 95 75	4 NI 4			(2.20)	*Between 13.48m and 13.54m: non intact sand and gravel.*		13		
					13.70	Medium strong, reddish brown, coarse grained SANDSTONE with rare lenses of mudstone. Discontinuities are 1) subhorizontal, very closely spaced, rough undulating and moderately wide with grey sandy clay fill. 2) 20 degrees, very widely spaced, rough undulating, moderately wide with film of grey sandy clay. Fractures stained yellow, grey and orange.		14		
13.70 - 15.20	71 43 7	9 AZCL 11			(2.40)			15		
15.20 - 16.70	73 37 24	AZCL 0 NI 10				*Between 15.83m and 16.00m: non intact stained yellow orange grey.*		16		
					16.10	Medium strong, reddish brown, locally coarse grained SANDSTONE with rare to occasional subangular medium and coarse gravel of mixed lithologies. Discontinuities are 1) subhorizontal, very closely spaced to closely spaced, rough, undulating, open to moderately wide with sand film fill and subangular, fine to coarse gravel fill. 2) 40-55 degrees, widely spaced, rough undulating, open with film of sand.				
16.70 - 18.20	100 93 42	20			(1.33)			17		
					17.43	Strong, thinly laminated, reddish brown, interbedded medium and coarse grained SANDSTONE. Discontinuities are 1) subhorizontal, very closely spaced to closely spaced, rough undulating, open to moderately wide with sand and gravel fill. 2) 40 degrees, widely spaced to very widely spaced, rough, undulating, open with film of grey clay fill.		18		
18.20 - 19.70	100 100 61	6			(1.63)	*Between 18.11m and 18.12m: bed of coarse sandstone and clay lenses.* *Between 18.12m and 18.60m: coarse grained sandstone with subrounded, medium and coarse gravel of mixed lithologies.* *At 18.50m: clay lense 30x 2mm.*				
					19.06	Medium strong to strong, reddish brown, coarse grained SANDSTONE with medium and coarse subrounded gravel of mixed lithologies and lenses of mudstone. Discontinuities are subhorizontal, very closely to widely spaced, rough undulating, open to moderately wide, clean and with sand film fill. 2) 15-25 degrees, very closely spaced to medium spaced, rough		19		
						Continued next sheet		20		

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)
				25.00	107

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
03/07	08:00	4.70	4.70	2.10
29/06	16:30	4.70	4.70	Dry
04/07	08:00	25.00		1.90
03/07	16:30	25.00	4.70	1.80

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter	
Depth (m)	Dia (mm)
4.70	200

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	8.80	Plain	19
8.80	10.00	Slotted	19

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Dando 2000/Comacchio 205	Project: St John's Masterplan		Location ID: **BH03**
Dates: 29/06/2018 - 03/07/2018	Client: Curtins Consulting		Sheet 3 of 3
Rotary Borehole Log	Location:	Ground level:	Logged by: HD	Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.70 - 21.20	100 100 71					Medium strong to strong, reddish brown, coarse grained SANDSTONE with medium and coarse subrounded gravel of mixed lithologies and lenses of mudstone. Discontinuities are subhorizontal, very closely to widely spaced, rough undulating, open to moderately wide, clean and with sand film fill. 2) 15-25 degrees, very closely spaced to medium spaced, rough undulating, open and clean.		21		
21.20 - 22.70	100 100 53	10			(5.44)			22		
22.70 - 24.20	100 100 73	5						23		
24.20 - 25.20	100 74 42	14 0			24.50 24.60 24.85 (0.35) 25.20	Extremely weak to weak, thinly laminated MUDSTONE. Discontinuities are subhorizontal smooth, undulating planar and stepped, very tight to moderately wide, clean and with clay film fill. Weak to medium strong, thinly to thickly laminated medium and coarse grained SANDSTONE. Discontinuities are subhorizontal, very closely to closely spaced, rough, stepped and undulating, open and with film of sand. Medium strong, reddish brown, coarse grained SANDSTONE. Discontinuities are subhorizontal, very closely to closely spaced, open with sand and silt film fill. End of Borehole at 25.20m		24 25		
								26		
								27		
								28		
								29		
								30		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
											SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan, Manchester		Location ID: **BH04B**
Dates: 02/07/2018 - 05/07/2018	Client: Manchester Quays Ltd HQ Building		Sheet 1 of 3
Cable Percussion and Rotary Boring Log	Location: 383131.02E 398018.96N	Ground level: 26.55mOD / Logged by: NC/LVC / Vertical scale: 1:50	Project ID: 42206

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
			26.30	0.25	MADE GROUND: Tarmacadam.			
				(0.35)	MADE GROUND: Light cream brown, very gravelly, fine to coarse SAND. Gravel is subangular to angular, fine to coarse including tarmacdam and concrete.			
			25.95	0.60				
0.80	ES1			(0.50)	MADE GROUND: Dark brown, cobbly, gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse including brick. Cobbles are subangular of brick.			
			25.45	1.10				
1.20		SPT(S) N=7 (1,1/1,2,2,2)			MADE GROUND: Brown mottled orange brown, clayey, gravelly, fine and medium SAND. Gravel is subangular to subrounded, fine to coarse including brick and sandstone.			
1.50	ES2				*Between 11.16m and 11.39m: non intact recovered as gravel including sandstone and quartzite.*			
2.10		SPT(S) N=16 (3,3/3,3,3,7)		(2.30)				
3.00		SPT(S) 50 (10,14/50 for 160mm)						
3.30		SPT(S) 50 (10,11/50 for 265mm)						
			23.15	3.40	dark grey, sandy GRAVEL with strong organic odour. Gravel is subrounded to rounded, fine and medium including sandstone and quartzite.			
			22.90	3.65				
			22.55	(0.35)	Extremely weak reddish brown weathered SANDSTONE.			
4.00 - 4.40	0	AZCL		4.00	Assumed zone of core loss.			
			22.15	(0.40)				
4.40 - 4.90	39 0 0	NI		4.40	Very weak, very thinly bedded, reddish brown, medium and coarse grained SANDSTONE. Discontinuities are 1) subhorizontal, very closely spaced, rough undulating, open to moderately wide sand fill. 2) 35-40 degrees, closely to medium spaced, rough undulating, open, sand fill and medium and coarse gravel fill.			
4.90 - 5.90	70 38 0	4.90m - SPT(S) 50 (25 for 30mm/50 for 30mm)			*At 4.40m: non intact recovered as gravel.*			
				(3.56)				
5.90 - 7.40	59 23 0	35			*Between 6.40m and 6.45m: medium grained gravel and clay lenses.*			
7.40 - 8.50	90 43 0	NI			*Between 7.69m and 7.74m: subrounded, medium grained gravel.*			
			18.59	7.96				
			18.41	8.14	Extremely weak to very weak, very thinly bedded reddish brown, coarse SANDSTONE. Completely weathered. Discontinuities are 1) subhorizontal, very closely spaced, rough undulating, partly open to moderately wide clay with subangular to subrounded gravel of quartz fill. 2) 80-90 degrees widely spaced tight with clay fill <3mm.			
		8.50m - C1		(0.72)	*Between 7.96m and 8.16m: non intact recovered as gravel.*			
			17.69	8.86	*Between 8.12m and 8.14m: MUDSTONE recovered as gravel.*			
8.50 - 10.00	100 57 33	31 9.66m - C2 9.82m - C3			Medium strong, thickly laminated to thinly bedded, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 1) subhorizontal, very closely spaced, rough undulating open, moderately wide sand and gravel fill. 2) 80-90 degrees widely spaced, tight with clay fill <3mm.			
					Medium strong, thickly laminated to thinly bedded, medium and			
	TCR/SCR/RQD	FI	Samples & Tests		Continued next sheet			

Chiselling

From (m)	To (m)	Time (mins)	Remarks
3.00	3.30	30	

Borehole Diameter

Depth (m)	Dia (mm)
25.10	107

Casing Diameter

Depth (m)	Dia (mm)
5.90	200

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
04/07	08:00	3.70	3.70	1.90
04/07	16:30	14.50	5.90	2.20
05/07	08:00	14.50	5.90	2.10

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	5.00	Plain	50
5.00	20.00	Slotted	50

Checked by: HH
Log status: DRAFT
IFA CP v01.01

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan, Manchester	**BH04B**
Dates:	**Client:**	Sheet 2 of 3
02/07/2018 - 05/07/2018	Manchester Quays Ltd HQ Building	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383131.02E 398018.96N	26.55mOD	NC/LVC	1:50	42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
10.00 - 11.50	83 53 0	NI	10.77m - C4	15.16	(2.53) 11.39	Medium strong, thickly laminated to thinly bedded, medium and coarse SANDSTONE, poorly sorted with medium and coarse gravel predominantly quartzite with striations along the walls of the subvertical fractures. Discontinuities are 1) subhorizontal to 15 degrees, very closely spaced, rough undulating, open, sand fill. 2) 80-90 degrees, medium spaced, rough striated undulating, open and discoloured grey.		11		
11.50 - 13.00	100 89 53		11.60m - C5 11.72m - C6 12.03m - C7 12.31m - C8 12.65m - C9 12.70m - C10		(2.11)	Weak, thickly laminated to thinly bedded reddish brown, medium and coarse SANDSTONE. Walls of subhorizontal fracture one weaker than the solid core. Discontinuities are subhorizontal, very closely to closely spaced, rough undulating open, moderately wide sand fill <1mm and gravel fill. *Between 12.45m and 12.50m: with localised, subangular to subrounded, fine and medium grained gravel of mixed lithology.* *Between 13.00m and 13.50m: with localised, subangular to subrounded, fine and medium grained gravel of mixed lithology.*		12		
13.00 - 14.50	100 77 23	10	13.05m - C11 14.10m - C12	13.05 12.24	13.50 (0.81) 14.31	Weak thinly laminated to very thinly bedded, reddish brown, coarse grained SANDSTONE interbedded with lenses of mudstone. Discontinuities are 1) subhorizontal, very closely spaced to closely spaced, rough undulating, open clay and sand fill <3mm. 2) 30 degrees, very closely spaced to closely spaced, rough undulating, open sand fill <1mm. *Between 13.50m and 14.00m: weathered clay.*		13 14		
14.50 - 16.00	100 89 53		14.50m - C13 14.90m - C14 15.00m - C15	11.25	(0.99) 15.30	Medium strong, thinly to thickly laminated reddish brown, medium grained SANDSTONE with lenses and very thinly bedded mudstone. Weathering stained black on surface. Discontinuities are 1) subhorizontal, very closely to closely spaced, rough undulating, open to moderately open sand and gravel fill <1mm 10mm. 2)30 degrees, closely spaced, rough, planar open stained black. *Between 14.96m and 15.20m: cross bedding.*		15		
16.00 - 17.50	100 71 53	25+	16.00m - C16 17.00m - C17			Weak, thinly bedded to thickly bedded, reddish brown, locally poorly sorted, coarse grained SANDSTONE. Discontinuities are 1) 15-20 degrees bedding fracture, very closely to closely spaced, rough undulating, open sand and clay fill. 2) 60 degrees closely to widely spaced, rough undulating, open grey and black staining. 3) 80-90 degrees widely spaces, rough undulating, striated, open with clay <1mm fill. *Between 15.50m and 15.60m: locally fine and medium grained.* *Between 15.75m and 15.78m: a bed of weak mudstone.* *Between 16.50m and 16.80m: frequent lenses <10mm of clay.* *Between 16.98m and 17.11m: medium grained.*		16 17		
17.50 - 19.00	100 99 85	7	18.26m - C18 19.00m - C19		(5.20)	*Between 18.71m and 18.72m: poorly sorted, coarse grained with medium grain gravel and lenses of mudstone 40mm by 5mm.* *Between 18.95m and 19.00m: poorly sorted, coarse grained.*		18 19		
19.00 - 20.50	100 92 61		19.80m - C20			*Between 19.40m and 19.75m: poorly sorted, coarse grained.*		20		

Continued next sheet

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)
3.70	25.10	Water		25.10	107

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
04/07	08:00	3.70	3.70	1.90
04/07	16:30	14.50	5.90	2.20
05/07	08:00	14.50	5.90	2.10

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter	
Depth (m)	Dia (mm)
5.90	200

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	5.00	Plain	50
5.00	20.00	Slotted	50

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan, Manchester	**BH04B**
Dates:	**Client:**	Sheet 3 of 3
02/07/2018 - 05/07/2018	Manchester Quays Ltd HQ Building	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383131.02E 398018.96N	26.55mOD	NC/LVC	1:50	42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
			20.14m - C21			Weak, thinly bedded to thickly bedded, reddish brown, locally poorly sorted, coarse grained SANDSTONE. Discontinuities are 1) 15-20 degrees bedding fracture, very closely to closely spaced, rough undulating, open sand and clay fill. 2) 60 degrees closely to widely spaced, rough undulating, open grey and black staining. 3) 80-90 degrees widely spaces, rough undulating, striated, open with clay <1mm fill.				
				6.05	20.50					
			20.73m - C22		(0.85)					
20.50 - 22.00	100 73 50	25+		5.20	21.35	Medium strong, very thinly bedded to medium bedded, reddish brown, poorly sorted, coarse grained SANDSTONE with inclusions of mudstone. Striations of clay between fracture walls. Walls are weaker than core occasionally broken to gravel sized fragments. Discontinuities are 1) 15-30 degrees bedding fracture, very closely to closely spaced, smooth rough, undulating stepped, open to moderately wide, clay sand and gravel fill. 2) 80 degrees, widely spaced, smooth rough undulating striated, dry sand and gravel fill.				
			21.55m - C23							
					(1.50)					
		3				Strong, medium bedded MUDSTONE with frequent lenses sandstone. Lightly stained, orange black and grey along fracture surface. Discontinuities are 1) subhorizontal bedding fracture, closely spaced, rough undulating open. 2) 30 degrees closely spaced, rough undulating open, stained orange and black. 3) 65-80 degrees, very closely spaced, rough undulating stepped, open clay and gravel fill, grey and orange staining.				
22.00 - 23.50	100 65 40	NI		3.70	22.85	*Between 21.80m and 22.70m: highly fractured with clay fill (possible fault zone).* *Between 22.07m and 22.20m: non intact recovered as gravel.* *Between 22.50m and 22.69m: non intact recovered as gravel.*				
			23.14m - C24							
		11			(1.30)					
23.50 - 24.25	100 100 93		24.04m - C25	2.40	24.15	Medium strong to strong. medium to thickly bedded, medium and coarse grain SANDSTONE. Slight black staining along fracture surface. Weathering along fracture wall. Discontinuities are 1) subhorizontal bedding fracture, very closely to closely spaced, rough undulating rough, tight to open sand fill. 2) 35 degrees, closely spaced to widely spaced, rough undulating, open to moderately wide sand and angular coarse gravel fill. 3) 75-85 degrees, closely spaced, rough undulating, tight to open to closed, stained black sand fill.				
			24.25m - C26							
24.25 - 25.10	100 100 100	0			(0.95)					
				1.45	25.10	Strong to very strong, thinly to medium bedded, medium and coarse grain SANDSTONE. *Between 24.35m and 24.45m: medium grain sandstone with subrounded to rounded, coarse gravel.*				
						End of Borehole at 25.10m				

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
											SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan		Location ID: **RBH02**
Dates: 29/06/2018 - 02/07/2018	Client: Curtins Consulting		Sheet 1 of 5
Dynamic Sampling and Rotary Boring Log	Location:	Ground level:	Logged by: HD/DO/HH	Vertical scale: 1:50	Project ID: 42206

Samples & In Situ Testing			Strata Details				Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
				0.20	MADE GROUND: Tarmacadam.			
0.30	D2			0.40	MADE GROUND: Greyish brown, slightly clayey, fine to coarse SAND very angular to subrounded, fine to coarse GRAVEL including brick, granite, tile, sandstone, limestone and mudstone.			
0.30	ES1				MADE GROUND: Red brick wall (possible canal). *Below 0.40m: brownish black.*			
0.50	D4							
0.50	ES3							
1.00	D6							
1.00	ES5							
1.20		SPT(S) 50 (25 for 10mm/50 for 10mm)						
1.20 - 1.65	D8							
1.20 - 2.00	B7							
2.00		SPT(S) 50 (25 for 85mm/50 for 3mm)						
2.00 - 2.45	D10							
2.00 - 3.00	B9			(4.60)				
3.00		SPT(S) 50 (25 for 40mm/50 for 10mm)						
3.00 - 3.45	D11							
3.40	B12							
3.90 - 4.35	D13							
4.00		SPT(S) N=8 (2,3/2,2,2,2)						
4.50 - 5.00	B14							
		NI		5.00	MADE GROUND : Strong, red BRICK and strong light grey CONCRETE well bonded.			
	100	5.00m - SPT(S) 50 (5,10/50 for 40mm)						
5.00 - 6.00	88	5.00m - D15		(1.25)				
	80	5						
		NI		6.25	Weak, reddish brown, fine grained SANDSTONE. Discontinuities are 0-20 degrees, closely spaced, planar and undulating rough, unstained. *Between 6.25m and 6.65m: 1no discontinuity, 45 degrees planar, rough, no infill. Colour changing to grey up to 5mm.*			
		6						
		NI						
	93	6						
6.00 - 7.75	93			(1.20)				
	87	NI			*Between 7.15m and 7.30m: with inclusions of angular to subangular, fine and medium gravel of siltstone.*			
		2						
		NI		7.45	Extremely weak, reddish brown MUDSTONE.			
		AZCL		7.55				
				7.65	Extremely weak, reddish brown, fine grained SANDSTONE recovered as gravelly, fine SAND. Gravel is angular to subangular, coarse including sandstone.			
				7.75				
				7.95	Assumed zoneof core loss.			
	100				Medium strong, reddish brown, fine and medium grained SANDSTONE. *At 7.88M: 1no of possibly DI fracture, 0 degrees, planar, rough, unstained no infill.*			
7.75 - 9.25	100			(1.20)				
	100	9						
				9.15	Weak, reddish brown, medium grained SANDSTONE. Discontinuities are 1) 0-10 degrees, predominantly very closely and rarely closely, planar smooth and occasionally rough unstained, no infill.			
				(1.65)	Medium strong, reddish brown, fine grained SANDSTONE. Discontinuities are 1) 0-10 degrees, closely spaced, planar, smooth, unstained, clay infill up to 1mm. 2) 45-60 degrees, medium spaced, planar smooth. Colour changing to grey.			
	TCR/SCR/RQD	FI	Samples & Tests		Continued next sheet			

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.
Rotary open hole from 5.00m.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	6.30	PLAIN	
6.30	20.00	SLOTTED	

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan	Location ID: **RBH02**
	Dates: 29/06/2018 - 02/07/2018	Client: Curtins Consulting	Sheet 2 of 5
Rotary Borehole Log	Location:	Ground level: / Logged by: HD/DO/HH / Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
9.25 - 10.75	100 100 100					Medium strong, reddish brown, fine grained SANDSTONE. Discontinuities are 1) 0-10 degrees, closely spaced, planar, smooth, unstained, clay infill up to 1mm. 2) 45-60 degrees, medium spaced, planar smooth. Colour changing to grey.				
10.75 - 12.25	100 100 100	6			10.80 (0.88) 11.68	Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 15-30 degrees, medium spaced, planar smooth with less then 2mm clay infill unstained.		11		
					(0.77)	Medium strong, reddish brown, fine grained SANDSTONE, locally weak. Discontinuities are 0-15 degrees, closely spaced, planar smooth with up to 1mm clay infill unstained.		12		
12.25 - 13.75	100 100 100	9			12.45 (0.30) 12.75	Medium strong locally weak, red brown, medium grained SANDSTONE. Discontinuities are 0-15 degrees, closely spaced, undulating smooth, unstained, no infill.				
						Medium strong, reddish brown, fine and medium grained SANDSTONE, locally weak. Discontinuities are 0-15 degrees, predominantly medium and locally closely spaced, smooth and rough unstained, no infill.		13		
13.75 - 15.25	100 100 100	3			(3.05)			14		
								15		
15.25 - 16.75	50 48 48	NI 6 AZCL			15.80 16.00 (0.75)	Weak, reddish brown, medium and coarse grained SANDSTONE. *At 15.90m: 1 no discontinuity 0 degrees, undulating smooth, unstained, no infill.* Assumed zone of core loss.		16		
16.75 - 17.75	100 100 100				16.75	Medium strong, reddish brown, fine and medium grained SANDSTONE with occasional inclusion of subrounded fine gravel of quartzite. Discontinuities are 0-15 degrees, closely spaced, planar smooth, unstained, no infill.		17		
17.75 - 19.25	100 100 100	4			(2.75)			18		
								19		
					19.50	Weak, reddish brown, medium and locally coarse grained SANDSTONE with inclusion of angular to subrounded, fine gravel of siltstone and quartzite. Discontinuities are 0-15 degrees, very		20		

Continued next sheet

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)
				40.00	107

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
29/06	16:30	19.25	6.20	2.90
02/07	08:00	19.25	6.20	1.60
02/07	16:00	40.00	6.20	1.50

Remarks:

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter	
Depth (m)	Dia (mm)
6.20	200

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan	Location ID: **RBH02**
	Dates: 29/06/2018 - 02/07/2018	Client: Curtins Consulting	Sheet 3 of 5
Rotary Borehole Log	Location:	Ground level: / Logged by: HD/DO/HH / Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.25 - 20.75	100 100 100				(1.60)	Weak, reddish brown, medium and locally coarse grained SANDSTONE with inclusion of angular to subrounded, fine gravel of siltstone and quartzite. Discontinuities are 0-15 degrees, very closely spaced, planar smooth and rough unstained no infill.				
20.75 - 22.25	100 100 73	9			21.10 (1.15)	Weak, reddish brown, fine, locally medium grained SANDSTONE with inclusion of subangular to subrounded, fine gravel of siltstone and quartzite. Discontinuities are 0-15 degrees, very closely spaced, planar smooth and rough unstained no infill.		21 22		
22.25 - 23.75	100 100 97	3 20			22.25	Medium strong, reddish brown, fine and medium grained SANDSTONE with occasional inclusion of angular to subrounded, fine gravel of siltstone and quartzite. Discontinuities are 0-15 degrees, closely to medium spaced, planar smooth with occasional clay infill up to 1mm unstained.		23		
23.75 - 25.25	100 100 97	4						24 25		
25.25 - 26.75	100 100 80				(6.20)	*Between 25.75 and 26.05m: 1no discontinuities approx 60-70 degrees, undulating smooth, with silt infill >2mm.*		26		
26.75 - 28.25	100 100 97	3				*Between 27.75 and 27.95m: 1no discontinuities approx 60-70 degrees, undulating smooth, unstained no infill.*		27 28		
28.25 - 29.75	100 100 73	16 5			28.45 (0.85) 29.30	Weak, reddish brown, medium grained SANDSTONE with occasional inclusion of angular to subrounded, fine gravel of siltstone. Discontinuities are 0-15 degrees, closely spaced, planar smooth and rough unstained no infill. Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-15 degrees, closely spaced, planar smooth with clay infill upto 1mm, unstained.		29		
						Continued next sheet		30		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan	Location ID: **RBH02**
	Dates: 29/06/2018 - 02/07/2018	Client: Curtins Consulting	Sheet 4 of 5
Rotary Borehole Log	Location:	Ground level: / Logged by: HD/DO/HH / Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
29.75 - 31.25	100 100 87	5 3			(3.10)	Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-15 degrees, closely spaced, planar smooth with clay infill upto 1mm, unstained. *Between 31.25m and 31.35m: assumed zone of ocre loss.* *At 31.75m: gravel infill* *Between 31.80m and 32.25m: medium spaced discontinuities.*		31		
31.25 - 32.75	80 73 40	AZCL 17 3 8 10			32.40	Weak, red brown, coarse grained SANDSTONE with rare mudstone inclusions (2mm in diameter). Discontinuities are subhorizontal very closely spaced, planar smooth. *Between 33.25m and 33.85m: medium spaced, undulating smooth discontinuities.*		32 33		
32.75 - 34.25	100 100 71	5 9				*Below 34.25m: medium strong.*		34		
34.25 - 35.75	100 100 85	6 16 7				*Between 35.40m and 35.70m: medium spaced discontinuities.*		35		
35.75 - 37.25	100 100 70	NI 4			(7.30)	*Between 35.95m and 36.00m: grey discolouration.* *Between 36.25m and 36.35m: non intact recovered as coarse gravel.* *Between 36.30m and 36.90m: medium spaced discontinuities.*		36		
37.25 - 38.75	100 88 57	7 20 7				*Between 37.15m and 37.25m: grey discolouration.* *Between 37.80m and 37.90m: a subvertical, widely spaced, undulating smooth and open fracture.* *At 37.90m: grey discolouration.* *Below 38.25m: fine to medium grained* *At 38.30m: grey discolouration.*		37 38		
38.75 - 40.00	87 73 64	NI 14 AZCL 9 NI			39.70 39.80 40.00	*At 38.75m: mudstone gravel.* *Between 38.75m to 38.95m: non intact recovered as coarse gravel.* *Between 39.02m and 39.25m: assumed zone of core loss.* *Below 39.30m: weak, medium to coarse grained.* Very weak, brown MUDSTONE. Weak, red brown, coarse grained SANDSTONE with rare Continued next sheet		39 40		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan		Location ID: **RBH02**
Dates: 29/06/2018 - 02/07/2018	Client: Curtins Consulting		Sheet 5 of 5
Rotary Borehole Log	Location:	Ground level:	Logged by: HD/DO/HH	Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Weak, red brown, coarse grained SANDSTONE with rare mudstone inclusions (2mm in diameter). Discontinuities are subhorizontal very closely spaced, planar smooth. *Between 39.90m and 40.00m: non intact recovered as coarse gravel.*		41		
						End of Borehole at 40.00m		42		
								43		
								44		
								45		
								46		
								47		
								48		
								49		
								50		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan, Manchester		Location ID: **RBH03**
Dates: 03/04/2018 - 06/04/2018	Client: Manchester Quays Ltd HQ Building		Sheet 1 of 5
Dynamic Sampling and Rotary Boring Log	Location:	Ground level:	Logged by: RS/HH	Vertical scale: 1:50	Project ID: 42206

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
				0.17	MADE GROUND: Concrete.			
0.20 0.25 - 0.60 0.40	D1 B2 ES3			0.25	MADE GROUND: Light pinkish grey, slightly sandy, subrounded to angular, fine to coarse GRAVEL including limestone.			
				(1.75)	MADE GROUND: Loose, brown, gravelly, slightly clayey, fine to coarse SAND with medium cobble content and low boulder content. Gravel is angular to subrounded of brick, sandstone and rare granite. Boulders are subangular to subrounded including sandstone and granite.			
1.20 1.20 - 1.65	D4	SPT(S) N=8 (2,2/2,2,2,2)						
				2.00	Black, spongy PEAT.			
2.20 2.20 - 2.65	D5	SPT(S) N=27 (4,5/7,6,7,7)		2.20	Medium dense, light, brown, gravelly SAND.			
				(1.00)				
3.20 3.20 - 3.65	D6	SPT(S) N=30 (4,5/5,5,7,13)		3.20	Dense, SAND and GRAVEL (driller's description).			
				(1.00)				
				4.20	Reddish brown SAND, possibly weathered sandstone (driller's description).			
				(0.66)				
4.20 - 5.40	0 0 0			4.86	No recovery assumed red SANDSTONE. Driller notes pushing a boulder down			
5.40 - 6.30	0 0 0	NR						
6.30 - 7.30	0 0 0			(3.44)				
7.30 - 8.30	0 0 0							
8.30 - 8.80	100 80 36	NI 7		8.30	Weak, red brown, medium and coarse SANDSTONE. Discontinuities are horizontal, very closely to closely spaced, undulating rough, open.			
		25+		(1.20)	*Between 8.30 and 8.48m: angular and coarse gravel.* *At 8.58m: mudstone infill.* *At 8.62m: siltstone inclusion at 2cm in diameter.* *Between 8.91m and 9.13m: extremely closely spaced, undulating, smooth.* *Between 9.07m and 9.13m: mudstone infill.* *Between 9.23m and 9.30m: subhorizontal.*			
8.80 - 10.30	100 100 31	9	9.60m - C7	9.50	Weak, very weak, red brown, fine and medium SANDSTONE. Discontinuities are horizontal, very closely to closely spaced, smooth undulating, open.			
	TCR/SCR/RQD	FI	Samples & Tests		Continued next sheet			

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: JT.01 Energy Ratio: 64%

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	14.50	Plain	19
14.50	16.50	Piezo tip	19

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan, Manchester		Location ID: **RBH03**
Dates: 03/04/2018 - 06/04/2018	Client: Manchester Quays Ltd HQ Building		Sheet 2 of 5
Rotary Borehole Log	Location:	Ground level:	Logged by: RS/HH	Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Weak, very weak, red brown, fine and medium SANDSTONE. Discontinuities are horizontal, very closely to closely spaced, smooth undulating, open.				
			10.50m - C8			*Below 10.50m: subhorizontal.*				
10.30 - 11.80	100 100 69	6	11.00m - C9					11		
			11.30m - C12			*At 11.20m: mudstone inclusion 2cm in diamter.*				
		25+				*Extremely closely spaced, undulating smooth, clay infill.*				
						Between 11.80m and 12.80m: medium and coarse grained sandstone.		12		
11.80 - 13.30	100 100 45	6	12.40m - C10		(5.40)	*At 12.52m: quartzite inclusions.*				
		25+				*At 13.10m: sand infill.*		13		
			13.40m - C11			*At 13.30m: subvertical widely spaced.*				
13.30 - 14.80	100 100 84	4	13.87m - C13					14		
			14.30m - C14							
		25+								
		7			14.90	Weak, red micaeceous, fine grained SANDSTONE.		15		
		25+	15.11m - C15		15.14	Discontinuities are horizontal, very closely spaced, planar, smooth, open and clean.				
14.80 - 16.30	100 100 78	4	15.40m - C16			Weak, very weak, red brown, fine and medium grained SANDSTONE. Discontinuities are horizontal, very closely to closely spaced, smooth undulating, open. *At 15.20m: yellow band (subvertical)>* *Between 15.37m and 15.40m: mudstone infill.*		16		
		25+								
			16.50m - C17							
		5	16.52m - C32							
16.30 - 17.80	100 100 66		17.06m - C37					17		
		25+				*Between 17.30m and 17.80m: mudstone inclusions 3cm in diameter.*				
					(5.06)					
			18.00m - C19			*Below 17.80m: medium and coarse grained with occasional quartzite clasts.*		18		
17.80 - 19.30	100 100 61	6								
			19.12m - C16			*At 19.10m: sand infill.*		19		
			20.00m - C21					20		

Continued next sheet

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
5.40	4.20	Water	80
6.30	5.40	Water	100
6.80	6.30	Water	100
7.30	6.80	Water	100
7.80	7.30	Water	100
8.30	7.80	Water	100
8.80	8.30	Water	100
10.30	8.80	Water	100

Checked by: HH
Log status: DRAFT
IFA RC v01.01

Borehole Diameter

Depth (m)	Dia (mm)
40.30	92

Casing Diameter

Depth (m)	Dia (mm)
5.40	200

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
03/04	16:30	4.20		3.50
04/04	08:00	4.20		3.20
04/04	16:30	5.40	4.20	3.20
05/04	08:00	5.40		

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: JT.01 Energy Ratio: 64%

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	14.50	Plain	19
14.50	16.50	Piezo tip	19

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan, Manchester		Location ID: **RBH03**
Dates: 03/04/2018 - 06/04/2018	Client: Manchester Quays Ltd HQ Building		Sheet 3 of 5
Rotary Borehole Log	Location:	Ground level:	Logged by: RS/HH	Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.30 - 20.80	100 90 66				20.20	Weak, very weak, red brown, fine and medium grained SANDSTONE. Discontinuities are horizontal, very closely to closely spaced, smooth undulating, open.				
20.80 - 22.30	100 100 81	3	22.00m - C18			Very weak red, medium and coarse grained SANDSTONE. Discontinuities are: subhorizontal, closely spaced, undulating, smooth clean. *At 21.10m: sand infill.* *Between 21.10m and 21.30m: subvertical, widely spaced.* *At 21.20m: iron stained, very weak.* *Below 21.30m: closely spaced.* *At 21.50m: mudstone inclusion.* *At 22.10m/: gravel infill.*		21 22		
22.30 - 23.80	100 100 75	5				*Below 22.30m: rare inclusions <2cm.*		23		
23.80 - 25.30	86 80 51	AZCL 5 NI	24.30m - C23		(10.88)	*Between 24.80m and 24.83m: mudstone.* *Between 24.80m and 25.00m: non intact recovered as gravel.* *Below 25.30m: extremely weak/very weak.*		24 25		
25.30 - 26.80	100 100 45	6	26.10m - C24			*Between 25.60m and 25.95m: vertical discontinuity.* *Below 26.30m: very weak to weak.*		26		
26.80 - 28.30	93 93 69	3	26.90m - C21 28.04m - C26			*Between 27.30m and 27.40m: vertical discontinuity.* *At 27.57m: quartzite inclusion.* *Between 27.64m and 29.69m: sand infill.* *At 28.10m: clay (mudstone) infill.*		27 28		
28.30 - 29.80	100 100 77		28.94m - C27 29.20m - C24			*Between 29.15m and 29.30m: very coarse grained with frequent inclusions of mudstone and quartzite.*		29		
						Continued next sheet		30		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
11.80	10.30	Water	100
13.30	11.80	Water	70
14.80	13.30	Water	70
16.30	14.80	Water	70
17.80	16.30	Water	35
19.30	17.80	Water	35
20.80	19.30	Water	35
22.30	20.80	Water	50

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
05/04	16:30	32.80	5.40	
06/04	08:00	32.80	5.40	3.97
06/04	16:00	40.30	5.40	

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:

SPT Hammer: JT.01 Energy Ratio: 64%

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan, Manchester		Location ID: **RBH03**
Dates: 03/04/2018 - 06/04/2018	Client: Manchester Quays Ltd HQ Building		Sheet 4 of 5
Rotary Borehole Log	Location:	Ground level:	Logged by: RS/HH	Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
29.80 - 31.30	100 100 80		30.42m - C29			Very weak red, medium and coarse grained SANDSTONE. Discontinuities are: subhorizontal, closely spaced, undulating, smooth clean. *Between 29.90m and 29.94m: 5cm mudstone inclusion.*				
		8			30.90					
		2	31.30m - C30		(0.80)	Weak, red medium grained SANDSTONE. Discontinuities are horizontal, very closely to closely spaced, smooth undulating, open. *Between 31.05m and 32.70m: closely spaced, subhorizontal.*		31		
31.30 - 32.80	100 100 56	12	32.50m - C31		31.70	Very weak, red medium and coarse grained SANDSTONE with rare mudstone inclusions. Discontinuities are horizontal, very closely to closely spaced, smooth undulating, open.		32		
32.80 - 34.30	100 100 78		33.90m - C28		(2.20) 33.90	Very weak to weak, red, medium grained SANDSTONE with frequent mudstone banding. Discontinuities are horizontal, very closely to closely spaced, smooth undulating, open. *Between 33.90m and 34.90m: ?????* *Between 34.30m and 33.83m: sand infill.*		33 34		
34.30 - 35.30	100 100 80	4	35.01m - C29					35		
35.30 - 37.30	100 100 60		36.30m - C30		(6.40)			36 37		
37.30 - 38.80	100 100 85	1	37.95m - C35			*Between 37.30m and 38.30m: medium spaced.* *At 38.40m: mudstone infill.* *At 38.60m: mudstone inclusions.*		38		
38.80 - 40.30	100 100 95	3	39.35m - C36 39.70m - C33					39 40		

Continued next sheet

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
23.80	22.30	Water	50
25.30	23.80	Water	50
26.80	25.30	Water	50
28.30	26.80	Water	50
29.80	28.30	Water	70
31.30	29.80	Water	70
32.80	31.30	Water	70
34.30	32.80	Water	50

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:

SPT Hammer: JT.01 Energy Ratio: 64%

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan, Manchester		Location ID: **RBH03**
Dates: 03/04/2018 - 06/04/2018	Client: Manchester Quays Ltd HQ Building		Sheet 5 of 5
Rotary Borehole Log	Location:	Ground level:	Logged by: RS/HH	Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		2			40.30	Very weak to weak, red, medium grained SANDSTONE with frequent mudstone banding. Discontinuities are horizontal, very closely to closely spaced, smooth undulating, open.				
						End of Borehole at 40.30m				

41 42 43 44 45 46 47 48 49 50

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
35.80	34.30	Water	50
37.30	35.80	Water	50
38.80	37.30	Water	50
40.30	38.80	Water	50

Borehole Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)

Remarks:

SPT Hammer: JT.01 Energy Ratio: 64%

Casing Diameter

Depth (m)	Dia (mm)

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan		Location ID: **RBH04**
Dates: 26/06/2018 - 28/06/2018	Client: Curtins Consulting		Sheet 1 of 5
Dynamic Sampling and Rotary Boring Log	Location:	Ground level:	Logged by: NC/MD / Vertical scale: 1:50 / Project ID: 42206

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Groundwater: Water Strike	Groundwater: Backfill/ Installation
0.18 - 0.28	B1			0.18	MADE GROUND: Grey tarmacadam.			
0.20	D3			0.28	MADE GROUND: Grey brown, gravelly, fine to coarse SAND. Gravel is subangular to subrounded, fine to coarse including brick and concrete.			
0.20	ES2			0.48	MADE GROUND: Reddish brown, gravelly, fine and medium SAND. Gravel is subrounded to rounded, coarse of sandstone.			
0.28 - 0.48	B4			(0.72)	Brown mottled orange brown, very clayey, fine SAND (driller's description).			
0.40	D6			1.20	Loose, brown, clayey, gravelly, fine and medium SAND.			
0.40	ES5							
0.48 - 1.20	B7							
1.00	D9							
1.00	ES8							
1.20		SPT(S) N=8 (1,1/2,2,2,2)						
1.20 - 1.65	D10							
2.00		SPT(S) N=21 (5,6/5,5,6,5)			*Below 2.00m: medium dense.* *Between 2.00m and 8.00m: rare red brown mudstone and grey sandstone.*			
2.00 - 2.45	D11			(4.30)				
3.00		SPT(S) N=41 (6,5/14,14,6,7)			*Below 3.00m: dense.*			
3.00 - 3.45	B12							
4.00 - 5.00	13 0 0	AZCL: 4.00m - SPT(S) 50 (6,9/50 for 190mm) 4.00m - D13			*Between 4.00m and 4.87m: assumed zone of core loss.*			
		NA: 5.00m - SPT(C) 50 (4,5/50 for 160mm)			*Between 4.87m and 5.00m: single cobble of limestone.* *Between 5.00m and 5.50m: assumed zone of core loss.*			
5.00 - 6.00	50 17 0	AZCL		5.50	Recovered as medium and coarse, rounded GRAVEL including granite, sandstone and basalt.			
		NA		5.70				
		15		5.80	Firm, red brown, slightly sandy, very gravelly CLAY. Gravel is subrounded to rounded including granite and sandstone.			
6.00 - 7.50	40 0 0	AZCL: 6.00m - SPT(C) 50 (25 for 60mm/50 for 77mm)		(0.80)	Extremely weak, very thinly bedded, red brown, fine and medium grained SANDSTONE. Discontinuities are horizontal, very closely spaced, planar rough and clean. *Between 6.00m and 7.50m: non intact.*			
		NI		6.60	Extremely weak, reddish brown SANDSTONE recovered as red brown, gravelly SAND. Gravel is angular, fine to coarse including sandstone.			
				(0.90)				
7.50 - 9.00	86 56 18	AZCL: 7.50m - SPT(S) 50 (25 for 100mm/50 for 20mm)		7.50	Assumed zone of core loss.			
		14		7.70	Extremely weak, thinly bedded, red brown, fine and medium grained SANDSTONE. Discontinuities are subhorizontal 5-10 degrees, closely spaced, planar rough clean.			
		NI		(1.50)	*Between 8.90m to 9.00m: non-intact recovered as coarse gravel.* *Between 9.00m and 9.20m: assumed zone of core loss.*			
9.00 - 10.50	86 38 27	AZCL		9.20	Extremely weak, thinly bedded, red brown, fine and medium grained SANDSTONE. Locally recovered as red brown, gravelly sand.			
		NI		(1.30)	*Between 9.20m and 10.50m: recovered as non intact with occasional solid core sections.*			
	TCR/SCR/RQD	FI: Samples & Tests			Continued next sheet			

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	9.20	PLAIN	19
9.20	10.20	SLOTTED	19

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan	Location ID: **RBH04**
	Dates: 26/06/2018 - 28/06/2018	Client: Curtins Consulting	Sheet 2 of 5
Rotary Borehole Log	Location:	Ground level:	Logged by: NC/MD / Vertical scale: 1:50 / Project ID: 42206

Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
						Extremely weak, thinly bedded, red brown, fine and medium grained SANDSTONE. Locally recovered as red brown, gravelly sand.			
					10.50				
		AZCL				Assumed zone of core loss.			
		NI			10.75	*Between 10.73m and 10.83m: non intact recovered as slightly gravelly sand.*			
10.50 - 12.00	83 0 0	10				Extremely weak, reddish brown, fine and medium grained, slightly weathered SANDSTONE. Discontinuities are 1) 0-30 degrees, very closely to closely spaced, planar and occasionally undulating, rough and clean. 2) medium spaced, planar, rough, occasionally weathered with light brown infill <5mm of clayey, fine and medium sand.			
		NI				*Between 11.60m and 11.65m: non intact recovered as gravel and cobbles.*			
		12			(1.63)				
		NI							
		27							
		NI							
		AZCL							
		30							
		NI			12.38				
12.00 - 13.50	93 0 0	11				Very weak, reddish brown, medium grained, slightly weathered SANDSTONE. Discontinuities are 1) 0-25 degrees, very close to closely spaced, planar, rough and clean. 2) 45-60 degrees, medium to widely spaced, planar, rough and clean.			
		NI							
13.50 - 15.00	100 91 52	11							
		16			(5.12)				
15.00 - 16.50	100 94 47	6				*At 15.62m: Discontinuity is 10 degrees, stepped, rough light, yellowish brown, infilled <5mm with fine to coarse sand. Between 15.62m and 15.77m: 1 no 75 degrees, discontinuity, planar, rough and smooth, stained yellowish brown and infilled <3mm with soft reddish brown clay. At 15.63m: band of <20mm of extremely weak reddish brown mudstone. Between 16.21m and 16.27m: sandy gravel. Below 16.50m: indistinctly very thinly bedded.*			
		NI							
		4							
		15							
16.50 - 18.00	100 80 53	4							
		19			17.50				
		NI			(0.50)	Very weak to weak, reddish brown mottled light yellowish brown indistinctly, very thinly bedded, partially weathered, fine and medium grained SANDSTONE. Discontinuities are 1) 10-30 degrees, extremely closely to closely spaced, planar and undulating, rough, clean. 2) 45-80 degrees, very closely to closely spaced, planar and undulating, filled <5mm with light yellowish brown, fine sand, rough.			
		7			18.00				
		NI				Weak, reddish brown, medium and coarse grained SANDSTONE. Discontinuities are 0-15 degrees, very closely to closely spaced, planar, rough, clean.			
18.00 - 19.50	100 87 57	5				*between 18.00m and 18.27m: occasional light yellowish brown mottling. Between 18.00m and 18.11m: non intact recovered as gravel. Between 18.27m and 18.37m: 1no 55 degrees discontinuity, planar, rough, clean. Between 18.40m and 18.46m: non intact recovered as gravel.*			
		9							
						Continued next sheet			

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %

Borehole Diameter

Depth (m)	Dia (mm)
40.00	107

Casing Diameter

Depth (m)	Dia (mm)
6.00	200

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
26/06	16:30	6.00	5.00	
27/06	08:00	6.00	6.00	1.80
27/06	16:30	33.00	6.00	1.50
28/06	08:00	33.00	6.00	1.50

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: N/R, Energy Ratio: N/R

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	9.20	PLAIN	19
9.20	10.20	SLOTTED	19

Checked by: HH
Log status: DRAFT
IFA RC v01.01

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan		Location ID: **RBH04**
Dates: 26/06/2018 - 28/06/2018	Client: Curtins Consulting		Sheet 3 of 5
Rotary Borehole Log	Location:	Ground level:	Logged by: NC/MD	Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	100 84 54	NI 3 NI 5				Weak, reddish brown, medium and coarse grained SANDSTONE. Discontinuities are 0-15 degrees, very closely to closely spaced, planar, rough, clean. *Between 20.37m and 20.43m: non intact recovered as gravel.* *Between 20.37m and 20.45m: frequent clasts and inclusions of subrounded <40mm mudstone and siltstone.* *Between 20.64m and 20.84m: frequent clasts of subangular to subrounded <30mm quartzite.* *Between 20.72m and 20.78m: non intact recovered as sandy gravel, unweathered.* *Between 21.00m and 21.05m: assumed zone of core loss.* *Between 21.05m and 21.20m: non intact recovered as gravel.* *Between 21.27m and 21.32m: 1no 0-45 degrees discontinuity infilled <50mm with soft, reddish brown very sandy clay, sand is fine to coarse, surface is rough.* *Between 21.42m and 21.48m: non intact recovered as gravel.*		21		
21.00 - 22.50	97 43 40	AZCL NI 23 NI 8 4						22		
22.50 - 24.00	100 71 35	7 23			(7.35)	*Between 23.59m and 23.89m: 6no discontinuities, 40-60 degrees, very closely spaced, planar and undulating, tough, clean.*		23		
24.00 - 25.50	100 55 21	NI 10 NI 8				*Between 23.89m and 24.24m: non intact recovered as gravel.* *Between 24.00m and 24.40m: stained yellowsih brown.*		24 25		
25.50 - 27.00	100 83 43	26 3 13			25.35	*Between 25.28m and 25.38m: non intact 40+.* Very weak, reddish brown, medium and coarse grained SANDSTONE with rare clasts <20mm 0off subangular limestone. Discontinuities are 0-20 degrees, very closely to medium spaced, undulating, rough, clean. *Between 25.50m and 26.31m: discontinuities, 30-40 degrees, closely to medium spaced, undulating, rough, occasionally stained blackish brown.*		26		
27.00 - 28.50	100 85 65	NI 6			(3.15)	*Between 27.00m and 27.17m: non intact recovered as gravel.*		27 28		
28.50 - 30.00	100 90 47	19			28.50	Very weak, reddish brown, medium and coarse grained SANDSTONE with rare mudstone inclusions <70mm of extremely weak reddish brown mudstone. Discontinuities are 0-10 degrees, very closely spaced, planar and occasionally undulating, rough, clean.		29		
						Continued next sheet		30		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
						28/06	16:30	40.00	6.00	1.80	

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan	Location ID: **RBH04**
	Dates: 26/06/2018 - 28/06/2018	Client: Curtins Consulting	Sheet 4 of 5
Rotary Borehole Log	Location:	Ground level: / Logged by: NC/MD / Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	100 100 58	7			(4.50)	Very weak, reddish brown, medium and coarse grained SANDSTONE with rare mudstone inclusions <70mm of extremely weak reddish brown mudstone. Discontinuities are 0-10 degrees, very closely spaced, planar and occasionally undulating, rough, clean.		31		
31.50 - 33.00	100 67 38	16 4				*Between 32.00m and 32.65m: extremely weak, stained orangish brown with 3no discontinuities, 10-90 degrees, very closely spaced, planar and undulating, rough and smooth infilled <10mm with soft sandy clay.*		32		
33.00 - 34.50	100 33 11	NI 8			33.00	Extremely weak to very weak, reddish brown, occasionally mottled orangish brown, medium and coarse grained SANDSTONE. Discontinuities are 1) 0-20 degrees, very closely to closely spaced, undulating and planar, rough, clean. 2) 50-90 degrees, closely spaced, planar, occasionally infilled <10mm with light brown and blackish brown. *Between 33.00m and 33.50m: 2no discontinuities, 80 degrees, planar, rough, infilled <15mm with soft clay.* *Between 33.00m and 33.78m: non intact recovered as clayey gravel.*		33		
34.50 - 36.00	100 59 9	27 NI 23 NI 9				*Between 34.69m and 34.73m: non intact recovered as gravel.* *Between 35.15m and 35.17m: non intact recovered as gravel.*		34 35		
36.00 - 37.50	100 64 9	NI 10			(6.70)	*Between 36.33m and 36.50m: non intact recovered as gravel.*		36 37		
37.50 - 39.00	83 0 0	AZCL NI NI				*Between 38.50m and 38.75m: non intact 40+.* *Between 38.75m and 39.00m: non intact recovered as gravel.*		38 39		
39.00 - 40.50	67 13 0	AZCL 15			39.70	Extremely weak, poorly cemented, medium and coarse grained SANDSTONE recovered as non intact, sandy gravel. Probable		40		
						Continued next sheet				

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan		Location ID: **RBH04**
Dates: 26/06/2018 - 28/06/2018	Client: Curtins Consulting		Sheet 5 of 5
Rotary Borehole Log	Location:	Ground level:	Logged by: NC/MD / Vertical scale: 1:50 / Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		NI			(0.80)	Extremely weak, poorly cemented, medium and coarse grained SANDSTONE recovered as non intact, sandy gravel. Probable fault gouge, weakly cemented.				
					40.50	*At 39.70m: subvertical, widely spaced and smooth (probable fault plane).* *Between 39.70m and 40.50m: non intact recovered as sandy gravel.* End of Borehole at 40.00m		41 42 43 44 45 46 47 48 49 50		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 305	Project: St John's Masterplan		Location ID: **RBH05**
Dates: 12/07/2018	Client: Curtins Consulting		Sheet 1 of 4
Dynamic Sampling and Rotary Boring Log	Location:	Ground level: / Logged by: NC/RS / Vertical scale: 1:50	Project ID: 42206

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
0.10 - 0.60	B1				Grass over Black TOPSOIL.				
0.20	D2			0.20 (0.30)	MADE GROUND: brown slightly gravelly fine to coarse SAND. Gravel is subangular to subrounded, fine to medium including sandstone, brick and metal wire fragments.				
0.40	ES3			0.50					
0.50	D5			0.60	MADE GROUND: Greyish brown gravely fine to coarse SAND. Gravel is subangular to subrounded, fine to medium including brick.				
0.50	ES4								
0.70 - 1.20	B6				Medium dense, light brown slightly gravely fine to coarse SAND. Gravel is subagnaualr to subrounded, fine and medium including sandstone and coal.		1		
0.80	ES7								
1.00	D8								
1.20		SPT(S) N=17 (1,4/5,4,4,4)							
1.20	D9								
1.50 - 2.00	B10								
2.00		SPT(S) N=25 (7,6/5,6,7,7)					2		
2.00	D11								
2.50 - 3.00	B12								
				(4.90)					
3.00		SPT(S) N=40 (8,9/9,10,11,10)			*Below 3.00m: dense.*		3		
3.00	D13								
4.00		SPT(S) 50 (10,12/50 for 235mm)			*Below 4.00m: very dense.*		4		
4.00	B14								
4.00	D15								
5.00 - 5.50	0 0 0	NR					5		
		NI		5.50					
5.50 - 6.00	100 68 0	14			Medium strong, reddish brown, fine grained SANDSTONE with occasional off white 5-10mm sized quartzite inclusions. Discontinuities are 2-50 degrees, very closely to closely spaced, subhorizontal, open and rough.		6		
		NI							
		AZCL							
6.00 - 7.50	86 80 35	12					7		
				(3.50)					
		AZCL					8		
7.50 - 9.00	40 37 0								
		19		9.00			9		
9.00 - 10.50	100 100 0			(1.36)	Weak to medium strong, reddish brown, fine and medium grained SANDSTONE with rare grey 10mm sized quartzite inclusions. Discontinuities are 3-50 degrees, very closely to closely spaced, subhorizontal, planar to undulating, open and rough.				
TCR/SCR/RQD	FI	Samples & Tests			Continued next sheet		10		

5.00m - SPT(S) N=50 (6,7/8,9,15,18)

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: JT.01 Energy Ratio: 64%

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	5.00	Plain	
5.00	20.00	Slotted	

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 305	Project: St John's Masterplan	Location ID: **RBH05**
	Dates: 12/07/2018	Client: Curtins Consulting	Sheet 2 of 4
Rotary Borehole Log	Location:	Ground level:	Logged by: NC/RS — Vertical scale: 1:50 — Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					10.36	Weak to medium strong, reddish brown, fine and medium grained SANDSTONE with rare grey 10mm sized quartzite inclusions. Discontinuities are 3-50 degrees, very closely to closely spaced, subhorizontal, planar to undulating, open and rough.				
10.50 - 12.00	66 42 22	NR NI 10			(0.64) 11.00	Medium strong, reddish brown, medium and coarse grained SANDSTONE with occasional off white and grey 4-8mm sized quartzite inclusions. Discontinuities are 1-30 degrees, closely spaced, subhorizontal, planar, open and rough.		11		
12.00 - 13.50	83 66 42	NI 10 AZCL			(3.00)	Medium strong, reddish brown, fine and medium grained SANDSTONE with occasional brown and grey 3-6mm sized quartzite and mudstone inclusions. Discontinuities are 2-6 degrees, closely spaced, subhorizontal, planar to undulating, open and rough.		12 13		
13.50 - 15.00	66 61 48	NI			14.00	Strong, reddish brown, fine and medium grained SANDSTONE with occasional off white and grey 3-10mm sized quartzite inclusions. Discontinuities are very 1-8 degrees, closely to closely spaced, subhorizontal, planar to undulating, open and rough.		14		
15.00 - 16.50	100 90 34	9			(4.00)			15 16		
16.50 - 18.00	100 100 48							17		
18.00 - 19.50	100 92 55	6 NI 16 6			18.00	Weak, reddish brown, thinly to medium bedded, medium and coarse grained SANDSTONE with very rare thin bands and pockets of extremely weak, reddish brown mudstone and rare clasts of subrounded quartzite. Discontinuities are 0-15 degrees, very closely spaced, undulating rough and clean.		18 19		
		NI				*Between 19.73m and 19.81m: band of extremely weak reddish brown mudstone.*		20		
						Continued next sheet				

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
5.00	6.00	Air mist	50
6.00	13.50	Air mist	0
13.50	19.50	Air mist	25
19.50	40.00	Air mist	20

Borehole Diameter	
Depth (m)	Dia (mm)
40.00	102

Casing Diameter	
Depth (m)	Dia (mm)
8.00	146

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
12/07	16:30	19.50	8.00	8.40
13/07	08:00	19.50	8.00	4.90
13/07	16:30	40.00	8.00	7.40

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: JT.01 Energy Ratio: 64%

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	5.00	Plain	
5.00	20.00	Slotted	

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 305	Project: St John's Masterplan		Location ID: **RBH05**
Dates: 12/07/2018	Client: Curtins Consulting		Sheet 3 of 4
Rotary Borehole Log	Location:	Ground level: / Logged by: NC/RS / Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	100 84 41	6 NI 10				Weak, reddish brown, thinly to medium bedded, medium and coarse grained SANDSTONE with very rare thin bands and pockets of extremely weak, reddish brown mudstone and rare clasts of subrounded quartzite. Discontinuities are 0-15 degrees, very closely spaced, undulating rough and clean.		21		
21.00 - 22.50	100 87 18	15 8						22		
22.50 - 24.00	100 81 37	24 NI 7			(8.00)			23		
24.00 - 25.50	100 97 66	24 7 33 5 40 6						24		
25.50 - 27.00	100 97 65	NI			26.00	*Between 25.90m and 26.00m: band of extremely weak reddish brown mudstone.* Medium strong, reddish brown, thinly to thickly bedded, fine and medium grained SANDSTONE with occasional reduction spots and rare pockets and bands of extremely to very weak, reddish brown mudstone. Discontinuities are 0-15 degrees, very closely to medium spaced, planar and undulating rough and clean.		26		
27.00 - 28.50	100 97 87	4			(6.18)			27 28		
28.50 - 30.00	100 93 69	NI 4				*Between 28.85m and 28.90m: stained light brown.* *Between 28.90m and 29.00m: extremely weak to very weak, reddish brown, highly fractured mudstone.*		29		
						Continued next sheet		30		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	SPT Hammer: JT.01 Energy Ratio: 64%

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 305	Project: St John's Masterplan		Location ID: **RBH05**
Dates: 12/07/2018	Client: Curtins Consulting		Sheet 4 of 4
Rotary Borehole Log	Location:	Ground level:	Logged by: NC/RS / Vertical scale: 1:50 / Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	100 90 57	NI 27				Medium strong, reddish brown, thinly to thickly bedded, fine and medium grained SANDSTONE with occasional reduction spots and rare pockets and bands of extremely to very weak, reddish brown mudstone. Discontinuities are 0-15 degrees, very closely to medium spaced, planar and undulating rough and clean.		31		
31.50 - 33.00	100 94 67	10 NI 5			32.18	Medium strong, thinly to thickly bedded, fine to coarse grained SANDSTONE with rare reduction spots <5mm. Discontinuities are 0-10 degrees, very closely to widely spaced, planar, rough and clean.		32		
33.00 - 34.50	100 100 86	1 6			(3.89)			33 34		
34.50 - 36.00	100 97 88	NI 3						35		
36.00 - 37.00	93 76 56	AZCL NI 5			36.07	Weak, reddish brown, indistinctly medium bedded, medium and coarse grained SANDSTONE with occasional pockets <40mm of extremely weak to very weak reddish brown mudstone. Discontinuities are 0-20 degrees, very closely to medium spaced, planar, rough and clean.		36		
37.00 - 38.50	77 40 21	AZCL NI 13			(2.43)			37 38		
38.50 - 40.00	97 93 72	AZCL NI 3			38.50 (1.50)	Weak, reddish brown, indistinctly medium bedded, medium and coarse grained SANDSTONE with rare reduction spots <5mm. Discontinuities are 0-10 degrees, medium spaced, undulating, rough and clean.		39		
					40.00	End of Borehole at 40.00m		40		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	SPT Hammer: JT.01 Energy Ratio: 64%

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205/Comacchio 305	Project: St John's Masterplan		Location ID: **RBH06**
Dates: 06/07/2018 - 10/07/2018	Client: Curtins Consulting		Sheet 1 of 6
Dynamic Sampling and Rotary Boring Log	Location:	Ground level:	Logged by: NC/NC/LVC	Vertical scale: 1:50	Project ID: 42206

Samples & In Situ Testing			Strata Details					Groundwater	
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				0.18	MADE GROUND: Light grey concrete.				
0.35 - 0.55	B1			0.38	MADE GROUND: Yellow and orange subangular COBBLES of brick and sandstone.				
0.55 - 1.00	B2			0.55	MADE GROUND: Yellow and dark brown, clayey, gravelly, fine to coarse SAND with low cobble content. Gravel is subangular, fine to coarse including brick. Cobbles are subangular including brick and sandstone.		1		
1.20 - 2.00	B3			(2.45)	MADE GROUND: Firm, orange brown and grey, sandy, gravelly CLAY. Gravel is angular to subangular, fine to coarse including concrete, sandstone and brick.				
2.00		SPT(S) N=17 (1,2/3,5,4,5)					2		
2.00 - 2.45	D5								
2.00 - 3.00	B4								
3.00		SPT(S) N=18 (1,3/5,4,5,4)		3.00	Medium dense, orange brown, gravelly, fine and medium SAND. Gravel is subrounded to rounded, fine and medium including sandstone.		3		
3.00 - 3.45	D7								
3.00 - 4.00	B6			(1.65)					
4.00		SPT(S) 50 (6,7/50 for 225mm)			*Below 4.00m: very dense.*		4		
4.00 - 4.45	D9								
4.00 - 5.00	B8								
4.50 - 5.00	70 50 0	AZCL NI 15 NI		4.65	Extremely weak to weak, very thinly bedded, reddish brown, coarse grained SANDSTONE with subangular, medium gravel including mudstone, quartzite and with lenses of mudstone <60x30mm. Discontinuities are subhorizontal, closely spaced, rough planar.		5		
5.00 - 6.00	73 49 0	AZCL 9 NI 11		(1.07)	*Between 5.39m and 5.40m: mudstone.* *Between 5.44m and 5.66m: mudstone.* *Between 5.58m and 5.60m: mudstone.*				
6.00 - 7.00	100 65 0	NI 25 NI 17		5.72	Weak to medium strong, thickly laminated, reddish brown, medium and coarse grained SANDSTONE. Discontinuities are subhorizontal, very closely spaced, rough stepped, undulating, open with clay and sand fill.		6		
				(1.68)					
					Between 7.14m and 7.16m: soft clay.		7		
7.00 - 8.50	97 65 0	AZCL NI 0 NI 17		7.40	Extremely weak to weak, very thinly bedded, reddish brown, coarse grained SANDSTONE with subangular, medium gravel of mixed lithologies. Locally recovered as sand and gravel. Discontinuities are subhorizontal, closely spaced, rough undulating, open moderately wide with sand and gravel fill <160mm.				
				(1.05)			8		
		NI 7 NI		8.45					
8.50 - 10.00	73 55 0	AZCL 12		8.53 (0.47) 9.00 (1.46)	Medium strong, very thinly bedded, mica rich reddish brown medium grained SANDSTONE. Extremely weak, very thinly bedded, reddish brown, coarse grained SANDSTONE with subangular, medium gravel of mixed lithologies. Locally recovered as sand. Medium strong, very thinly bedded, coarse grained SANDSTONE with subangular, fine and medium gravel of mixed lithologies. Discontinuities are subhorizontal, very closely to closely spaced, rough undulating planar, open with sand film.		9		
	TCR/SCR/RQD	FI	Samples & Tests		Continued next sheet		10		

Dynamic Sample Recovery

Top (m)	Base (m)	Dia (mm)	Recovery %	Remarks
1.20	2.00		100	
2.00	3.00		100	
3.00	4.00		100	
4.00	4.50		100	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: JT.01 Energy Ratio: 64%

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
10.20	10.50	Slotted	19
0.00	10.20	Plain	19

Checked by:	HH	IFA DS v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205/Comacchio 305	Project: St John's Masterplan	Location ID: **RBH06**
	Dates: 06/07/2018 - 10/07/2018	Client: Curtins Consulting	Sheet 2 of 6
Rotary Borehole Log	Location:	Ground level:	Logged by: NC/NC/LVC — Vertical scale: 1:50 — Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					10.46	Medium strong, very thinly bedded, coarse grained SANDSTONE with subangular, fine and medium gravel of mixed lithologies. Discontinuities are subhorizontal, very closely to closely spaced, rough undulating planar, open with sand film.				
10.00 - 11.50	100 35 7	18 NI 6 NI 10			(0.74)	Extremely weak to weak, very thinly bedded, reddish brown, coarse grained SANDSTONE. Discontinuities are subhorizontal, very closely spaced, rough undulating open, moderately wide with sand and gravel fill <200mm.		11		
					11.20	*Between 11.00m and 11.20m: sand and gravel.*				
11.50 - 13.00	83 53 28	NI 8 AZCL			(3.01)	Weak to strong, very thinly bedded, reddish brown, coarse grained SANDSTONE. Discontinuities are subhorizontal, rough undulating, open to wide with clay sand fill <5mm and gravel fill 120mm.		12 13		
13.00 - 14.50	95 88 55	6 20			14.21 14.31	Extremely weak, very thinly bedded, reddish brown, coarse grained SANDSTONE. Discontinuities are 1) subhorizontal, very closely spaced, rough undulating open, moderately wide with sand film fill. 2) 80 degrees, very widely spaced, rough undulating, moderately wide with sand film fill.		14		
14.50 - 16.00	97 53 37	6 NI AZCL 3			(0.97) 15.28	Weak to thinly bedded, reddish brown, coarse grained SANDSTONE. Discontinuities are 10-15 degrees, closely spaced, rough undulating, with sand fill and stained orange yellow.		15		
					15.55	Extremely weak, reddish brown, coarse grained SANDSTONE. Recovered as coarse sand.				
16.00 - 17.50	100 100 40	11				Weak to medium strong, very closely to closely bedded, reddish brown, coarse grained SANDSTONE, locally with subrounded fine to coarse gravel of mixed lithologies. *Between 15.77m and 15.78m: with coarse subhorizontal gravel.*		16		
						Between 16.77m and 16.78m: with coarse subrounded gravel.		17		
17.50 - 19.00	100 100 18				(4.95)			18		
						Between 18.72m and 18.88m: with coarse subhorizontal gravel. *Between 18.81m and 18.86m: lenses of clay <10mm x 40mm.*		19		
19.00 - 20.50	100 97 63	0 14				*Between 19.05m and 19.06m: medium gravel.*				
						Continued next sheet		20		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
8.50	4.50	Air mist	80
10.00	8.50	Air mist	70
50.50	10.00	Air mist	10
55.00	50.50	Air mist	0

Borehole Diameter	
Depth (m)	Dia (mm)
55.00	102

Casing Diameter	
Depth (m)	Dia (mm)
7.50	146

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
06/07	09:00	1.20		Dry
09/07	08:00	1.20		Dry
09/07	16:30	14.50	7.50	4.80
10/07	08:00	14.50	7.50	2.80

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

SPT Hammer: JT.01 Energy Ratio: 64%

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)
10.20	10.50	Slotted	19
0.00	10.20	Plain	19

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205/Comacchio 305	St John's Masterplan	**RBH06**
Dates:	**Client:**	Sheet 3 of 6
06/07/2018 - 10/07/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
			NC/NC/LVC	1:50	42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Weak to medium strong, very closely to closely bedded, reddish brown, coarse grained SANDSTONE, locally with subrounded fine to coarse gravel of mixed lithologies.				
					20.50	*Between 19.89m and 19.90m: lenses of mudstone.* *Between 20.13m and 20.18m: lenses of mudstone (40mm x 2mm).* *Between 20.25m and 20.26m: with medium gravel.* *Between 20.44m and 20.52m: glauconitic patch.*				
					(0.50)					
20.50 - 22.00	100 93 55	6			21.00	Extremely weak to very weak, thinly laminated reddish brown, fine grained MUDSTONE. Locally glauconitic . Discontinuities are subhorizontal, closely spaced, smooth, undulating, open and wide with clay and mudstone gravel fill. *Between 20.53m and 20.55m: glauconitic lenses.*		21		
22.00 - 23.50	100 100 69	4			(2.88)	Medium strong, thinly laminated to closely bedded, reddish brown, coarse grained SANDSTONE with mudstone interlaminated and lenses of mudstone <20mm x5mm. Discontinuities are subhorizontal, closely spaced, rough, undulating, open wide with sand and coarse gravel fill. *Between 22.04m and 22.05m: lense of glauconite.* *Between 23.34m and 23.88m: lenses of mudstone 40mm x 2mm and with subangular, fine and medium gravel.*		22		
23.50 - 25.00	100 91 64	2 NI NI 0 NI			23.88	Medium strong, very thinly bedded to thinly bedded, reddish brown, coarse grained SANDSTONE. Discontinuities are 1) subhorizontal, closely spaced, rough, undulating, open moderately wide with sand film fill and subangular coarse gravel fill. 2) 20 degrees, very closely to closely spaced, rough stepped undulating moderately wide to wide, with sand film fill and subangular coarse gravel fill.		23		
25.00 - 26.50	100 97 72				(4.48)			24		
26.50 - 28.00	100 98 68	6				*Between 27.83m and 27.84m: lense of mudstone 20mm x 5mm.*		25		
28.00 - 29.50	100 98 67				28.36	Medium strong, very thinly laminated, reddish brown, medium and coarse grained SANDSTONE. Discontinuities are 1) subhorizontal, closely spaced, rough undulating, open to wide with sand film fill. 2) 20 degrees, closely spaced, rough undulating, open with sand film fill.		26		
		AZCL			(1.64)			27		
					30.00	Continued next sheet		28		
								29		
								30		

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
10/07	16:30	49.00	7.50	4.20
11/07	08:00	49.00	7.50	5.80
11/07	16:30	55.00	7.50	5.10

Remarks:

SPT Hammer: JT.01 Energy Ratio: 64%

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205/Comacchio 305	Project: St John's Masterplan	Location ID: **RBH06**
	Dates: 06/07/2018 - 10/07/2018	Client: Curtins Consulting	Sheet 4 of 6
Rotary Borehole Log	Location:	Ground level: / Logged by: NC/NC/LVC / Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
29.50 - 31.00	93 90 52	6			(1.84)	Medium strong, thickly laminated, reddish brown, medium grained SANDSTONE. Discontinuities are 1) subhorizontal, closely spaced, rough undulating, open, with sand film fill. 2) 40 degrees widely spaced, rough stepped, wide and clean. *Between 30.95m and 31.00m: coarse grained sandstone.* *Between 31.29m and 31.33m: mudstone.*		31		
31.00 - 32.50	100 89 51	~~NI~~ ~~0~~ ~~NI~~ 0 ~~40+~~ ~~0~~ ~~NI~~ ~~NI~~			31.84	Weak to medium strong, thinly laminated to very thinly bedded, reddish brown, coarse grained SANDSTONE with rare beds of mudstone. Discontinuities are 1) subhorizontal, very closely to closely spaced, rough undulating, open to moderately wide with, subangular, fine to coarse gravel and clay fill. 2)15-25 degrees, closely spaced, rough undulating tight to moderately wide with sand film fill.		32		
32.50 - 34.00	100 100 75	6			(3.96)			33 34		
34.00 - 35.50	100 96 91					*Between 35.21m and 35.23m: lense of mudstone.*		35		
35.50 - 37.00	91 90 74	AZCL 5 0 9			35.80 (0.39) 36.19	Medium strong, reddish brown, medium grained SANDSTONE. Glauconitic. *Between 35.85m and 35.86m: lense of glauconite.* Medium strong to strong, thinly laminated to thinly bedded, reddish brown, coarse grained SANDSTONE. Discontinuities are 1) subhorizontal, very closely to medium spaced, rough undulating, open moderately wide with angular fine to coarse gravel of mudstone and sandstone and sand fill. 2) 25 degrees medium spaced, rough, undulating, open and clean. 3) 85 degrees, widely spaced, rough undulating, open with sand film fill. *Between 36.94m and 36.95m: incipent fracture.* *Between 37.31m and 37.34m: mudstone.*		36 37		
37.00 - 38.50	100 94 73	2 13			(3.81)	*Between 38.34m and 38.37m: with fine and medium grained gravel and lense of mudstone <30 x 10mm).*		38		
38.50 - 40.00	100 92 85	2 6 2			40.00	*Between 39.04m and 39.12m: beds and lenses of mudstone.*		39 40		
						Continued next sheet				

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	SPT Hammer: JT.01 Energy Ratio: 64%

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205/Comacchio 305	Project: St John's Masterplan		Location ID: **RBH06**
Dates: 06/07/2018 - 10/07/2018	Client: Curtins Consulting		Sheet 5 of 6
Rotary Borehole Log	Location:	Ground level:	Logged by: NC/NC/LVC	Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
40.00 - 41.50	100 100 93	12 0			(2.00)	Medium strong to strong, thinly bedded to medium bedded, reddish brown, medium and coarse grained SANDSTONE. Discontinuities are subhorizontal, very closely to widely spaced, rough undulating, open, clean and reduced strength <3mm.		41		
41.50 - 43.00	100 98 93	8 0 36			42.00 (1.00) 43.00	Medium strong, thickly laminated to thinly bedded, reddish brown, coarse grained SANDSTONE. Discontinuities are subhorizontal, very closely to widely spaced, rough undulating, open moderately wide, clean and with sand and angular, fine to coarse gravel fill.		42		
43.00 - 44.50	100 100 100	1 5			(0.84) 43.84 (1.51)	Strong, thinly to thickly laminated, reddish brown, medium grained SANDSTONE. Discontinuities are subhorizontal, widely spaced, rough undulating, open and clean. Medium strong to strong, thickly laminated to closely bedded, reddish brown, coarse grained SANDSTONE with subangular, fine and medium gravel. Discontinuities are subhorizontal, closely spaced, rough undulating, open clean and with clay fill. *Between 44.77m and 44.78m: mudstone weathered to clay in discontinuity.*		43 44 45		
44.50 - 46.00	100 97 83				45.35 45.56 (0.67) 46.23	Strong, thinly laminated, reddish brown, fine grained SILTSTONE. Discontinuities are subhorizontal, closely spaced, rough undulating, open to moderately wide with clay fill <6mm. *Between 45.52m and 45.53m: mica present.* *Between 45.54m and 45.55m: clay fill.* Strong, thinly to thickly laminated, reddish brown, coarse grained SANDSTONE. Discontinuities are subhorizontal, very closely spaced, rough undulating, open moderately wide and clean.		46		
46.00 - 47.50	100 99 69	7			(1.23) 47.46	Strong, thinly to thickly laminated, reddish brown, coarse grained SANDSTONE. Discontinuities are subhorizontal, closely spaced, rough undulating, open moderately wide, clean and with to subangular, fine and medium gravel fill. 2) 30-45 degrees, very closely spaced, rough, undulating, clean and with spot of glauconite <10mm.		47		
47.50 - 49.00	100 100 77	0 10				Medium strong to strong, very thinly bedded to medium bedded, reddish brown, coarse grained SANDSTONE. Discontinuities are 1) subhorizontal, very closely to medium spaced, rough undulating, open moderately wide clean and with sand film fill. 2) 50 degrees, very widely spaced, rough undulating, moderately wide and with clay sand and fine gravel fill. *Between 47.86m and 48.00m: with subangular, fine to coarse gravel of mixed lithologies.*		48 49		
49.00 - 50.50	100 100 87	0				*Between 49.07m and 49.18m: with subangular, fine to coarse gravel of mixed lithologies.*		50		

Continued next sheet

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	SPT Hammer: JT.01 Energy Ratio: 64%

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205/Comacchio 305	Project: St John's Masterplan		Location ID: **RBH06**
Dates: 06/07/2018 - 10/07/2018	Client: Curtins Consulting		Sheet 6 of 6
Rotary Borehole Log	Location:	Ground level:	Logged by: NC/NC/LVC	Vertical scale: 1:50	Project ID: 42206

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		6				Medium strong to strong, very thinly bedded to medium bedded, reddish brown, coarse grained SANDSTONE. Discontinuities are 1) subhorizontal, very closely to medium spaced, rough undulating, open moderately wide clean and with sand film fill. 2) 50 degrees, very widely spaced, rough undulating, moderately wide and with clay sand and fine gravel fill.				
50.50 - 52.00	100 100 36	19						51		
		0			(5.14)					
		12						52		
52.00 - 53.50	100 97 88	1			52.60	*Between 52.48m and 52.60m: with sandstone with subangular, fine to coarse gravel of mixed lithologies.*				
					(0.48)	Strong, very thinly bedded, reddish brown, medium grained SANDSTONE. Discontinuities are subhorizontal, closely spaced, rough undulating, open moderately wide and clean.		53		
		9			53.08	*Between 52.77m and 52.79m: subrounded, coarse gravel of mudstone.* *Between 52.88m and 52.89m: subangular gravel.*				
53.50 - 55.00	100 100 81				(0.92)	Strong, very thinly bedded, reddish brown, coarse grained SANDSTONE. Discontinuities are subhorizontal, closely spaced, rough undulating, open moderately wide, clean and with clay, sand and subangular, fine to coarse gravel fill.		54		
		0			54.00	*Between 53.17m and 53.45m: sandstone with coarse gravel.*				
		9			(0.75)	Strong, thinly laminated, reddish brown, medium grained SANDSTONE. Discontinuities are subhorizontal, closely to medium spaced, rough undulating, open moderately wide and clean.				
					54.75					
					55.00	Strong, thinly bedded, reddish brown, coarse grained SANDSTONE. Discontinuities are subhorizontal, closely spaced, rough undulating, open and clean.		55		
						End of Borehole at 55.00m				
								56		
								57		
								58		
								59		
								60		

Flush Details				Borehole Diameter		Boring Progress				
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)

Remarks:

SPT Hammer: JT.01 Energy Ratio: 64%

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Core Photographs
BH02



Core Photographs
BH02



Core Photographs
BH02



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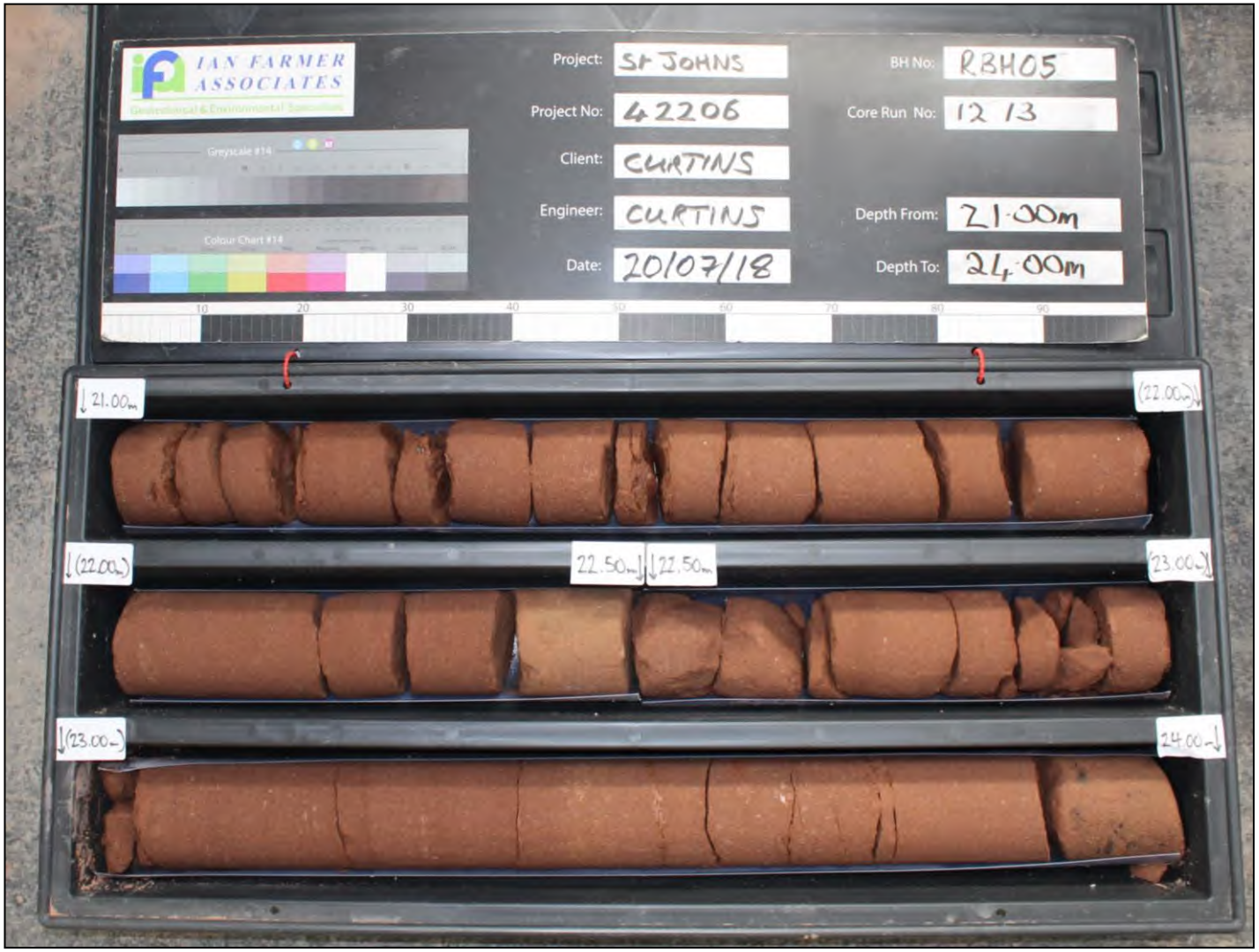
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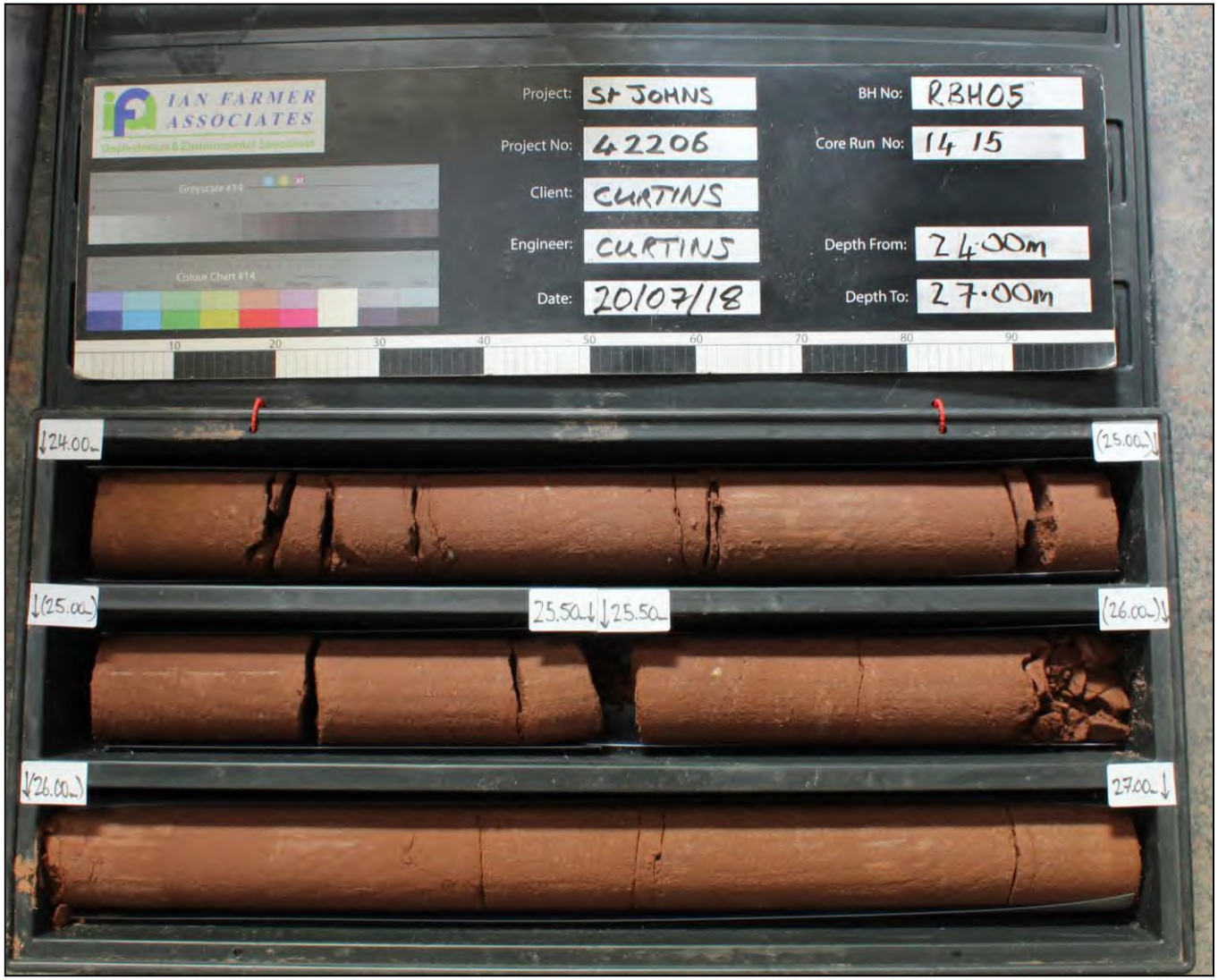
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IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Dando 2000/Comacchio 205	St John's Masterplan Phase 2	**BH06**
Dates:	**Client:**	Sheet 1 of 3
10/10/2018	Curtins Consulting	

Cable Percussion and Rotary Boring Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383040.53E 398022.26N	26.52mOD	DO	1:50	42269

Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
					Samples & In Situ Testing / **Strata Details** / **Groundwater**			
0.20 - 1.00	B1		26.32	0.20	MADE GROUND: Concrete.			
0.30	ES2				MADE GROUND: Dark brown mottled black, fine to coarse SAND and angular to subrounded, fine to coarse GRAVEL with high cobble content. Gravel includes limestone, granite, concrete and brick.			
0.50	ES3			(1.00)				
1.00	ES4							
1.20		SPT(S) N=9 (1,2/2,2,3,2)	25.32	1.20	MADE GROUND: Firm, orange mottled black and grey, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse including sandstone, mudstone, coal and brick.			
1.20 - 1.65	D5							
1.30 - 1.70	B6							
1.70	ES7							
2.00	B9							
2.00 - 2.45	U8	24 blows. 90% recovery		(1.80)				
2.45	D10							
2.80	ES11							
3.00		SPT(S) N=27 (5,6/5,6,7,9)	23.52	3.00	MADE GROUND: Medium dense, dark brown speckled black, slightly clayey, fine to coarse SAND and angular to subrounded, fine to coarse GRAVEL. Gravel includes sandstone, siltstone, quartzite and rare brick.			
3.00 - 3.45	B12			(0.40)				
3.00 - 3.45	D13		23.12	3.40	Dense, dark brown, fine to coarse SAND and subangular to subrounded, fine to coarse GRAVEL. Gravel includes siltstone, quartzite, sandstone and mudstone.			
4.00		SPT(C) N=47 (9,9/10,11,11,15)		(1.10)				
4.00 - 4.45	B14							
4.50	D15		22.02	4.50	Red SANDSTONE recovered as gravelly, fine and medium sand.			
5.00		SPT(S) 50 (8,9/50 for 275mm)						
5.00 - 5.43	D16			(1.95)				
		AZCL						
		NI	20.07	6.45	Weak, reddish brown with yellow banding, fine and medium grained SANDSTONE. Discontinuity are 0-25 degrees, closely spaced, planar smooth and rough in places, with occasional clay infill.			
6.00 - 7.50	87 60 30	20 NI 8 20			*Between 6.50m and 6.60m: recovered as angular to subangular gravel and cobbles of sandstone.* *Between 6.65m and 6.70m: recovered as angular to subangular, fine to coarse gravel of mudstone and occasional sandstone.* *Between 6.80m and 6.85m: reduction spots.* *Between 7.00m and 7.05m: reduction spots.* *Between 7.20m and 7.22m: mudstone interbedded* *Between 7.25m and 7.35m: reduction spots.* *Between 7.68m and 8.00m: inter laminated sandstone.*			
		7.10m - C17						
7.50 - 9.00	73 73 46	5 15		(6.75)	*Between 8.50m and 8.60m: medium grained sandstone.*			
		8.00m - C18						
		AZCL						
9.00 - 10.50	87 83 53	5 NI			*Between 9.60m and 9.65m: recovered as angular to subangular, fine to coarse gravel.*			
		9.25m - C19						
	TCR/SCR/RQD	FI			Continued next sheet			
		9.98m - C20						
		Samples & Tests						

Chiselling

From (m)	To (m)	Time (mins)	Remarks
4.50	5.00	60	

Borehole Diameter

Depth (m)	Dia (mm)
5.43	200

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
10/10	16:30	1.20		
11/10	08:00	1.30		Dry
11/10	16:30	5.00	5.00	Dry
23/10	08:00	5.00	5.00	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.
Borehole terminated ate 5.00m due to possible bedrock.
SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter

Depth (m)	Dia (mm)
5.00	200

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	2.50	Plain	50
2.50	7.50	Slotted	50

Checked by:	HH	IFA CP v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Dando 2000/Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **BH06**
	Dates: 10/10/2018	Client: Curtins Consulting	Sheet 2 of 3
Rotary Borehole Log	Location: 383040.53E 398022.26N	Ground level: 26.52mOD / Logged by: DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		8				Weak, reddish brown with yellow banding, fine and medium grained SANDSTONE. Discontinuity are 0-25 degrees, closely spaced, planar smooth and rough in places, with occasional clay infill.				
		NI				*Between 10.70m and 10.72m: reduction spot.* *Between 10.75m and 10.77m: reduction spots.* *Between 10.85m and 10.95m: non intact recovered as gravel.*		11		
10.50 - 12.00	100 93 54	4	11.30m - C21			*Between 11.35m and 12.70m: non intact recovered and, fine to coarse sand and angular to subangular, fine to coarse gravel.*		12		
		AZCL								
12.00 - 13.50	100 77 6		12.88m - C22					13		
				13.32	13.20 (0.30)	Weak, reddish brown, fine grained SANDSTONE.				
		7		13.02	13.50	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuity are 0-25 degrees, closely spaced, planar smooth and rough in places, with occasional clay infill.		14		
13.50 - 15.00	100 100 33		14.14m - C23		(1.50)					
		NI		11.52	15.00	Medium strong, very weak to weak in places, reddish brown, fine and medium grained SANDSTONE. Discontinuity are 0-25 degrees, very closely to closely spaced in places, planar smooth and undulating smooth and rough with rare silt infill.		15		
15.00 - 16.50	100 97 56		15.47m - C24			*Between 15.00m and 15.05m: non intact recovered as cobble*		16		
		3	16.50m - C25							
16.50 - 18.00	100 100 60		17.16m - C26		(10.00)			17		
		NI				*Between 18.00m and 18.10m: non intact recovered as fine and medium, gravelly sand.*		18		
18.00 - 19.50	67 67 60	3	18.37m - C27					19		
		AZCL								
19.50 - 20.25	100 87 87	NI 2	19.60m - C28			*Between 19.50m and 19.60m: recovered as fine and medium sand.*		20		
						Continued next sheet				

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
13.50	15.00	Air	80
15.00	16.50	Air	80
16.50	18.00	Air	80
18.00	19.50	Air	80
19.50	20.25	Air	80
20.25	21.00	Air	80
21.00	22.50	Air	80
22.50	24.00	Air	80

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)
5.43	200

Casing Diameter	
Depth (m)	Dia (mm)
5.00	200

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
10/10	16:30	1.20		
11/10	08:00	1.30		Dry
11/10	16:30	5.00	5.00	Dry
23/10	08:00	5.00	5.00	

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:
Service inspection pit hand excavated from GL to 1.20m.
Borehole terminated ate 5.00m due to possible bedrock.
SPT Hammer: N/R, Energy Ratio: N/R

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	2.50	Plain	50
2.50	7.50	Slotted	50

IAN FARMER ASSOCIATES

Plant used: Dando 2000/Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **BH06**	
Dates: 10/10/2018	Client: Curtins Consulting	Sheet 3 of 3	
Rotary Borehole Log	Location: 383040.53E 398022.26N	Ground level: 26.52mOD	Logged by: DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
20.25 - 21.00	100 100 100	4				Medium strong, very weak to weak in places, reddish brown, fine and medium grained SANDSTONE. Discontinuity are 0-25 degrees, very closely to closely spaced in places, planar smooth and undulating smooth and rough with rare silt infill. *Between 20.50m and 20.65m: interbedded with mudstone.*		21		
21.00 - 22.50	100 90 90	7	21.37m - C29			*Between 21.00m and 21.05m: recovered a fine and medium sand and angular to subangular, fine to coarse gravel including sandstone.* *Between 21.80m and 21.85m: recovered as subangular, fine gravel*		22		
		NI				*Between 22.35m and 22.70m: non intact recovered as gravelly, fine to coarse sand. .*				
22.50 - 24.00	100 83 60	2 NI 11	23.00m - C30			*Between 23.30m and 23.35m: non intact recovered as angular to subangular, fine to coarse gravel.* *Between 23.35m and 23.70m: non intact.* *Between 23.70m and 25.00m: non intact.*		23		
24.00 - 25.00	100 100 100	1	24.00m - C31 24.40m - C32					24		
				1.52	25.00	End of Borehole at 25.00m		25		
								26		
								27		
								28		
								29		
								30		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
24.00	25.00	Air	80

Borehole Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
23/10	16:00	13.50	6.00	3.40
24/10	08:00	13.50	6.00	2.60
24/10	16:30	25.00	6.00	1.80

Remarks:

SPT Hammer: N/R, Energy Ratio: N/R

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH07**	
Dates: 10/10/2018 - 16/10/2018	Client: Curtins Consulting	Sheet 1 of 5	
Rotary Borehole Log	Location: 383071.58E 397984.33N	Ground level: 26.50mOD	Logged by: /JW	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
			0.00m - B1		(0.60)	MADE GROUND: Reddish brown, sandy GRAVEL with high cobble content. Gravel is angular, fine to coarse including brick and concrete.				
			0.50m - ES2 0.60m - B3	25.90	0.60					
					(0.60)	MADE GROUND: Greyish brown, slightly gravelly, clayey, fine to coarse SAND. Gravel is angular, fine to coarse including brick, sandstone and quartzite.		1		
				25.30	1.20					
						Brown SAND and GRAVEL (drillers description).		2		
					(3.30)			3		
								4		
				22.00	4.50	Red SAND and GRAVEL (driller's description).				
					(1.20)			5		
5.00 - 6.00	30 0 0	AZCL								
		NI		20.80 20.66	5.70 5.84	Red, medium grained SANDSTONE, recovered as brown, slightly gravelly, fine and medium sand.				
				20.50	6.00	Greyish brown, angular to subangular, medium GRAVEL including various lithologies.		6		
6.00 - 7.00	0 0 0	AZCL			(1.18)	Red SANDSTONE, recovered as sand.				
7.00 - 7.50	64 0 0	NI		19.32	7.18	Grey, angular to subangular, medium GRAVEL including various lithologies.		7		
				19.09 19.03	7.41 7.47	Red SANDSTONE recovered as angular gravel.				
7.50 - 8.50	0 0 0	AZCL			(1.53)	Extremely weak, red, fine and medium grained SANDSTONE. *Between 7.50m and 9.00m: assumed zone of core loss, assumed sandstone.*		8		
8.50 - 9.00	0 0 0									
		AZCL NI		17.50 17.40 17.32	9.00 9.10 9.18	Extremely weak, reddish brown, fine and medium grained SANDSTONE.		9		
9.00 - 10.00	90 58 12	25+				Red SANDSTONE recovered as angular gravel. Extremely weak, reddish brown, fine and medium SANDSTONE. Discontinuities are horizontal, very close, planar rough with sand infill. *Between 9.50m and 9.70m: 1 no subvertical, planar rough calcitic*		10		
						Continued next sheet				

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
7.50	8.50	Air mist	80
8.50	9.00	Air mist	80
9.00	10.00	Air mist	80
10.00	11.00	Air mist	80
11.00	12.00	Air mist	80
12.00	13.00	Air mist	80
13.00	14.00	Air mist	80
14.00	15.00	Air mist	80

Checked by: HH
Log status: DRAFT
IFA RC v01.01

Borehole Diameter

Depth (m)	Dia (mm)
40.50	107

Casing Diameter

Depth (m)	Dia (mm)
6.50	200

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
12/10	16:00	1.20		
15/10	08:00	1.20		0.90
15/10	16:30	25.50	6.50	2.63
16/10	08:00	25.50	6.50	4.52

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH07**
	Dates: 10/10/2018 - 16/10/2018	Client: Curtins Consulting	Sheet 2 of 5
Rotary Borehole Log	Location: 383071.58E 397984.33N	Ground level: 26.50mOD / Logged by: /JW / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
10.00 - 11.00	100 46 0	NI 20	10.34m - C4			Extremely weak, reddish brown, fine and medium SANDSTONE. Discontinuities are horizontal, very close, planar rough with sand infill. *Between 9.50m and 9.70m: 1 no subvertical, planar rough calcitic infilled discontinuity.* *Between 10.00m and 10.37m: recovered as medium grained.* *At 10.22m: planar rough, black surface staining on fractures.* *At 10.50m: 1no, subvertical, planar rough discontinuity.*		11		
11.00 - 12.00	50 26 14	AZCL NI 25+				*Between 11.47m and 11.65m: recovered as gravel.* *Below 11.65m: very weak and thinly bedded.*				
12.00 - 13.00	58 48 38	AZCL 7	12.44m - C5		(5.14)			12		
13.00 - 14.00	50 39 0	AZCL 16				*Below 13.50m: extremely weak to weak.*		13		
14.00 - 15.00	100 81 58	NI 10	14.68m - C6	12.18	14.32	*Between 14.20m and 14.32m: fine grained.*		14		
					(0.49)	Medium strong, thinly bedded, reddish brown SILTSTONE. Discontinuities are subhorizontal, very closely spaced and planar smooth.				
				11.69	14.81					
15.00 - 16.50	97 72 38	NI 14 NI 8 NI	15.65m - C7			Extremely weak, reddish brown, fine and medium SANDSTONE. Discontinuities are horizontal, very close, planar rough with sand infill. *Between 14.90m and 15.00m: non-intact, recovered as sand.* *At 15.00m: weak.* *Between 15.22m and 15.42m: recovered as gravel.*		15		
						Below 15.90: very weak. *At 15.90m: 1no vertical discontinuity, undulating rough.*		16		
16.50 - 18.00	97 78 47	11 NI 15	17.88m - C8		(4.84)	*Between 16.92m and 17.10m: 1no, curved, planar rough discontinuities with calcite infill.*		17		
18.00 - 19.50	96 88 74	25+ 5	18.85m - C9					18		
								19		
		NI	19.93m - C10	6.85	19.65	Weak, reddish brown, medium grained SANDSTONE with rare quartzite inclusions.		20		
						Continued next sheet				

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
15.00	16.50	Air mist	80
16.50	18.00	Air mist	80
18.00	19.50	Air mist	80
19.50	21.00	Air mist	80
21.00	22.50	Air mist	80
22.50	24.00	Air mist	80
24.00	25.50	Air mist	75
25.50	27.00	Air mist	75

Checked by: HH
Log status: DRAFT
IFA RC v01.01

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
16/10	14:00	40.50	6.50	0.90
17/10	08:00	24.00		5.10

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2		Location ID: **RBH07**
Dates: 10/10/2018 - 16/10/2018	Client: Curtins Consulting		Sheet 3 of 5
Rotary Borehole Log	Location: 383071.58E 397984.33N	Ground level: 26.50mOD / Logged by: /JW / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	90 82 44		21.00m - C11			Weak, reddish brown, medium grained SANDSTONE with rare quartzite inclusions. *Between 16.65m and 24.73m: horizontal, medium spaced, planar rough with rare sand infill.*		21		
21.00 - 22.50	95 86 70	5	21.89m - C12					22		
22.50 - 24.00	100 100 74		22.93m - C13					23		
			24.00m - C14					24		
24.00 - 25.50	96 95 63	17 4	25.10m - C15			*Below 24.73m: very closely spaced.*		25		
25.50 - 27.00	96 81 19	13 10	26.00m - C16					26		
		NI	27.00m - C17			*Between 27.00m and 27.20m: assumed zone of core loss.*		27		
27.00 - 28.50	88 75 45	11	27.50m - C18					28		
28.50 - 30.00	100 99 89	4	29.00m - C19			*At 28.34m: 1no subvertical, planar rough and clean.* *Between 28.60m and 31.70m: medium strong.*		29		
			30.00m - C20			Continued next sheet		30		

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
27.00	28.50	Air mist	75
28.50	30.00	Air mist	75
30.00	31.50	Air mist	75
31.50	33.00	Air mist	50
33.00	34.50	Air mist	50
34.50	36.00	Air mist	60
36.00	37.50	Air mist	60
37.50	39.00	Air mist	80

Checked by: HH
Log status: DRAFT
IFA RC v01.01

Borehole Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)

Remarks:

Casing Diameter

Depth (m)	Dia (mm)

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan Phase 2	**RBH07**
Dates:	Client:	Sheet 4 of 5
10/10/2018 - 16/10/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383071.58E 397984.33N	26.50mOD	/JW	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	99 94 94	13 4	31.00m - C21			Weak, reddish brown, medium grained SANDSTONE with rare quartzite inclusions. *At 30.77m: 1no, 30mm angular gnesis clast.*		31		
31.50 - 33.00	89 76 60	AZCL 5 9	32.98m - C22			*Below 31.68m: mudstone, medium and coarse grained.*		32 33		
33.00 - 34.50	100 100 84	3	34.40m - C23					34		
34.50 - 36.00	99 99 88	10	35.95m - C24		(20.85)	*Between 35.24m and 35.30m: coarse grained sandstone.*		35 36		
36.00 - 37.50	100 99 88		36.94m - C25			*Between 36.94m and 37.00m: 1no large reddish brown mudstone clast.*		37		
37.50 - 39.00	98 96 82	4	37.96m - C26					38		
39.00 - 40.50	100 98 96		39.99m - C27			*At 39.50m: 1no subvertical, planar rough dicontinuities.*		39 40		
						Continued next sheet				

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
39.00	40.50	Air mist	80								

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

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Plant used: Comacchio 205	Project: St John's Masterplan Phase 2		Location ID: **RBH07**
Dates: 10/10/2018 - 16/10/2018	Client: Curtins Consulting		Sheet 5 of 5
Rotary Borehole Log	Location: 383071.58E 397984.33N	Ground level: 26.50mOD / Logged by: /JW / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Weak, reddish brown, medium grained SANDSTONE with rare quartzite inclusions.				
				-14.00	40.50	End of Borehole at 40.50m				

41 42 43 44 45 46 47 48 49 50

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2		Location ID: **RBH08**
Dates: 10/10/2018 - 12/10/2018	Client: Curtins Consulting		Sheet 1 of 5
Rotary Borehole Log	Location: 383099.39E 397977.27N	Ground level: 26.13mOD / Logged by: JW / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details				Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
			0.20m - B1 0.20m - D2 0.50m - ES3		(0.75)	MADE GROUND: Black and grey, slightly silty, gravelly, fine to coarse SAND. Gravel is angular, fine to coarse including clinker and brick.			
			0.95m - B4 1.00m - D5	25.38	0.75	Firm, yellowish brown, silty CLAY with occasional sandy pockets.			
					(0.95)				
				24.43	1.70	SAND and GRAVEL (drillers description).			
					(2.80)				
				21.63	4.50	Red SANDSTONE, recovered as reddish brown, subangular, medium and coarse gravel.			
5.50 - 6.50	27 0 0	NR			(2.40)	*Between 5.50m and 6.23m: assumed zone of core loss.*			
		NI				*6.23m to 6.50m: Between 6.92m and 6.97m: non intact recovered as gravel.*			
6.50 - 7.50	70 47 0	NR				*Between 6.50m and 6.80m: assumed zone of core loss.*			
		NI		19.23	6.90	*Between 6.80m and 6.97m: non intact recovered as gravel.*			
		13				Extremely weak, reddish brown, medium grained SANDSTONE. Discontinuities 1) are horizontal, closely spaced, smooth planar and clean. 2) subhorizontal, medium spaced, planar rough and sand infilled.			
7.50 - 9.00	100 96 47	11	8.02m - C6			*At 7.50m: weak.* *Between 7.63m and 7.68m: 1 no vertical, planar rough, clean.* *Between 9.00m and 9.16m: non intact recovered as gravel.*			
		25+							
		NI				*Between 9.00m and 9.07m: assumed zone of core loss.*			
9.00 - 10.50	95 88 40	15	9.50m - C7			*Between 9.68m and 9.73m: weak.*			
						Continued next sheet			

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
1.70	4.50	Air mist	100
4.50	5.50	Air mist	100
5.50	6.50	Air mist	40
6.50	7.50	Air mist	40
7.50	9.00	Air mist	40
9.00	10.50	Air mist	70
10.50	12.00	Air mist	70
12.00	13.50	Air mist	70

Checked by: HH
Log status: DRAFT
IFA RC v01.01

Borehole Diameter

Depth (m)	Dia (mm)
40.50	107

Casing Diameter

Depth (m)	Dia (mm)
5.50	200
7.00	150

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
10/10	16:00	5.50	5.50	4.30
11/10	08:00	5.50	5.50	4.80
11/10	16:30	27.00	7.00	2.40
12/10	08:00	27.00	7.00	2.60

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.70	4.50		20	4.30	

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2		Location ID: **RBH08**
Dates: 10/10/2018 - 12/10/2018	Client: Curtins Consulting		Sheet 2 of 5
Rotary Borehole Log	Location: 383099.39E 397977.27N	Ground level: 26.13mOD / Logged by: JW / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Extremely weak, reddish brown, medium grained SANDSTONE. Discontinuities 1) are horizontal, closely spaced, smooth planar and clean. 2) subhorizontal, medium spaced, planar rough and sand infilled.				
						At 10.14m: 1 no ironstone inclusion, 5mm diatmeter.				
						Between 10.22m and 10.38m: 1no 45 degrees, planar, rough, clean.				
						Between 10.70m and 11.86m: very weak to weak and fine grained.				
						Between 10.89m and 11.02m: 2no 45 degrees, planar, rough, clean fractures.				
10.50 - 12.00	95 93 69	4	11.10m - C8					11		
12.00 - 13.50	93 91 56	13	12.50m - C9					12		
13.50 - 15.00	98 95 83	6	13.89m - C10					13		
15.00 - 16.50	99 95 67	10	15.50m - C11			*At 15.50m: medium strong.*		14		
16.50 - 18.00	98 97 56	4	17.00m - C12					15		
18.00 - 19.50	100 98 92	9	18.00m - C13 18.90m - C14					16		
			19.64m - C15					17		
								18		
								19		
								20		

Continued next sheet

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
13.50	15.00	Air mist	70
15.00	16.50	Air mist	70
16.50	18.00	Air mist	70
18.00	19.50	Air mist	80
19.50	21.00	Air mist	80
21.00	22.50	Air mist	80
22.50	24.00	Air mist	80
24.00	25.50	Air mist	80

Checked by: HH
Log status: DRAFT
IFA RC v01.01

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
12/10	16:30	40.50	7.00	3.80

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan Phase 2	**RBH08**
Dates:	**Client:**	Sheet 3 of 5
10/10/2018 - 12/10/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383099.39E 397977.27N	26.13mOD	JW	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	99 95 58	5				Extremely weak, reddish brown, medium grained SANDSTONE. Discontinuities 1) are horizontal, closely spaced, smooth planar and clean. 2) subhorizontal, medium spaced, planar rough and sand infilled.		21		
21.00 - 22.50	99 95 65	10	21.82m - C16			*Between 21.00m and 21.38m: very weak* *Between 21.13m and 21.31m: 1no 45 degrees, undulating rough, some sand infilling.* *At 21.38m: medium strong.*		22		
22.50 - 24.00	95 92 72	4	23.60m - C17					23		
24.00 - 25.50	98 98 88		25.10m - C18		(33.60)	*Between 27.00m and 27.50m: coarse grained with frequent clasts of sandstone and quartzite.*		24 25		
25.50 - 27.00	95 91 77	3	26.00m - C19			*Between 26.40m and 26.50m: 1no 45 degrees, planar with black staining.*		26		
27.00 - 28.50	98 98 88	5	27.00m - C20 27.90m - C21					27 28		
28.50 - 30.00	100 100 93	3	29.57m - C22					29		
						Continued next sheet		30		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
25.50	27.00	Air mist	90
27.00	28.50	Air mist	90
28.50	30.00	Air mist	90
30.00	31.50	Air mist	90
31.50	33.00	Air mist	90
33.00	34.50	Air mist	90
34.50	36.00	Air mist	90
36.00	37.50	Air mist	90

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH08**
	Dates: 10/10/2018 - 12/10/2018	Client: Curtins Consulting	Sheet 4 of 5
Rotary Borehole Log	Location: 383099.39E 397977.27N	Ground level: 26.13mOD / Logged by: JW / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	98 98 94		30.96m - C23			Extremely weak, reddish brown, medium grained SANDSTONE. Discontinuities 1) are horizontal, closely spaced, smooth planar and clean. 2) subhorizontal, medium spaced, planar rough and sand infilled.		31		
31.50 - 33.00	98 96 71	20 4	31.90m - C24			*Between 31.60m nd 31.90m: discontinuities are horizontal, very closely spaced and clean.*		32		
33.00 - 34.50	94 83 56	16 5	33.56m - C25			*Between 33.23m and 33.30m: non intact.* *Between 33.25m and 33.60m: very weak.*		33 34		
34.50 - 36.00	100 98 47	18	35.03m - C26			*Between 34.79m and 35.39m: very weak. Discontinuities are horizontal, very closely spaced, planar and undulating rough with sand infill.* *Between 35.75m and 35.78m: strong reddish brown siltstone band.*		35 36		
36.00 - 37.50	97 95 79	4	36.62m - C27					37		
37.50 - 39.00	100 99 82		37.90m - C28			*Between 37.75m and 38.18m: 1no vertical, undulating striated with calcite fill.*		38 39		
39.00 - 40.50	100 99 76	6	39.93m - C29			*Between 39.61m and 39.81m: frequent subrounded, reddish brown mudstone clasts.* *Between 39.75m and 39.94m: 1no 45 degrees, planar undulating*		40		
						Continued next sheet				

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
37.50	39.00	Air mist	90
39.00	40.50	Air mist	90

Borehole Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Remarks:

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH08**	
Dates: 10/10/2018 - 12/10/2018	Client: Curtins Consulting	Sheet 5 of 5	
Rotary Borehole Log	Location: 383099.39E 397977.27N	Ground level: 26.13mOD	Logged by: JW	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				-14.37	40.50	Extremely weak, reddish brown, medium grained SANDSTONE. Discontinuities 1) are horizontal, closely spaced, smooth planar and clean. 2) subhorizontal, medium spaced, planar rough and sand infilled. *Between 39.75m and 39.94m: 1no 45 degrees, planar undulating rough. Frequent calcite crystals of 2mm in diameter.* End of Borehole at 40.50m		41 42 43 44 45 46 47 48 49 50		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH09**
	Dates: 19/10/2018 - 23/10/2018	Client: Curtins Consulting	Sheet 1 of 5
Rotary Borehole Log	Location: 383084.13E 398012.45N	Ground level: 26.37mOD / Logged by: N/A / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				26.17	0.20	MADE GROUND: Tarmacadam (driller's description).				
				25.97	0.40	MADE GROUND: MOT type 1 (driller's description).				
				25.82	0.55	MADE GROUND: Tarmacadam (driller's description).				
					(0.95)	MADE GROUND: Red, SAND and GRAVEL including brick (driller's description).		1		
				24.87	1.50	Dark brown, sandy CLAY (driller's description).				
					(1.70)			2		
								3		
				23.17	3.20	Brown SAND and GRAVEL (driller's description).				
					(2.80)			4		
								5		
				20.37	6.00	Red SANDSTONE recovered as angular to subangular, fine to coarse gravel.		6		
6.00 - 7.00	14 14 0	AZCL								
		NI			(2.00)	*Between 6.86m and 7.00m: cobble of igneous lithology.*		7		
7.00 - 7.50	0 0 0	AZCL								
7.50 - 8.00	66 0 0	NI								
				18.37	8.00	Extremely weak, reddish brown, medium grained SANDSTONE discolouration on some surfaces. Discontinuities are horizontal, closely spaced, planar rough, clean with some sand infill.		8		
8.00 - 9.00	91 79 11		8.44m - C1							
		11						9		
9.00 - 10.50	97 82 25		9.50m - C2							
						Continued next sheet		10		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
6.00	7.00	Water	90
7.00	7.50	Water	90
7.50	8.00	Water	0
8.00	9.00	Water	0
9.00	10.50	Water	0
10.50	12.00	Water	0
12.00	13.50	Water	5
13.50	15.00	Water	0

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
19/10	08:00	15.00	3.00	4.00
19/10	16:30	15.00	6.00	9.80
22/10	08:00	15.00	9.00	3.30
22/10	16:30	36.00	9.00	1.54

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.00	3.00	6.00	20	3.70	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	2.50	Plain	50
2.50	7.50	Slotted	50

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH09**	
Dates: 19/10/2018 - 23/10/2018	Client: Curtins Consulting	Sheet 2 of 5	
Rotary Borehole Log	Location: 383084.13E 398012.45N	Ground level: 26.37mOD	Logged by: N/A	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Extremely weak, reddish brown, medium grained SANDSTONE discolouration on some surfaces. Discontinuities are horizontal, closely spaced, planar rough, clean with some sand infill.				
10.50 - 12.00	98 91 36	8	11.00m - C3			*Between 10.70m and 11.80m: weak.*		11		
12.00 - 13.50	96 83 35	10	11.93m - C4 12.94m - C5			*At 11.80m: very weak.* *At 12.50m: 1no. 45 degrees, planar rough discontinuity.*		12 13		
13.50 - 15.00	66 32 0	AZCL NI 6	14.50m - C6			*Between 14.00m and 14.51m: non intact recovered as gravelly sand.* *Between 14.51m and 15.00m: very closey.*		14		
15.00 - 16.50	55 0 0	AZCL NI				*Between 15.83m and 16.50m: non intact recovered as gravelly sand.*		15 16		
16.50 - 17.30	78 70 34	8	17.00m - C7			*Between 16.50m and 20.90m: closely spaced.*		17		
17.30 - 18.00	93 81 50	AZCL 11	18.00m - C8					18		
18.00 - 19.50	59 50 34	AZCL 6	19.38m - C9			*Between 18.61m and 20.90m: weak.*		19		
		AZCL				Continued next sheet		20		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
15.00	16.50	Water	80
16.50	17.30	Water	80
17.30	18.00	Water	80
18.00	19.50	Air	80
19.50	20.50	Air	75
20.50	20.85	Air	75
20.85	21.60	Air	75
21.60	22.50	Air	75

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
23/10	08:00	36.00	9.00	3.20
23/10	16:30	4.05	9.00	3.40

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2		Location ID: **RBH09**
Dates: 19/10/2018 - 23/10/2018	Client: Curtins Consulting		Sheet 3 of 5
Rotary Borehole Log	Location: 383084.13E 398012.45N	Ground level: 26.37mOD / Logged by: N/A / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 20.50	55 37 0	14 NI				Extremely weak, reddish brown, medium grained SANDSTONE discolouration on some surfaces. Discontinuities are horizontal, closely spaced, planar rough, clean with some sand infill.				
20.50 - 20.85	100	11 NI				*Between 20.18m and 20.32m: non intact recovered as gravel.*				
20.85 - 21.60	100 84 84		21.14m - C10 21.48m - C11			*Between 20.85m and 20.90m: non intact recovered as sand.* *Between 20.90m and 28.50m: medium strong.* *Between 20.90m and 28.50m: medium spaced.*		21		
21.60 - 22.50	88 88 72					*At 22.30m: 1no. vertical, planar smooth with calcite infill.*		22		
22.50 - 24.00	97 83 79		23.03m - C12			*At 23.358m: 1no. 45 degrees, planar rough with calcite infill.*		23		
24.00 - 25.50	100 88 76	2	24.00m - C13 24.94m - C14		(32.50)			24 25		
25.50 - 27.00	96 95 90		26.20m - C15 26.90m - C16					26 27		
27.00 - 28.50	98 96 78		28.12m - C17			*Between 28.50m and 30.18m: closely spaced.*		28		
28.50 - 30.00	96 92 88	NI 11	29.00m - C18 29.98m - C19			*Between 29.46m and 30.18m: weak.*		29 30		
						Continued next sheet				

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
22.50	24.00	Air	75
24.00	25.50	Air	75
25.50	27.00	Air	75
27.00	28.50	Air	75
28.50	30.00	Air	75
30.00	31.50	Air	75
31.50	33.00	Air	75
33.00	34.50	Air	75

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan Phase 2	**RBH09**
Dates:	Client:	Sheet 4 of 5
19/10/2018 - 23/10/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383084.13E 398012.45N	26.37mOD	N/A	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	100 92 88	4	30.50m - C20			Extremely weak, reddish brown, medium grained SANDSTONE discolouration on some surfaces. Discontinuities are horizontal, closely spaced, planar rough, clean with some sand infill. *At 30.18m: medium spaced discontinuity.* *Between 30.18m and 32.53m: weak, medium strong.*		31		
31.50 - 33.00	100 98 75	13	32.37m - C21			*Between 32.53m and 32.91m:weak.*		32		
33.00 - 34.50	96 88 34					*At 32.91m: 1no. planar rough and clean discontinuity.* *Below 32.91m: discontinuities are medium spaced, planar, rough and clean.*		33		
34.50 - 36.00	100 96 84		34.90m - C22 35.38m - C23			*At 34.23m: 1no. 45 degrees, planar stepped with calcite infill.*		34 35		
36.00 - 37.50	98 96 73	3	36.93m - C24					36		
37.50 - 39.00	100 98 86		38.12m - C25 38.90m - C26					37 38		
39.00 - 40.50	100 100 91		39.64m - C27					39		
						Continued next sheet		40		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
34.50	36.00	Air	
36.00	37.50	Air	80
37.50	39.00	Air	80
39.00	40.50	Air	80

Borehole Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Remarks:

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2		Location ID: **RBH09**
Dates: 19/10/2018 - 23/10/2018	Client: Curtins Consulting		Sheet 5 of 5
Rotary Borehole Log	Location: 383084.13E 398012.45N	Ground level: 26.37mOD / Logged by: N/A / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Extremely weak, reddish brown, medium grained SANDSTONE discolouration on some surfaces. Discontinuities are horizontal, closely spaced, planar rough, clean with some sand infill.				
				-14.13	40.50	End of Borehole at 40.50m				

41 42 43 44 45 46 47 48 49 50

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH10**	
Dates: 16/10/2018	Client: Curtins Consulting	Sheet 1 of 4	
Rotary Borehole Log	Location: 383088.51E 398054.22N	Ground level: 26.37mOD	Logged by: JW / Vertical scale: 1:50 / Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				26.27	0.10	MADE GROUND: Tarmacadam.				
						MADE GROUND: Ash and brick fill (drillers description).				
			0.50m - B1 0.50m - ES2		(0.90)					
			1.00m - B3 1.00m - ES4	25.37	1.00	Yellowish brown, SAND and GRAVEL (drillers description).		1		
								2		
					(3.50)			3		
								4		
				21.87	4.50	Red SAND and GRAVEL (drillers description).				
					(0.50)					
				21.37	5.00	Weak, fractured, red SANDSTONE (drillers description).		5		
					(1.54)			6		
6.00 - 7.00	45 0 0	AZCL								
		NI		19.83	6.54	Multicoloured angular to subrounded, medium and coarse GRAVEL of mixed lithologies (collapsed material from above).				
					(0.46)					
				19.37	7.00	Extremely weak, reddish brown SANDSTONE. Discontinuities are horizontal, very closely spaced, planar rough and clean.		7		
7.00 - 8.50	16 11 0	AZCL			(1.25)			8		
		NI		18.12	8.25	Extremely weak, reddish brown, medium grained SANDSTONE. Discontinuities are horizontal, very closely spaced, planar rough and clean.				
		17								
8.50 - 10.00	42 26 20	AZCL						9		
		NI								
		14	9.74m - C5							
		NI				Continued next sheet		10		

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
6.00	7.00	Air	100
7.00	8.50	Air	100
8.50	10.00	Air	100
10.00	11.50	Air	100
11.50	13.00	Air	100
13.00	14.50	Air	100
16.00	17.00	Air	100
18.00	17.00	Air	100

Checked by: HH
Log status: DRAFT
IFA RC v01.01

Borehole Diameter

Depth (m)	Dia (mm)
39.50	146

Casing Diameter

Depth (m)	Dia (mm)
2.00	150
35.00	125

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
16/10	16:30	2.00	2.00	
17/10	08:00	2.00	2.00	
17/10	16:30	20.00	20.00	
18/10	08:00	20.00	20.00	

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
	35.00	35.00	0	0.00	
8.00	20.00	20.00	0	0.00	

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH10**	
Dates: 16/10/2018	Client: Curtins Consulting	Sheet 2 of 4	
Rotary Borehole Log	Location: 383088.51E 398054.22N	Ground level: 26.37mOD	Logged by: JW	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
10.00 - 11.50	2 2 0	AZCL				Extremely weak, reddish brown, medium grained SANDSTONE. Discontinuities are horizontal, very closely spaced, planar rough and clean.		11		
		NI	11.46m - C6							
11.50 - 13.00	44 22 9	AZCL						12		
		NI	12.44m - C7							
		14	12.83m - C8							
13.00 - 14.50	45 10 0	AZCL				*All non-intact areas are recovered as angular gravel.*		13		
		25+	14.10m - C9			*Between 14.02 and 14.15m: very closely spaced discontinuities.*		14		
		NI								
14.50 - 16.00	0 0 0	AZCL						15		
16.00 - 17.00	29 20 0		16.45m - C10					16		
		NI								
		23								
		NI								
		AZCL				*Below 17.00m: closely spaced.*		17		
17.00 - 18.00	66 34 0	25+								
		NI	17.52m - C11							
		25+								
		15						18		
18.00 - 19.00	58 11 0	AZCL								
		25+	18.47m - C12							
		AZCL						19		
		NI								
19.00 - 20.00	14 14 0	AZCL								
			19.88m - C13					20		
						Continued next sheet				

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
18.00	19.00	Air	100
19.00	20.00	Air	100
20.00	20.50	Air	100
20.50	21.00	Air	100
21.00	22.50	Air	100
22.50	23.50	Air	100
23.50	24.50	Air	100
24.50	26.00	Air	100

Checked by: HH | IFA RC v01.01
Log status: DRAFT

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
18/10	16:30	35.00	35.00	
19/10	08:00	35.00	35.00	
19/10	13:00	39.50	35.00	

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH10**	
Dates: 16/10/2018	Client: Curtins Consulting	Sheet 3 of 4	
Rotary Borehole Log	Location: 383088.51E 398054.22N	Ground level: 26.37mOD	Logged by: JW / Vertical scale: 1:50 / Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
20.00 - 20.50	50 32 0	NI 18				Extremely weak, reddish brown, medium grained SANDSTONE. Discontinuities are horizontal, very closely spaced, planar rough and clean.				
20.50 - 21.00	18 14 0	AZCL 1	20.60m - C14					21		
21.00 - 22.00	0 0 0	AZCL								
22.00 - 22.50	18 18 0	11	22.00m - C15					22		
22.50 - 23.00	0 0 0									
23.00 - 23.50	0 0 0	AZCL						23		
23.50 - 24.00	0 0 0									
24.00 - 24.50	18 18 0	NI	24.42m - C16					24		
24.50 - 25.00	0 0 0	AZCL			(31.25)					
25.00 - 26.00	79 17 17	NI 5	25.82m - C17			*Below 25.83m: medium strong.*		25		
26.00 - 26.50	12 12 0	AZCL 25+				*Below 26.38m: extremely weak.*		26		
26.50 - 27.00	90 50 0	NI 25+	26.90m - C18					27		
27.00 - 28.00	37 18 10	AZCL NI 25+	27.93m - C19							
28.00 - 29.00	16 5 0	AZCL NI						28		
29.00 - 30.00	21 21 21	AZCL	29.90m - C20					29		
						Continued next sheet		30		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
26.00	27.00	Air	100
27.00	28.00	Air	100
28.00	29.00	Air	100
29.00	30.00	Air	100
30.50	32.00	Air	100
32.00	33.50	Air	100
33.50	35.00	Air	0
35.00	36.50	Air	0

Checked by: HH
Log status: DRAFT
IFA RC v01.01

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH10**	
Dates: 16/10/2018	Client: Curtins Consulting	Sheet 4 of 4	
Rotary Borehole Log	Location: 383088.51E 398054.22N	Ground level: 26.37mOD	Logged by: JW / Vertical scale: 1:50 / Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 30.50	33 22 19	8	30.30m - C21			Extremely weak, reddish brown, medium grained SANDSTONE. Discontinuities are horizontal, very closely spaced, planar rough and clean. *Below 30.00m: weak.*		31		
30.50 - 32.00	14 6 6	AZCL								
		20 NI	32.00m - C22					32		
32.00 - 33.50	0 0 0	AZCL						33		
33.50 - 35.00	8 3 0							34		
		NI	34.88m - C23					35		
35.00 - 36.50	0 0 0							36		
36.50 - 38.00	0 0 0	AZCL						37		
38.00 - 39.50	0 0 0							38		
								39		
				-13.13	39.50	End of Borehole at 39.50m				
								40		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
36.50	38.00	Air	0
38.00	39.50	Air	0

Borehole Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Remarks:

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacciho 300	Project: St John's Masterplan Phase 2	Location ID: **RBH10A**	
Dates: 02/11/2018 - 08/11/2018	Client: Curtins Consulting	Sheet 1 of 5	
Rotary Borehole Log	Location: 383084.29E 398055.52N	Ground level: 26.28mOD	Logged by: JW/DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						MADE GROUND: Black and dark grey, gravelly, medium SAND with high cobble content. Gravel is angular to subangular, fine to coarse including brick, limestone and tarmacadam.				
					(1.70)			1		
				24.58	1.70	Brown SAND and GRAVEL (driller's description).				
					(2.30)			2		
								3		
				22.28	4.00	Red SAND and GRAVEL (driller's description).				
					(1.50)			4		
								5		
				20.78	5.50					
5.50 - 6.00	100 20 0	NI		20.71	5.57 (0.33)	Yellowish grey, subrounded COBBLES of strong coarse grained sandstone.				
		10		20.38	5.90	Reddish brown, gravelly, fine and medium SAND. Gravel is angular to subangular, fine to coarse including sandstone.				
6.00 - 6.50	100 0 0	NI		20.28	6.00	Weak, greenish grey, fine and medium grained SANDSTONE. Discontinuities are subhorizontal, planar smooth and clean.		6		
						Reddish brown, gravelly, fine and medium SAND. Gravel is angular to subangular, fine to coarse including extremely weak sandstone.				
6.50 - 7.50	40 0 0	AZCL						7		
		NI								
					(3.50)					
7.50 - 8.50	0 0 0	AZCL						8		
8.50 - 9.00	0 0 0							9		
		NI		16.78	9.50					
					(0.40)	Recovered as reddish brown, angular to subrounded COBBLE of very weak, fine and medium grained sandstone.				
				16.38	9.90			10		
						Continued next sheet				

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
13.50	5.50	Water	80
16.50	13.50	Water	60
18.00	16.50	Water	80
24.00	18.00	Water	60
25.50	24.00	Water	30
40.50	25.50	Water	70

Borehole Diameter

Depth (m)	Dia (mm)
40.50	146

Casing Diameter

Depth (m)	Dia (mm)
13.50	200

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
02/11	16:30	5.50	5.50	Dry
05/11	08:00	5.50	5.50	3.80
05/11	16:30	24.00	9.00	3.20
06/11	08:00	24.00	9.00	3.20

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacciho 300	Project: St John's Masterplan Phase 2	Location ID: **RBH10A**
	Dates: 02/11/2018 - 08/11/2018	Client: Curtins Consulting	Sheet 2 of 5
Rotary Borehole Log	Location: 383084.29E 398055.52N	Ground level: 26.28mOD / Logged by: JW/DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
9.00 - 11.50	87 47 35	18			(2.30)	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 1) 0-25 degrees, very closely to closely spaced, planar smooth unstained, occasional clay infill. 2) 45 degrees, closely spaced, planar smooth, occasional stained black silt infill. *Between 11.16m and 11.48m: reduction spot.*		11		
11.50 - 12.00	0 0 0	AZCL						12		
12.00 - 13.50	87 87 60	6		14.08	12.20	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely, locally very closely spaced, planar smooth, unstained clean and occasional clay infill.		13		
13.50 - 15.00	100 100 100	13 7			(3.00)	*Between 14.15m and 14.30m: 1no. 45-55 degrees, planar smooth, occasional black stained clay infill.*		14		
15.00 - 16.50	87 70 63	AZCL 7 NI 10 NI 3 7 NI 5		11.08	15.20	Weak, reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, very closely spaced, planar smooth occasional stained black and clay infill. *Between 15.50m and 15.60m: recovered as angular to subangular, fine and medium grained of very weak sandstone.* *Between 16.20m and 16.30m: non intact recovered as sandy gravel. Gravel is angular subangular, fine to coarse.*		15 16		
16.50 - 18.00	100 100 93	5			(3.60)	*Between 17.20m and 18.05m: 1no. 45-55 degrees, planar smooth, yellowish grey stained.*		17		
18.00 - 19.50	100 98 73	NI 7		7.48	18.80	*Between 18.00m and 18.10m: recovered as 2no. subrounded cobble of weak sandstone.* *At 18.10m: non intact 1no. gravel of quartzite.* *At 18.70m: non intact 1no. gravel of quartzite.*		18 19		
					(2.30)	Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuity 0-10 degrees, closely to medium spaced, planar and undulating smooth, unstained and occasional clay infill. *At 19.75m: non intact 1no. gravel of quartzite, predominantly fine grained.*		20		
						Continued next sheet				

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
06/11	16:30	25.50	9.00	3.70
07/11	08:00	25.50	9.00	Dry
07/11	16:30	25.50	13.50	Dry
08/11	08:00	25.50	13.50	3.60

Remarks:

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacciho 300	Project: St John's Masterplan Phase 2		Location ID: **RBH10A**
Dates: 02/11/2018 - 08/11/2018	Client: Curtins Consulting		Sheet 3 of 5
Rotary Borehole Log	Location: 383084.29E 398055.52N	Ground level: 26.28mOD / Logged by: JW/DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	100 100 98					Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuity 0-10 degrees, closely to medium spaced, planar and undulating smooth, unstained and occasional clay infill.		21		
21.00 - 22.50	100 83 57	NI 9 NI 9		5.18	21.10	Weak locally very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuity 0-25 degrees, very closely to closely spaced, planar undulating and smooth, unstained with occasional clay infill. *Between 21.10m and 21.30m: non intact recovered as angular to subangular cobble.* *Between 21.30m and 21.40m: 1no. 45 degrees, planar smooth, unstained clean.* *Between 21.52m and 21.64m: 1no. 45 degrees, planar smooth, unstained clean.* *Between 22.10m and 22.15m: non intact recovered as angular to subangular cobble 2m diameter.* *Between 22.30m and 25.30m: occasional gravel inclusions of quartzite.* *Between 22.35m and 22.40m: 1no. 45 degrees, planar smooth, unstained clean.* *Between 22.90m and 23.00m: non intact recovered as angular to subangular cobble.* *Between 23.05m and 23.10m: 1no. 45 degrees, planar smooth, unstained clean.* *Between 23.30m and 23.37m: 1no. discontinuity 45-55 degrees, planar smooth, with yellowish grey staining.* *Between 24.00m and 24.20m: non intact recovered as angular to subangular cobble.*		22 23 24		
22.50 - 24.00	100 83 53	NI 7 NI 10 10			(3.85)					
24.00 - 25.50	100 87 69	NI 9 3 10		1.33 0.98	24.95 (0.35) 25.30	Medium strong, locally weak medium grained SANDSTONE. Discontinuity horizontal, medium spaced, planar smooth, unstained, clean. Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuity 0-10 degrees, closely spaced, planar undulating smooth, unstained with occasional clay infill.		25		
25.50 - 27.00	100 93 63	NI 10 NI 7				*Below 26.60m: medium strong, fine grained, clay infill.*		26		
27.00 - 28.50	100 100 100	2						27 28		
28.50 - 30.00	100 100 83	20 5 20 6 2						29 30		

Continued next sheet

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
						08/11	16:30	40.50	13.50	3.20	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacciho 300	Project: St John's Masterplan Phase 2	Location ID: **RBH10A**
	Dates: 02/11/2018 - 08/11/2018	Client: Curtins Consulting	Sheet 4 of 5
Rotary Borehole Log	Location: 383084.29E 398055.52N	Ground level: 26.28mOD / Logged by: JW/DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	100 94 85	8 NI 4				Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuity 0-10 degrees, closely spaced, planar undulating smooth, unstained with occasional clay infill. *Below 30.00m: clean discontinuity, medium and coarse grained.* *Between 30.40m and 30.50m: non intact recovered as coarse gravel.*		31		
31.50 - 33.00	100 100 90	1 7				*Between 31.50m and 38.50m: light yellow mottling surface.*		32 33		
33.00 - 34.50	100 100 90	3 2				*Below 33.60m: fine and medium grained, discontinuities are medium spaced.*		34		
34.50 - 36.00	100 100 83	4			(15.20)	*Between 35.30m and 35.35m: 1no discontinuity, 45 degrees, planar smooth, black stained and clean.* *Between 35.85m and 35.87m: 1no discontinuity, 80 degrees, planar smooth, unstained.*		35 36		
36.00 - 37.50	100 100 80	8 3 NI				*Below 36.50m: quartzite veins and interbedded mudstone.* *Between 36.65m and 36.70m: reduction spot.* *Between 36.82m and 36.85m: reduction spot.* *Between 36.86m and 36.94m: 1no discontinuity 45 degrees, planar smooth, black stained and clean.* *Between 36.94m and 36.98m: 1no discontinuity, 55 degrees, planar smooth, greenish stained grey.*		37		
37.50 - 39.00	100 98 94	2 6				*Between 38.00m and 38.03m: non intact recovered as gravel.* *Between 38.39m and 38.48m: 1no discontinuity 50-60 degrees, planar smooth, black stained surface with clay infill.*		38 39		
39.00 - 40.50	100 97 97							40		

Continued next sheet

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacciho 300	Project: St John's Masterplan Phase 2	Location ID: **RBH10A**	
Dates: 02/11/2018 - 08/11/2018	Client: Curtins Consulting	Sheet 5 of 5	
Rotary Borehole Log	Location: 383084.29E 398055.52N	Ground level: 26.28mOD	Logged by: JW/DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				-14.22	40.50	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuity 0-10 degrees, closely spaced, planar undulating smooth, unstained with occasional clay infill. *Between 39.90m and 39.95m: reduction spot.* End of Borehole at 40.50m		41 42 43 44 45 46 47 48 49 50		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH11**	
Dates: 19/11/2018 - 21/11/2018	Client: Curtins Consulting	Sheet 1 of 5	
Rotary Borehole Log	Location: 383127.10E 398026.04N	Ground level: 26.65mOD	Logged by: DO/	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details				Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
			0.20m - B1	26.45	0.20	MADE GROUND: Tarmacadam.			
			0.40m - ES2	26.20	0.45	MADE GROUND: Light grey, sandy, angular to subangular, fine to coarse GRAVEL including limestone and concrete.			
				26.05	0.60	MADE GROUND: Reddish brown, angular to subangular, COBBLE including brick.			
					(3.40)	MADE GROUND: Light grey, angular to subangular COBBLE and BOULDER including concrete.			
				22.65	4.00	Brown SAND and GRAVEL (driller's description).			
				21.95	(0.70) 4.70	Red SANDSTONE recovered as sand (driller's description).			
					(0.80)				
5.50 - 6.00	70 20 20	AZCL NI		21.15	5.50	Weak very weak in places, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely locally very closely spaced, planar locally undulating smooth, locally rough, unstained and clean. *Between 5.65m and 5.90m: collapse material - MADE GROUND: Recovered as light grey mottled white, subangular to subrounded GRAVEL and COBBLES of limestone and granite.*			
6.00 - 6.75	100 100 80	7							
6.75 - 7.50	84 48 33	AZCL NI 10	7.50m - C3		(3.50)	*Between 6.85m and 7.15m: non-intact recovered as angular to subangular gravel.*			
7.50 - 9.00	67 67 27	NI 15 5 13 AZCL				*Between 7.88m and 8.15m: non-intact recovered as soft reddish brown, slightly gravelly, silty clay.* *Between 8.05m and 8.10m: 1no discontinuity 45 degrees, stepped, smooth, unstained and clean.*			
9.00 - 10.50	100 100 41	13 8	9.00m - C4	17.65	9.00 (1.50)	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely locally very closely spaced, planar locally undulating smooth rough, unstained and clean.			
						Continued next sheet			

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
5.50	6.00	Air	80
6.00	6.75	Air	80
6.75	7.50	Air	80
7.50	9.00	Air	80
9.00	10.50	Air	70
10.50	12.00	Air	70
12.00	13.50	Air	70
13.50	15.00	Air	70

Checked by: HH
Log status: DRAFT
IFA RC v01.01

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
20/11	08:00	4.00		3.90
20/11	16:30	25.50	7.50	4.60
21/11	08:00	25.50	7.50	6.30
21/11	16:30	40.50	7.50	8.80

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan Phase 2	**RBH11**
Dates:	**Client:**	Sheet 2 of 5
19/11/2018 - 21/11/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383127.10E 398026.04N	26.65mOD	DO/	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		AZCL		16.15	10.50	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely locally very closely spaced, planar locally undulating smooth rough, unstained and clean.				
10.50 - 12.00	100 100 78	9	10.72m - C5		(0.90)	Weak locally medium strong, reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely locally very closely spaced, planar locally undulating smooth, unstained and with silt infill <1mm.		11		
		2	11.55m - C6	15.25	11.40	Weak and very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, medium locally closely spaced, planar and undulating smooth, locally rough, unstained with occasional silt infill <1mm.				
		8						12		
12.00 - 13.50	100 100 80	4	13.05m - C7			*Between 13.35m and 13.65m: 1no discontinuity, 55-65 degrees, stepped smooth, unstained and clean.* *Between 13.40m and 13.50m: becoming gravelly. Gravel is angular to subangular, fine and medium of quartzite.*		13		
13.50 - 15.00	93 93 82		14.15m - C8		(4.85)	*Between 14.30m and 14.50m: becoming gravelly. Gravel is angular to subangular, fine and medium of quartzite.* *Between 14.60m and 14.90m: discontinuities are becoming closely locally very closely spaced.*		14		
		13								
		AZCL						15		
		NI				*Between 15.00m and 15.10m: non-intact recovered as subangular cobble of very weak, fine and medium grained sandstone.* *Between 15.20m and 16.25m: becoming weak and locally medium strong.*				
		6	15.30m - C9							
15.00 - 16.50	100 77 75	4	15.80m - C10			*Between 15.55m and 15.68m: 1no discontinuity, 55-65 degrees, stepped smooth, unstained and clean.*		16		
		10		10.40	16.25	*Between 16.15m and 16.20m: 1no discontinuity 75-85 degrees, planar smooth, stained yellowish grey (reduction) penetrating <2mm.*				
		NI		10.15	16.50	Red SANDSTONE recovered as reddish brown, very gravelly, fine and medium SAND.				
		5				Weak locally medium strong, reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced, planar smooth, unstained and clean.				
		12	17.14m - C11		(0.90)	*Between 16.50m and 16.66m: black.* *Between 16.50m and 16.90m: 1no discontinuity 75-85 degrees, planar smooth, stained yellowish grey.* *Between 16.88m and 16.90m: penetrating <1mm, silt infill <1mm.* *Between 17.00m and 17.05m: 1no discontinuities are 90 degrees, planar smooth, unstained and clean.* *Between 17.30m and 17.36m: 1no discontinuities are 90 degrees, planar smooth, unstained and clean.*		17		
16.50 - 19.00	100 75 67	NI		9.25	17.40 (0.38)					
		11		8.87	17.78	Red SANDSTONE recovered as reddish brown, very gravelly, fine and medium SAND.		18		
			18.30m - C12			Medium strong, locally weak reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely to medium spaced, planar and undulating smooth, locally rough smooth, unstained and clean. *Between18.87m and 19.06m: 1no discontinuity 50-60 planar smooth, unstained and clean.*				
19.00 - 19.50	100 100 90	4	19.40m - C13			*Between 19.50m and 19.80m: slightly gravelly. Gravel is subangular to subrounded, fine and medium including quartzite and siltstone.*		19		
						Continued next sheet		20		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
15.00	16.50	Air	70
16.50	18.00	Air	70
18.00	19.50	Air	50
19.50	21.00	Air	50
21.00	22.50	Air	60
22.50	24.00	Air	60
24.00	25.50	Air	60
25.50	27.00	Air	60

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH11**	
Dates: 19/11/2018 - 21/11/2018	Client: Curtins Consulting	Sheet 3 of 5	
Rotary Borehole Log	Location: 383127.10E 398026.04N	Ground level: 26.65mOD	Logged by: DO/	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	100 100 73	10 5 3	20.60m - C14			Medium strong, locally weak reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely to medium spaced, planar and undulating smooth, locally rough smooth, unstained and clean. *Between 20.10m and 20.25m: becoming locally very weak.* *Between 20.90m and 20.95m: 1no discontinuity 25-35 degrees, undulating smooth, unstained and clean.* *Between 21.00m and 21.60m: becoming rarely gravelly. Gravel is angular to subangular, fine including quartzite.*		21		
21.00 - 22.50	100 100 90	10	21.90m - C15		(4.72)			22		
22.50 - 24.00	100 97 90	6 NI 6	23.40m - C16	4.15	22.50 (1.70)	Weak, locally very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely locally very closely spaced, planar smooth and rough, unstained and clean. *Between 23.00m and 23.05m: non intact recovered as angular to subangular cobbles of very weak, fine and medium grained sandstone.* *Between 23.15m and 23.25m: 1no 70-80 degrees, stepped rough, unstained and clean (possible drilling induced).* *Between 25.55m and 25.70m: 1no discontinuity, 45 degrees, planar smooth, unstained and clean.* *Between 23.90m and 24.00m: 1no discontinuity, 90 degrees, planar smooth, unstained and clean. Recovered as angular to subangular gravel.*		23		
24.00 - 25.50	87 70 13	NI 10 NI 20 NI 18 18 15 NI	24.90m - C17	2.45 2.15	24.20 (0.30) 24.50	*Between 24.00m and 24.10m: non intact recovered as gravelly, fine and medium sand. Gravel is angular to subangular , fine to coarse of extremely weak, fine and medium grained sandstone.* *Between 24.00m and 24.12m: 1no discontinuity 90 degrees, slightly undulating to planar smooth, unstained and clean.* Red SANDSTONE recovered as reddish brown, very gravelly, fine and medium SAND.		24 25		
25.50 - 27.00	100 80 63	AZCL 20 10 NI 14	26.00m - C18		(3.60)	Medium strong locally weak reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely to medium spaced, planar and undulating smooth, locally rough smooth, unstained and clean. *Between 24.80m and 24.88m: 1no discontinuity, 85 degrees, planar smooth, unstained and clean.* *Between 24.92m and 24.94: 1no discontinuity, 90 degrees, planar smooth, unstained and clean. Recovered as angular to subangular cobble.* *Between 24.96m and 24.98m: 1no discontinuity, 90 degrees, planar smooth, stained yellowish grey, penetrating <1mm clean.* *Between 25.20m and 25.30m: 1no discontinuity 45-55 degrees, planar smooth, unstained, silt infill <1mm.* *Between 25.50m and 26.50m: becoming very weak, locally weak.* *Between 25.55m and 25.70m: 1no discontinuity, 90 degrees, stepped smooth, unstained and clean.* *Between 25.60m and 26.75m: 4no 90 degrees, planar and stepped rough, unstained and clean (possible drilling induced).* *Between 25.80m and 26.00m: becoming slightly gravelly. Gravel is subrounded to rounded, fine and medium including quartzite.* *Between 27.20m and 27.15m: 1no discontinuity 75-85 degrees, planar smooth, unstained, silt infill <1mm.* *Between 27.50ma n*		26		
27.00 - 28.50	100 100 73	5	26.90m - C19					27 28		
28.50 - 30.00	100 100 97	2 4 25+ 5	28.20m - C20 29.30m - C21	-1.45	28.10	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely to medium spaced, planar locally undulating locally stepped smooth locally rough, unstained, occasional silt infill <1mm. *Between 28.15m and 28.25m: 1no discontinuity, 75-85 degrees, planar smooth, unstained and clean.* *Between 28.30m and 29.50: becoming slightly gravelly. Gravel is angular to subrounded, fine including siltstone and quartzite.* *Between 28.80m and 28.30m: becoming rarely gravelly. Gravel is subangular, fine including quartzite.* *Between 29.00m and 29.03m: change of hue to grey (reduction spot).*		29 30		

Continued next sheet

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
27.00	28.50	Air	60
28.50	30.00	Air	60
30.00	31.50	Air	60
31.50	33.00	Air	60
33.00	34.50	Air	50
34.50	36.00	Air	30
36.00	37.50	Air	20
37.50	39.00	Air	20

Checked by: HH
Log status: DRAFT
IFA RC v01.01

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan Phase 2	**RBH11**
Dates:	Client:	Sheet 4 of 5
19/11/2018 - 21/11/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383127.10E 398026.04N	26.65mOD	DO/	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	100 100 97	10 5	30.20m - C22 31.40m - C23			Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely to medium spaced, planar locally undulating locally stepped smooth locally rough, unstained, occasional silt infill <1mm. *Between 30.00m and 30.03m: 1no discontinuity, 90 degrees planar, rough unstained (possible drilling induced).*		31		
31.50 - 33.00	100 100 96		32.05m - C24					32		
33.00 - 34.50	100 100 96	10 5	33.30m - C25 34.40m - C26		(7.90)	*At 33.48m: 1no. subrounded, fine gravel including quartzite.* *Between 34.17m and 35.30m: 2) 40-50 degrees, closely spaced, planar locally undulating smooth, unstained and clean.*		33 34		
34.50 - 36.00	100 100 96	10 20 4	35.06m - C27			*At 34.60m: discontinuities are 0 degrees, planar smooth, locally undulating, clean.* *At 34.64m: discontinuities are 0 degrees, planar smooth, locally undulating, clean.* *At 34.80m: 1 no discontinuity, subrounded, medium gravel including quartzite.* *At 35.09m: discontinuities are 0 degrees, planar smooth, locally undulating, clean.* *At 35.14m: discontinuities are 0 degrees, planar smooth, locally undulating, clean.* *At 35.42m and 35.47m 1no, incipient fracture, 45 degrees planar.*		35		
36.00 - 37.50	100 100 98	2	36.10m - C28 36.95m - C29	-9.35	36.00 (1.50)	Weak, reddish brown, fine grained SANDSTONE. Discontinuities are 0-10 degrees, medium spaced, planar smooth locally rough, unstained and clean.		36 37		
37.50 - 39.00	100 100 97	6	39.00m - C30	-10.85	37.50 (3.00)	Medium strong locally weak, reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced planar, locally undulating, smooth unstained and clean. *Between 38.68m and 38.72m: locally very weak.*		38 39		
39.00 - 40.50	100 100 97	5	40.00m - C31			*Between 39.40m and 39.60m: 1no discontinuity, 90 degrees planar smooth, unstained and clean.* *Between 39.50m and 39.70m: locally weak.*		40		

Continued next sheet

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
39.00	40.50	Air	20								

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2		Location ID: **RBH11**
Dates: 19/11/2018 - 21/11/2018	Client: Curtins Consulting		Sheet 5 of 5
Rotary Borehole Log	Location: 383127.10E 398026.04N	Ground level: 26.65mOD / Logged by: DO/ / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Medium strong locally weak, reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced planar, locally undulating, smooth unstained and clean.				
				-13.85	40.50	End of Borehole at 40.50m				

41 42 43 44 45 46 47 48 49 50

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH12A**	
Dates: 19/10/2018 - 26/10/2018	Client: Curtins Consulting	Sheet 1 of 4	
Rotary Borehole Log	Location: 383098.57E 398086.99N	Ground level: 26.45mOD	Logged by: JW/DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				26.33	0.12	MADE GROUND: Tarmacadam.				
				26.15	0.30	MADE GROUND: Light grey, very sandy, angular, fine to coarse GRAVEL of limestone.				
			0.45m - B1 0.50m - ES2	26.00	0.45	MADE GROUND: Sandstone COBBLE with bitumen tar banding. Strong odour.				
					(0.59)	MADE GROUND: Dark brown, gravelly, slightly silty, medium SAND. Gravel is angular, fine to coarse including brick, tar fragments and sandstone.				
			1.05m - B3	25.41	1.04			1		
				25.25	1.20	Stiff, light brown, clayey SILT.				
						Brown clayey fine to coarse SAND and GRAVEL (drillers description).		2		
					(3.50)			3		
								4		
				21.75	4.70	Fractured, red SANDSTONE (drillers description).		5		
					(1.30)					
		AZCL		20.45	6.00	SANDSTONE recovered as reddish brown, very gravelly, fine and medium sand with low cobble content. Gravel is angular to subangular, fine to coarse including sandstone.		6		
					(0.50)					
		NI		19.95	6.50	Weak, reddish brown fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely to medium spaced, planar smooth, unstained, no infill.				
6.00 - 7.50	80 67 60	20 2			(1.00)			7		
		15	7.50m - C4	18.95	7.50	Weak, strong in places reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, very closely to medium spaced, planar smooth and rough, unstained, no infill.				
		NI				*Between 7.70m and 7.85m: recovered as subangular to subrounded gravel and cobbles of sandstone.*		8		
		15				*At 7.82m: 1no 30-40 degrees, planar smooth.*				
7.50 - 9.00	87 70 25		8.20m - C5		(1.60)					
		4				*Between 8.60m and 8.70m: recovered as gravelly fine sand.*				
		NI 10								
		AZCL						9		
		10		17.35	9.10	Medium strong, reddish brown, medium grained SANDSTONE with occasional interlaminated mudstone.				
		25+		17.15	9.30					
9.00 - 10.50	93 87 57	NI 9	9.47m - C6	16.95	9.50	Very weak to weak, reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, very closely spaced, planar smooth, unstained, clay infill.				
						Between 9.45m and 9.55m: recovered as angular to subangular, fine to		10		

Continued next sheet

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
6.00	20.00	Air	100
20.00	30.00	Air	0
30.00	33.00	Air	50
33.00	40.00	Air	0

Borehole Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
23/10	16:30	9.00	6.00	Dry
25/10	08:00	33.00	33.00	6.00
25/10	16:30	36.50	6.00	6.00
26/10	08:00	36.50	6.00	6.00

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Casing Diameter

Depth (m)	Dia (mm)

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH12A**
	Dates: 19/10/2018 - 26/10/2018	Client: Curtins Consulting	Sheet 2 of 4
Rotary Borehole Log	Location: 383098.57E 398086.99N	Ground level: 26.45mOD / Logged by: JW/DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		3	10.10m - C7			Very weak to weak, reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, very closely spaced, planar smooth, unstained, clay infill. *Between 9.45m and 9.55m: recovered as angular to subangular, fine to coarse of sandstone and mudstone.*				
10.50 - 12.00	100 100 100	6	11.42m - C8		(2.85)	Medium strong, weak in places, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, medium, locally closely spaced, planar, locally undulating smooth, unstained, no infill. *Between 11.15m and 11.20m: with gravel inclusion. Gravel is angular to subrounded, fine of quartzite and siltstone.* *Between 11.37m and 11.50m: becoming gravelly. Gravel is angular to subrounded, fine to coarse of various lithologies including quartzite and siltstone.*		11		
		9	12.33m - C9	14.10	12.35			12		
12.00 - 13.50	80 70 47	NI 16 NI				Very weak to very weak in places, reddish brown, fine to coarse grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced, locally very closely spaced, planar and undulating rough, unstained, no infill. *Between 12.60m and 13.20m: recovered as subangular gravel and cobble of sandstone.*		13		
		AZCL			(1.65)					
		7	14.00m - C10	12.45	14.00			14		
13.50 - 15.00	67 67 45	25+ 10 NI		12.15	(0.30) 14.30	Medium strong, reddish brown, fine and medium grained SANDSTONE with occasional interlaminated mudstone. *Between 14.00m and 14.15m: discontinuities are 45-55 degrees, planar smooth, stained black.* *At 14.23m:1 no 0-15 degrees, planar smooth, unstained, no infill.*				
		25+ NI 20 10				Weak locally very weak in places, reddish brown, medium grained SANDSTONE. *Between 14.90m and 15.10m: recovered as subrounded cobble of sandstone.*		15		
15.00 - 16.50	73 50 13	NI 10	15.75m - C11		(2.70)					
		AZCL						16		
		7		9.45	17.00			17		
16.50 - 18.00	67 67 63	3 7	17.27m - C12		(1.10)	Medium strong, reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, medium, closely spaced in places, planar smooth, unstained, no infill. *Between 17.50m and 17.80m: with occasional subrounded to rounded, medium gravel of quartzite and siltstone.* *Between 17.50m and 18.00m: with occasional interlaminated mudstone.* *At 17.70m: 40 degrees, planar, smooth unstained.*				
		NI		8.35	18.10			18		
18.00 - 18.70	100 86 57	10	18.35m - C13			Medium strong, locally weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced, planar smooth, unstained, no infill. *Between 18.10m and 18.20m: recovered as angular to subangular gravel and cobble.*				
		5								
18.70 - 19.50	100 88 88	NI 6			(1.60)	*Between 18.90m and 19.00m: recovered as subangular gravel of sandstone.* *Between 19.35m and 19.45m: 70-80 degrees, planar smooth, clay infill.*		19		
		AZCL								
		13	19.80m - C14	6.75 6.60	19.70 19.85	Medium strong, reddish brown, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely		20		
						Continued next sheet				

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
26/10	12:00	40.00	6.00	
24/11	08:00	9.00	9.00	6.00
24/11	16:30	33.00	33.00	6.00

Remarks:

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2		Location ID: **RBH12A**
Dates: 19/10/2018 - 26/10/2018	Client: Curtins Consulting		Sheet 3 of 4
Rotary Borehole Log	Location: 383098.57E 398086.99N	Ground level: 26.45mOD / Logged by: JW/DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	87 20 6	NI 25 NI 25	21.00m - C15	6.15 5.67	(0.45) 20.30 (0.48) 20.78	Medium strong, reddish brown, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced, planar smooth, unstained, no infill. Red SANDSTONE recovered as reddish brown, angular to subrounded, fine to coarse gravel including sandstone. *Between 19.85m and 20.30m: recovered as angular to subangular, fine to coarse gravel of sandstone.*				
21.00 - 22.50	67 40 40	NI 8 AZCL	21.70m - C16 22.50m - C17	3.95	(1.72) 22.50	Very weak, extremely weak in places, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, very closely spaced in places, planar smooth, unstained, clay infill. *Between 20.38m and 20.70m: recovered as clayey gravel, low to medium gravel content. Gravel and cobbles are subangular of sandstone.* *Between 20.70m and 20.76m: 1no 90 degrees, planar smooth, unstained, clay infill.* Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-10 degrees, closely spaced in places, planar smooth, unstained, no infill. *Between 20.78m and 21.00m: recovered as clayey gravel, low to medium gravel content. Gravel and cobbles are subangular of sandstone.* *Between 21.00m and 21.10m: 1no 90 degrees, planar smooth stained black no infill.*		21 22		
22.50 - 23.50	100 100 95	8 1	23.00m - C18		(1.10)	*At 21.10m: 1no 45 degrees, planar smooth, stained black no infill.* *Between 21.10m and 21.50m: non intact recovered as subangular, fine and medium gravel and cobble of sandstone.*		23		
23.50 - 24.50	100 80 55	NI 7	24.42m - C19	2.85	23.60 (1.00)	Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 25-45 degrees, planar smooth, closely to medium spaced, unstained, no infill. *Between 23.50, and 23.55m: reduction spot.* *Between 23.50m and 23.65m: becoming coarse grained.* Weak to medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 1) 0-10 degrees, closely spaced planar smooth, unstained, no infill. 2) 25-45 degrees, very closely spaced, planar smooth, unstained silt infill.		24		
24.50 - 25.50	100 90 90	NI 4	25.61m - C20	1.85	24.60	*Between 23.65m and 23.90m: non intact recovered as subangular to subrounded gravel and cobbles of sandstone.* *Between 24.00m and 24.50m: with occasional gravel inclusion. Gravel is angular to subrounded, fine and medium including quartzite and siltstone.* *Between 24.50m and 24.60m: non intact recovered as angular to subrounded gravel and cobbles of sandstone.*		25		
25.50 - 27.00	100 87 67	13 NI 10	26.53m - C21		(3.90)	Medium strong, reddish brown, slightly gravelly, fine and medium grained SANDSTONE. Gravel is angular to subrounded, fine, occasionally of various lithologies including quartzite and siltstone. Discontinuities are 0-20 degrees, medium, locally closely spaced i, undulating, locally planar smooth, unstained, no infill. *Between 24.65m and 25.00m: 1no discontinuity 45 degrees, planar, smooth unstained clay infill.* *Between 26.40m and 26.50m: non intact recovered as angular to subrounded gravel and cobbles of sandstone.* *Below 26.50m: weak*		26		
27.00 - 28.50	100 100 97	4 5	27.26m - C22					27 28		
28.50 - 30.00	100 87 67	NI 15 20 NI 8	29.00m - C23	-2.05	28.50 (1.85)	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, locally very closely spaced, planar smooth, unstained, clean. *Between 28.50m and 28.60m: recovered as angular, coarse gravel of sandstone.* *Between 28.90m and 29.00m: non intact recovered as subangular cobbles of sandstone.*		29 30		

Continued next sheet

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH12A**	
Dates: 19/10/2018 - 26/10/2018	Client: Curtins Consulting	Sheet 4 of 4	
Rotary Borehole Log	Location: 383098.57E 398086.99N	Ground level: 26.45mOD	Logged by: JW/DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	100 77 57	NI 5 9	30.32m - C24 31.36m - C25	-3.90 -4.20	30.35 (0.30) 30.65 (1.15)	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, locally very closely spaced, planar smooth, unstained, clean. *Between 30.00m and 30.35m: non intact recovered as subangular to subrounded gravel cobbles of sandstone.* Strong, brown speckled grey, coarse grained SANDSTONE. Discontinuities are 0-10 degrees, planar rough, unstained, clean. *Between 30.35m and 30.65m: strong.* Weak to medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, locally very closely spaced, planar smooth, unstained, clean. *Between 31.48m and 31.50m: 1no 45 degrees. planar smooth, stained black.*		31		
31.50 - 33.00	80 80 30	AZCL 5 21 9	32.70m - C26	-5.35	31.80 (2.70)	Weak, locally medium strong, fine grained SANDSTONE. Discontinuities are 0-10 degrees, extremely to very closely spaced, planar smooth, unstained, no infill.		32 33		
33.00 - 34.50	60 40 28	NI 10 NI AZCL 20	33.50m - C27			*Between 33.40m and 33.50m: non intact recovered as subangular to subrounded gravel and cobbles of mudstone.* *Between 33.70m and 33.90m: non intact recovered as angular to subangular gravel of sandstone.*		34		
34.50 - 36.50	100 100 50	NI 4 NI 2 16	34.82m - C28 35.66m - C29 36.40m - C30	-8.05	34.50	Medium strong, locally weak, reddish brown, fine and medium grained SANDSTONE with occasional interlaminated reddish brown mudstone. Discontinuities are 0-25 degrees, closely spaced, locally medium spaced, planar undulating smooth, clean. *Between 34.55m and 34.75m: non intact recovered as angular to subangular cobbles of sandstone.* *Between 35.20m and 35.35m: non intact recovered as angular to subangular gravel and cobbles of sandstone.*		35 36		
36.50 - 37.50	100 90 85	NI 5 3			(5.50)	*Between 36.50m and 36.60m: non intact recovered as angular medium and coarse gravel of sandstone.*		37		
37.50 - 39.00	100 100 80	25+	38.61m - C31			*At 38.50m: 1no undulating smooth, unstained clean.*		38 39		
39.00 - 40.00	80 80 80	3 AZCL	39.54m - C32	-13.55	40.00	*At 39.50m: 1no 25-45 degrees, planar smooth, stained black, clean.*		40		
						End of Borehole at 40.00m				

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH13**	
Dates: 09/11/2018 - 12/11/2018	Client: Curtins Consulting	Sheet 1 of 5	
Rotary Borehole Log	Location: 383126.43E 398085.27N	Ground level: 26.60mOD	Logged by: JW/DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details				Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
				26.40	0.20	Topsoil (driller's description).			
					(0.40)	MADE GROUND: Brick fill (driller's description).			
				26.00	0.60	Brown SAND and GRAVEL (driller's description).			
					(4.80)				
				21.20	5.40	Red SAND (driller's description).			
6.00 - 6.50	0 0 0	AZCL			(1.10)				
6.50 - 7.00	100 20 0	NI 10		20.10	6.50 (0.30)	Recovered as greenish grey, angular to subrounded GRAVEL and COBBLES of mixed lithologies.			
7.00 - 7.50	50 10 0	AZCL NI 20		19.80	6.80 (1.10)	Extremely weak locally very weak, reddish brown, fine and medium grained SANDSTONE. *Between 7.25m and 7.45m: recovered as fine and medium sand.*			
7.50 - 8.50	60 50 35	AZCL 5 20 NI 7 NI 20		18.70	7.90 (0.75)	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuity 0-10 degrees, very closely spaced, planar smooth, unstained clean. *Between 8.20m and 8.25m: recovered as clayey, sandy, angular to subangular, fine to coarse gravel.* *Between 8.40m and 8.45m: recovered as angular to subangular, coarse gravel.*			
8.50 - 9.00	70 40 40	AZCL NI 5	8.85m - C1	17.95	8.65	Extremely weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-10 degrees, very closely spaced, planar smooth, unstained clean. *Between 8.65m and 8.80m: recovered as fine and medium sand.* *Between 9.00m and 9.15m: recovered as greenish grey, angular to subangular gravel.* *Between 9.40m and 9.50m: recovered as subangular cobble.*			
9.00 - 9.50	100 50 36	NI 8 NI			(0.85)				
		8	9.74m - C2	17.10	9.50	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 1) 25-40 degrees, closely spaced, planar			
						Continued next sheet			

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
6.00	24.00	Water	70
24.00	28.50	Water	60
24.00	30.00	Water	30
30.00	33.00	Water	20
33.00	36.00	Water	10
36.00	40.30	Water	0

Borehole Diameter

Depth (m)	Dia (mm)
40.30	146

Casing Diameter

Depth (m)	Dia (mm)
6.00	200

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
09/11	16:30	18.00	6.00	1.20
12/11	08:00	18.00	6.00	2.90
12/11	16:30	40.30	6.00	3.10

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH13**
	Dates: 09/11/2018 - 12/11/2018	Client: Curtins Consulting	Sheet 2 of 5
Rotary Borehole Log	Location: 383126.43E 398085.27N	Ground level: 26.60mOD / Logged by: JW/DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
9.50 - 10.50	100 95 50	NI				Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 1) 25-40 degrees, closely spaced, planar smooth, unstained clean. 2) 0-10 degrees, closely spaced, planar smooth, unstained clean. *Between 10.45m and 10.50m: recovered as sandy, angular to subangular, medium and coarse gravel.*		11		
10.50 - 12.00	100 100 50	10	10.95m - C3		(2.50)					
		4	11.76m - C4							
				14.60	12.00	Very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuity is 0-10 degrees, extremely closely spaced ,and undulating smooth with occasional black stain, clean.		12		
12.00 - 13.50	100 100 53	16	12.94m - C5	13.90	(0.70) 12.70	Locally weak, reddish brown, fine and medium grained SANDSTONE. Discontinuity is 0-10 degrees, medium spaced, locally closely spaced, planar smooth, unstained clean.		13		
13.50 - 15.00	100 100 100	2	14.00m - C6					14		
			14.88m - C7					15		
15.00 - 16.50	100 97 87	9	15.86m - C8					16		
		NI	16.41m - C9		(11.70)	*Between 16.35m and 16.40m: recovered as sandy, angular to subangular, medium gravel.*				
16.50 - 18.00	100 100 87	4	17.28m - C10					17		
			18.45m - C11					18		
18.00 - 19.50	100 100 90					*At 18.60m: 1no discontinuity, 30 degrees, planar smooth, unstained clean (possible drilling induced fracture).*		19		
			19.55m - C12			*At 19.40m: 1no discontinuity, 30 degrees, planar smooth, unstained clean (possible drilling induced fracture).* *At 19.70m: 1no discontinuity 30-35 degrees, undulating smooth, unstained clean.*		20		
						Continued next sheet				

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH13**
	Dates: 09/11/2018 - 12/11/2018	Client: Curtins Consulting	Sheet 3 of 5
Rotary Borehole Log	Location: 383126.43E 398085.27N	Ground level: 26.60mOD / Logged by: JW/DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	100 100 97	6	20.58m - C13			Locally weak, reddish brown, fine and medium grained SANDSTONE. Discontinuity is 0-10 degrees, medium spaced, locally closely spaced, planar smooth, unstained clean.		21		
21.00 - 22.50	100 100 97	10	21.50m - C14 22.55m - C15			*Between 22.45m and 22.55m: discontinuity becoming very closely spaced, planar smooth, unstained and clean.*		22		
22.50 - 24.00	100 100 100	2	23.38m - C16					23		
24.00 - 25.00	100 100 87	10 2	24.70m - C17	2.20 1.90 1.60	24.40 (0.30) 24.70 (0.30) 25.00	Weak, reddish brown, fine and medium grained MUDSTONE. *A 24.50m: 1no discontinuity 45 degrees, undulating.* *At 24.60m: 1no discontinuity 10 degrees, planar smooth, stained greenish grey, clean.* *1no discontinuity 60-70 degrees, undulating smooth, unstained clean.*		24 25		
25.00 - 27.00	100 100 96	5	25.50m - C18 26.60m - C19	1.10	25.50	Medium strong, light greenish grey mottled reddish brown, fine and medium grained SANDSTONE. (0.50) Weak, reddish brown, fine and medium grained SANDSTONE. *At 25.35m: 1no discontinuity is horizontal, planar rough, unstained clean (possible drilling induced).* Medium strong, locally weak reddish brown, fine and medium grained SANDSTONE. Discontinuity is 0-25 degrees, medium spaced, planar smooth, unstained, occasional silt infill.		26 27		
27.00 - 28.50	100 100 100	8	27.78m - C20 28.56m - C21		(3.50)			28		
28.50 - 30.00	100 100 93	6	29.50m - C22	-2.40	29.00	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuity is 0-25 degrees, closely to medium spaced in places, planar and undulating smooth and undulating rough, unstained clean.		29 30		

Continued next sheet

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan Phase 2	**RBH13**
Dates:	Client:	Sheet 4 of 5
09/11/2018 - 12/11/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383126.43E 398085.27N	26.60mOD	JW/DO	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	100 100 80	20 3 7 2	30.29m - C23			Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuity is 0-25 degrees, closely to medium spaced in places, planar and undulating smooth and undulating rough, unstained clean.		31		
		17	31.50m - C24		(4.00)	*Between 31.35m and 31.60m: very closely.*				
31.50 - 33.00	100 93 78	2 NI 10	32.30m - C25			*Between 32.05m and 32.15m: recovered as reddish brown, angular to subangular, fine to coarse gravel of mudstone.*		32		
		2	33.45m - C26	-6.40	33.00	Medium strong, medium grained SANDSTONE. Discontinuity is 0-25 degrees, medium, closely spaced in places, planar and undulating smooth and rough, locally stained black, occasional clay infill.		33		
33.00 - 34.50	100 87 83	NI 3				*Between 34.15m and 34.35m: extremely weak to very weak, non intact recovered as reddish brown, sandy, angular to subangular gravel.*		34		
34.50 - 36.00	100 100 87	6 2 10	34.66m - C27 35.84m - C28					35		
36.00 - 37.50	100 93 87	6 NI 8	36.75m - C29		(7.30)	*Between 36.30m and 36.40m: extremely weak.* *Between 36.50m and 36.60m: recovered as clayey, reddish brown, sandy, angular to subangular gravel.* *Between 33.50m and 36.65m: extremely weak to very weak.* *Between 36.95m and 37.00m: very weak.*		36 37		
			37.40m - C30							
37.50 - 39.00	100 100 97	3 6 3	38.40m - C31			*Between 37.95m and 38.00m: very weak.*		38		
		11				*Between 39.00m and 39.15m: Discontinuity is 0-10 degrees, very closely spaced, planar rough, silt infill (possible drilling induced fractures).*		39		
39.00 - 40.30	100 93 83	8 2				*Between 39.40m and 39.55m: Discontinuity is 0-10 degrees, very closely spaced, planar rough, silt infill (possible drilling induced fractures).*				
						Continued next sheet		40		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH13**	
Dates: 09/11/2018 - 12/11/2018	Client: Curtins Consulting	Sheet 5 of 5	
Rotary Borehole Log	Location: 383126.43E 398085.27N	Ground level: 26.60mOD	Logged by: JW/DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		7 NI		-13.70	40.30	Medium strong, medium grained SANDSTONE. Discontinuity is 0-25 degrees, medium, closely spaced in places, planar and undulating smooth and rough, locally stained black, occasional clay infill. *Between 40.25m and 40.30m: recovered as angular t subangular of weak, fine and medium grained sandstone.* End of Borehole at 40.30m		41 42 43 44 45 46 47 48 49 50		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH14**	
Dates: 01/11/2018 - 07/11/2018	Client: Curtins Consulting	Sheet 1 of 5	
Rotary Borehole Log	Location: 383125.73E 398117.64N	Ground level: 26.72mOD	Logged by: RS	Vertical scale: 1:50	Project ID: 42269

Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Groundwater: Water Strike	Groundwater: Backfill/Installation
			0.00m - B1 0.30m - ES2 0.60m - B3 0.65m - ES4 0.70m - B5 1.00m - ES6		(0.90)	MADE GROUND: Gravel, brick and ash (driller's description).			
				25.82	0.90				
					(0.60)	Soft, yellowish brown, sandy, silty CLAY (driller's description).			
				25.22	1.50				
					(2.70)	Brown SAND and GRAVEL (driller's description).			
				22.52	4.20				
					(1.30)	Red SANDSTONE (driller's description).			
5.50 - 6.50	40 10 0	AZCL NI 1		21.22	5.50 (0.90)	Reddish brown and grey, slightly sandy, subrounded, fine to coarse GRAVEL of medium grained sandstone and limestone. *Between 6.10m and 6.40m: non intact recovered as gravel.*			
6.50 - 7.50	70 52 20	AZCL 25+ 9 NI 11		20.32 19.92 19.59	6.40 (0.40) 6.80 (0.33) 7.13	Very weak, reddish brown, medium grained SANDSTONE. *Between 6.50m and 6.80m: assumed zone of core loss.* Extremely weak, thinly laminated, reddish brown, occasionally grey stained, fine grained, SANDSTONE. Discontinuities are 0-10 degrees, very closely spaced, stepped smooth and clean. Very weak, reddish brown, medium grained SANDSTONE. Discontinuities are 0-5 degrees, very close to closely spaced, planar rough and clean. *Between7.25m and 7.31m: non intact recovered as gravel.* *Between 7.50m and 8.50m: assumed zone of core loss.*			
7.50 - 8.50	50 21 11	AZCL NI 10	8.28m - C4			*Between 8.00m and 8.29m: non intact recovered as gravel.*			
8.50 - 8.80	83/83/50	AZCL 8				*Below 8.55m: medium grained.*			
8.80 - 9.50	57 54 16	AZCL 13	9.27m - C5			*Below 9.10m: discontinuities are 0-15 degrees.*			
		AZCL 7 29				*Between 9.70m and 9.75m: non intact recovered as gravel.*			
						Continued next sheet			

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
40.80	5.50	Water	10

Borehole Diameter

Depth (m)	Dia (mm)
40.80	146

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
01/11	16:30	5.50	5.50	Dry
02/11	08:00	5.50	21.00	Dry
02/11	16:30	21.00	5.50	Dry
05/11	08:00	21.00	5.50	6.00

Remarks: Service inspection pit hand excavated from GL to 1.20m.

Casing Diameter

Depth (m)	Dia (mm)
5.50	200
40.80	150

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	9.00	Plain	50
9.00	15.00	Slotted	50

Checked by: HH
Log status: DRAFT

IFA RC v01.01

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Massenza M18	St John's Masterplan Phase 2	**RBH14**
Dates:	**Client:**	Sheet 2 of 5
01/11/2018 - 07/11/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383125.73E 398117.64N	26.72mOD	RS	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
9.50 - 10.50	80 61 40	6 15	10.12m - C6			Very weak, reddish brown, medium grained SANDSTONE. Discontinuities are 0-5 degrees, very close to closely spaced, planar rough and clean. *Between 10.30m and 10.50m: occasional clasts of quartzite.*				
10.50 - 11.50	70 62 30	AZCL 25+ NI 11 5	11.30m - C7			*At 10.87m: occasional clasts of elongated, reddish brown mudstone.* *Between 10.87m and 10.98m: non intact recovered as gravel.*		11		
11.50 - 12.50	75 62 25	AZCL NI 13	12.30m - C8		(6.57)	*Below 11.75m: rare clasts of elongated, rounded reddish brown mudstone.* *Between 11.75m and 11.86m: non intact recovered as gravel.*		12		
12.50 - 13.50	65 37 0	AZCL 15 NI 18				*Between 13.12m and 13.22m: frequent elongated reddish brown mudstone clasts.*		13		
13.50 - 14.00	60 50 0	AZCL 10	13.80m - C9	13.02	13.70	Weak to medium strong, reddish brown, medium and coarse grained SANDSTONE. Discontinuities are 0-35 degrees, extremely to very closely spaced, planar and undulating rough and clean.				
14.00 - 14.50	46 46 20	AZCL 17						14		
14.50 - 15.50	73 58 12	AZCL 11 NI 15	15.04m - C10			*Between 14.95m and 15.04m: non intact recovered as gravel.*		15		
15.50 - 16.50	85 56 24	AZCL NI 13 NI 6	16.10m - C11			*Between 15.65m and 15.83m: non intact, occasional clasts of rounded quartzite, limestone and mudstone.*		16		
16.50 - 18.00	31 19 0	AZCL NI 15	17.88m - C12		(6.69)			17		
18.00 - 19.00	48 40 14	AZCL NI 10	19.00m - C13			*Between 18.52m and 18.58m: non intact recovered as clayey sand.* *Between 18.58m and 18.69m: non intact recovered as gravel.*		18 19		
19.00 - 20.00	87 82 39	6 11 AZCL	19.90m - C14					20		

Continued next sheet

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
05/11	16:30	29.10	5.50	6.00
06/11	08:00	29.10	5.50	6.00
06/11	16:30	32.20	29.00	6.00
07/11	08:00	32.20	32.20	6.00

Remarks:

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH14**
	Dates: 01/11/2018 - 07/11/2018	Client: Curtins Consulting	Sheet 3 of 5
Rotary Borehole Log	Location: 383125.73E 398117.64N	Ground level: 26.72mOD / Logged by: RS / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
20.00 - 20.50	80 16 0	17 NI		6.33	20.39	Weak to medium strong, reddish brown, medium and coarse grained SANDSTONE. Discontinuities are 0-35 degrees, extremely to very closely spaced, planar and undulating rough and clean.				
20.50 - 21.00	100 70 0	20 NI 17		5.90	(0.43) 20.82	*Below 20.30m: stained light greyish brown.* Extremely weak, thinly laminated reddish brown MUDSTONE. Discontinuities are 1) 0-10 degrees, extremely to very closely spaced, planar and undulating, smooth and rough and clean. 2) 85-90 degrees, spacing not discernable, undulating smooth and clean.		21		
21.00 - 22.50	51 32 17	AZCL 17 NI 7	21.00m - C15 22.25m - C16			*Between 20.60m and 20.65m: non intact recovered as gravel.* Weak to medium strong, reddish brown, medium and coarse grained SANDSTONE with rare clasts of subrounded, flattened mudstone. Discontinuities are 0-15 degrees, very closely to closely spaced, planar and undulating rough and clean. *Between 20.82m and 21.00m: mottled light greyish green.* *Between 22.04m and 22.20m: non intact recovered as gravel.*		22		
22.50 - 23.50	65 45 26	AZCL NI 6 NI 20	23.10m - C17			*Between 22.85m and 22.99m: non intact recovered as gravel.* *Between 23.34m and 23.90m: non intact recovered as gravel.*		23		
23.50 - 24.50	100 90 47	4 13	24.10m - C18			*At 24.38m: 1no clast of rounded quartzite.*		24		
24.50 - 25.50	100 95 61	5 17	24.94m - C19		(8.68)			25		
25.50 - 27.00	70 37 8	AZCL 18 NI 13	26.73m - C20			*Between 26.12m and 26.56m: non intact recovered as gravel.*		26		
27.00 - 27.70	100 100 31	7						27		
27.70 - 29.10	100 97 31	25 3 11 NI	28.10m - C21 29.04m - C22					28 29		
29.10 - 29.80	100 54 40	4 NI 14	29.83m - C23	-2.78	29.50	Extremely weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 1) 0-10 degrees, very closely spaced, undulating rough and clean.		30		
						Continued next sheet				

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
						07/11	16:30	40.50	40.80	6.00	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH14**	
Dates: 01/11/2018 - 07/11/2018	Client: Curtins Consulting	Sheet 4 of 5	
Rotary Borehole Log	Location: 383125.73E 398117.64N	Ground level: 26.72mOD	Logged by: RS	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
29.80 - 30.70	100 94 37	2 20		-3.90	(1.12) 30.62	Extremely weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 1) 0-10 degrees, very closely spaced, undulating rough and clean.				
30.70 - 32.20	90 81 71	4 27 2 20 4 AZCL NI	30.80m - C24			Very weak to medium strong, thickly laminated, reddish brown, fine to coarse grained SANDSTONE. Discontinuities are 0-15 degrees, closely spaced, planar and undulating rough and clean. *Between 30.62m and 32.20m: flatted reddish brown mudstone clasts.*		31 32		
32.20 - 33.70	100 56 34	24 5 NI 9	32.55m - C25 33.15m - C26					33		
33.70 - 34.80	100 71 56	5 17				*Below 34.00m: extremely closely spaced discontinuity.*		34		
34.80 - 36.30	100 95 73	25+ 4 24 NI 20	34.87m - C27 35.78m - C28		(10.18)	*Between 36.27m and 36.34m: non intact recovered as gravel.* *Between 36.39m and 36.50m: non intact recovered as gravel.*		35 36		
36.30 - 37.80	100 69 43	NI 9 NI 5 NI 20 AZCL	36.93m - C29			*Between 36.80m and 36.86m: occasional elongated reddish brown mudstone clasts.* *Between 36.85m and 36.92m: non intact recovered as gravel.* *Between 37.50m and 37.60m: non intact recovered as gravel.*		37		
37.80 - 39.30	100 83 71	NI 6 NI 3 13 NI	37.93m - C30 38.88m - C31			*Between 37.80m and 37.92m: non intact recovered as gravel.* *Between 38.08m and 38.12m: band of very weak, reddish brown mudstone.*		38 39		
		6				Continued next sheet		40		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2		Location ID: **RBH14**
Dates: 01/11/2018 - 07/11/2018	Client: Curtins Consulting		Sheet 5 of 5
Rotary Borehole Log	Location: 383125.73E 398117.64N	Ground level: 26.72mOD / Logged by: RS / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
39.30 - 40.80	100 86 47	~~NI~~ 8	40.11m - C32			Very weak to medium strong, thickly laminated, reddish brown, fine to coarse grained SANDSTONE. Discontinuities are 0-15 degrees, closely spaced, planar and undulating rough and clean. *Between 40.15m and 40.18m: recovered as sand.*				
				-14.08	40.80	End of Borehole at 40.80m				

41 42 43 44 45 46 47 48 49 50

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH15**	
Dates: 08/11/2018 - 09/11/2018	Client: Curtins Consulting	Sheet 1 of 5	
Rotary Borehole Log	Location: 383155.97E 398102.16N	Ground level: 26.94mOD	Logged by: RS	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details				Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
					(1.40)	MADE GROUND: Gravel, brick and ash (driller's description).			
				25.54	1.40				
					(2.50)	Brown SAND and GRAVEL (driller's description).			
				23.04	3.90				
					(2.70)	SANDSTONE (driller's description).			
5.00 - 6.80	20 0 0	AZCL							
		NI		20.34	6.60	Reddish brown SANDSTONE recovered as sandy, subrounded to subangular, fine to coarse gravel. *Between 6.60m and 6.80m: non intact recovered as gravel.*			
6.80 - 7.50	42 12 0	AZCL			(0.80)				
		NI				*Between 7.20m and 7.40m: non intact recovered as gravel.*			
		25+		19.54	7.40	Weak, locally weak reddish brown medium grained SANDSTONE. Discontinuities are 0-10 degrees, , extremely to closely spaced, planar, rough and clean. *Between 7.50m and 7.64m: non intact recovered as gravel.* *Between 7.74m and 7.80m: non intact recovered as gravel.* *Between 7.85m and 8.06m: band of fine grained sandstone with occasional light grey staining.*			
		NI							
		20							
		NI							
7.50 - 8.30	100 44 33	11							
		25+							
		7							
		NI				*Between 8.39m and 8.56m: non intact recovered as gravel.*			
8.30 - 9.80	100 69 27	10	8.90m - C1			*Between 9.40m and 11.80m: rare clasts of rounded quartzite.*			
						Continued next sheet			

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)
				41.00	146

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
08/11	16:30	21.30	21.30	6.00
09/11	08:00	21.30	21.30	
09/11	16:30	41.00	21.30	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Casing Diameter	
Depth (m)	Dia (mm)
21.30	200

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH15**
	Dates: 08/11/2018 - 09/11/2018	Client: Curtins Consulting	Sheet 2 of 5
Rotary Borehole Log	Location: 383155.97E 398102.16N	Ground level: 26.94mOD / Logged by: RS / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
9.80 - 11.30	56 46 23	AZCL NI 11	10.54m - C2			Weak, locally weak reddish brown medium grained SANDSTONE. Discontinuities are 0-10 degrees, , extremely to closely spaced, planar, rough and clean. *Between 10.46m and 10.54m: non intact recovered as gravel.*		11		
11.30 - 11.80	12 12 0	AZCL 17	11.30m - C3							
11.80 - 12.80	76 23 10	AZCL NI 17 38 11	12.62m - C4			*Between 12.10m and 12.32m: band of extremely weak, reddish brown mudstone recovered as gravelly clay.* *Between 12.43m and 12.47m: band of extremely weak, reddish brown mudstone recovered as clayey gravel.* *Between 12.64m and 12.48m: non intact recovered as clayey gravel.*		12		
12.80 - 13.80	29 28 11	AZCL 14	13.65m - C5		(9.00)			13		
13.80 - 14.30	100 40 0	NI 13 NI 15 NI 5	14.35m - C6			*Between 13.88m and 14.03m: non intact recovered as gravel.* *Between 14.11m and 14.17m: non intact recovered as gravel.* *Between 14.30m and 14.34m: non intact recovered as gravel.*		14		
14.30 - 14.80	100 60 38	NI 13				*Between 14.53m and 14.65m: non intact recovered as gravel.*				
14.80 - 15.80	72 70 40	AZCL 10	15.30m - C7			*Between 15.07m and 15.22m: indistinctly very thinly laminated.*		15		
15.80 - 16.80	40 25 25	AZCL NI 4		10.54	16.40			16		
16.80 - 17.30	100 90 48	17 4 25				Weak locally medium strong, thinly laminated, reddish brown, medium and coarse grained SANDSTONE with rare clasts of subrounded quartzite. Discontinuities are 0-15 degrees, extremely to closely spaced, planar stepped and undulating rough and clean. *Between 16.40m and 16.57m: non intact recovered as gravel.*		17		
17.30 - 18.80	95 92 61	4 12 AZCL						18		
18.80 - 20.30	59 40 15	AZCL 17 2	19.48m - C8					19		
						Continued next sheet		20		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH15**
	Dates: 08/11/2018 - 09/11/2018	Client: Curtins Consulting	Sheet 3 of 5
Rotary Borehole Log	Location: 383155.97E 398102.16N	Ground level: 26.94mOD / Logged by: RS / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		22 10	20.20m - C9			Weak locally medium strong, thinly laminated, reddish brown, medium and coarse grained SANDSTONE with rare clasts of subrounded quartzite. Discontinuities are 0-15 degrees, extremely to closely spaced, planar stepped and undulating rough and clean.				
20.30 - 21.30	25 20 0	AZCL 24				*Below 20.00m: rare clasts, subrounded to subangular, flattened of reddish brown mudstone.* *Between 21.05m and 21.16m: 1no discontinuity 85-90 degrees, planar rough, infilled with calcite.*		21		
21.30 - 21.80	60 28 0	AZCL NI 12	21.58m - C10							
21.80 - 22.80	82 50 11	AZCL 29 NI 13 NI 10	22.70m - C11					22		
22.80 - 23.80	71 68 37	AZCL 18 2 13	23.16m - C12					23		
23.80 - 24.80	70 41 15	AZCL NI 6 5 NI 31 13	24.70m - C13			*Below 23.80m: clasts of quartzite are absent.* *Between 24.10m and 24.22m: non intact recovered as gravel.* *Between 24.43m and 24.56m: non intact recovered as gravel.*		24		
24.80 - 25.30	74 62 0	AZCL NI 13			(14.70)	*Between 24.93m and 24.99m: non intact recovered as gravel.*		25		
25.30 - 26.30	73 45 34	AZCL NI 5 29 NI AZCL	25.66m - C14			*Between 25.57m and 25.68m: non intact recovered as gravel.* *Between 26.15m and 26.34m: non intact recovered as gravel.*		26		
26.30 - 27.30	96 82 25	13 NI 21 10	26.76m - C15			*Below 26.80m: clay clasts are <70mm in length.* *Between 26.98m and 27.01m: non intact recovered as gravel.*		27		
27.30 - 28.30	85 64 38	AZCL 5 NI 10	27.60m - C16			*Between 27.95m and 28.10m: non intact recovered as gravel.*		28		
28.30 - 29.30	12 6 0	AZCL NI 14				*Between 29.18m and 29.23m: non intact recovered as gravel.*		29		
29.30 - 29.80	60 24 0	AZCL NI 14 NI 20 AZCL 10	29.60m - C17			*Between 29.50m and 29.59m: non intact recovered as gravel.* *Between 29.66m and 29.75m: non intact recovered as gravel.*		30		

Continued next sheet

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2		Location ID: **RBH15**
Dates: 08/11/2018 - 09/11/2018	Client: Curtins Consulting		Sheet 4 of 5
Rotary Borehole Log	Location: 383155.97E 398102.16N	Ground level: 26.94mOD / Logged by: RS / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
29.80 - 30.30	84/80/24	43 13				Weak locally medium strong, thinly laminated, reddish brown, medium and coarse grained SANDSTONE with rare clasts of subrounded quartzite. Discontinuities are 0-15 degrees, extremely to closely spaced, planar stepped and undulating rough and clean.				
30.30 - 30.80	90 90 84	AZCL 7	30.50m - C18							
30.80 - 31.30	92 34 0	AZCL 18 NI NI 13		-4.16 -4.28	31.10 31.22	*Between 30.95m and 31.10m: non intact recovered as gravel.* Firm, reddish brown, sandy, slightly gravelly CLAY. Gravel is subangular, fine to coarse of reddish brown mudstone. *Between 31.10m and 31.22m: non intact recovered as clay.*		31		
31.30 - 32.30	57 48 0	AZCL NI 23 NI 24	31.90m - C19		(1.99)	Weak to medium strong, reddish brown, fine and medium grained SANDSTONE with rare clasts <70mm flattened of reddish brown mudstone. Discontinuities are 0-5 degrees, very closely to closely spaced, planar rough and clean. *Between 31.73m and 31.77m: non intact recovered as gravel.* *Between 32.02m and 32.08m: band of weak, light grey coarse grained sandstone.* *Between 32.08m and 32.13m: band of very weak, reddish brown occasionally stained greyish brown, highly fractured mudstone.*		32		
32.30 - 32.80	90 48 20	AZCL 24 NI				*Between 32.70m and 32.80m: non intact recovered as gravel.*				
32.80 - 33.80	70 35 0	AZCL 18 NI 23	33.40m - C20	-6.27	33.21	Very weak locally medium strong, medium and coarse grained SANDSTONE with occasional clasts 70mm flattened, of reddish brown mudstone. Discontinuities are 0-20 degrees, very close to closely, undulating rough and clean. *Between 33.21m and 33.41m: non intact recovered as gravel.*		33		
33.80 - 35.30	37 37 27	AZCL	34.68m - C21			*Between 34.75m and 35.30m: very thinly laminated.*		34		
		5	35.00m - C22					35		
35.30 - 35.80	40 11 0	AZCL 30 10				*Between 35.80m and 35.95m: non intact recovered as gravel.*				
35.80 - 36.30	100 66 30	NI 11						36		
36.30 - 37.30	57 57 44	AZCL NI	37.00m - C23		(7.79)			37		
37.30 - 38.30	55 55 16	11	38.00m - C24					38		
38.30 - 38.80	78 34 26	AZCL NI 6 NI				*Between 38.40m and 38.55m: non intact recovered as gravel.* *Between 38.41m and 38.55m: band of very weak reddish brown mudstone recovered as angular gravel.* *Between 38.71m and 38.80m: non intact recovered as gravel.*				
38.80 - 39.50	77 53 0	AZCL 12 NI 21 NI				*Between 38.96m and 39.12m: fine grained.*		39		
		9								
		NI	40.00m - C25					40		

Continued next sheet

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH15**	
Dates: 08/11/2018 - 09/11/2018	Client: Curtins Consulting	Sheet 5 of 5	
Rotary Borehole Log	Location: 383155.97E 398102.16N	Ground level: 26.94mOD	Logged by: RS	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
39.50 - 41.00	100 91 46	8				Very weak locally medium strong, medium and coarse grained SANDSTONE with occasional clasts 70mm flattened, of reddish brown mudstone. Discontinuities are 0-20 degrees, very close to closely, undulating rough and clean.				
				-14.06	41.00	End of Borehole at 41.00m				

41
42
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Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan Phase 2	**RBH16**
Dates:	**Client:**	Sheet 1 of 5
13/11/2018 - 14/11/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383136.00E 398137.31N	26.60mOD	DO/MC	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				26.45	0.15	Concrete.				
				26.25	0.35	Light grey, fine to coarse SAND and angular to subangular, fine to coarse GRAVEL including limestone and granite.				
			0.50m - B2 0.50m - ES1			MADE GROUND: Dark brown, fine to coarse SAND and GRAVEL with high cobble content. Gravel and cobbles are angular to subangular including concrete, brick and occasional slag.				
			1.00m - ES3					1		
					(2.00)					
								2		
				24.25	2.35	Brown SAND and GRAVEL (driller's description).				
					(1.10)			3		
				23.15	3.45	Weathered SANDSTONE (driller's description).				
					(0.55)					
4.00 - 4.25	56/0/0	NI		22.60	4.00	Reddish brown, slightly clayey SAND and GRAVEL. Gravel is subangular to subrounded, fine to coarse including grey sandstone.		4		
4.25 - 4.50	92/8/0	AZCL NI			(0.50)	*Between 4.00m and 5.00m: driller notes cobble.*				
4.50 - 5.00	96 24 0	25+ NI 25+ NI		22.10 22.01	4.50 4.59	Light grey, subangular to subrounded, fine to coarse GRAVEL including sandstone and limestone (Collapse). *Between 4.50m and 4.59m: non intact recovered as gravel.*				
5.00 - 6.00	88 78 11	AZCL NI 25+			(1.21)	Extremely weak, thinly laminated, reddish brown, fine grained SANDSTONE. Discontinuities are 0-5 degrees, extremely closely spaced, planar rough and clean. RIVER TERRACE DEPOSITS *Between 4.59m and 4.73m: non intact recovered as sand and gravel of reddish brown sandstone.* *Between 4.95m and 5.00m: non intact recovered as sand and gravel.* *Between 5.12m and 5.22m: non intact recovered as sand and gravel.*		5		
		15		20.80	5.80					
6.00 - 7.50	100 77 44	NI 13 8 NI 10 25+			(3.25)	Extremely weak to very weak, reddish brown, fine to coarse SANDSTONE. Discontinuities are 0-5 degrees, planar rough and clean. *Between 6.00m and 6.13m: non intact recovered as gravel.* *Between 7.05m and 7.12m: non intact recovered as gravel.* *Between 7.42m and 7.46m: non intact recovered as gravel.* *Between 7.68m and 7.74m: non intact recovered as gravel.*		6 7		
7.50 - 9.00	88 70 24	AZCL NI 13 NI 41 NI 8				*Between 8.12m and 8.21m: non intact recovered as gravel.* *Between 8.71m and 8.75m: non intact recovered as gravel.*		8		
9.00 - 9.50	100 100 64	5		17.55	9.05	Weak locally strong, medium and coarse SANDSTONE with white discolouration sandstone. Discontinuities are 0-5 degrees, very closely to closely, planar and undulating, rough, very tight and clean.		9		
						Continued next sheet		10		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
4.00	6.00	Water	95
6.00	24.00	Water	80
24.00	27.00	Water	70
24.00	40.50	Water	60

Borehole Diameter	
Depth (m)	Dia (mm)
40.50	145

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
13/11	16:30	6.00	4.00	2.20
14/11	08:00	6.00	4.00	3.20
14/11	16:30	40.50	4.00	5.00

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Casing Diameter	
Depth (m)	Dia (mm)
4.00	200

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH16**	
Dates: 13/11/2018 - 14/11/2018	Client: Curtins Consulting	Sheet 2 of 5	
Rotary Borehole Log	Location: 383136.00E 398137.31N	Ground level: 26.60mOD	Logged by: DO/MC	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
9.50 - 12.00	100 97 81	8 5				Weak locally strong, medium and coarse SANDSTONE with white discolouration sandstone. Discontinuities are 0-5 degrees, very closely to closely, planar and undulating, rough, very tight and clean.		11		
12.00 - 13.50	100 97 85	8 NI 40 NI			(6.95)	*Between 13.45m and 13.50: non intact recovered as sand and gravel.* *Between 13.55m and 13.61m: non intact recovered as gravel.*		12 13		
13.50 - 15.00	100 97 79	10 5				*Between 15.00m and 15.21m: clay fill.*		14 15		
15.00 - 16.50	100 95 68	10 3 20 13 NI		10.60 10.42 10.18 10.04 9.95 9.89 9.85 9.65	16.00 16.18 16.42 16.56 16.65 16.75 16.95	Weak, grey medium SANDSTONE. Discontinuities are 0-5 degrees, very closely spaced, planar rough and clean. Extremely weak, reddish brown MUDSTONE. Discontinuities are 0-5 degrees, undulating rough and clean. Extremely weak, reddish brown, fine SANDSTONE. Discontinuities are 0-5 degrees, very closely spaced, planar, rough and clean. *Between 16.42m and 16.50m: non intact recovered as broken core and gravel.* *Between 16.50m and 16.56m: non intact recovered as broken core and gravel.* Extremely weak, reddish brown MUDSTONE. Extremely weak, reddish brown, fine SANDSTONE. Extremely weak, reddish brown MUDSTONE. Weak, grey, medium and coarse SANDSTONE.		16		
16.50 - 18.00	100 96 96	NI 3						17		
18.00 - 19.50	100 91 59	13 3 8			(2.65)	Very weak to weak, reddish brown, fine SANDSTONE. Discontinuities are 1) 0-5 degrees, very close to closely spaced, undulating rough and clean. 2) 20 degrees, closely spaced, planar rough, tight and clean. *At 18.80m: 1no discontinuity, 20 degree, joint, planar rough, tight and clean.* *At 18.90m: 1no discontinuity, 20 degree, joint, planar rough, tight and clean.*		18 19		
		10 NI		7.00	19.60	*At 19.50m: 45 degree, undulating rough and clean.* Extremely weak to very weak, reddish brown, fine SANDSTONE. Discontinuities are 1) 0-10 degrees, very closely to closely		20		

Continued next sheet

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH16**
	Dates: 13/11/2018 - 14/11/2018	Client: Curtins Consulting	Sheet 3 of 5
Rotary Borehole Log	Location: 383136.00E 398137.31N	Ground level: 26.60mOD / Logged by: DO/MC / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	100 62 50	11 NI				Extremely weak to very weak, reddish brown, fine SANDSTONE. Discontinuities are 1) 0-10 degrees, very closely to closely spaced, planar rough, open with clay infill. 2) 70-80 degrees, undulating and planar rough tight conjugate. *At 19.75m: discontinuity 0 degrees, planar, rough, open clay infill. Between 19.92m and 20.00m: non intact recovered as sand and gravel.*		21		
21.00 - 22.50	100 92 75	7 AZCL NI				*Between 22.50m: and 22.55m: single piece of broken core.* *At 22.90m: joint 30 degrees, planar rough, tight and clean.*		22 23		
22.50 - 24.00	99 97 1	4 17			(8.05)			24		
24.00 - 25.50	99 93 90	5				*At 24.90m: joint 60 degrees, planar rough, tight and clean.*		25		
25.50 - 26.50	100 92 84	5						26		
26.50 - 27.00	100 87 71	13						27		
27.00 - 28.50	100 100 93	5		-1.05 -1.12	27.65 27.72	Extremely weak, reddish brown MUDSTONE. Weak to moderately strong, reddish brown, fine and medium SANDSTONE. Discontinuities are 0-5 degrees, medium spaced, undulating, rough and clean.		28		
28.50 - 30.00	100 100 90			-2.32 -2.44 -2.79 -2.96	28.92 29.04 (0.35) 29.39 29.56	*Between 28.79m and 29.04m: subvertical, planar rough and clean fracture.* Extremely weak to moderately weak, light grey, fine SANDSTONE. Extremely weak, reddish brown MUDSTONE. Moderately weak, light grey, fine SANDSTONE. Moderately weak to medium strong, reddish brown, thinly laminated, fine SANDSTONE. Discontinuities are 0-10 degrees,		29 30		
						Continued next sheet				

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH16**	
Dates: 13/11/2018 - 14/11/2018	Client: Curtins Consulting	Sheet 4 of 5	
Rotary Borehole Log	Location: 383136.00E 398137.31N	Ground level: 26.60mOD	Logged by: DO/MC	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	100 100 97	3				Moderately weak to medium strong, reddish brown, thinly laminated, fine SANDSTONE. Discontinuities are 0-10 degrees, planar and undulating rough, tight and clean.		31		
31.50 - 33.00	100 98 94					*Between 31.83m and 31.86m: non intact recovered as gravel.*		32		
33.00 - 34.50	100 100 90	5						33		
34.50 - 36.00	100 95 88	NI 2 NI 8			(10.94)	*Between 34.50m and 34.57m: non intact recovered as gravel.*		34 35		
36.00 - 37.50	100 100 88	3 10						36 37		
37.50 - 39.00	100 98 87	3 11				*Between 37.81m and 37.84m: non intact recovered as gravel.*		38 39		
39.00 - 40.50	100 98 87	20 2				Continued next sheet		40		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2		Location ID: **RBH16**
Dates: 13/11/2018 - 14/11/2018	Client: Curtins Consulting		Sheet 5 of 5
Rotary Borehole Log	Location: 383136.00E 398137.31N	Ground level: 26.60mOD / Logged by: DO/MC / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Moderately weak to medium strong, reddish brown, thinly laminated, fine SANDSTONE. Discontinuities are 0-10 degrees, planar and undulating rough, tight and clean.				
				-13.90	40.50	End of Borehole at 40.50m				

41 42 43 44 45 46 47 48 49 50

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH17**	
Dates: 15/11/2018 - 16/11/2018	Client: Curtins Consulting	Sheet 1 of 5	
Rotary Borehole Log	Location: 383159.27E 398122.01N	Ground level: 25.98mOD	Logged by: DO	Vertical scale: 1:50	Project ID: 42269

Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
			0.30m - B2 0.50m - ES1	25.68	(0.30) 0.30	MADE GROUND: Yellowish brown, clayey, fine to coarse SAND with occasional pockets of clay.			
					(2.80)	MADE GROUND: Light grey, fine to coarse SAND and GRAVEL with high cobble content. Gravel and cobble are angular to subangular including concrete and brick.			
				22.88	3.10	Red SANDSTONE recovered as sand (driller's description).			
					(1.60)				
		NI							
		AZCL		21.28	4.70				
4.00 - 6.00	62 10 10	NI			(1.20)	Recovered as subangular to subrounded, coarse GRAVEL of light grey limestone and micro granite (collapse).			
		10		20.08	5.90				
		AZCL				Weak locally very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 1) 0-25 degrees, closely spaced, planar smooth locally rough, unstained and clean. 2) 25-35 degrees, very closely spaced, undulating smooth, unstained and clean.			
		NI							
		9							
6.00 - 7.50	93 51 33	NI			(1.95)	*Between 6.80m and 6.88m: non intact recovered as sandy, angular to subangular, fine to coarse gravel.* *Between 7.00m to 7.30m: non-intact recovered as sand.*			
		8							
		NI				*Between 7.30m and 7.40m: with inclusion of subangular to subrounded, medium grained gravel.* *Between 7.40m to 7.50m: MUDSTONE recovered as angular, fine to coarse gravel.*			
				18.13	7.85	*Between 7.50m and 7.85m: non-intct recovered as sand.*			
		20		17.98	8.00	Very weak, reddish brown, fine and medium grained MUDSTONE. Discontinuities are 0-10 degrees, extremely closely to closely, planar smooth, unstained clean			
		NI							
7.50 - 9.00	73 60 30	6				Medium strong locally weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-10 degrees, closely locally extremely closely planar smooth, occasionally rough, unstained infill <2mm.			
		NI							
		AZCL							
			9.00m - C3		(4.00)	*Between 8.00m and 8.15m: non intact recovered as sandy, angular to subangular, fine to coarse gravel.* *Between 8.00m and 8.20m: non-intact recovered as angular to subangular, fine to coarse gravel.* *At 8.20m: 1no discontinuity, 0 degrees, planar smooth, unstained and clean.* *Between 8.50m and 8.60m: non intact recovered as fine and medium sand.*			
9.00 - 10.50	100 100 97	5							
			10.00m - C4			Continued next sheet			

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
4.00	6.00	Water	90
6.00	12.00	Water	80
12.00	15.00	Water	70
15.00	18.00	Water	50
18.00	22.50	Water	70
22.50	24.00	Water	0
24.00	25.50	Water	20
25.50	30.00	Water	50

Checked by: HH
Log status: DRAFT
IFA RC v01.01

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
15/11	16:30	15.00	4.00	2.70
16/11	08:00	15.00	4.00	3.20
16/11	16:30	40.50	4.00	5.10

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan Phase 2	**RBH17**
Dates:	**Client:**	Sheet 2 of 5
15/11/2018 - 16/11/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383159.27E 398122.01N	25.98mOD	DO	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Medium strong locally weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-10 degrees, closely locally extremely closely planar smooth, occasionally rough, unstained infill <2mm.				
10.50 - 12.00	100 100 83	7	11.00m - C5					11		
			11.84m - C6	13.98	12.00					
12.00 - 13.50	100 60 39	NI 10	12.90m - C7			Weak, locally very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-20 degrees, closely spaced, planar, locally undulating smooth and rough, unstained, occasional silt infill <1mm. *Between 12.00m nd 12.60m: non-intact recovered as sand.*		12 13		
13.50 - 15.00	100 100 85	20 8	14.00m - C8		(3.10)			14		
		NI	15.00m - C9	10.88	15.10	*Between 15.00m and 15.05m: non intact recovered as slightly clayey, fine and medium sand.*		15		
15.00 - 16.50	100 97 85	6	16.00m - C10		(1.40)	Medium strong locally weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 25-35 degrees, closely spaced, planar smooth, locally undulating, unstained, occasional clay infill <1mm. *Between 15.94m and 15.97m: discontinuity is becoming very closely spaced.* *Between 16.10m and 16.20m: locally extremely weak to very weak.*		16		
				9.48	16.50	*At 16.35m: 1no discontinuity, 0 degrees undulating smooth, unstained, silt infill <1mm.*				
16.50 - 18.00	100 100 93	10 2 13	17.00m - C11 18.00m - C12			Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely locally medium spaced, planar and undulating, occasionally stained black, occasional clay infill <2mm. *Between 17.00m and 17.10m: 1no discontinuity, 25-35 degrees, planar smooth, stained, clean.*		17 18		
18.00 - 19.50	100 87 83	4 3 8 NI 10	19.00m - C13		(4.15)	*Between 18.55m and 18.57m: reduction spot.* *At 18.95m: extremely weak.* *At 19.25m: reduction spot.* *Between 19.30m and 19.50m: non intact recovered as clayey, angular to subangular gravel and cobbles.*		19		
						Continued next sheet		20		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
30.00	34.50	Water	40								
34.50	40.50	Water	0								

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan Phase 2	**RBH17**
Dates:	**Client:**	Sheet 3 of 5
15/11/2018 - 16/11/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383159.27E 398122.01N	25.98mOD	DO	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	100 97 87	8	20.10m - C14	5.33	20.65	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely locally medium spaced, planar and undulating, occasionally stained black, occasional clay infill <2mm.				
			21.00m - C15		(0.85)	Weak locally very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely locally very closely spaced, planar and undulating, unstained, occasional clay infill <3mm.		21		
21.00 - 22.50	100 90 67	NI 5	21.90m - C16	4.48	21.50	*Between 21.45m and 21.50m: recovered as subangular gravel and cobbles.*				
					(1.10)	Weak, locally medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced, locally undulating, unstained and clean. *At 22.30m: 1no of subrounded, medium grained of quartzite.*		22		
22.50 - 24.00	100 100 97	25 10 NI 2 NI 8	23.20m - C17	3.38 2.88	22.60 (0.50) 23.10	Very weak, locally weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-10 degrees, planar and rough, unstained and clean. *Between 23.00m and 23.05m: recovered as subangular to subrounded, fine to coarse gravel.*		23		
			24.00m - C18			Medium strong locally very weak and very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 25 degrees, medium, closely in places, smooth, rough in places, locally stained black, occasional clay infill <3mm. *Between 23.50m and 23.60m: non intact, recovered as subangular, fine to coarse gravel.*		24		
24.00 - 25.50	100 100 97		25.10m - C19					25		
			25.50m - C20							
25.50 - 27.00	100 100 93	2			(11.40)			26		
			27.30m - C21					27		
27.00 - 28.50	100 100 93		28.13m - C22			*At 28.33m: reduction spot.* *Between 28.35m and 28.40m: with interbedded reddish brown mudstone.*		28		
28.50 - 30.00	100 100 100		29.00m - C23			*At 29.80m: extremely weak to very weak.*		29		
			30.00m - C24			Continued next sheet		30		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH17**
	Dates: 15/11/2018 - 16/11/2018	Client: Curtins Consulting	Sheet 4 of 5
Rotary Borehole Log	Location: 383159.27E 398122.01N	Ground level: 25.98mOD / Logged by: DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	100 93 93	5	30.84m - C25			Medium strong locally very weak and very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 25 degrees, medium, closely in places, smooth, rough in places, locally stained black, occasional clay infill <3mm.		31		
31.50 - 33.00	100 100 93	3	31.84m - C26			*At 32.20m: extremely weak to very weak.* *Between 32.20m and 32.25m: reduction spot.* *Between 32.60m and 32.70m: non intact, recovered as subangular, gravel and cobbles.*		32		
33.00 - 34.50	100 100 70	NI 3 20 2 13 2	33.25m - C27			*At 33.48m and 33.50m: extremely weak to very weak.* *Between 34.40m and 34.50m: reduction spot.*		33 34		
34.50 - 36.00	100 100 90	20 5	34.80m - C28 36.00m - C29	-8.52	34.50 (1.20)	Medium strong, locally weak reddish brown, fine grained SANDSTONE. Discontinuities are 0-25 degrees, closely to medium spaced, planar smooth, unstained, occasional clay infill <1mm. *Between 34.65m and 34.68m: reduction spot.*		35		
36.00 - 37.50	100 93 80	NI 13 3 8	36.73m - C30	-9.72	35.70 (1.80)	Weak, reddish brown, medium grained SANDSTONE. Discontinuities are 0-15 degrees, closely locally medium spaced, planar and undulating, smooth and rough, unstained and clean. *Between 36.40m and 36.50m: non intact, recovered as sandy gravel and cobbles.* *Between 36.40m and 36.60m: extremely weak to very weak.*		36 37		
37.50 - 39.00	100 100 80	2	38.20m - C31 39.00m - C32	-11.52 -12.02	37.50 (0.50) 38.00 (2.50)	Weak, very weak in places, reddish brown, medium grained SANDSTONE. Discontinuities are 0-10 degrees, very closely to closely spaced, planar and undulating, smooth and locally rough, occasionally stained black, occasional clay infill <1mm. Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, locally closely spaced, planar smooth, locally rough, unstained and clean. *Between 38.03m and 38.07m: 1no discontinuity, 35degrees, planar smooth, stained black, clean.* *Between 38.40m and 38.50m: extremely weak to very weak.*		38 39		
39.00 - 40.50	100 100 93					Continued next sheet		40		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2		Location ID: **RBH17**
Dates: 15/11/2018 - 16/11/2018	Client: Curtins Consulting		Sheet 5 of 5
Rotary Borehole Log	Location: 383159.27E 398122.01N	Ground level: 25.98mOD / Logged by: DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		3	40.20m - C33	-14.52	40.50	Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, locally closely spaced, planar smooth, locally rough, unstained and clean.				
						End of Borehole at 40.50m				

41 42 43 44 45 46 47 48 49 50

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH18A**
	Dates: 17/10/2018 - 22/10/2018	Client: Curtins Consulting	Sheet 1 of 5
Rotary Borehole Log	Location: 383065.83E 398013.83N	Ground level: 26.47mOD / Logged by: HH/DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				26.32	0.15	MADE GROUND: Tarmacadam (driller's description).				
				26.07	0.40	MADE GROUND: Type 1 MOT (driller's description).				
			0.50m - ES30			MADE GROUND: Red sand and gravel (driller's description).		1		
					(3.60)			2		
								3		
				22.47	4.00	Red sand and gravels (driller's description).		4		
					(1.50)			5		
		13		20.97	5.50					
5.50 - 6.00	100 20 0	NI 10		20.89	5.58	Strong, grey, fine grained SANDSTONE. Weak, red, medium grained SANDSTONE. *Below 5.58m: non-intact, recovered as angular gravel.*		6		
6.00 - 6.50	100 0 0	NI			(0.92)	*Between 6.00 and 6.40m: gravel collapsed from above.*				
		3		19.97	6.50	Weak, locally medium strong, reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced very closely in places, planar smooth, with clay infill.		7		
6.50 - 7.50	100 100 50		7.15m - C1							
7.50 - 9.00	100 100 80	4			(4.75)			8		
			9.00m - C2					9		
9.00 - 10.50	100 93 55									
						Continued next sheet		10		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
5.50	6.00	Air	95
6.00	6.50	Air	95
6.50	7.50	Air	95
7.50	9.00	Air	95
9.00	10.50	Air	60
10.50	12.00	Air	80
12.00	13.50	Air	80
13.50	15.00	Air	75

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)
40.50	1

Casing Diameter	
Depth (m)	Dia (mm)
5.50	200

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
17/10	16:00	24.00	5.50	5.10
18/10	08:00	24.00	5.50	5.80
18/10	16:30	40.50	5.50	3.10

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.00	5.50	0.00	20	3.70	

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	8.50	Plain	50
8.50	14.50	Slotted	50

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH18A**	
Dates: 17/10/2018 - 22/10/2018	Client: Curtins Consulting	Sheet 2 of 5	
Rotary Borehole Log	Location: 383065.83E 398013.83N	Ground level: 26.47mOD	Logged by: HH/DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		13	10.20m - C3			Weak, locally medium strong, reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced very closely in places, planar smooth, with clay infill. *Between 9.90m and 10.00m: 1 no. 45 degrees, planar smooth. Between 10.20m and 10.30m: recovered as angular to subangular, fine to coarse gravel. Between 10.48m and 10.80m: 1 no. 70-80 degrees, wide, undulating smooth, stained black discontinuity.*				
		NI								
10.50 - 12.00	87 87 56	7 20	11.00m - C4	15.22	11.25	Medium strong, reddish brown, fine grained SANDSTONE. Discontinuities are closely spaced, planar smooth with clay infill. *At 11.49m and 11.55m: reduction spots.*		11		
					(1.25)			12		
12.00 - 13.50	66 66 66	AZCL	12.50m - C5	13.97	12.50	Weak, reddish brown, medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced, planar rough and clean.		13		
					(1.40)					
13.50 - 15.00	100 100 90		14.06m - C6	12.57	13.90	Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely to medium spaced, planar smooth and clean.		14		
						Between 15.10m and 15.20m: inclusion of subangular, fine to coarse siltstone gravel.		15		
15.00 - 16.50	100 100 100		15.38m - C7 16.13m - C8					16		
		3			(5.30)					
16.50 - 18.00	100 100 93		16.85m - C9 17.64m - C10			*At 17.10m: 1 no. 25-30 degrees undulating, smooth, clay infilled discontinuity.*		17		
18.00 - 19.50	100 100 93					*At 18.40m: inclusion of angular to subrounded, fine to coarse gravel including siltstone, mudstone and sandstone.*		18		
			19.10m - C11	7.27	19.20	*At 18.90m: 1 no. 60-70 degrees, undulating smooth, clean discontinuity. At 19.10m: 25-30 degrees, undulating smooth with clay infill.* Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced, planar smooth, with occasional clay infill. *Between 19.25m and 19.43m: 90 degrees, undulating smooth and clean.*		19		
						Continued next sheet		20		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
15.00	16.50	Air	80
16.50	18.00	Air	95
18.00	19.50	Air	95
19.50	21.00	Air	90
21.00	22.50	Air	85
22.50	24.00	Air	80
24.00	25.50	Air	85
25.50	27.00	Air	80

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2		Location ID: **RBH18A**
Dates: 17/10/2018 - 22/10/2018	Client: Curtins Consulting		Sheet 3 of 5
Rotary Borehole Log	Location: 383065.83E 398013.83N	Ground level: 26.47mOD / Logged by: HH/DO / Vertical scale: 1:50	Project ID: 42269

Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Groundwater: Water Strike	Groundwater: Backfill/ Installation
19.50 - 21.00	100 100 80	10	20.30m - C12		(1.75)	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced, planar smooth, with occasional clay infill. *Between 19.50m and 20.95m: some gravel inclusions. Gravel is subrounded to rounded, fine and medium including siltstone and quartzite.*				
				5.52	20.95					
21.00 - 22.50	100 100 93	4	21.20m - C13			Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely to medium spaced, planar smooth and undulating rough, with occasional clay and calcite infill.		21		
			22.25m - C14					22		
22.50 - 24.00	100 97 90	NI 14 22	23.30m - C15			*At 22.70m: subrounded cobble of quartzite.* *Between 23.00m and 23.05m: recovered as subrounded to rounded, fine to coarse gravel.*		23		
		2						24		
24.00 - 25.50	100 87 80	NI 20 NI	24.23m - C16			*Between 24.35m and 24.50m: non-intact, recovered as gravelly, fine and medium sand.* *Between 24.55m and 24.60m: non-intact, recovered as angular to subangular, fine to coarse gravel.*		25		
			25.25m - C17		(11.55)					
25.50 - 27.00	100 100 93	4	26.10m - C18					26		
27.00 - 28.50	100 87 87	NI 4 NI 1	27.23m - C19			*Between 27.00m and 27.15m: non-intact, recovered as fine and medium sandy gravel.* *Between 28.00m and 28.15m: non-intact, recovered as very gravelly sand.*		27 28		
			28.30m - C20							
28.50 - 30.00	100 93 87	4	29.10m - C21			*Between 28.80m and 29.60m: non-intact, recovered as very gravelly sand.* *Between 29.00m and 29.30m: 75-80 degrees, undulating smooth, with silt infill.* *Between 29.40m and 29.50m: non-intact, recovered as fine and medium sand and angular to subangular, fine to coarse gravel.*		29		
		6						30		

Continued next sheet

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
27.00	28.50	Air	90
28.50	30.00	Air	80
30.00	31.50	Air	80
31.50	33.00	Air	80
33.00	34.50	Air	80
34.50	36.00	Air	80
36.00	37.50	Air	80
37.50	39.00	Air	80

Checked by: HH — IFA RC v01.01
Log status: DRAFT

Borehole Diameter

Depth (m)	Dia (mm)

Casing Diameter

Depth (m)	Dia (mm)

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH18A**	
Dates: 17/10/2018 - 22/10/2018	Client: Curtins Consulting	Sheet 4 of 5	
Rotary Borehole Log	Location: 383065.83E 398013.83N	Ground level: 26.47mOD	Logged by: HH/DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		NI								
30.00 - 31.50	100 93 90	10	30.70m - C22			Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely to medium spaced, planar smooth and undulating rough, with occasional clay and calcite infill. *Between 30.00m and 30.05m: recovered as, fine and medium sand and angular to subangular, fine to coarse gravel including sandstone.* *Between 31.00m and 31.05m: 40 degrees, undulating smooth with silt infill.* *Between 31.40m and 31.45m: recovered as, fine and medium sand and angular to subangular, fine to coarse gravel including sandstone.* *Between 31.70m and 32.00m: very gravelly. Gravel is subangular to subrounded, fine to coarse including siltstone, sandstone and quartzite.*		31		
		NI								
31.50 - 33.00	100 100 97	2	31.74m - C23					32		
		4	32.90m - C24	-6.03	32.50 (0.50)	Medium strong, reddish brown, gravelly, medium grained SANDSTONE. Discontinuities are horizontal, closely spaced, undulating smooth and clean.				
33.00 - 34.50	100 100 100	2	34.20m - C25	-6.53	33.00	Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely to medium spaced, planar smooth and undulating rough, with occasional clay infill. *Between 33.30 and 33.40m: 1 no. 45 degrees planar smooth, clean discontinuity.*		33 34		
34.50 - 36.00	100 100 97	7	35.74m - C26					35		
36.00 - 37.50	100 100 100	3	37.09m - C27		(6.80)			36 37		
37.50 - 39.00	100 87 82	NI 2 13	38.14m - C28			*Between 37.70m and 37.75m: non intact recovered as sandy gravel.* *Between 38.05m and 38.20m: non-intact, recovered as gravel.*		38 39		
39.00 - 40.50	100 100 100	2	39.40m - C29	-13.33	39.80	Medium strong, reddish brown, gravelly, medium grained		40		
						Continued next sheet				

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
39.00	40.50	Air	80								

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH18A**	
Dates: 17/10/2018 - 22/10/2018	Client: Curtins Consulting	Sheet 5 of 5	
Rotary Borehole Log	Location: 383065.83E 398013.83N	Ground level: 26.47mOD	Logged by: HH/DO
Vertical scale: 1:50	Project ID: 42269		

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		5		-14.03	(0.70) 40.50	Medium strong, reddish brown, gravelly, medium grained SANDSTONE. Discontinuities are horizontal, closely spaced, planar rough and clean. *Below 39.80m: medium grained with horizontal, clean discontinuity. Between 40.30m and 40.35m: horizontal reduction spot.* End of Borehole at 40.50m		41 42 43 44 45 46 47 48 49 50		

Flush Details				Borehole Diameter		Boring Progress				
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)

Remarks:

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH19**
Dates: 29/10/2018	Client: Curtins Consulting	Sheet 1 of 5
Rotary Borehole Log	Location: 383061.89E 398046.81N	Ground level: 26.49mOD	Logged by: DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
					(0.30)	MADE GROUND: Taramacadam (driller's description).				
				26.19	0.30					
				25.99	0.50	MADE GROUND: Grey, angular to subangular, fine to coarse GRAVEL (driller's description).				
					(0.50)	MADE GROUND: Gravelly CLAY with ash (driller's description).				
				25.49	1.00					
						Brown, clayey SAND and GRAVEL (driller's description).		1		
								2		
					(2.80)					
								3		
				22.69	3.80					
						Red SANDSTONE (driller's description).		4		
					(2.40)			5		
								6		
				20.29	6.20					
						Reddish brown MUDSTONE, recovered as stiff clay.				
					(0.80)					
		NI		19.49	7.00					
						Red SANDSTONE recovered as clayey, fine SAND.		7		
7.00 - 8.00	15 0 0									
								8		
8.00 - 9.00	0 0 0	AZCL			(4.70)					
								9		
9.00 - 9.50	0 0 0									
9.50 - 10.00	0 0 0									
						Continued next sheet		10		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %

Borehole Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
29/10	16:30	7.00		
30/10	08:00	7.00	7.00	6.00
30/10	16:30	28.50		
31/10	08:00	28.50	28.50	6.00

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Casing Diameter	
Depth (m)	Dia (mm)
7.00	150

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
6.00			20	6.00	

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	2.50	Plain	
2.50	7.50	Slotted	

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH19**
	Dates: 29/10/2018	Client: Curtins Consulting	Sheet 2 of 5
Rotary Borehole Log	Location: 383061.89E 398046.81N	Ground level: 26.49mOD / Logged by: DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
10.00 - 10.50	0 0 0					Red SANDSTONE recovered as clayey, fine SAND.				
10.50 - 11.00	0 0 0							11		
11.00 - 11.50	0 0 0									
11.50 - 12.50	100 50 40	NI 14 NI 6		14.64	11.85 (0.50)	Extremely weak, reddish brown, fine grained SANDSTONE. Discontinuities are closely spaced, planar undulating, planar smooth with rare clay infill.		12		
				14.14	12.35	*Below 12.20m: non-intact recovered as gravel.*				
12.50 - 13.00	0 0 0	AZCL				Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-10 degrees, very closely to closely spaced, planar smooth, unstained and clean.		13		
13.00 - 13.50	0 0 0									
13.50 - 14.00	60 60 40	18						14		
14.00 - 14.50	40 40 20									
14.50 - 15.00	0 0 0	AZCL						15		
15.00 - 15.50	20 20 20	10			(6.10)					
15.50 - 16.00	0 0 0							16		
16.00 - 16.50	0 0 0									
16.50 - 17.00	0 0 0	AZCL						17		
17.00 - 17.50	0 0 0									
17.50 - 18.00	0 0 0							18		
18.00 - 18.50	60 14 0	NI 25+				*Below 18.20m: non-intact recovered as gravel and cobbles.*				
				8.04	18.45	Very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are horizontal, very closely spaced, planar smooth and clay infilled.		19		
18.50 - 19.00	0 0 0					*At 18.48m: 1no, 0 degrees, undulating smooth, clay infilled*				
19.00 - 19.50	0 0 0	AZCL			(3.05)					
19.50 - 20.00	0 0 0							20		
						Continued next sheet				

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
31/10	16:30	40.60	40.60	6.00

Remarks:

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH19**
	Dates: 29/10/2018	Client: Curtins Consulting	Sheet 3 of 5
Rotary Borehole Log	Location: 383061.89E 398046.81N	Ground level: 26.49mOD / Logged by: DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
20.00 - 21.50	67 0 0	4 16				Very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are horizontal, very closely spaced, planar smooth and clay infilled. *Below 20.50m: black surface staining of fractures.* *Between 20.85m and 20.90m: 1 no discontinuity, 90 degrees, planar smooth, unstained and clean.*		21		
21.50 - 23.00	87 73 70	AZCL 5 NI 6		4.99 4.54	21.50 (0.45) 21.95 (1.55)	Medium strong, reddish brown, fine and medium grained SANDSTONE. *Between 21.70m and 21.95m: 1no discontinuity 80-85 degrees, planar smooth unstained with silt infill.* *Between 21.90m and 22.10m: non-intact recovered as angular to subangular cobble and 1no subangular cobble of mudstone.* Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-10 degrees, closely spaced, planar smooth, unstained clean. *Between 23.00m and 25.20m: with some gravel inclusions.*		22 23		
23.00 - 24.50	67 63 63	AZCL 2 8		2.99	23.50	Medium strong, weak in places, reddish brown, medium grained SANDSTONE. Discontinuities are 0-10 degrees, closely spaced, planar smooth, unstained clean.		24		
24.50 - 25.50	40 30 20	AZCL 8 NI				*Between 25.35m and 25.50m: non-intact recovered as fine and medium sand and a subrounded cobble.*		25		
25.50 - 26.50	50 30 20	AZCL 20 NI 4 20				*Between 26.05m and 26.15m: non-intact recovered as subangular to subrounded, coarse gravel.* *Between 26.40m and 26.45m: non-intact rrecovered as subangular to subrounded, coarse gravel.*		26		
26.50 - 27.50	50 50 35	AZCL 4 15						27		
27.50 - 28.50	100 90 35	NI 7				*Between 27.95m and 28.05m: non-intact recovered as angular to subangular, coarse gravel.*		28		
28.50 - 29.50	87 87 33	AZCL 14						29		
		2				Continued next sheet		30		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES	Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH19**
	Dates: 29/10/2018	Client: Curtins Consulting	Sheet 4 of 5
Rotary Borehole Log	Location: 383061.89E 398046.81N	Ground level: 26.49mOD / Logged by: DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
29.50 - 30.50	100 100 80	10				Medium strong, weak in places, reddish brown, medium grained SANDSTONE. Discontinuities are 0-10 degrees, closely spaced, planar smooth, unstained clean.		31		
30.50 - 32.00	87 80 60	AZCL 23 NI 5				*Between 31.70m and 31.80m: non-intact recovered as slightly sandy gravel with 1no cobble.*		32		
32.00 - 33.50	47 47 26	AZCL 4				*Between 33.35m and 33.50m: non-intact recovered as angular to subangular, coarse gravel.* *Between 33.50m and 33.60m: non-intact recovered as subrounded cobble of weak sandstone.* *Between 33.60m and 33.70m: non-intact recovered as subangular cobble.*		33		
33.50 - 34.50	100 90 75	NI 9 4 20				*Between 34.18m and 34.22m: 1no discontinuity 25-35 degrees undulating rough, stained greenish grey.*		34		
34.50 - 35.00	0 0 0	AZCL			(17.10)			35		
35.00 - 36.50	100 83 75	6 2				*Between 35.00m and 35.15m: 1no discontinuity 90 degrees, planar smooth, stained black.* *Between 35.20m and 35.38m: 1no discontinuity 80 degrees, planar smooth, unstained and clean.*		36		
36.50 - 38.00	80 40 37	AZCL 2 25+ NI				*Between 37.30m to 37.40m: extremely closely spaced discontinuities.* *Between 37.40m and 38.00m: non-intact recovered as slightly sandy gravel and cobbles.*		37		
38.00 - 38.70	100 100 57	6						38		
38.70 - 39.00	100/100/93							39		
39.00 - 39.60	100 100 30	25+ 1				*Between 39.20m and 39.30m: extremely closely spaced discontinuities.*				
						Continued next sheet		40		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Massenza M18	Project: St John's Masterplan Phase 2	Location ID: **RBH19**	
Dates: 29/10/2018	Client: Curtins Consulting	Sheet 5 of 5	
Rotary Borehole Log	Location: 383061.89E 398046.81N	Ground level: 26.49mOD	Logged by: DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
39.60 - 40.60	100 100 50	10 5		-14.11	40.60	Medium strong, weak in places, reddish brown, medium grained SANDSTONE. Discontinuities are 0-10 degrees, closely spaced, planar smooth, unstained clean. *Between 40.00m and 40.15m: 1no discontinuity 45-55 degrees including smooth greenish grey stained (possible reduction spot).* End of Borehole at 40.60m				

41 42 43 44 45 46 47 48 49 50

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Commachio 205	St John's Masterplan Phase 2	**RBH20**
Dates:	**Client:**	Sheet 1 of 5
31/10/2018 - 01/11/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383018.36E 398038.25N	26.58mOD	JO	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
				26.53	0.05	Tarmacadam (driller's description).				
				26.28	0.30	MADE GROUND: Concrete and rebar (driller's description).				
			0.50m - ES33		(1.40)	MADE GROUND: Sandy, angular to subangular, fine to coarse GRAVEL of brick (driller's description).		1		
				24.88	1.70	Brown, sandy, gravelly CLAY (driller's description).				
					(2.50)			2		
								3		
								4		
				22.38	4.20	Red SAND and GRAVEL (driller's description).				
					(0.80)					
				21.58	5.00	Extremely weak, thinly laminated, reddish brown, fine and medium SANDSTONE. Discontinuities are horizontal, very closely to closely spaced, planar rough and clean.		5		
5.00 - 5.50	0 0 0	AZCL								
5.50 - 6.00	60 60 0	14								
		AZCL						6		
6.00 - 7.50	86 36 3	NI				*Between 6.20m and 6.81m: non intact recovered as gravel.*				
		18	7.10m - C1			*At 6.73m: 1no subvertical, planar rough and clean.*		7		
		AZCL								
7.50 - 9.00	91 89 7	10	8.00m - C2			*Between 7.83m and 7.84m: reddish brown mudstone.*		8		
		AZCL				*Between 8.78m and 8.83m: non intact recovered as gravel.*		9		
9.00 - 10.50	78 75 19	14	9.30m - C3			*Between 9.30m and 10.60m: weak.*				
						Continued next sheet		10		

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
5.50	12.00	Water	90
12.00	36.00	Water	60
36.00	37.50	Water	40
37.50	40.50	Water	20

Borehole Diameter

Depth (m)	Dia (mm)
40.50	146

Casing Diameter

Depth (m)	Dia (mm)
5.50	200

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
31/10	16:30	12.00	5.50	1.50
01/11	08:00	12.00	5.50	5.70
01/11	16:30	33.00	5.50	4.80
02/11	08:00	33.00	5.50	5.75

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
3.70			20	3.70	

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Commachio 205	St John's Masterplan Phase 2	**RBH20**
Dates:	Client:	Sheet 2 of 5
31/10/2018 - 01/11/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	383018.36E 398038.25N	26.58mOD	JO	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
			10.30m - C4			Extremely weak, thinly laminated, reddish brown, fine and medium SANDSTONE. Discontinuities are horizontal, very closely to closely spaced, planar rough and clean.				
10.50 - 12.00	97 96 46	7	10.90m - C5			*Between 10.60m and 11.00m: very weak.* *Between 11.00m and 12.40m: weak.*		11		
12.00 - 13.50	97 83 46	4 7	12.20m - C6 13.38m - C7			*Between 12.40m and 13.35m:very weak.* *Between 13.35m and 20.10m: weak.*		12 13		
13.50 - 15.00	80 77 56	AZCL 19 5	14.25m - C8 15.30m - C9			*Between 14.70m and 15.18m: 1no 45 degrees, planar rough with clacite infilled discontinuity.* *At 15.30m: 1no calcite vein.*		14 15		
15.00 - 16.50	100 88 36	13	15.75m - C10					16		
16.50 - 17.70	73 48 22	AZCL NI 11 NI	16.96m - C11			*Between 16.99m and 17.13m: 1no 45 degrees, planar rough, calcite infilled discontinuity*		17		
17.70 - 18.70	70 32 0	AZCL NI 9	18.00m - C12					18		
18.70 - 19.50	91 71 38	AZCL NI 5	19.20m - C13			*Between 18.80m and 18.92m: non intact recovered as sand.*		19		
		NI				*Between 19.50m and 19.76m: non intact recovered as sand.*		20		

Continued next sheet

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
02/11	16:30	40.50	5.50	3.90

Remarks:

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Commachio 205	Project: St John's Masterplan Phase 2		Location ID: **RBH20**
Dates: 31/10/2018 - 01/11/2018	Client: Curtins Consulting		Sheet 3 of 5
Rotary Borehole Log	Location: 383018.36E 398038.25N	Ground level: 26.58mOD / Logged by: JO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	98 71 62	6 NI 5	20.20m - C14 21.00m - C15			Extremely weak, thinly laminated, reddish brown, fine and medium SANDSTONE. Discontinuities are horizontal, very closely to closely spaced, planar rough and clean. *Between 20.10m and 23.10m: weak* *Between 20.41m and 20.52m: non intact recovered as sand.*		21		
21.00 - 22.50	100 97 65	8	22.00m - C16 22.85m - C17					22		
22.50 - 24.00	100 96 65		24.00m - C18			*Between 23.10m and 31.05m: medium strong.* *Between 23.50m and 23.71m: 1no 45 degrees planar and undulating rough with clay and calcite infilled discontinuity.*		23 24		
24.00 - 25.50	100 98 88		24.73m - C19		(35.50)			25		
25.50 - 27.00	100 98 91	4	26.03m - C20					26		
27.00 - 28.50	100 93 66		27.30m - C21 28.30m - C22					27 28		
28.50 - 30.00	100 100 80	1	29.10m - C23			Continued next sheet		29 30		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Commachio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH20**	
Dates: 31/10/2018 - 01/11/2018	Client: Curtins Consulting	Sheet 4 of 5	
Rotary Borehole Log	Location: 383018.36E 398038.25N	Ground level: 26.58mOD	Logged by: JO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	90 75 44	AZCL 8	30.40m - C24 31.40m - C25			Extremely weak, thinly laminated, reddish brown, fine and medium SANDSTONE. Discontinuities are horizontal, very closely to closely spaced, planar rough and clean. *Between 31.05m and 32.36m: weak.*		31		
31.50 - 33.00	97 64 36		32.00m - C26			*Between 31.98m and 32.48m: 1no vertical planar rough discontinuity.* *Between 32.36m and 32.71: very weak.*		32		
33.00 - 34.50	55 0 0	NI AZCL NI				*Between 33.67m and 34.50m: non intact recovered as sand.*		33 34		
34.50 - 36.00	98 70 42	5 7	34.70m - C27			*Between 35.10m and 35.58m: non intact recovered as gravel.* *Between 35.72m and 35.92m: 2no 45 degrees, planar rough with calcite infilled discontinuity.* *Between 35.75m and 40.02m: weak.*		35 36		
36.00 - 37.50	98 94 88	6	36.27m - C28 37.25m - C29			*Between 37.42m and 37.66m: 1no vertical planar, rough with calcite infilled discontinuity.*		37		
37.50 - 39.00	94 85 41	20	38.40m - C30					38		
39.00 - 40.50	91 82 38	AZCL	39.00m - C31 39.92m - C32					39 40		

Continued next sheet

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Commachio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH20**	
Dates: 31/10/2018 - 01/11/2018	Client: Curtins Consulting	Sheet 5 of 5	
Rotary Borehole Log	Location: 383018.36E 398038.25N	Ground level: 26.58mOD	Logged by: JO / Vertical scale: 1:50 / Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		3		-13.92	40.50	Extremely weak, thinly laminated, reddish brown, fine and medium SANDSTONE. Discontinuities are horizontal, very closely to closely spaced, planar rough and clean. *Between 40.02m and 40.50m: medium strong.* End of Borehole at 40.50m		41 42 43 44 45 46 47 48 49 50		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205/	Project: St John's Masterplan Phase 2	Location ID: **RBH21**	
Dates: 26/10/2018 - 31/10/2018	Client: Curtins Consulting	Sheet 1 of 4	
Rotary Borehole Log	Location: 382999.09E 398042.53N	Ground level: 26.23mOD	Logged by: DO/	Vertical scale: 1:50	Project ID: 42269

Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Groundwater: Water Strike	Groundwater: Backfill/ Installation
			0.15m - ES2	26.08	0.15	MADE GROUND: Tarmacadam.			
			0.40m - ES3 0.50m - ES1	25.83	0.40	MADE GROUND: Light grey, fine to coarse SAND and angular to subangular, fine to coarse GRAVEL including limestone, granite and concrete.			
					(1.30)	MADE GROUND: Yellowish brown, mottled black, sandy GRAVEL with medium cobbles content. Gravel and cobbles are angular to subrounded including brick, slag and concrete. *At 0.50m: thin layer of tarmacadam.*			
				24.53	1.70	Brown gravelly CLAY (drillers description).			
					(1.70)				
				22.83	3.40	Red SAND and GRAVEL (drillers description).			
					(1.40)				
4.50 - 5.10	50 0 0	AZCL NI		21.43	4.80	Very weak, reddish brown, fine grained SANDSTONE. Discontinuities are 0-10 degrees, very closely spaced, planar smooth and clean.			
					(0.50)				
5.10 - 5.65	82 45 0	AZCL NI 32 NI		20.93	5.30	Very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-10 degrees, extremely, locally very closely spaced, planar smooth, unstained clean (possible drilling induced fractures). *Between 5.55m and 5.65m: non intact recovered as sand.*			
5.65 - 6.00	100/10/0	24 NI							
6.00 - 7.50	93 87 73	AZCL NI 20 5	7.00m - C4			*Between 6.10m and 6.20m: recovered as angular to subangular, fine and medium gravel of sandstone.* *Between 6.35m and 6.40m: with interlaminated mudstone.*			
7.50 - 9.00	100 93 60	NI 8	8.00m - C5 8.85m - C6			*Between 8.10m and 8.60m: recovered as fine and medium sand.* *Between 8.60m and 8.70m: 1no discontinuity is 45-55 degrees, planar smooth, unstained and clean.*			
9.00 - 10.50	33 0 0	NI 10				*Between 9.00m and 9.50m: non intact recovered as fine and medium sand.*			

Continued next sheet

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
4.50	5.10	Water	90
5.10	5.65	Water	90
5.65	6.00	Water	80
6.00	7.50	Water	80
7.50	9.00	Water	60
9.00	10.50	Water	80
10.50	11.50	Water	80
11.50	12.00	Water	80

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Log status: DRAFT

Borehole Diameter

Depth (m)	Dia (mm)
40.50	146

Casing Diameter

Depth (m)	Dia (mm)
4.50	200

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
26/10	16:00	1.20		
29/10	08:00	1.20		
29/10	16:00	24.00	4.50	1.70
30/10	08:00	24.00	4.50	3.10

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

IAN FARMER ASSOCIATES

Plant used: Comacchio 205/	Project: St John's Masterplan Phase 2	Location ID: **RBH21**	
Dates: 26/10/2018 - 31/10/2018	Client: Curtins Consulting	Sheet 2 of 4	
Rotary Borehole Log	Location: 382999.09E 398042.53N	Ground level: 26.23mOD	Logged by: DO/	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		NI				Very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-10 degrees, extremely, locally very closely spaced, planar smooth, unstained clean (possible drilling induced fractures).				
			10.50m - C7							
10.50 - 11.50	100 100 90	7	10.90m - C8 11.20m - C9			*At 11.15m: 1no 30 degrees, planar smooth and clean discontinuity.*		11		
11.50 - 12.00	70 70 50		11.70m - C10			*Between 11.35m and 11.40m: mudstone inter laminated.*				
		AZCL						12		
12.00 - 13.50	67 57 40	7	12.60m - C11			*Below 12.50m: weak and medium grained.* *At 12.80m: 1no 50-60 degrees, planar smooth and clean discontinuity.*		13		
		NI				*At 13.10m: 1no 50-60 degrees, planar smooth and clean discontinuity.*				
13.50 - 14.00	100 50 40	7 NI 10	13.60m - C12			*Between 13.40m and 13.50m: non intact recovered as fine and medium sand.* *Between 13.70m and 13.90m: non intact recovered as sand and gravel.*		14		
14.00 - 15.00	100 95 90	3	14.50m - C13			*Between 14.10m and 14.25m: 1no degrees, planar smooth, unstained, clay infill.*		15		
			15.50m - C14							
15.00 - 16.50	100 100 85	30	16.39m - C15					16		
16.50 - 18.00	100 100 100		17.10m - C16					17		
			18.00m - C17					18		
18.00 - 19.50	100 100 100	1	19.00m - C18					19		
			19.92m - C19					20		
						Continued next sheet				

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
12.00	13.50	Water	80
13.50	14.00	Water	80
14.00	15.00	Water	80
15.00	16.50	Air	80
16.50	18.00	Air	80
18.00	19.50	Air	80
19.50	21.00	Air	80
21.00	22.50	Air	80

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
30/10	16:00	36.00	4.50	3.90
31/10	08:00	36.00	4.50	11.20

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

IAN FARMER ASSOCIATES

Plant used: Comacchio 205/	Project: St John's Masterplan Phase 2		Location ID: **RBH21**
Dates: 26/10/2018 - 31/10/2018	Client: Curtins Consulting		Sheet 3 of 4
Rotary Borehole Log	Location: 382999.09E 398042.53N	Ground level: 26.23mOD / Logged by: DO/ / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	100 100 90	6	20.78m - C20			Very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-10 degrees, extremely, locally very closely spaced, planar smooth, unstained clean (possible drilling induced fractures).		21		
21.00 - 22.50	100 86 80	NI 3	22.10m - C21			*Below 21.00m: weak.*		22		
22.50 - 24.00	100 98 80		22.70m - C22 23.80m - C23			*Between 22.60m and 23.43m: 1no discontinuity 80-90 degrees, undulating smooth, unstained clean.* *Between 23.43m and 23.50m: non intact recovered as fine and medium sand.*		23		
24.00 - 25.50	80 0 0	AZCL 5	24.90m - C24		(30.70)	*Below 24.00m: weak.* *Between 24.25m and 24.38m: discontinuities are 90 degrees, planar smooth, stained black.* *Between 24.54m and 27.00m: discontinuities are 80-90 degrees, undulating smooth, unstained, silt infill.* *At 25.25m: 1no 90 degrees planar smooth, black stained discontinuity.*		24 25		
25.50 - 27.00	100 100 93	2	26.00m - C25 27.00m - C26			*Between 26.54m and 27.00m: 1no 80-90 degrees undulating, smooth with silt infill discontinuity.*		26 27		
27.00 - 28.50	100 100 93	1 10 5	27.80m - C27 28.95m - C28			*At 27.05m: 1no subangular, medium gravel of quartzite.* *At 27.30: 3no. subangular, medium gravel of quartzite.* *Below 27.46m: medium strong, fine grained. Discontinuities are subhorizontal, medium spaced, planar smooth and clean.*		28 29		
28.50 - 30.00	100 100 90		29.80m - C29					30		

Continued next sheet

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
22.50	24.00	Air	65
24.00	25.50	Air	65
25.50	27.00	Air	30
27.00	28.50	Air	20
28.50	30.00	Air	0
30.00	31.50	Air	0
31.50	33.00	Air	0
33.00	34.50	Air	0

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Remarks:

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205/	St John's Masterplan Phase 2	**RBH21**
Dates:	Client:	Sheet 4 of 4
26/10/2018 - 31/10/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	382999.09E 398042.53N	26.23mOD	DO/	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	100 100 90	2 5	31.00m - C30			Very weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-10 degrees, extremely, locally very closely spaced, planar smooth, unstained clean (possible drilling induced fractures). *At 30.35m: 1no. subangular, medium gravel of siltstone.*		31		
31.50 - 33.00	100 100 87		32.00m - C31 32.26m - C32			*At 32.10m: 1no discontinuity 30 degrees, planar smooth, unstained clean.* *Between 32.87m and 33.07m: grey reduction spot.*		32 33		
33.00 - 34.50	100 100 80	6	33.90m - C33					34		
34.50 - 36.00	100 100 73		35.15m - C34			*At 35.10m: 1no discontinuity 30 degrees, planar smooth, unstained clean.* *Between 35.60m and 35.63m: 1no discontinuity 90 degrees, planar smooth, unstained, clean.*		35		
				-9.77	36.00	End of Borehole at 36.00m		36 37 38 39 40		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	
34.50	36.00	Air	0								

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH22**	
Dates: 25/10/2018 - 26/10/2018	Client: Curtins Consulting	Sheet 1 of 5	
Rotary Borehole Log	Location: 382982.06E 398051.17N	Ground level: 25.97mOD	Logged by: DO	Vertical scale: 1:50	Project ID: 42269

Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Groundwater: Water Strike	Groundwater: Backfill/ Installation
				25.77	0.20	MADE GROUND: Tarmacadam.			
			0.40m - B1 0.50m - ES2	25.57	0.40	MADE GROUND: Light grey, sandy GRAVEL. Gravel is angular to subangular, fine to coarse including limestone, granite and concrete.			
					(1.50)	MADE GROUND: Brown, mottled black, sandy GRAVEL with medium cobble content. Gravel and cobbles are angular to subrounded, fine to coarse including brick, slag and concrete.			
			1.90m - B3	24.07	1.90	Orange brown speckled black, gravelly, fine to coarse SAND. Gravel is angular to subrounded, fine including sandstone.			
					(2.30)				
				21.77	4.20	Red SANDSTONE (drillers description).			
4.50 - 5.50	0 0 0	AZCL			(1.40)				
5.50 - 6.00	80 20 0	NI		20.37	5.60	Weak, reddish brown, fine and medium grained SANDSTONE. *At 5.60m: 1no. discontinuity, 0 degrees, planar smooth, unstained, clean.* *Between 5.64m and 5.74m: non intact recovered as angular to subangular gravel.*			
		16		19.87	6.10	*Between 5.80m and 6.10m: non intact recovered as angular to subangular gravel.*			
		NI							
6.00 - 7.50	100 83 53	9				Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, very closely, planar smooth, unstained, clay infill. *Between 6.35m and 6.45m: non intact recovered as angular to subangular gravel.*			
		NI			(2.95)	*Between 7.35m and 7.55m: non intact recovered as clayey, sandy, angular to subangular cobble.*			
7.50 - 9.00	97 93 33	10							
		AZCL		16.92	9.05				
9.00 - 10.50	97 97 90	5		16.67 16.60	9.30 9.37	Medium strong reddish brown, fine and medium grained SANDSTONE. *At 9.15m: 1no. discontinuity 0-10 degrees, planar rough, unstained, clean (possible drilling induced fracture).* Extremely weak, reddish brown MUDSTONE.			
						Weak, medium strong reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced,			
						Continued next sheet			

Flush Details

Top (m)	Base (m)	Flush Type	Flush Return %
5.50	6.00	Air	95
6.00	7.50	Air	95
7.50	9.00	Air	95
9.00	10.50	Air	95
10.50	12.00	Air	95
12.00	13.50	Air	95
13.50	15.00	Air	100
15.00	16.50	Air	100

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Log status: DRAFT

Borehole Diameter

Depth (m)	Dia (mm)
40.50	146

Casing Diameter

Depth (m)	Dia (mm)
4.50	200

Boring Progress

Date	Time	Depth (m)	Cased (m)	Water (m)
25/10	16:30	24.00	4.50	2.60
26/10	08:00	24.00	4.50	3.70
26/10	16:30	40.50	4.50	3.70

Water Strikes

Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations

Top (m)	Base (m)	Pipe Type	Dia (mm)
0.00	2.50	Plain	50
2.50	7.20	Slotted	50

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH22**	
Dates: 25/10/2018 - 26/10/2018	Client: Curtins Consulting	Sheet 2 of 5	
Rotary Borehole Log	Location: 382982.06E 398051.17N	Ground level: 25.97mOD	Logged by: DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
						Weak, medium strong reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced, planar smooth and undulating in places, unstained, occasional clay infill. *At 9.37m: 1no. discontinuity, 0-10 degrees, planar smooth, unstained clean.* *Between 10.50m and 12.00m: widely spaced.*		11		
10.50 - 12.00	100 100 100	1						12		
12.00 - 13.50	100 100 100	10						13		
13.50 - 15.00	100 100 100				(10.13)			14		
15.00 - 16.50	100 100 100	2						15		
16.50 - 18.00	100 100 93							16		
18.00 - 19.50	100 93 83	NI 7				*Between 18.50m and 18.60m: non intact recovered as reddish brown, gravelly, fine and medium sand.*		17		
								18		
				6.47	19.50	Extremely weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 1) 45-55 degrees, closely, very closely in places, planar smooth, unstained, clay infill in places. 2)		19		
						Continued next sheet		20		

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
16.50	18.00	Air	100
18.00	19.50	Air	80
19.50	21.00	Air	80
21.00	22.50	Air	70
22.50	24.00	Air	65
24.00	25.50	Air	60
25.50	27.00	Air	60
28.50	30.00	Air	60

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

Borehole Diameter	
Depth (m)	Dia (mm)

Casing Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Remarks:

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

IAN FARMER ASSOCIATES	Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH22**
	Dates: 25/10/2018 - 26/10/2018	Client: Curtins Consulting	Sheet 3 of 5
Rotary Borehole Log	Location: 382982.06E 398051.17N	Ground level: 25.97mOD / Logged by: DO / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
19.50 - 21.00	100 100 83	14 7				Extremely weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 1) 45-55 degrees, closely, very closely in places, planar smooth, unstained, clay infill in places. 2) 0-25 degrees, very closely spaced, planar smooth, unstained, clay infill. *Between 19.70m and 21.00: 1no. discontinuity 80-90 degrees, undulating, planar smooth and rough, unstained, clean.* *At 20.85m: medium strong.*		21		
21.00 - 22.50	100 80 75	11 NI			(3.30)	*Between 22.25m and 22.50m: recovered as reddish brown, gravelly, fine and medium sand.*		22		
22.50 - 24.00	100 100 87	1 10		3.17	22.80	Weak, locally medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 1) 45 degrees, undulating rough, unstained, clean. 2) 0-25 degrees, closely to medium spaced, planar smooth, unstained, clean.		23		
24.00 - 25.50	100 100 100	5 NI			(3.00)	*Between 25.50m and 25.80m: non intact recovered as sand.*		24 25		
25.50 - 27.00	100 60 60	6 NI		0.17	25.80	Medium strong, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, closely spaced, planar smooth, unstained, clean. *Between 26.50m and 26.90m: non intact recovered as gravelly, fine and medium sand.*		26		
27.00 - 28.50	100 100 100	8 NI			(2.70)	*At 27.15m: 1no. discontinuity 0 degrees, undulating rough, unstained, clean (possible drilling induced fracture).* *Between 27.15m and 28.50m: non intact recovered as sandy, angular to subangular, cobble of weak sandstone.*		27 28		
28.50 - 30.00	100 87 63	10 20 10 14 NI 7 NI		-2.53	28.50	Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-20 degrees, closely, locally extremely closely spaced, planar smooth, unstained, clean. *Between 29.22m and 29.30m: non intact recovered as gravelly, fine and medium sand.* *Between 29.45m and 30.10m: bon intact recovered as angular to subangular cobble.*		29 30		

Continued next sheet

Flush Details			
Top (m)	Base (m)	Flush Type	Flush Return %
30.00	31.50	Air	60
31.50	33.00	Air	20
33.00	34.50	Air	20
36.00	37.50	Air	60
37.50	39.00	Air	60
39.00	40.50	Air	60

Borehole Diameter	
Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)

Remarks:

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project:	Location ID:
Comacchio 205	St John's Masterplan Phase 2	**RBH22**
Dates:	Client:	Sheet 4 of 5
25/10/2018 - 26/10/2018	Curtins Consulting	

Rotary Borehole Log	Location:	Ground level:	Logged by:	Vertical scale:	Project ID:
	382982.06E 398051.17N	25.97mOD	DO	1:50	42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
30.00 - 31.50	100 83 73	7 NI 4				Weak, reddish brown, fine and medium grained SANDSTONE. Discontinuities are 0-20 degrees, closely, locally extremely closely spaced, planar smooth, unstained, clean. *Between 30.45m and 30.60m: non intact recovered as gravelly, fine and medium sand.*		31		
31.50 - 33.00	68 53 33	9 NI AZCL			(4.85)	*Between 31.90m and 32.00m: 1no. discontinuity 75-80 degrees, undulating smooth, unstained, clay infill.* *Between 32.30m and 32.50m: non intact recovered as sand.*		32		
33.00 - 34.50	93 83 49	NI 3 NI 2 NI		-7.38 -8.33	33.35 (0.95) 34.30	*Between 33.10m and 33.35m: non intact recovered as gravel.* *Between 33.10m and 33.50m: non intact recovered as sand.* Weak, reddish brown and greenish grey mottled, fine and medium grained SANDSTONE. Discontinuities are 0-25 degrees, very closely spaced planar, undulating rough, unstained clean. *At 27.15m: 1no. discontinuity 45-55 degrees, undulating rough, unstained, clean (possible drilling induced fracture).* *Between 34.00m and 34.75m: with occasional gravel inclusion.*		33 34		
34.50 - 36.00	100 100 97	60 8 12 NI				Medium strong, weak in places reddish brown, medium grained SANDSTONE. *Between 34.40m and 34.45m: non intact recovered as fine to coarse sand and angular to subangular gravel.*		35		
36.00 - 37.50	97 97 95	2 20			(6.20)	*Between 36.00m and 36.05m: non intact recovered as reddish brown, slightly sandy, angular to subangular, fine to coarse gravel.* *Between 36.67m and 36.38m: 1no. 80 degrees, planar smooth, unstained, clay infill in places.*		36 37		
37.50 - 39.00	100 100 95	3				*Between 37.50m and 38.50m: with occasional gravel inclusion.* *Between 37.75m and 33.80m: non intact recovered as angular to subangular gravel.*		38		
39.00 - 40.50	100 69 42	10 NI				*Between 39.03m and 39.13m: 1no. 80-85 degrees, planar smooth, unstained clean.* *Between 39.13m and 38.28m: non intact recovered as reddish brown, fine to coarse sand.* *Between 39.20m and 39.48m: discontinuities is becoming closely to very closely spaced, planar smooth, unstained, silt infill.* *Between 39.68m and 40.15m: non intact recovered as sand.*		39 40		

Continued next sheet

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: Comacchio 205	Project: St John's Masterplan Phase 2	Location ID: **RBH22**	
Dates: 25/10/2018 - 26/10/2018	Client: Curtins Consulting	Sheet 5 of 5	
Rotary Borehole Log	Location: 382982.06E 398051.17N	Ground level: 25.97mOD	Logged by: DO	Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details					Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend		Water Strike	Backfill/ Installation
		3		-14.53	40.50	Medium strong, weak in places reddish brown, medium grained SANDSTONE. *At 40.36m: 1no. discontinuity 0 degrees, undulating rough, unstained, clean (possible drilling induced fracture).* End of Borehole at 40.50m		41 42 43 44 45 46 47 48 49 50		

Flush Details				Borehole Diameter		Boring Progress					Remarks:
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)	Date	Time	Depth (m)	Cased (m)	Water (m)	

Casing Diameter		Water Strikes						Monitoring Installations			
Depth (m)	Dia (mm)	Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks	Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by:	HH	IFA RC v01.01
Log status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used:	Project: St John's Masterplan Phase 2		Location ID: **RBH23**
Dates: 19/11/2018	Client: Curtins Consulting		Sheet 1 of 1
Rotary Borehole Log	Location: 382979.25E 398054.93N	Ground level: 25.36mOD / Logged by: DO/N/A / Vertical scale: 1:50	Project ID: 42269

Coring, Samples & In Situ Testing				Strata Details				Groundwater	
Depth	TCR/SCR/ RQD	FI	Samples & Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Water Strike	Backfill/ Installation
			0.50m - B2 0.50m - ES1	25.16	0.20	MADE GROUND: Light grey, angular to subangular, fine to coarse GRAVEL including limestone and granite.			
					(1.80)	MADE GROUND: Light grey, fine to coarse SAND and GRAVEL with high coble content. gravel and cobbles are subangular including concrete and occasional brick.			
				23.36	2.00	Brown CLAY (driller's description).			
					(4.40)				
				18.96	6.40	Brown SAND and GRAVEL (driller's description).			
					(1.30)				
				17.66	7.70	Red SANDSTONE (driller's description).			
					(0.80)				
				16.86	8.50	End of Borehole at 8.50m			

1 2 3 4 5 6 7 8 9 10

Flush Details				Borehole Diameter	
Top (m)	Base (m)	Flush Type	Flush Return %	Depth (m)	Dia (mm)

Boring Progress				
Date	Time	Depth (m)	Cased (m)	Water (m)
19/11	16:30	8.50	7.50	4.20

Remarks:
Service inspection pit hand excavated from GL to 1.20m.

Casing Diameter	
Depth (m)	Dia (mm)

Water Strikes					
Strike (m)	Cased (m)	Sealed (m)	Time (mins)	Rose to (m)	Remarks
4.00	3.00		20	4.00	

Monitoring Installations			
Top (m)	Base (m)	Pipe Type	Dia (mm)

Checked by: HH
Log status: DRAFT
IFA RC v01.01

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IAN FARMER ASSOCIATES

Plant used: JCB 3CX	Project: St John's Masterplan Phase 2		Location ID: **TT01**
Dates: 11/10/2018 - 12/10/2018	Client: Curtins Consulting		Sheet 1 of 1
Trial Pit Log	Location: 383045.23E 398039.09N	Ground level: 27.35mOD / Logged by: DO / Vertical scale: 1:25	Contract ID: 42269

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
				(0.30)	MADE GROUND: Concrete.				
			27.05	0.30					
0.50	ES1			(0.45)	MADE GROUND: Dark brown, fine to coarse SAND and GRAVEL with high cobble content. Gravel and cobbles are angular to subrounded including limestone, granite, wood, concrete and brick.				
			26.60	0.75					
1.00	ES2				MADE GROUND: Brown mottled orange, fine to coarse SAND and GRAVEL with high cobble content and medium boulder content. Gravel is angular to subrounded, fine to coarse including sandstone, concrete and wood. Cobbles and boulders are predominately sandstone and concrete.		1		
2.00	ES3			(2.75)			2		
3.00	ES4						3		
			23.85	3.50	End of Trial Pit at 3.50m				
							4		
							5		

Termination:

Stability:
Major collapse between ground level and 3.50m.

Remarks:
Trial trench log - material excavated between 0 to 3m, refer to sketch for further details.

Dimensions (Length m x Width m):
3.00 x 1.20

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks

Checked by:	HH	IFA TP v01.01
Status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: 20T Tracked Excavator	Project: St John's Masterplan Phase 2		Location ID: **TT01.1**
Dates: 11/10/2018	Client: Curtins Consulting		Sheet 1 of 1
Trial Pit Log	Location: 383045.23E 398039.09N	Ground level: 27.35mOD / Logged by: DO / Vertical scale: 1:25	Contract ID: 42269

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
				(0.30)	MADE GROUND: Concrete.				
			27.05	0.30					
0.50	ES1			(0.40)	MADE GROUND: Dark brown, fine to coarse SAND and GRAVEL with high cobble content. Gravel is angular to subrounded, fine to coarse including limestone, granite, wood, concrete and brick and cobbles.				
0.50	ES2								
			26.65	0.70					
1.00	ES3				MADE GROUND: Dark brown, fine to coarse SAND and GRAVEL with high cobble and boulder content. Gravel is angular to subrounded, fine to coarse including limestone, concrete, slag, metal, brick, plastic and wood. Cobbles and boulders are subangular of reinforced concrete, metal, brick and sandstone.		1		
1.00	ES4								
2.00	ES5						2		
2.00	ES6			(2.80)					
3.00	ES7						3		
3.00	ES8								
			23.85	3.50	End of Trial Pit at 3.50m				
							4		
							5		

Termination:

Stability:
Major spalling of pit sides between 0.30m and 3.50m.

Remarks:
Trial trench log - material excavated between 3 to 6m, refer to sketch for further details.

Dimensions (Length m x Width m):
3.00 x 1.20

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks

Checked by:	HH
Status:	DRAFT

IFA TP v01.01

IAN FARMER ASSOCIATES

Plant used: 20T Tracked Excavator	Project: St John's Masterplan Phase 2		Location ID: **TT1A**
Dates: 11/10/2018	Client: Curtins Consulting		Sheet 1 of 1
Trial Pit Log	Location: 383049.50E 398044.07N	Ground level: 27.35mOD / Logged by: / Vertical scale: 1:25	Contract ID: 42269

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
			27.17	0.18	MADE GROUND: Concrete.				
			26.95	0.40	MADE GROUND: Brown, gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including limestone, granite and concrete.				
0.50	ES1			(0.35)	MADE GROUND: Dark brownish grey, fine to coarse SAND and GRAVEL with high cobble content. Gravel and cobbles are subangular, fine to coarse including concrete and brick. Cobbles are subangular of concrete and brick.				
			26.60	0.75	MADE GROUND: Dark brown fine to coarse SAND and GRAVEL with high cobble and boulder content. Gravel is angular to subrounded, fine to coarse including concrete, brick, plastic, metal, glass. Cobble are subangular, reinforced concrete, brick, wood and plastic. Boulders are subangular including wood and metal.				
1.00	ES2						1		
2.00	ES3			(2.75)			2		
3.00	ES4						3		
			23.85	3.50	End of Trial Pit at 3.50m				
							4		
							5		

Termination:

Stability:
Major spalling of pit sides between 0.30m and 3.50m.

Remarks:
Terminated at 3.50m due to water.

Dimensions (Length m x Width m):
8.00 x 3.00

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks
3.50	20	3.50	

Checked by:	HH	IFA TP v01.01
Status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: 20T Tracked Excavator	Project: St John's Masterplan Phase 2		Location ID: **TT1B**
Dates: 12/10/2018	Client: Curtins Consulting		Sheet 1 of 1
Trial Pit Log	Location: 383052.57E 398047.67N	Ground level: 27.33mOD / Logged by: DO / Vertical scale: 1:25	Contract ID: 42269

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
					MADE GROUND: Concrete.				
			27.15	0.18					
					MADE GROUND: Brown, fine to coarse SAND.				
			27.03	0.30					
0.50	ES1			(0.30)	MADE GROUND: Dark brown mottled black, fine to coarse SAND and angular to subangular, fine to coarse GRAVEL including concrete, plastic fragments and brick.				
			26.73	0.60					
1.00	ES2				MADE GROUND: Dark brownish mottled orange, fine to coarse SAND and GRAVEL with high cobble and boulder content. Gravel is angular to subangular, fine to coarse including concrete, brick, glass, plastic fragments and metal. Cobbles are subangular including subangular including sandstone, brick and concrete. Boulders are subangular of reinforced concrete, metal and sandstone.		1		
				(2.20)					
2.00	ES3						2		
			24.53	2.80					
					MADE GROUND: Dark, brownish grey, fine to coarse SAND and GRAVEL with high cobble content. Gravel and cobbles are angular to subrounded including sandstone, concrete, metal, glass and brick.				
3.00	ES4						3		
				(0.70)					
			23.83	3.50				▼	
					End of Trial Pit at 3.50m				
							4		
							5		

Termination:

Stability:
Major spalling of pit sides between 0.20m and 3.50m.

Remarks:

Dimensions (Length m x Width m):
9.60 x 3.00

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks
3.50	20	3.50	

Checked by:	HH	IFA TP v01.01
Status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: 20T Tracked excavator	Project: St John's Masterplan Phase 2		Location ID: **TT02**
Dates: 15/10/2018	Client: Curtins Consulting		Sheet 1 of 1
Trial Pit Log	Location: 383063.63E 398037.76N	Ground level: 26.81mOD / Logged by: DO / Vertical scale: 1:25	Contract ID: 42269

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
			26.61	0.20	MADE GROUND: Tarmacadam.				
					Greyish brown, fine to coarse SAND and GRAVEL. Gravel angular to subrounded, fine to coarse including limestone, granite and concrete.				
			26.41	0.40					
0.50	ES1				MADE GROUND: Dark brown and black mottled, fine to coarse SAND and GRAVEL with high cobble content. Gravel is angular to subangular, fine to coarse including concrete, brick and metal. Cobble are subangular including brick and concrete.				
				(0.90)			1		
			25.51	1.30	MADE GROUND: Reddish brown, orange black mottled black, very gravelly, fine to coarse SAND with medium cobble content. Gravel is angular to subangular, fine to coarse including sandstone and brick.				
				(0.70)					
			24.81	2.00	MADE GROUND: Reddish brown, gravelly, fine to coarse SAND with low cobble and boulder content. Gravel is angular to subangular, fine to coarse including sandstone and metal.		2		
				(1.30)					
							3		
3.30	ES2		23.51	3.30	End of Trial Pit at 3.30m				
							4		
							5		

Termination:

Stability:

Remarks:
Terminated due to water.

Dimensions (Length m x Width m):
5.00 x 1.50

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks
3.30	0	3.30	

Checked by:	HH	IFA TP v01.01
Status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: 20T Tracked excavator	Project: St John's Masterplan Phase 2		Location ID: **TT02A**
Dates: 15/10/2018	Client: Curtins Consulting		Sheet 1 of 1
Trial Pit Log	Location: 383063.14E 398039.53N	Ground level: 26.65mOD / Logged by: DO / Vertical scale: 1:25	Contract ID: 42269

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
			26.50	0.15	MADE GROUND: Tarmacadam.				
0.20	ES1			(0.35)	MADE GROUND: Greyish brown, fine to coarse SAND and GRAVEL. Gravel angular to subangular, fine to coarse including limestone and concrete.				
			26.15	0.50	MADE GROUND: Orange and black mottled, fine to coarse SAND and GRAVEL with high cobble and boulder content. Gravel is angular to subangular, fine to coarse including concrete, brick, wood and plastic.				
				(1.00)			1		
			25.15	1.50	MADE GROUND: Reddish brown, gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including sandstone and occasional brick.				
				(1.00)			2		
			24.15	2.50	MADE GROUND: Firm, orange mottled grey and black, slightly gravelly, very sandy CLAY. Gravel is angular to subangular, fine to coarse including sandstone, mudstone and occasional brick.				
				(1.40)	*At 3.40m: grey mottled.*		3		
			22.75	3.90	Firm, greenish grey, very sandy CLAY with sand lenses (possible made ground).				
4.00	ES2		22.65	4.00	End of Trial Pit at 4.00m		4	▼	
							5		

Termination:

Stability:
Slight spalling of pit sides between GL and 2.50m.

Remarks:
Terminated at 4.00m due to water.

Dimensions (Length m x Width m):
3.80 x 1.00

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks
4.00	0	4.00	

Checked by:	HH	IFA TP v01.01
Status:	DRAFT	

IAN FARMER ASSOCIATES

Plant used: 20 T tracked excavator.	Project: St John's Masterplan Phase 2		Location ID: **TT03**
Dates: 15/10/2018	Client: Curtins Consulting		Sheet 1 of 1
Trial Pit Log	Location: 383056.85E 398038.42N	Ground level: 26.31mOD / Logged by: DO / Vertical scale: 1:25	Contract ID: 42269

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
			26.13	0.18	MADE GROUND: Tarmacadam.				
			25.91	0.40	MADE GROUND: Greyish brown, fine to coarse SAND and GRAVEL. Gravel angular to subangular, fine to coarse including limestone and concrete.				
				(1.40)	MADE GROUND: Orange mottled grey and black, fine to coarse SAND GRAVEL. Gravel angular to subangular, fine to coarse GARVEL including concrete, brick and sandstone.		1		
1.50	ES1								
			24.51	1.80	MADE GROUND: Firm, greenish grey, gravelly, sandy CLAY with low cobble and boulder content. Gravel is angular to subangular, fine to coarse including sandstone, mudstone, brick and concrete. Cobble are subangular of sandstone and brick, boulder is subangular of sandstone.		2		
				(2.20)			3		
3.00	ES2								
			22.31	4.00	End of Trial Pit at 4.00m		4		
							5		

Termination:

Stability:
Major spalling between 0.70m to 4.00m.

Remarks:

Dimensions (Length m x Width m):
5.00 x 2.00

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks

Checked by:	HH
Status:	DRAFT

IFA TP v01.01

IAN FARMER ASSOCIATES

Plant used: 20t Tracked Excavator	Project: St John's Masterplan Phase 2		Location ID: **TT04**
Dates: 16/10/2018	Client: Curtins Consulting		Sheet 1 of 1
Trial Pit Log	Location: 383051.58E 398029.98N	Ground level: 26.36mOD / Logged by: DO / Vertical scale: 1:25	Contract ID: 42269

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
			26.16	0.20	MADE GROUND: Tarmacadam.				
			25.96	0.40	MADE GROUND: Greyish brown, fine to coarse SAND and GRAVEL. Gravel is angular to subangular, fine to coarse including limestone and concrete.				
			25.76	0.60	MADE GROUND: Orange and black mottled, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including brick, metal and concrete.				
				(3.20)	MADE GROUND: Reddish brown and black mottled, sandy GRAVEL with medium cobble and medium boulder content. Gravel is angular to subangular, fine to coarse including brick and concrete. Cobbles and boulders are angular of brick and concrete.		1		
2.00	ES1						2		
							3		
3.50	ES2								
			22.56	3.80	End of Trial Pit at 3.80m		4	▼	
							5		

Termination:
Terminated due to stagnant water at 3.80m.

Stability:
Pit remained stable during excavation.

Remarks:
Please refer to sketch for further details.

Dimensions (Length m x Width m):
6.00 x 3.80

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks
3.80	20	3.80	

Checked by:	HH
Status:	DRAFT

IFA TP v01.01

IAN FARMER ASSOCIATES

Plant used: 20t Tracked excavator	Project: St John's Masterplan Phase 2		Location ID: **TT05**
Dates: 16/10/2018	Client: Curtins Consulting		Sheet 1 of 1
Trial Pit Log	Location: 383050.93E 398028.20N	Ground level: 26.37mOD / Logged by: DO / Vertical scale: 1:25	Contract ID: 42269

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
			26.37		MADE GROUND: Tarmacadam.				
			26.17	0.20	MADE GROUND: Greyish brown, fine to coarse SAND and GRAVEL. Gravel is angular to subangular, fine to coarse including limestone and concrete.				
				(0.30)					
			25.87	0.50	MADE GROUND: Dark brown, fine to coarse SAND and GRAVEL with high cobble content and high boulder content. Gravel is angular to subangular, fine to coarse including sandstone, brick and concrete. Cobbles and boulders are subangular of brick, sandstone and concrete.				
				(0.40)					
			25.47	0.90	MADE GROUND: Reddish brown and black mottled, fine to coarse SAND and GRAVEL. Gravel is angular to subangular, fine to coarse including sandstone, brick and concrete with rare pockets of ash.				
1.00	ES1						1		
				(0.60)					
			24.87	1.50	MADE GROUND: Reddish brown, gravelly, fine to coarse SAND. Gravel is angular to subangular, fine to coarse including sandstone, quartzite and brick.				
				(1.00)			2		
			23.87	2.50	MADE GROUND: Firm soft in places, yellowish brown and bluish grey mottled, gravelly, very sandy CLAY.				
				(0.50)					
			23.37	3.00	MADE GROUND: Firm soft in places, greenish grey black mottled gravelly, very sandy CLAY with rare pockets of fine to coarse sand.		3		
				(0.80)					
3.50	ES2								
			22.57	3.80	End of Trial Pit at 3.80m			▼	
							4		
							5		

Termination:
Terminated due to stagnant water at 3.80m.

Stability:
Pit remained stable during excavation.

Remarks:
Please refer to sketch for further details.

Dimensions (Length m x Width m):
6.00 x 2.00

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks
3.80	0	3.80	

Checked by:	HH
Status:	DRAFT

IFA TP v01.01

IAN FARMER ASSOCIATES

Plant used: 20t Tracked Excavator	Project: St John's Masterplan Phase 2		Location ID: **TT06**
Dates: 16/10/2018	Client: Curtins Consulting		Sheet 1 of 1
Trial Pit Log	Location: 383051.35E 398039.03N	Ground level: 26.25mOD / Logged by: DO / Vertical scale: 1:25	Contract ID: 42269

Samples & In Situ Testing			Strata Details						
Depth	Sample ID	Test Result	Level (mAOD)	Depth (m) (Thickness)	Strata Description	Legend	Scale	Water Strike	Backfill/ Installation
			26.07	0.18	MADE GROUND: Tarmacadam.				
			25.90	0.35	MADE GROUND: Light grey, fine to coarse SAND and GRAVEL. Gravel ia angular to subangular, fine to coarse including limestone.				
				(0.55)	MADE GROUND: Orangish brown, fine to coarse SAND and GRAVEL. Gravel is angular to subangular, fine to coarse including sandstone, limestone and concrete.				
			25.35	0.90					
1.00	ES1			(0.60)	MADE GROUND: Grey mottled black, fine to coarse SAND and GRAVEL with high cobble and high boulder content. Gravel is angular to subangular, fine to coarse including sandstone, ash, glass, brick, plastic fragments and ceramic. Cobbles and boulders are subangular including brick and reinforced concrete.		1		
			24.75	1.50	MADE GROUND: Reddish brown, fine to coarse SAND and GRAVEL with high cobble content and high boulder content. Cobbles are subangular, including brick and concrete, glass, metal and plastic. Boulder is subangular, including reinforced concrete.		2		
				(1.95)					
3.00	ES2						3		
			22.80	3.45	End of Trial Pit at 3.45m			▼	
							4		
							5		

Termination:

Stability:
Pit remained stable during excavation

Remarks:

Dimensions (Length m x Width m):
3.50 x 2.00

Water Strikes

Strike (m)	Time (mins)	Rose to (m)	Remarks
3.45	0	3.45	

Checked by:	HH	IFA TP v01.01
Status:	DRAFT	

Appendix C – Chemical Laboratory Testing Results

- Envirolab, Environmental Chemistry Analysis Results (Soil):
  - Certificate No. 18-02606-1
  - Certificate No. 18-05180-1
  - Certificate No. 18-05337-1
  - Certificate No. 18-05734-1
  - Certificate No. 18-05735-1
  - Certificate No. 18-08489-1
  - Certificate No. 18-08762-1
  - Certificate No. 18-09025-1
  - Certificate No. 18-09265-1
- Envirolab, Environmental Chemistry Analysis Results (Groundwater):
  - Certificate No. 18-06429-1

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envirolab
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

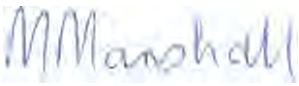
FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/02606
Issue Number: 1 **Date:** 18 April, 2018

Client:
Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

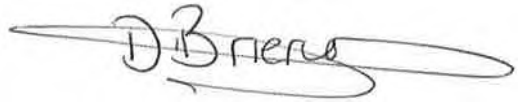
Project Manager: Hannah Hadwin
Project Name: St Johns
Project Ref: 42206
Order No: 44368
Date Samples Received: 06/04/18
Date Instructions Received: 10/04/18
Date Analysis Completed: 18/04/18

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 18/02606

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/02606/1								Units	Method ref
Client Sample No	2									
Client Sample ID	RBH03									
Depth to Top	0.40									
Depth To Bottom										
Date Sampled	03-Apr-18									
Sample Type	Soil - ES									
Sample Matrix Code	4AB									
% Stones >10mm$_A$	16.6								% w/w	A-T-044
pH$_D$ M#	7.75								pH	A-T-031s
Sulphate (water sol 2:1)$_D$ M#	1.23								g/l	A-T-026s
Cyanide (total)$_A$ M#	2								mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2								mg/kg	A-T-050s
Sulphide$_A$	<5								mg/kg	A-T-S2-s
Sulphur (elemental)$_D$ M#	15								mg/kg	A-T-029s
Organic matter$_D$ M#	9.7								% w/w	A-T-032 OM
Arsenic$_D$ M#	23								mg/kg	A-T-024s
Boron (water soluble)$_D$ M#	1.4								mg/kg	A-T-027s
Cadmium$_D$ M#	1.1								mg/kg	A-T-024s
Copper$_D$ M#	128								mg/kg	A-T-024s
Chromium$_D$ M#	30								mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1								mg/kg	A-T-040s
Lead$_D$ M#	970								mg/kg	A-T-024s
Mercury$_D$	0.91								mg/kg	A-T-024s
Nickel$_D$ M#	41								mg/kg	A-T-024s
Selenium$_D$ M#	<1								mg/kg	A-T-024s
Zinc$_D$ M#	188								mg/kg	A-T-024s

Envirolab Job Number: 18/02606

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/02606/1								Units	Method ref
Client Sample No	2									
Client Sample ID	RBH03									
Depth to Top	0.40									
Depth To Bottom										
Date Sampled	03-Apr-18									
Sample Type	Soil - ES									
Sample Matrix Code	4AB									
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD									A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A									

Envirolab Job Number: 18/02606

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/02606/1								Units	Method ref
Client Sample No	2									
Client Sample ID	RBH03									
Depth to Top	0.40									
Depth To Bottom										
Date Sampled	03-Apr-18									
Sample Type	Soil - ES									
Sample Matrix Code	4AB									
PAH-16MS										
Acenaphthene$_A^{M\#}$	0.07								mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	0.05								mg/kg	A-T-019s
Anthracene$_A^{M\#}$	0.21								mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.61								mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.47								mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.59								mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.35								mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	0.19								mg/kg	A-T-019s
Chrysene$_A^{M\#}$	0.73								mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.08								mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	1.52								mg/kg	A-T-019s
Fluorene$_A^{M\#}$	0.06								mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.38								mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	0.04								mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	0.73								mg/kg	A-T-019s
Pyrene$_A^{M\#}$	1.48								mg/kg	A-T-019s
PAH (total 16)$_A^{M\#}$	7.55								mg/kg	A-T-019s

Envirolab Job Number: 18/02606

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/02606/1								Units	Method ref
Client Sample No	2									
Client Sample ID	RBH03									
Depth to Top	0.40									
Depth To Bottom										
Date Sampled	03-Apr-18									
Sample Type	Soil - ES									
Sample Matrix Code	4AB									
VOC										
Dichlorodifluoromethane$_A^{\#}$	<1								µg/kg	A-T-006s
Chloromethane$_A^{\#}$	<10								µg/kg	A-T-006s
Vinyl Chloride$_A^{\#}$	<1								µg/kg	A-T-006s
Bromomethane$_A^{\#}$	<1								µg/kg	A-T-006s
Chloroethane$_A^{\#}$	<1								µg/kg	A-T-006s
Trichlorofluoromethane$_A^{\#}$	<1								µg/kg	A-T-006s
1,1-Dichloroethene$_A^{\#}$	<1								µg/kg	A-T-006s
Carbon Disulphide$_A^{\#}$	<1								µg/kg	A-T-006s
Dichloromethane$_A$	<5								µg/kg	A-T-006s
trans 1,2-Dichloroethene$_A^{\#}$	<1								µg/kg	A-T-006s
1,1-Dichloroethane$_A^{\#}$	<1								µg/kg	A-T-006s
cis 1,2-Dichloroethene$_A^{\#}$	<1								µg/kg	A-T-006s
2,2-Dichloropropane$_A^{\#}$	<1								µg/kg	A-T-006s
Bromochloromethane$_A^{\#}$	<5								µg/kg	A-T-006s
Chloroform$_A^{\#}$	<1								µg/kg	A-T-006s
1,1,1-Trichloroethane$_A^{\#}$	<1								µg/kg	A-T-006s
1,1-Dichloropropene$_A^{\#}$	<1								µg/kg	A-T-006s
Carbon Tetrachloride$_A^{\#}$	<1								µg/kg	A-T-006s
1,2-Dichloroethane$_A^{\#}$	<2								µg/kg	A-T-006s
Benzene$_A^{\#}$	<1								µg/kg	A-T-006s
Trichloroethene$_A^{\#}$	<1								µg/kg	A-T-006s
1,2-Dichloropropane$_A^{\#}$	<1								µg/kg	A-T-006s
Dibromomethane$_A^{\#}$	<1								µg/kg	A-T-006s
Bromodichloromethane$_A^{\#}$	<10								µg/kg	A-T-006s
cis 1,3-Dichloropropene$_A^{\#}$	<1								µg/kg	A-T-006s
Toluene$_A^{\#}$	<1								µg/kg	A-T-006s
trans 1,3-Dichloropropene$_A^{\#}$	<1								µg/kg	A-T-006s
1,1,2-Trichloroethane$_A^{\#}$	<1								µg/kg	A-T-006s
1,3-Dichloropropane$_A^{\#}$	<1								µg/kg	A-T-006s
Tetrachloroethene$_A^{\#}$	<1								µg/kg	A-T-006s
Dibromochloromethane$_A^{\#}$	<3								µg/kg	A-T-006s
1,2-Dibromoethane$_A^{\#}$	<1								µg/kg	A-T-006s

Envirolab Job Number: 18/02606

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/02606/1								Units	Method ref
Client Sample No	2									
Client Sample ID	RBH03									
Depth to Top	0.40									
Depth To Bottom										
Date Sampled	03-Apr-18									
Sample Type	Soil - ES									
Sample Matrix Code	4AB									
Chlorobenzene$_{A}^{\#}$	<1								µg/kg	A-T-006s
1,1,1,2-Tetrachloroethane$_{A}$	<1								µg/kg	A-T-006s
Ethylbenzene$_{A}^{\#}$	<1								µg/kg	A-T-006s
m & p Xylene$_{A}^{\#}$	<1								µg/kg	A-T-006s
o-Xylene$_{A}^{\#}$	<1								µg/kg	A-T-006s
Styrene$_{A}^{\#}$	<1								µg/kg	A-T-006s
Bromoform$_{A}^{\#}$	<1								µg/kg	A-T-006s
Isopropylbenzene$_{A}^{\#}$	<1								µg/kg	A-T-006s
1,1,2,2-Tetrachloroethane$_{A}$	<1								µg/kg	A-T-006s
1,2,3-Trichloropropane$_{A}^{\#}$	<1								µg/kg	A-T-006s
Bromobenzene$_{A}^{\#}$	<1								µg/kg	A-T-006s
n-Propylbenzene$_{A}^{\#}$	<1								µg/kg	A-T-006s
2-Chlorotoluene$_{A}^{\#}$	<1								µg/kg	A-T-006s
1,3,5-Trimethylbenzene$_{A}^{\#}$	<1								µg/kg	A-T-006s
4-Chlorotoluene$_{A}^{\#}$	<1								µg/kg	A-T-006s
tert-Butylbenzene$_{A}^{\#}$	<2								µg/kg	A-T-006s
1,2,4-Trimethylbenzene$_{A}^{\#}$	<1								µg/kg	A-T-006s
sec-Butylbenzene$_{A}^{\#}$	<1								µg/kg	A-T-006s
4-Isopropyltoluene$_{A}^{\#}$	<1								µg/kg	A-T-006s
1,3-Dichlorobenzene$_{A}$	<1								µg/kg	A-T-006s
1,4-Dichlorobenzene$_{A}^{\#}$	<1								µg/kg	A-T-006s
n-Butylbenzene$_{A}^{\#}$	<1								µg/kg	A-T-006s
1,2-Dichlorobenzene$_{A}^{\#}$	<1								µg/kg	A-T-006s
1,2-Dibromo-3-chloropropane$_{A}$	<2								µg/kg	A-T-006s
1,2,4-Trichlorobenzene$_{A}$	<3								µg/kg	A-T-006s
Hexachlorobutadiene$_{A}^{\#}$	<1								µg/kg	A-T-006s
1,2,3-Trichlorobenzene$_{A}$	<3								µg/kg	A-T-006s

Envirolab Job Number: 18/02606

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/02606/1								Units	Method ref
Client Sample No	2									
Client Sample ID	RBH03									
Depth to Top	0.40									
Depth To Bottom										
Date Sampled	03-Apr-18									
Sample Type	Soil - ES									
Sample Matrix Code	4AB									
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01								mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01								mg/kg	A-T-022s
Ali >C8-C10$_A^{\#}$	<0.01								mg/kg	A-T-022s
Ali >C10-C12$_A^{\#}$	2.2								mg/kg	A-T-023s
Ali >C12-C16$_A^{\#}$	11.7								mg/kg	A-T-023s
Ali >C16-C21$_A^{\#}$	14.9								mg/kg	A-T-023s
Ali >C21-C35$_A^{\#}$	192								mg/kg	A-T-023s
Total Aliphatics$_A$	221								mg/kg	A-T-023s
Aro >C5-C7$_A^{\#}$	<0.01								mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01								mg/kg	A-T-022s
Aro >C8-C9$_A^{\#}$	<0.01								mg/kg	A-T-022s
Aro >C9-C10$_A^{\#}$	<0.01								mg/kg	A-T-022s
Aro >C10-C12$_A^{\#}$	0.9								mg/kg	A-T-023s
Aro >C12-C16$_A^{\#}$	6.1								mg/kg	A-T-023s
Aro >C16-C21$_A^{\#}$	19.0								mg/kg	A-T-023s
Aro >C21-C35$_A^{\#}$	182								mg/kg	A-T-023s
Total Aromatics$_A$	208								mg/kg	A-T-023s
TPH (Ali & Aro)$_A$	430								mg/kg	A-T-023s
BTEX - Benzene$_A^{\#}$	<0.01								mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01								mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01								mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01								mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01								mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01								mg/kg	A-T-022s

REPORT NOTES

General:
This report shall not be reproduced, except in full, without written approval from Envirolab.
All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.
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 and there is insufficient sample to repeat the analysis. 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.

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: Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF

Project: St Johns

Clients Project No: 42206

Project No: 18/02606

Date Instructions Received: 10/04/2018 (am)

Cool Box Temperatures (°C): 7.6

Lab Sample ID	18/02606/1
Client Sample No	2
Client Sample ID/Depth	RBH03 0.40m
Date Sampled	03/04/18
Deviation Code	
F	✓

Key
F *Maximum holding time exceeded between sampling date and analysis for analytes listed below*

HOLDING TIME EXCEEDANCES

Lab Sample ID	18/02606/1
Client Sample No	2
Client Sample ID/Depth	RBH03 0.40m
Date Sampled	03/04/18
Sulphide	✓

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
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/05180
Issue Number: 1 **Date:** 09 July, 2018

Client:
Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

Project Manager: Hannah Hadwin/Michelle Louise Hirst-Watson
Project Name: St Johns
Project Ref: 42206
Order No: 44837
Date Samples Received: 25/06/18
Date Instructions Received: 29/06/18
Date Analysis Completed: 09/07/18

Prepared by:



Kate Keningale
Sales Executive

Approved by:



Danielle Bescoby
Quality Manager

Envirolab Job Number: 18/05180

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05180/2	18/05180/4	18/05180/6	18/05180/8	18/05180/10	18/05180/12	18/05180/14	18/05180/16	Units	Method ref
Client Sample No							3	8		
Client Sample ID	WS6	WS6	WS8	WS8	WS11	WS11	WS10	WS10		
Depth to Top	0.80	2.20	0.60	2.20	0.40	1.70	0.50	2.00		
Depth To Bottom										
Date Sampled	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	24-Jun-18	24-Jun-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	6	4A	6A	5A	6A	5A	6AB	4A		
% Stones >10mm$_A$	<0.1	22.8	<0.1	21.7	21.9	33.8	7.5	25.4	% w/w	A-T-044
pH$_D^{M\#}$	7.05	7.58	7.40	7.64	7.57	7.31	7.00	7.27	pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	0.05	0.02	0.20	0.04	0.16	0.04	0.10	0.02	g/l	A-T-026s
Cyanide (total)$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	A-T-050s
Organic matter$_D^{M\#}$	3.8	1.5	3.8	0.5	4.3	0.2	17.5	1.5	% w/w	A-T-032 OM
Arsenic$_D^{M\#}$	11	2	9	3	12	3	19	1	mg/kg	A-T-024s
Boron (water soluble)$_D^{M\#}$	1.7	<1.0	1.4	<1.0	1.6	<1.0	<1.0	<1.0	mg/kg	A-T-027s
Cadmium$_D^{M\#}$	0.6	<0.5	0.6	0.5	0.9	<0.5	1.6	<0.5	mg/kg	A-T-024s
Copper$_D^{M\#}$	25	5	47	3	27	4	125	6	mg/kg	A-T-024s
Chromium$_D^{M\#}$	21	6	19	9	10	7	21	8	mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-040s
Lead$_D^{M\#}$	80	8	254	5	751	6	921	8	mg/kg	A-T-024s
Mercury$_D$	0.26	<0.17	0.48	<0.17	0.20	<0.17	1.66	<0.17	mg/kg	A-T-024s
Nickel$_D^{M\#}$	16	9	16	12	16	8	38	10	mg/kg	A-T-024s
Selenium$_D^{M\#}$	<1	<1	<1	<1	<1	<1	2	<1	mg/kg	A-T-024s
Zinc$_D^{M\#}$	47	18	125	31	35	18	119	27	mg/kg	A-T-024s

Envirolab Job Number: 18/05180

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05180/2	18/05180/4	18/05180/6	18/05180/8	18/05180/10	18/05180/12	18/05180/14	18/05180/16	Units	Method ref
Client Sample No							3	8		
Client Sample ID	WS6	WS6	WS8	WS8	WS11	WS11	WS10	WS10		
Depth to Top	0.80	2.20	0.60	2.20	0.40	1.70	0.50	2.00		
Depth To Bottom										
Date Sampled	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	24-Jun-18	24-Jun-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	6	4A	6A	5A	6A	5A	6AB	4A		
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		

Envirolab Job Number: 18/05180

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05180/2	18/05180/4	18/05180/6	18/05180/8	18/05180/10	18/05180/12	18/05180/14	18/05180/16	Units	Method ref
Client Sample No							3	8		
Client Sample ID	WS6	WS6	WS8	WS8	WS11	WS11	WS10	WS10		
Depth to Top	0.80	2.20	0.60	2.20	0.40	1.70	0.50	2.00		
Depth To Bottom										
Date Sampled	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	24-Jun-18	24-Jun-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	6	4A	6A	5A	6A	5A	6AB	4A		
PAH-16MS										
Acenaphthene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.02	mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.11	0.11	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04	<0.04	0.06	<0.04	<0.04	<0.04	0.59	0.61	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.04	<0.04	0.06	<0.04	<0.04	<0.04	0.59	0.45	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.05	<0.05	0.08	<0.05	0.06	<0.05	0.72	0.54	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.38	0.18	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	0.25	0.19	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	<0.06	<0.06	0.08	<0.06	<0.06	<0.06	0.68	0.62	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.10	0.06	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08	<0.08	0.13	<0.08	<0.08	<0.08	0.96	1.22	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.03	0.02	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	<0.03	<0.03	0.04	<0.03	<0.03	<0.03	0.40	0.23	mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	<0.03	<0.03	0.08	<0.03	<0.03	<0.03	0.40	0.30	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	<0.07	<0.07	0.11	<0.07	<0.07	<0.07	1.02	1.18	mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	<0.08	<0.08	0.64	<0.08	<0.08	<0.08	6.30	5.73	mg/kg	A-T-019s

Envirolab Job Number: 18/05180

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05180/2	18/05180/4	18/05180/6	18/05180/8	18/05180/10	18/05180/12	18/05180/14	18/05180/16	Units	Method ref
Client Sample No							3	8		
Client Sample ID	WS6	WS6	WS8	WS8	WS11	WS11	WS10	WS10		
Depth to Top	0.80	2.20	0.60	2.20	0.40	1.70	0.50	2.00		
Depth To Bottom										
Date Sampled	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	23-Jun-18	24-Jun-18	24-Jun-18		
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES		
Sample Matrix Code	6	4A	6A	5A	6A	5A	6AB	4A		
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	2	<1	<1	<1	<1	2	<1	mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	<1	2	<1	<1	<1	<1	2	2	mg/kg	A-T-055s
Ali >C21-C35$_A^{M\#}$	7	2	<1	<1	5	<1	4	2	mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A^{\#}$	7	4	<1	<1	6	<1	9	5	mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	<1	<1	<1	<1	<1	<1	2	<1	mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	<1	<1	<1	<1	<1	<1	2	<1	mg/kg	A-T-055s
Aro >C12-C16$_A^{M\#}$	3	2	<1	<1	3	<1	7	2	mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	3	<1	<1	<1	15	<1	19	8	mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	11	2	3	<1	55	<1	59	21	mg/kg	A-T-055s
Total Aromatics >C5-C35$_A^{\#}$	16	4	3	<1	73	<1	89	31	mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A^{\#}$	23	9	3	<1	79	<1	98	36	mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s

Envirolab Job Number: 18/05180

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05180/18	18/05180/20	18/05180/22	18/05180/24					Units	Method ref
Client Sample No	3	9	3	9						
Client Sample ID	WS05	WS05	WS04	WS04						
Depth to Top	0.80	1.90	0.60	2.00						
Depth To Bottom										
Date Sampled	24-Jun-18	24-Jun-18	24-Jun-18	24-Jun-18						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	4A	5B	2A	5						
% Stones >10mm$_A$	19.7	<0.1	8.5	<0.1					% w/w	A-T-044
pH$_D$ M#	7.34	7.31	7.51	4.46					pH	A-T-031s
Sulphate (water sol 2:1)$_D$ M#	1.24	0.07	0.17	0.20					g/l	A-T-026s
Cyanide (total)$_A$ M#	<1	<1	<1	<1					mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2					mg/kg	A-T-050s
Organic matter$_D$ M#	11.2	0.3	2.5	0.3					% w/w	A-T-032 OM
Arsenic$_D$ M#	35	<1	7	15					mg/kg	A-T-024s
Boron (water soluble)$_D$ M#	1.2	<1.0	1.4	<1.0					mg/kg	A-T-027s
Cadmium$_D$ M#	1.0	<0.5	0.6	1.5					mg/kg	A-T-024s
Copper$_D$ M#	163	5	22	<1					mg/kg	A-T-024s
Chromium$_D$ M#	18	5	10	5					mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1					mg/kg	A-T-040s
Lead$_D$ M#	511	6	49	6					mg/kg	A-T-024s
Mercury$_D$	2.63	<0.17	<0.17	<0.17					mg/kg	A-T-024s
Nickel$_D$ M#	38	5	16	15					mg/kg	A-T-024s
Selenium$_D$ M#	2	<1	<1	<1					mg/kg	A-T-024s
Zinc$_D$ M#	128	15	46	18					mg/kg	A-T-024s

Envirolab Job Number: 18/05180

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05180/18	18/05180/20	18/05180/22	18/05180/24					Units	Method ref
Client Sample No	3	9	3	9						
Client Sample ID	WS05	WS05	WS04	WS04						
Depth to Top	0.80	1.90	0.60	2.00						
Depth To Bottom										
Date Sampled	24-Jun-18	24-Jun-18	24-Jun-18	24-Jun-18						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	4A	5B	2A	5						
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD	NAD	NAD						A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A						

Envirolab Job Number: 18/05180

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05180/18	18/05180/20	18/05180/22	18/05180/24					Units	Method ref
Client Sample No	3	9	3	9						
Client Sample ID	WS05	WS05	WS04	WS04						
Depth to Top	0.80	1.90	0.60	2.00						
Depth To Bottom										
Date Sampled	24-Jun-18	24-Jun-18	24-Jun-18	24-Jun-18						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	4A	5B	2A	5						
PAH-16MS										
Acenaphthene$_A^{M\#}$	0.05	<0.01	<0.01	<0.01					mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	0.05	<0.01	<0.01	<0.01					mg/kg	A-T-019s
Anthracene$_A^{M\#}$	0.17	<0.02	0.03	<0.02					mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.50	<0.04	0.11	<0.04					mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.49	<0.04	0.11	<0.04					mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.63	<0.05	0.14	<0.05					mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.36	<0.05	0.07	<0.05					mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	0.20	<0.07	<0.07	<0.07					mg/kg	A-T-019s
Chrysene$_A^{M\#}$	0.58	<0.06	0.13	<0.06					mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.08	<0.04	<0.04	<0.04					mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	1.01	<0.08	0.22	<0.08					mg/kg	A-T-019s
Fluorene$_A^{M\#}$	0.07	<0.01	<0.01	<0.01					mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.34	<0.03	0.08	<0.03					mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03	<0.03	<0.03	<0.03					mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	0.68	<0.03	0.07	<0.03					mg/kg	A-T-019s
Pyrene$_A^{M\#}$	0.96	<0.07	0.21	<0.07					mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	6.17	<0.08	1.17	<0.08					mg/kg	A-T-019s

Envirolab Job Number: 18/05180

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05180/18	18/05180/20	18/05180/22	18/05180/24					Units	Method ref
Client Sample No	3	9	3	9						
Client Sample ID	WS05	WS05	WS04	WS04						
Depth to Top	0.80	1.90	0.60	2.00						
Depth To Bottom										
Date Sampled	24-Jun-18	24-Jun-18	24-Jun-18	24-Jun-18						
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES						
Sample Matrix Code	4A	5B	2A	5						
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	<1	<1	<1	<1					mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	<1	<1					mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	<1	<1	<1					mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	2	<1	<1	<1					mg/kg	A-T-055s
Ali >C21-C35$_A^{M\#}$	8	<1	1	<1					mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A^{\#}$	11	<1	1	<1					mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	<1	<1	<1	<1					mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	<1	<1	<1	<1					mg/kg	A-T-055s
Aro >C12-C16$_A^{M\#}$	5	<1	2	<1					mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	9	<1	3	<1					mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	36	1	10	1					mg/kg	A-T-055s
Total Aromatics >C5-C35$_A^{\#}$	53	1	15	1					mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A^{\#}$	64	1	16	1					mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01					mg/kg	A-T-022s

REPORT NOTES

General:
This report shall not be reproduced, except in full, without written approval from Envirolab.
All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.
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 and there is insufficient sample to repeat the analysis. 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.

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: Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF

Project: St Johns

Clients Project No: 42206

Project No: 18/05180

Date Instructions Received: 29/06/2018 (am)

Cool Box Temperatures (°C): 23.0, 22.9, 27.4, 25.6

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
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/05337
Issue Number: 1 **Date:** 17 July, 2018

Client:
Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

Project Manager: Hannah Hadwin
Project Name: St Johns
Project Ref: 42206
Order No: 44842
Date Samples Received: 29/06/18
Date Instructions Received: 05/07/18
Date Analysis Completed: 17/07/18

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Richard Wong
Client Manager

Envirolab Job Number: 18/05337

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05337/2	18/05337/5	18/05337/8						Units	Method ref
Client Sample No	3	3	5							
Client Sample ID	BH03	RBH02	RBH04							
Depth to Top	0.50	0.50	0.40							
Depth To Bottom										
Date Sampled	29-Jun-18	29-Jun-18	26-Jun-18							
Sample Type	Soil - ES	Solid	Soil - ES							
Sample Matrix Code	4AB	7	4A							
% Stones >10mm$_A$	27.3	<0.1	6.9						% w/w	A-T-044
pH$_D$ M#	9.99	10.01	7.99						pH	A-T-031s
Sulphate (water sol 2:1)$_D$ M#	0.06	0.06	0.03						g/l	A-T-026s
Cyanide (total)$_A$ M#	<1	<1	<1						mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2						mg/kg	A-T-050s
Organic matter$_D$ M#	4.7	4.3	1.3						% w/w	A-T-032 OM
Arsenic$_D$ M#	4	4	3						mg/kg	A-T-024s
Boron (water soluble)$_D$ M#	<1.0	<1.0	<1.0						mg/kg	A-T-027s
Cadmium$_D$ M#	0.6	1.4	<0.5						mg/kg	A-T-024s
Copper$_D$ M#	19	32	12						mg/kg	A-T-024s
Chromium$_D$ M#	17	17	9						mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1						mg/kg	A-T-040s
Lead$_D$ M#	104	581	61						mg/kg	A-T-024s
Mercury$_D$	0.91	0.99	<0.17						mg/kg	A-T-024s
Nickel$_D$ M#	15	18	12						mg/kg	A-T-024s
Selenium$_D$ M#	<1	<1	<1						mg/kg	A-T-024s
Zinc$_D$ M#	46	107	27						mg/kg	A-T-024s

Envirolab Job Number: 18/05337

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05337/2	18/05337/5	18/05337/8						Units	Method ref
Client Sample No	3	3	5							
Client Sample ID	BH03	RBH02	RBH04							
Depth to Top	0.50	0.50	0.40							
Depth To Bottom										
Date Sampled	29-Jun-18	29-Jun-18	26-Jun-18							
Sample Type	Soil - ES	Solid	Soil - ES							
Sample Matrix Code	4AB	7	4A							
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD	NAD							A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A							

Envirolab Job Number: 18/05337

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05337/2	18/05337/5	18/05337/8						Units	Method ref
Client Sample No	3	3	5							
Client Sample ID	BH03	RBH02	RBH04							
Depth to Top	0.50	0.50	0.40							
Depth To Bottom										
Date Sampled	29-Jun-18	29-Jun-18	26-Jun-18							
Sample Type	Soil - ES	Solid	Soil - ES							
Sample Matrix Code	4AB	7	4A							
PAH-16MS										
Acenaphthene$_A^{M\#}$	<0.01	0.39	<0.01						mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	0.12	<0.01						mg/kg	A-T-019s
Anthracene$_A^{M\#}$	<0.02	1.17	<0.02						mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04	4.52	<0.04						mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.04	4.07	<0.04						mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.05	4.47	<0.05						mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05	2.55	<0.05						mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	1.76	<0.07						mg/kg	A-T-019s
Chrysene$_A^{M\#}$	<0.06	5.13	<0.06						mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	0.57	<0.04						mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08	9.69	<0.08						mg/kg	A-T-019s
Fluorene$_A^{M\#}$	<0.01	0.31	<0.01						mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	<0.03	2.96	<0.03						mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03	<0.30	<0.03						mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	<0.03	4.18	<0.03						mg/kg	A-T-019s
Pyrene$_A^{M\#}$	<0.07	8.68	<0.07						mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	<0.08	50.6	<0.08						mg/kg	A-T-019s

Envirolab Job Number: 18/05337

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05337/2	18/05337/5	18/05337/8						Units	Method ref
Client Sample No	3	3	5							
Client Sample ID	BH03	RBH02	RBH04							
Depth to Top	0.50	0.50	0.40							
Depth To Bottom										
Date Sampled	29-Jun-18	29-Jun-18	26-Jun-18							
Sample Type	Soil - ES	Solid	Soil - ES							
Sample Matrix Code	4AB	7	4A							
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	<1	<1	<1						mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	<1						mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	3	<1						mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	<1	4	<1						mg/kg	A-T-055s
Ali >C21-C35$_A^{M\#}$	2	94	1						mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A^{\#}$	2	100	1						mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	<1	2	<1						mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	<1	4	<1						mg/kg	A-T-055s
Aro >C12-C16$_A^{M\#}$	2	16	2						mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	<1	118	1						mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	3	1070	4						mg/kg	A-T-055s
Total Aromatics >C5-C35$_A^{\#}$	4	1210	6						mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A^{\#}$	6	1310	8						mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s

REPORT NOTES

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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.

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: Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF

Project: St Johns

Clients Project No: 42206

Project No: 18/05337

Date Instructions Received: 05/07/2018 (am)

Cool Box Temperatures (°C): 29.4, 22.4, 21.4

Lab Sample ID	18/05337/5
Client Sample No	3
Client Sample ID/Depth	RBH02 0.50m
Date Sampled	29/06/18
Deviation Code	
F	✓

Key
F *Maximum holding time exceeded between sampling date and analysis for analytes listed below*

HOLDING TIME EXCEEDANCES

Lab Sample ID	18/05337/5
Client Sample No	3
Client Sample ID/Depth	RBH02 0.50m
Date Sampled	29/06/18
PAH-16MS	✓

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
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/05734
Issue Number: 1 **Date:** 26 July, 2018

Client:
Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

Project Manager: Hannah Hadwin
Project Name: St Johns
Project Ref: 42206
Order No: 44884
Date Samples Received: 09/07/18
Date Instructions Received: 18/07/18
Date Analysis Completed: 26/07/18

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Georgia King
Admin & Client Services Supervisor

Envirolab Job Number: 18/05734

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05734/1	18/05734/2	18/05734/3	18/05734/4	18/05734/5				Units	Method ref
Client Sample No	1	2	1	2	1					
Client Sample ID	RBH06	RBH06	WS03	WS03	WS02					
Depth to Top	0.40	0.80	0.30	1.00	0.30					
Depth To Bottom										
Date Sampled	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18					
Sample Type	Solid	Soil - ES	Solid	Soil - ES	Solid					
Sample Matrix Code	7	3A	7	6AB	7					
% Stones >10mm$_A$	<0.1	3.6	<0.1	18.7	<0.1				% w/w	A-T-044
pH$_D^{M\#}$	7.71	7.87	8.36	7.56	8.49				pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	0.22	0.04	0.50	0.02	0.07				g/l	A-T-026s
Cyanide (total)$_A^{M\#}$	<1	<1	<1	<1	<1				mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2	<0.2				mg/kg	A-T-050s
Organic matter$_D^{M\#}$	5.2	2.5	14.9	4.2	21.4				% w/w	A-T-032 OM
Arsenic$_D^{M\#}$	17	8	29	10	31				mg/kg	A-T-024s
Boron (water soluble)$_D^{M\#}$	<1.0	1.4	<1.0	<1.0	<1.0				mg/kg	A-T-027s
Cadmium$_D^{M\#}$	1.5	0.8	12.7	1.2	0.9				mg/kg	A-T-024s
Copper$_D^{M\#}$	4820	26	530	74	294				mg/kg	A-T-024s
Chromium$_D^{M\#}$	17	14	61	18	20				mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	<1				mg/kg	A-T-040s
Lead$_D^{M\#}$	698	228	2010	281	444				mg/kg	A-T-024s
Mercury$_D$	<0.17	<0.17	1.67	0.55	1.93				mg/kg	A-T-024s
Nickel$_D^{M\#}$	32	14	72	15	31				mg/kg	A-T-024s
Selenium$_D^{M\#}$	<1	<1	1	<1	<1				mg/kg	A-T-024s
Zinc$_D^{M\#}$	8230	131	1880	130	150				mg/kg	A-T-024s

Envirolab Job Number: 18/05734

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05734/1	18/05734/2	18/05734/3	18/05734/4	18/05734/5				Units	Method ref
Client Sample No	1	2	1	2	1					
Client Sample ID	RBH06	RBH06	WS03	WS03	WS02					
Depth to Top	0.40	0.80	0.30	1.00	0.30					
Depth To Bottom										
Date Sampled	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18					
Sample Type	Solid	Soil - ES	Solid	Soil - ES	Solid					
Sample Matrix Code	7	3A	7	6AB	7					
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD	NAD	NAD	NAD					A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A					

Envirolab Job Number: 18/05734

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05734/1	18/05734/2	18/05734/3	18/05734/4	18/05734/5				Units	Method ref
Client Sample No	1	2	1	2	1					
Client Sample ID	RBH06	RBH06	WS03	WS03	WS02					
Depth to Top	0.40	0.80	0.30	1.00	0.30					
Depth To Bottom										
Date Sampled	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18					
Sample Type	Solid	Soil - ES	Solid	Soil - ES	Solid					
Sample Matrix Code	7	3A	7	6AB	7					
PAH-16MS										
Acenaphthene$_A^{M\#}$	0.05	<0.01	9.43	5.54	0.21				mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	0.17	0.04	0.13				mg/kg	A-T-019s
Anthracene$_A^{M\#}$	0.10	<0.02	10.9	3.65	0.52				mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.46	<0.04	23.6	6.94	1.50				mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.45	<0.04	17.8	5.63	1.62				mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.53	<0.05	23.1	6.44	1.85				mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.30	<0.05	8.17	3.19	1.07				mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	0.21	<0.07	8.45	2.24	0.63				mg/kg	A-T-019s
Chrysene$_A^{M\#}$	0.53	<0.06	25.9	7.42	1.71				mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.08	<0.04	2.54	0.94	0.29				mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	1.01	<0.08	55.5	20	2.94				mg/kg	A-T-019s
Fluorene$_A^{M\#}$	0.02	<0.01	7.65	4.37	0.29				mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.32	<0.03	9.86	3.40	1.05				mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03	<0.03	0.93	4.35	0.30				mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	0.46	<0.03	43	21.1	2.16				mg/kg	A-T-019s
Pyrene$_A^{M\#}$	0.93	<0.07	49.4	19.5	3.05				mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	5.45	<0.08	296	115	19.3				mg/kg	A-T-019s

Envirolab Job Number: 18/05734

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05734/1	18/05734/2	18/05734/3	18/05734/4	18/05734/5				Units	Method ref
Client Sample No	1	2	1	2	1					
Client Sample ID	RBH06	RBH06	WS03	WS03	WS02					
Depth to Top	0.40	0.80	0.30	1.00	0.30					
Depth To Bottom										
Date Sampled	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18					
Sample Type	Solid	Soil - ES	Solid	Soil - ES	Solid					
Sample Matrix Code	7	3A	7	6AB	7					
SVOC excluding PAH-16										
Hexachlorobenzene$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Diethyl phthalate$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Dimethyl phthalate$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Dibenzofuran$_A$	<100	<100	6150	2710	644				µg/kg	A-T-052s
Carbazole$_A$	<100	<100	3680	1110	683				µg/kg	A-T-052s
Butylbenzyl phthalate$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Bis(2-ethylhexyl)phthalate$_A$	<500	<500	<5000	<5000	<500				µg/kg	A-T-052s
Bis(2-chloroethoxy)methane$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Bis(2-chloroethyl)ether$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
4-Nitrophenol$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
4-Methylphenol$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
4-Chloro-3-methylphenol$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
2-Nitrophenol$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
2-Methylphenol$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
1,2,4-Trichlorobenzene$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
2-Chlorophenol$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
2,6-Dinitrotoluene$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
2,4-Dinitrotoluene$_A$	<100	<100	1190	1230	<100				µg/kg	A-T-052s
2,4-Dimethylphenol$_A$	<100	<100	<1000	1320	<100				µg/kg	A-T-052s
2,4-Dichlorophenol$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
2,4,6-Trichlorophenol$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
2,4,5-Trichlorophenol$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
1,4-Dichlorobenzene$_A$	<100	<100	1400	1350	<100				µg/kg	A-T-052s
1,3-Dichlorobenzene$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
1,2-Dichlorobenzene$_A$	<100	<100	9190	7440	<100				µg/kg	A-T-052s
2-Chloronaphthalene$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
2-Methylnaphthalene$_A$	<100	<100	2280	3460	751				µg/kg	A-T-052s
Bis(2-chloroisopropyl)ether$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Phenol$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Pentachlorophenol$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
n-Nitroso-n-dipropylamine$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
n-Dioctylphthalate$_A$	<500	<500	<5000	<5000	<500				µg/kg	A-T-052s

Envirolab Job Number: 18/05734

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05734/1	18/05734/2	18/05734/3	18/05734/4	18/05734/5				Units	Method ref
Client Sample No	1	2	1	2	1					
Client Sample ID	RBH06	RBH06	WS03	WS03	WS02					
Depth to Top	0.40	0.80	0.30	1.00	0.30					
Depth To Bottom										
Date Sampled	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18					
Sample Type	Solid	Soil - ES	Solid	Soil - ES	Solid					
Sample Matrix Code	7	3A	7	6AB	7					
n-Dibutylphthalate$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Nitrobenzene$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Isophorone$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Hexachloroethane$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Hexachlorocyclopentadiene$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Hexachlorobutadiene$_A$	<100	<100	<1000	<1000	<100				µg/kg	A-T-052s
Perylene$_A$	276	<100	4490	2760	1120				µg/kg	A-T-052s

Envirolab Job Number: 18/05734

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/05734/1	18/05734/2	18/05734/3	18/05734/4	18/05734/5				Units	Method ref
Client Sample No	1	2	1	2	1					
Client Sample ID	RBH06	RBH06	WS03	WS03	WS02					
Depth to Top	0.40	0.80	0.30	1.00	0.30					
Depth To Bottom										
Date Sampled	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18	06-Jul-18					
Sample Type	Solid	Soil - ES	Solid	Soil - ES	Solid					
Sample Matrix Code	7	3A	7	6AB	7					
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	0.06	0.09	<0.01				mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	<1	<1	159	409	2				mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	566	1350	4				mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	35	<1	591	1370	10				mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	101	<1	665	1390	9				mg/kg	A-T-055s
Ali >C21-C35$_A^{M\#}$	31	<1	156	207	28				mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A^{\#}$	167	<1	2140	4710	54				mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	<1	<1	148	377	4				mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	<1	<1	403	962	5				mg/kg	A-T-055s
Aro >C12-C16$_A^{M\#}$	6	<1	1100	897	20				mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	26	<1	4080	718	38				mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	58	6	6040	700	145				mg/kg	A-T-055s
Total Aromatics >C5-C35$_A^{\#}$	90	6	11800	3650	211				mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A^{\#}$	257	6	14000	8360	265				mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	0.04	<0.01				mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s

REPORT NOTES

General:
This report shall not be reproduced, except in full, without written approval from Envirolab.
All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.
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 and there is insufficient sample to repeat the analysis. 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.

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: Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF

Project: St Johns

Clients Project No: 42206

Project No: 18/05734

Date Instructions Received: 18/07/2018 (am)

Cool Box Temperatures (°C): 31.6

Lab Sample ID	18/05734/1	18/05734/2	18/05734/3	18/05734/4	18/05734/5
Client Sample No	1	2	1	2	1
Client Sample ID/Depth	RBH06 0.40m	RBH06 0.80m	WS03 0.30m	WS03 1.00m	WS02 0.30m
Date Sampled	06/07/18	06/07/18	06/07/18	06/07/18	06/07/18
Deviation Code					
F	✓	✓	✓	✓	✓

Key
F *Maximum holding time exceeded between sampling date and analysis for analytes listed below*

HOLDING TIME EXCEEDANCES

Lab Sample ID	18/05734/1	18/05734/2	18/05734/3	18/05734/4	18/05734/5
Client Sample No	1	2	1	2	1
Client Sample ID/Depth	RBH06 0.40m	RBH06 0.80m	WS03 0.30m	WS03 1.00m	WS02 0.30m
Date Sampled	06/07/18	06/07/18	06/07/18	06/07/18	06/07/18
Cyanide (total)	✓	✓	✓	✓	✓
VPHCWG					✓

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
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/05735
Issue Number: 1 **Date:** 26 July, 2018

Client:
Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

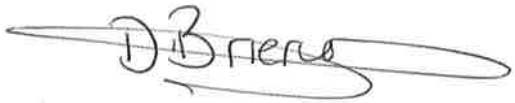
Project Manager: Hannah Hadwin
Project Name: St Johns Manchester
Project Ref: 42206
Order No: 44888
Date Samples Received: 13/07/18
Date Instructions Received: 18/07/18
Date Analysis Completed: 26/07/18

Prepared by:



Richard Wong
Client Manager

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 18/05735

Client Project Name: St Johns Manchester

Client Project Ref: 42206

Lab Sample ID	18/05735/1	18/05735/3	18/05735/5	18/05735/6	18/05735/7				Units	Method ref
Client Sample No			3	4	7					
Client Sample ID	BH02	BH02	RBH05	RBH05	RBH05					
Depth to Top	0.20	1.80	0.40	0.50	0.80					
Depth To Bottom										
Date Sampled	13-Jul-18	13-Jul-18	12-Jul-18	12-Jul-18	12-Jul-18					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	6ABD	5A	4AE	4A	5					
% Stones >10mm$_A$	16.0	4.1	12.2	20.3	<0.1				% w/w	A-T-044
pH$_D^{M\#}$	8.05	7.90	7.67	8.05	7.91				pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	<0.01	<0.01	<0.01	<0.01	0.04				g/l	A-T-026s
Cyanide (total)$_A^{M\#}$	<1	<1	<1	<1	<1				mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2	<0.2				mg/kg	A-T-050s
Organic matter$_D^{M\#}$	7.0	1.2	4.0	3.3	0.9				% w/w	A-T-032 OM
Arsenic$_D^{M\#}$	12	4	10	14	<1				mg/kg	A-T-024s
Boron (water soluble)$_D^{M\#}$	<1.0	<1.0	<1.0	<1.0	<1.0				mg/kg	A-T-027s
Cadmium$_D^{M\#}$	1.0	<0.5	0.6	0.6	<0.5				mg/kg	A-T-024s
Copper$_D^{M\#}$	88	17	32	44	4				mg/kg	A-T-024s
Chromium$_D^{M\#}$	18	8	13	14	9				mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	<1				mg/kg	A-T-040s
Lead$_D^{M\#}$	307	43	106	144	19				mg/kg	A-T-024s
Mercury$_D$	0.90	<0.17	0.51	9.99	<0.17				mg/kg	A-T-024s
Nickel$_D^{M\#}$	16	12	11	13	4				mg/kg	A-T-024s
Selenium$_D^{M\#}$	<1	<1	2	<1	<1				mg/kg	A-T-024s
Zinc$_D^{M\#}$	202	42	105	101	19				mg/kg	A-T-024s

Envirolab Job Number: 18/05735

Client Project Name: St Johns Manchester

Client Project Ref: 42206

Lab Sample ID	18/05735/1	18/05735/3	18/05735/5	18/05735/6	18/05735/7				Units	Method ref
Client Sample No			3	4	7					
Client Sample ID	BH02	BH02	RBH05	RBH05	RBH05					
Depth to Top	0.20	1.80	0.40	0.50	0.80					
Depth To Bottom										
Date Sampled	13-Jul-18	13-Jul-18	12-Jul-18	12-Jul-18	12-Jul-18					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	6ABD	5A	4AE	4A	5					
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD	NAD	NAD	NAD					A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A					

Envirolab Job Number: 18/05735

Client Project Name: St Johns Manchester

Client Project Ref: 42206

Lab Sample ID	18/05735/1	18/05735/3	18/05735/5	18/05735/6	18/05735/7				Units	Method ref
Client Sample No			3	4	7					
Client Sample ID	BH02	BH02	RBH05	RBH05	RBH05					
Depth to Top	0.20	1.80	0.40	0.50	0.80					
Depth To Bottom										
Date Sampled	13-Jul-18	13-Jul-18	12-Jul-18	12-Jul-18	12-Jul-18					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	6ABD	5A	4AE	4A	5					
PAH-16MS										
Acenaphthene$_{A}^{M\#}$	1.02	6.10	0.74	0.26	<0.01				mg/kg	A-T-019s
Acenaphthylene$_{A}^{M\#}$	0.25	<1.00	0.03	0.07	<0.01				mg/kg	A-T-019s
Anthracene$_{A}^{M\#}$	1.97	8.78	0.94	0.54	<0.02				mg/kg	A-T-019s
Benzo(a)anthracene$_{A}^{M\#}$	5.33	14.1	1.61	1.51	<0.04				mg/kg	A-T-019s
Benzo(a)pyrene$_{A}^{M\#}$	5.22	10	1.43	1.52	<0.04				mg/kg	A-T-019s
Benzo(b)fluoranthene$_{A}^{M\#}$	6.21	12.4	1.73	1.76	<0.05				mg/kg	A-T-019s
Benzo(ghi)perylene$_{A}^{M\#}$	2.85	<5.00	0.83	1.00	<0.05				mg/kg	A-T-019s
Benzo(k)fluoranthene$_{A}^{M\#}$	2.07	<7.00	0.58	0.57	<0.07				mg/kg	A-T-019s
Chrysene$_{A}^{M\#}$	5.59	17.9	1.81	1.66	<0.06				mg/kg	A-T-019s
Dibenzo(ah)anthracene$_{A}^{M\#}$	0.77	<4.00	0.22	0.26	<0.04				mg/kg	A-T-019s
Fluoranthene$_{A}^{M\#}$	12.3	33.1	4.31	3.14	<0.08				mg/kg	A-T-019s
Fluorene$_{A}^{M\#}$	1.10	6.04	0.52	0.25	<0.01				mg/kg	A-T-019s
Indeno(123-cd)pyrene$_{A}^{M\#}$	2.98	5.37	0.86	1.01	<0.03				mg/kg	A-T-019s
Naphthalene$_{A}^{M\#}$	0.78	4.50	0.11	0.11	<0.03				mg/kg	A-T-019s
Phenanthrene$_{A}^{M\#}$	8.67	51.7	4.22	2.24	<0.03				mg/kg	A-T-019s
Pyrene$_{A}^{M\#}$	12.1	33.8	3.68	3.00	<0.07				mg/kg	A-T-019s
Total PAH-16MS$_{A}^{M\#}$	69.2	204	23.6	18.9	<0.08				mg/kg	A-T-019s

Envirolab Job Number: 18/05735

Client Project Name: St Johns Manchester

Client Project Ref: 42206

Lab Sample ID	18/05735/1	18/05735/3	18/05735/5	18/05735/6	18/05735/7				Units	Method ref
Client Sample No			3	4	7					
Client Sample ID	BH02	BH02	RBH05	RBH05	RBH05					
Depth to Top	0.20	1.80	0.40	0.50	0.80					
Depth To Bottom										
Date Sampled	13-Jul-18	13-Jul-18	12-Jul-18	12-Jul-18	12-Jul-18					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	6ABD	5A	4AE	4A	5					
SVOC excluding PAH-16										
Hexachlorobenzene$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Diethyl phthalate$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Dimethyl phthalate$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Dibenzofuran$_A$	459	1930	<100	661	<100				µg/kg	A-T-052s
Carbazole$_A$	617	1350	107	716	<100				µg/kg	A-T-052s
Butylbenzyl phthalate$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Bis(2-ethylhexyl)phthalate$_A$	<500	<500	<500	<500	<500				µg/kg	A-T-052s
Bis(2-chloroethoxy)methane$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Bis(2-chloroethyl)ether$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
4-Nitrophenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
4-Methylphenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
4-Chloro-3-methylphenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
2-Nitrophenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
2-Methylphenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
1,2,4-Trichlorobenzene$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
2-Chlorophenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
2,6-Dinitrotoluene$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
2,4-Dinitrotoluene$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
2,4-Dimethylphenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
2,4-Dichlorophenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
2,4,6-Trichlorophenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
2,4,5-Trichlorophenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
1,4-Dichlorobenzene$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
1,3-Dichlorobenzene$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
1,2-Dichlorobenzene$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
2-Chloronaphthalene$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
2-Methylnaphthalene$_A$	254	1770	<100	517	<100				µg/kg	A-T-052s
Bis(2-chloroisopropyl)ether$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Phenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Pentachlorophenol$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
n-Nitroso-n-dipropylamine$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
n-Dioctylphthalate$_A$	<500	<500	<500	<500	<500				µg/kg	A-T-052s

Envirolab Job Number: 18/05735

Client Project Name: St Johns Manchester

Client Project Ref: 42206

Lab Sample ID	18/05735/1	18/05735/3	18/05735/5	18/05735/6	18/05735/7				Units	Method ref
Client Sample No			3	4	7					
Client Sample ID	BH02	BH02	RBH05	RBH05	RBH05					
Depth to Top	0.20	1.80	0.40	0.50	0.80					
Depth To Bottom										
Date Sampled	13-Jul-18	13-Jul-18	12-Jul-18	12-Jul-18	12-Jul-18					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	6ABD	5A	4AE	4A	5					
n-Dibutylphthalate$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Nitrobenzene$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Isophorone$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Hexachloroethane$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Hexachlorocyclopentadiene$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Hexachlorobutadiene$_A$	<100	<100	<100	<100	<100				µg/kg	A-T-052s
Perylene$_A$	1430	1680	387	1010	<100				µg/kg	A-T-052s

Envirolab Job Number: 18/05735

Client Project Name: St Johns Manchester

Client Project Ref: 42206

Lab Sample ID	18/05735/1	18/05735/3	18/05735/5	18/05735/6	18/05735/7				Units	Method ref
Client Sample No			3	4	7					
Client Sample ID	BH02	BH02	RBH05	RBH05	RBH05					
Depth to Top	0.20	1.80	0.40	0.50	0.80					
Depth To Bottom										
Date Sampled	13-Jul-18	13-Jul-18	12-Jul-18	12-Jul-18	12-Jul-18					
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES					
Sample Matrix Code	6ABD	5A	4AE	4A	5					
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	<1	<1	<1	<1	<1				mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	2	<1	<1	<1				mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	4	6	<1	2	<1				mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	5	6	2	4	<1				mg/kg	A-T-055s
Ali >C21-C35$_A^{M\#}$	27	5	16	19	1				mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A^{\#}$	38	20	20	27	1				mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	2	1	<1	3	<1				mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	4	14	3	4	<1				mg/kg	A-T-055s
Aro >C12-C16$_A^{M\#}$	20	104	8	11	2				mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	105	338	24	40	<1				mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	373	736	100	218	5				mg/kg	A-T-055s
Total Aromatics >C5-C35$_A^{\#}$	502	1190	137	275	6				mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A^{\#}$	541	1210	157	302	8				mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01				mg/kg	A-T-022s

REPORT NOTES

General:
This report shall not be reproduced, except in full, without written approval from Envirolab.
All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.
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 and there is insufficient sample to repeat the analysis. 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.

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: Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF

Project: St Johns Manchester

Clients Project No: 42206

Project No: 18/05735

Date Instructions Received: 18/07/2018 (am)

Cool Box Temperatures (°C): 20.7, 21.6

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
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/06429
Issue Number: 1 **Date:** 21 August, 2018

Client:
Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

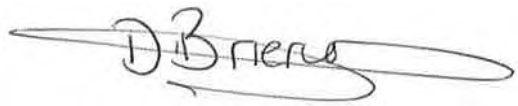
Project Manager: Hannah Hadwin
Project Name: St Johns
Project Ref: 42206
Order No: 45039
Date Samples Received: 10/08/18
Date Instructions Received: 13/08/18
Date Analysis Completed: 21/08/18

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Danielle Brierley
Client Manager

UKAS TESTING 1247

Envirolab Job Number: 18/06429

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/06429/1	18/06429/2	18/06429/3	18/06429/4					Units	Method ref
Client Sample No										
Client Sample ID	WS10	RBH02	BH04	BH02						
Depth to Top										
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18						
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW						
Sample Matrix Code	N/A	N/A	N/A	N/A						
pH (w)$_{A}^{\#}$	6.96	8.54	8.42	7.00					pH	A-T-031w
Hardness Total$_{A}^{\#}$	536	119	232	495					mg/l Ca CO3	A-T-049w
Sulphate (w)$_{A}^{\#}$	254	187	114	195					mg/l	A-T-026w
Cyanide (total) (w)$_{A}^{\#}$	0.007	0.014	<0.005	<0.005					mg/l	A-T-042wTCN
Phenols - Total by HPLC (w)$_{A}$	<0.01	<0.01	<0.01	<0.01					mg/l	A-T-050w
Sulphide (w)$_{A}$	<0.1	<0.1	<0.1	<0.1					mg/l	A-T-S2-w
Arsenic (dissolved)$_{A}^{\#}$	<1	8	1	<1					µg/l	A-T-025w
Boron (dissolved)$_{A}^{\#}$	158	64	155	99					µg/l	A-T-025w
Cadmium (dissolved)$_{A}^{\#}$	<0.2	<0.2	<0.2	<0.2					µg/l	A-T-025w
Copper (dissolved)$_{A}^{\#}$	<1	3	<1	<1					µg/l	A-T-025w
Chromium (dissolved)$_{A}^{\#}$	1	10	13	7					µg/l	A-T-025w
Lead (dissolved)$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-025w
Mercury (dissolved)$_{A}^{\#}$	<0.1	<0.1	<0.1	<0.1					µg/l	A-T-025w
Nickel (dissolved)$_{A}^{\#}$	<1	4	2	6					µg/l	A-T-025w
Selenium (dissolved)$_{A}^{\#}$	<1	27	2	<1					µg/l	A-T-025w
Zinc (dissolved)$_{A}^{\#}$	8	3	1	13					µg/l	A-T-025w

Envirolab Job Number: 18/06429

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/06429/1	18/06429/2	18/06429/3	18/06429/4					Units	Method ref
Client Sample No										
Client Sample ID	WS10	RBH02	BH04	BH02						
Depth to Top										
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18						
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW						
Sample Matrix Code	N/A	N/A	N/A	N/A						
PAH 16MS (w)										
Acenaphthene (w)$_A^{\#}$	<0.01	0.23	<0.01	0.45					µg/l	A-T-019w
Acenaphthylene (w)$_A^{\#}$	<0.01	0.05	<0.01	0.13					µg/l	A-T-019w
Anthracene (w)$_A^{\#}$	<0.01	0.74	<0.01	0.69					µg/l	A-T-019w
Benzo(a)anthracene (w)$_A^{\#}$	<0.01	2.47	0.02	2.03					µg/l	A-T-019w
Benzo(a)pyrene (w)$_A^{\#}$	<0.01	3.06	0.02	2.01					µg/l	A-T-019w
Benzo(b)fluoranthene (w)$_A^{\#}$	<0.01	2.96	0.02	2.01					µg/l	A-T-019w
Benzo(ghi)perylene (w)$_A^{\#}$	<0.01	1.51	<0.01	0.80					µg/l	A-T-019w
Benzo(k)fluoranthene (w)$_A^{\#}$	<0.01	1.08	<0.01	0.66					µg/l	A-T-019w
Chrysene (w)$_A^{\#}$	<0.01	2.63	0.02	2.28					µg/l	A-T-019w
Dibenzo(ah)anthracene (w)$_A^{\#}$	<0.01	0.32	<0.01	0.22					µg/l	A-T-019w
Fluoranthene (w)$_A^{\#}$	0.01	5.94	0.03	4.71					µg/l	A-T-019w
Fluorene (w)$_A^{\#}$	<0.01	0.17	<0.01	0.46					µg/l	A-T-019w
Indeno(123-cd)pyrene (w)$_A^{\#}$	<0.01	2.05	0.01	0.96					µg/l	A-T-019w
Naphthalene (w)$_A^{\#}$	<0.01	0.01	<0.01	0.18					µg/l	A-T-019w
Phenanthrene (w)$_A^{\#}$	0.01	2.29	0.01	3.79					µg/l	A-T-019w
Pyrene (w)$_A^{\#}$	0.01	5.39	0.03	4.97					µg/l	A-T-019w
Total PAH 16MS (w)$_A^{\#}$	0.03	30.9	0.16	26.4					µg/l	A-T-019w

Envirolab Job Number: 18/06429

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/06429/1	18/06429/2	18/06429/3	18/06429/4					Units	Method ref
Client Sample No										
Client Sample ID	WS10	RBH02	BH04	BH02						
Depth to Top										
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18						
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW						
Sample Matrix Code	N/A	N/A	N/A	N/A						
SVOC (excluding PAH-16) (w)										
2,4,5-Trichlorophenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
2,4,6-Trichlorophenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
2,4-Dichlorophenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
2,4-Dimethylphenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
2,4-Dinitrotoluene$_A$	<1	<1	<1	<1					µg/l	A-T-052w
2,6-Dinitrotoluene$_A$	<1	<1	<1	<1					µg/l	A-T-052w
2-Chloronaphthalene$_A$	<1	<1	<1	<1					µg/l	A-T-052w
2-Chlorophenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
2-Methylnaphthalene$_A$	<1	<1	<1	<1					µg/l	A-T-052w
2-Methylphenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
2-Nitrophenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
4-Bromophenyl phenyl ether$_A$	<1	<1	<1	<1					µg/l	A-T-052w
4-Chloro-3-methylphenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Bis(2-chloroisopropyl)ether$_A$	<1	<1	<1	<1					µg/l	A-T-052w
4-Methylphenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
4-Nitrophenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Bis(2-chloroethyl)ether$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Bis(2-chloroethoxy)methane$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Bis(2-ethylhexyl)phthalate$_A$	<10	<10	<10	<10					µg/l	A-T-052w
Butylbenzyl phthalate$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Carbazole$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Dibenzofuran$_A$	<1	<1	<1	<1					µg/l	A-T-052w
n-Dibutylphthalate$_A$	<1	<1	<1	<1					µg/l	A-T-052w
n-Dioctylphthalate$_A$	<10	<10	<10	<10					µg/l	A-T-052w
n-Nitroso-n-dipropylamine$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Diethyl phthalate$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Dimethyl phthalate$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Hexachlorobenzene$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Pentachlorophenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Phenol$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Hexachloroethane$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Nitrobenzene$_A$	<1	<1	<1	<1					µg/l	A-T-052w

Envirolab Job Number: 18/06429

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/06429/1	18/06429/2	18/06429/3	18/06429/4					Units	Method ref
Client Sample No										
Client Sample ID	WS10	RBH02	BH04	BH02						
Depth to Top										
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18						
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW						
Sample Matrix Code	N/A	N/A	N/A	N/A						
Isophorone$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Hexachlorocyclopentadiene$_A$	<1	<1	<1	<1					µg/l	A-T-052w
Perylene$_A$	<1	<1	<1	<1					µg/l	A-T-052w

Envirolab Job Number: 18/06429

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/06429/1	18/06429/2	18/06429/3	18/06429/4					Units	Method ref
Client Sample No										
Client Sample ID	WS10	RBH02	BH04	BH02						
Depth to Top										
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18						
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW						
Sample Matrix Code	N/A	N/A	N/A	N/A						
VOC (w)										
Dichlorodifluoromethane$_{A}$	<1	<1	<1	<1					µg/l	A-T-006w
Chloromethane$_{A}$	<10	<10	<10	<10					µg/l	A-T-006w
Vinyl Chloride$_{A}^{\#}$	<1	2	<1	<1					µg/l	A-T-006w
Bromomethane$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Chloroethane$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Trichlorofluoromethane$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
trans 1,2-Dichloroethene$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Dichloromethane$_{A}$	<5	<5	<5	<5					µg/l	A-T-006w
Carbon Disulphide$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,1-Dichloroethene$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,1-Dichloroethane$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
cis 1,2-Dichloroethene$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Bromochloromethane$_{A}^{\#}$	<5	<5	<5	<5					µg/l	A-T-006w
Chloroform$_{A}^{\#}$	<1	5	1	2					µg/l	A-T-006w
2,2-Dichloropropane$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,2-Dichloroethane$_{A}^{\#}$	<2	<2	<2	<2					µg/l	A-T-006w
1,1,1-Trichloroethane$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,1-Dichloropropene$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Benzene$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Carbon Tetrachloride$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Dibromomethane$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,2-Dichloropropane$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Bromodichloromethane$_{A}^{\#}$	<10	<10	<10	<10					µg/l	A-T-006w
Trichloroethene$_{A}^{\#}$	1	<1	<1	<1					µg/l	A-T-006w
cis 1,3-Dichloropropene$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
trans 1,3-Dichloropropene$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,1,2-Trichloroethane$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Toluene$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,3-Dichloropropane$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Dibromochloromethane$_{A}^{\#}$	<3	<3	<3	<3					µg/l	A-T-006w
1,2-Dibromoethane$_{A}^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Tetrachloroethene$_{A}$	<1	<1	<1	<1					µg/l	A-T-006w

Envirolab Job Number: 18/06429

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/06429/1	18/06429/2	18/06429/3	18/06429/4					Units	Method ref
Client Sample No										
Client Sample ID	WS10	RBH02	BH04	BH02						
Depth to Top										
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18						
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW						
Sample Matrix Code	N/A	N/A	N/A	N/A						
1,1,1,2-Tetrachloroethane$_A$	<1	<1	<1	<1					µg/l	A-T-006w
Chlorobenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Ethylbenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
m & p Xylene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Bromoform$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Styrene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,1,2,2-Tetrachloroethane$_A$	<1	<1	<1	<1					µg/l	A-T-006w
o-Xylene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,2,3-Trichloropropane$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Isopropylbenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
Bromobenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
2-Chlorotoluene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
n-propylbenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
4-Chlorotoluene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,2,4-Trimethylbenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
4-Isopropyltoluene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,3,5-Trimethylbenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,2-Dichlorobenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,4-Dichlorobenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
sec-Butylbenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
tert-Butylbenzene$_A^{\#}$	<2	<2	<2	<2					µg/l	A-T-006w
1,3-Dichlorobenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
n-butylbenzene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w
1,2-Dibromo-3-chloropropane$_A^{\#}$	<2	<2	<2	<2					µg/l	A-T-006w
1,2,4-Trichlorobenzene$_A^{\#}$	<3	<3	<3	<3					µg/l	A-T-006w
1,2,3-Trichlorobenzene$_A^{\#}$	<3	<3	<3	<3					µg/l	A-T-006w
Hexachlorobutadiene$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-006w

Envirolab Job Number: 18/06429

Client Project Name: St Johns

Client Project Ref: 42206

Lab Sample ID	18/06429/1	18/06429/2	18/06429/3	18/06429/4					Units	Method ref
Client Sample No										
Client Sample ID	WS10	RBH02	BH04	BH02						
Depth to Top										
Depth To Bottom										
Date Sampled	09-Aug-18	09-Aug-18	09-Aug-18	09-Aug-18						
Sample Type	Water - EW	Water - EW	Water - EW	Water - EW						
Sample Matrix Code	N/A	N/A	N/A	N/A						
TPH CWG (w)										
Ali >C5-C6 (w)$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-022w
Ali >C6-C8 (w)$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-022w
Ali >C8-C10 (w)$_A^{\#}$	<5	<5	<5	<5					µg/l	A-T-055w
Ali >C10-C12 (w)$_A^{\#}$	<5	<5	<5	<5					µg/l	A-T-055w
Ali >C12-C16 (w)$_A^{\#}$	<5	<5	<5	<5					µg/l	A-T-055w
Ali >C16-C21 (w)$_A^{\#}$	<5	<5	<5	<5					µg/l	A-T-055w
Ali >C21-C35 (w)$_A^{\#}$	<5	<5	<5	<5					µg/l	A-T-055w
Total Aliphatics >C5-C35 (w)$_A^{\#}$	<5	<5	<5	<5					µg/l	A-T-055w
Aro >C5-C7 (w)$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-022w
Aro >C7-C8 (w)$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-022w
Aro >C8-C10 (w)$_A$	<5	<5	<5	<5					µg/l	A-T-055w
Aro >C10-C12 (w)$_A^{\#}$	<5	<5	<5	<5					µg/l	A-T-055w
Aro >C12-C16 (w)$_A^{\#}$	<5	<5	<5	<5					µg/l	A-T-055w
Aro >C16-C21 (w)$_A^{\#}$	<5	<5	<5	<5					µg/l	A-T-055w
Aro >C21-C35 (w)$_A^{\#}$	<10	<10	<10	<10					µg/l	A-T-055w
Total Aromatics >C5-C35 (w)$_A$	<10	<10	<10	<10					µg/l	A-T-055w
TPH (Ali & Aro >C5-C35) (w)$_A$	<10	<10	<10	<10					µg/l	A-T-055w
BTEX - Benzene (w)$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-022w
BTEX - Toluene (w)$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-022w
BTEX - Ethyl Benzene (w)$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-022w
BTEX - m & p Xylene (w)$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-022w
BTEX - o Xylene (w)$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-022w
MTBE (w)$_A^{\#}$	<1	<1	<1	<1					µg/l	A-T-022w

REPORT NOTES

General:
This report shall not be reproduced, except in full, without written approval from Envirolab.
All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.
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 and there is insufficient sample to repeat the analysis. 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.

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: Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF

Project: St Johns

Clients Project No: 42206

Project No: 18/06429

Date Instructions Received: 13/08/2018 (am)

Cool Box Temperatures (°C): 22.1, 22.4

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
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/08489
Issue Number: 1 **Date:** 26 October, 2018

Client:
Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

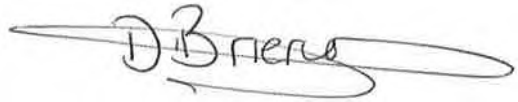
Project Manager: Hannah Hadwin
Project Name: St John Mp Phase 2
Project Ref: 42269
Order No: 45430
Date Samples Received: 11/10/18
Date Instructions Received: 16/10/18
Date Analysis Completed: 26/10/18

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 18/08489

Client Project Name: St John Mp Phase 2

Client Project Ref: 42269

Lab Sample ID	18/08489/2	18/08489/3	18/08489/4	18/08489/6	18/08489/7	18/08489/8	18/08489/9	18/08489/11	Units	Method ref
Client Sample No										
Client Sample ID	Trench 1 - 1.50	Trench 1 - 1.50	Trench 1 - 1.50	Trench 1 - 3.00m	Trench 1 - 3.00m	Trench 1 - 3.00m	Trench 1 - 5.00m	Trench 1 - 5.00m		
Depth to Top	1.00	2.00	3.00	1.00	2.00	3.00	0.50	2.00		
Depth To Bottom										
Date Sampled	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18		
Sample Type	Solid	Soil - ES	Soil - ES	Soil - ES	Solid	Solid	Solid	Solid		
Sample Matrix Code	7	4AB	4AB	4ABE	7	7	7	7		
% Stones >10mm$_A$	<0.1	5.3	21.5	13.4	<0.1	<0.1	<0.1	<0.1	% w/w	A-T-044
pH$_D$$^{M\#}$	9.41	9.67	9.68	9.96	9.16	11.77	10.30	10.46	pH	A-T-031s
Sulphate (water sol 2:1)$_D$$^{M\#}$	0.08	0.11	0.07	0.07	0.04	0.05	0.09	0.08	g/l	A-T-026s
Cyanide (total)$_A$$^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	mg/kg	A-T-050s
Organic matter$_D$$^{M\#}$	2.5	3.0	2.0	2.2	5.9	2.1	1.1	2.0	% w/w	A-T-032 OM
Arsenic$_D$$^{M\#}$	10	9	9	10	8	7	5	10	mg/kg	A-T-024s
Boron (water soluble)$_D$$^{M\#}$	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	mg/kg	A-T-027s
Cadmium$_D$$^{M\#}$	1.1	1.2	1.0	1.0	1.0	0.8	0.9	1.0	mg/kg	A-T-024s
Copper$_D$$^{M\#}$	189	51	44	47	46	37	37	38	mg/kg	A-T-024s
Chromium$_D$$^{M\#}$	17	21	15	16	17	14	16	16	mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-040s
Lead$_D$$^{M\#}$	231	212	205	204	204	186	151	169	mg/kg	A-T-024s
Mercury$_D$	<0.17	0.17	0.20	<0.17	0.31	0.20	<0.17	0.22	mg/kg	A-T-024s
Nickel$_D$$^{M\#}$	16	18	15	16	16	13	16	17	mg/kg	A-T-024s
Selenium$_D$$^{\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-024s
Zinc$_D$$^{M\#}$	204	178	192	183	176	135	142	125	mg/kg	A-T-024s

Envirolab Job Number: 18/08489

Client Project Name: St John Mp Phase 2

Client Project Ref: 42269

Lab Sample ID	18/08489/2	18/08489/3	18/08489/4	18/08489/6	18/08489/7	18/08489/8	18/08489/9	18/08489/11	Units	Method ref
Client Sample No										
Client Sample ID	Trench 1 - 1.50	Trench 1 - 1.50	Trench 1 - 1.50	Trench 1 - 3.00m	Trench 1 - 3.00m	Trench 1 - 3.00m	Trench 1 - 5.00m	Trench 1 - 5.00m		
Depth to Top	1.00	2.00	3.00	1.00	2.00	3.00	0.50	2.00		
Depth To Bottom										
Date Sampled	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18		
Sample Type	Solid	Soil - ES	Soil - ES	Soil - ES	Solid	Solid	Solid	Solid		
Sample Matrix Code	7	4AB	4AB	4ABE	7	7	7	7		
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{A}^{\#}$	NAD	NAD	NAD	NAD	Chrysotile	NAD	NAD	NAD		A-T-045
Asbestos Matrix (microscope)$_{A}$	-	-	-	-	Loose Fibres	-	-	-		A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A		
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	-	-	-	-	<0.001	-	-	-	% w/w	A-T-054

Envirolab Job Number: 18/08489

Client Project Name: St John Mp Phase 2

Client Project Ref: 42269

Lab Sample ID	18/08489/2	18/08489/3	18/08489/4	18/08489/6	18/08489/7	18/08489/8	18/08489/9	18/08489/11	Units	Method ref
Client Sample No										
Client Sample ID	Trench 1 - 1.50	Trench 1 - 1.50	Trench 1 - 1.50	Trench 1 - 3.00m	Trench 1 - 3.00m	Trench 1 - 3.00m	Trench 1 - 5.00m	Trench 1 - 5.00m		
Depth to Top	1.00	2.00	3.00	1.00	2.00	3.00	0.50	2.00		
Depth To Bottom										
Date Sampled	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18		
Sample Type	Solid	Soil - ES	Soil - ES	Soil - ES	Solid	Solid	Solid	Solid		
Sample Matrix Code	7	4AB	4AB	4ABE	7	7	7	7		
PAH-16MS										
Acenaphthene$_A^{M\#}$	0.07	0.14	0.12	0.08	0.14	0.10	0.07	0.14	mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	0.03	0.03	0.02	0.04	0.03	0.02	0.02	0.02	mg/kg	A-T-019s
Anthracene$_A^{M\#}$	0.14	0.29	0.25	0.19	0.37	0.18	0.19	0.28	mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.81	1.14	0.96	0.92	1.63	0.81	0.81	0.90	mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.93	1.13	0.89	1.06	1.61	0.85	0.73	0.80	mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	1.07	1.29	1.00	1.23	1.87	0.99	0.86	0.91	mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.72	0.76	0.60	0.75	0.94	0.53	0.42	0.44	mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	0.38	0.45	0.36	0.42	0.66	0.36	0.32	0.32	mg/kg	A-T-019s
Chrysene$_A^{M\#}$	0.98	1.34	1.03	1.10	1.78	0.93	0.88	0.93	mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.16	0.16	0.13	0.16	0.21	0.12	0.10	0.10	mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	1.62	2.69	2.14	1.89	3.67	1.73	1.80	2.06	mg/kg	A-T-019s
Fluorene$_A^{M\#}$	0.04	0.09	0.08	0.05	0.08	0.07	0.04	0.10	mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.76	0.83	0.67	0.81	1.11	0.61	0.50	0.52	mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	0.65	1.26	1.05	0.78	1.69	0.78	0.64	1.19	mg/kg	A-T-019s
Pyrene$_A^{M\#}$	1.54	2.41	1.94	1.79	3.28	1.59	1.64	1.87	mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	9.90	14	11.2	11.3	19.1	9.67	9.02	10.6	mg/kg	A-T-019s

Envirolab Job Number: 18/08489

Client Project Name: St John Mp Phase 2

Client Project Ref: 42269

Lab Sample ID	18/08489/2	18/08489/3	18/08489/4	18/08489/6	18/08489/7	18/08489/8	18/08489/9	18/08489/11	Units	Method ref
Client Sample No										
Client Sample ID	Trench 1 - 1.50	Trench 1 - 1.50	Trench 1 - 1.50	Trench 1 - 3.00m	Trench 1 - 3.00m	Trench 1 - 3.00m	Trench 1 - 5.00m	Trench 1 - 5.00m		
Depth to Top	1.00	2.00	3.00	1.00	2.00	3.00	0.50	2.00		
Depth To Bottom										
Date Sampled	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18	11-Oct-18		
Sample Type	Solid	Soil - ES	Soil - ES	Soil - ES	Solid	Solid	Solid	Solid		
Sample Matrix Code	7	4AB	4AB	4ABE	7	7	7	7		
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	1	<1	<1	<1	1	1	<1	mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	3	2	2	2	2	3	4	3	mg/kg	A-T-055s
Ali >C21-C35$_A$	13	12	12	12	13	45	21	12	mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A$	14	15	15	14	16	50	28	16	mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	<1	<1	<1	<1	<1	<1	<1	<1	mg/kg	A-T-055s
Aro >C12-C16$_A$	3	4	4	3	3	3	8	2	mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	12	18	16	15	16	15	49	15	mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	82	95	100	82	97	159	257	82	mg/kg	A-T-055s
Total Aromatics >C5-C35$_A$	96	116	120	98	116	179	313	100	mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	110	132	135	112	130	228	340	116	mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	mg/kg	A-T-022s

Envirolab Job Number: 18/08489

Client Project Name: St John Mp Phase 2

Client Project Ref: 42269

Lab Sample ID	18/08489/12	18/08489/13							Units	Method ref
Client Sample No										
Client Sample ID	Trench 1 - 5.00m	RBH08								
Depth to Top	3.00	0.50								
Depth To Bottom										
Date Sampled	11-Oct-18	11-Oct-18								
Sample Type	Solid	Soil - ES								
Sample Matrix Code	7	5A								
% Stones >10mm$_A$	<0.1	12.1							% w/w	A-T-044
pH$_D$$^{M\#}$	9.33	7.19							pH	A-T-031s
Sulphate (water sol 2:1)$_D$$^{M\#}$	<0.06	1.31							g/l	A-T-026s
Cyanide (total)$_A$$^{M\#}$	<1	<1							mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2							mg/kg	A-T-050s
Organic matter$_D$$^{M\#}$	1.5	5.3							% w/w	A-T-032 OM
Arsenic$_D$$^{M\#}$	5	8							mg/kg	A-T-024s
Boron (water soluble)$_D$$^{M\#}$	<1.0	<1.0							mg/kg	A-T-027s
Cadmium$_D$$^{M\#}$	0.7	1.0							mg/kg	A-T-024s
Copper$_D$$^{M\#}$	31	52							mg/kg	A-T-024s
Chromium$_D$$^{M\#}$	14	18							mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<6	<1							mg/kg	A-T-040s
Lead$_D$$^{M\#}$	115	1960							mg/kg	A-T-024s
Mercury$_D$	<0.17	0.48							mg/kg	A-T-024s
Nickel$_D$$^{M\#}$	14	28							mg/kg	A-T-024s
Selenium$_D$$^{\#}$	<1	<1							mg/kg	A-T-024s
Zinc$_D$$^{M\#}$	115	89							mg/kg	A-T-024s

Envirolab Job Number: 18/08489

Client Project Name: St John Mp Phase 2

Client Project Ref: 42269

Lab Sample ID	18/08489/12	18/08489/13							Units	Method ref
Client Sample No										
Client Sample ID	Trench 1 - 5.00m	RBH08								
Depth to Top	3.00	0.50								
Depth To Bottom										
Date Sampled	11-Oct-18	11-Oct-18								
Sample Type	Solid	Soil - ES								
Sample Matrix Code	7	5A								
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{A}^{\#}$	Chrysotile	NAD								A-T-045
Asbestos Matrix (microscope)$_{A}$	Loose Fibres	-								A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A								
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	<0.001	-							% w/w	A-T-054

Envirolab Job Number: 18/08489

Client Project Name: St John Mp Phase 2

Client Project Ref: 42269

Lab Sample ID	18/08489/12	18/08489/13							Units	Method ref
Client Sample No										
Client Sample ID	Trench 1 - 5.00m	RBH08								
Depth to Top	3.00	0.50								
Depth To Bottom										
Date Sampled	11-Oct-18	11-Oct-18								
Sample Type	Solid	Soil - ES								
Sample Matrix Code	7	5A								
PAH-16MS										
Acenaphthene$_A^{M\#}$	0.05	0.13							mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	0.02	0.02							mg/kg	A-T-019s
Anthracene$_A^{M\#}$	0.24	0.49							mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.90	1.19							mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.80	0.94							mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.93	1.11							mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.39	0.46							mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	0.35	0.41							mg/kg	A-T-019s
Chrysene$_A^{M\#}$	0.93	1.18							mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.09	0.13							mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	2.07	3.07							mg/kg	A-T-019s
Fluorene$_A^{M\#}$	0.04	0.11							mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.47	0.58							mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03	<0.03							mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	0.77	1.41							mg/kg	A-T-019s
Pyrene$_A^{M\#}$	1.85	2.62							mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	9.90	13.8							mg/kg	A-T-019s

Envirolab Job Number: 18/08489

Client Project Name: St John Mp Phase 2

Client Project Ref: 42269

Lab Sample ID	18/08489/12	18/08489/13							Units	Method ref
Client Sample No										
Client Sample ID	Trench 1 - 5.00m	RBH08								
Depth to Top	3.00	0.50								
Depth To Bottom										
Date Sampled	11-Oct-18	11-Oct-18								
Sample Type	Solid	Soil - ES								
Sample Matrix Code	7	5A								
TPH CWG										
Ali >C5-C6$_{A}^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Ali >C6-C8$_{A}^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Ali >C8-C10$_{A}^{M\#}$	<1	<1							mg/kg	A-T-055s
Ali >C10-C12$_{A}^{M\#}$	<1	<1							mg/kg	A-T-055s
Ali >C12-C16$_{A}^{M\#}$	4	4							mg/kg	A-T-055s
Ali >C16-C21$_{A}^{M\#}$	9	8							mg/kg	A-T-055s
Ali >C21-C35$_{A}$	40	40							mg/kg	A-T-055s
Total Aliphatics >C5-C35$_{A}$	53	53							mg/kg	A-T-055s
Aro >C5-C7$_{A}^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Aro >C7-C8$_{A}^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Aro >C8-C10$_{A}^{M\#}$	<1	<1							mg/kg	A-T-055s
Aro >C10-C12$_{A}^{M\#}$	1	1							mg/kg	A-T-055s
Aro >C12-C16$_{A}$	19	21							mg/kg	A-T-055s
Aro >C16-C21$_{A}^{M\#}$	84	278							mg/kg	A-T-055s
Aro >C21-C35$_{A}^{M\#}$	259	880							mg/kg	A-T-055s
Total Aromatics >C5-C35$_{A}$	363	1180							mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_{A}$	416	1230							mg/kg	A-T-055s
BTEX - Benzene$_{A}^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - Toluene$_{A}^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - Ethyl Benzene$_{A}^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - m & p Xylene$_{A}^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - o Xylene$_{A}^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
MTBE$_{A}^{\#}$	<0.01	<0.01							mg/kg	A-T-022s

REPORT NOTES

General:
This report shall not be reproduced, except in full, without written approval from Envirolab.
All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.
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.

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: Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF

Project: St John Mp Phase 2

Clients Project No: 42269

Project No: 18/08489

Date Instructions Received: 16/10/2018 (am)

Cool Box Temperatures (°C): 15.5

Lab Sample ID	18/08489/6
Client Sample No	
Client Sample ID/Depth	Trench 1 - 3.00m 1.00m
Date Sampled	11/10/18
Deviation Code	
B1 (no VPH)	✓

Key
B1 (no VPH) *Separate container not supplied for VPH/BTEX analysis*

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
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/08762
Issue Number: 1 **Date:** 01 November, 2018

Client:
Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

Project Manager: Hannah Hadwin
Project Name: St Johns Manchester Ph2
Project Ref: 42269
Order No: 45456
Date Samples Received: 18/10/18
Date Instructions Received: 24/10/18
Date Analysis Completed: 01/11/18

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Iain Haslock
Analytical Consultant

Envirolab Job Number: 18/08762

Client Project Name: St Johns Manchester Ph2

Client Project Ref: 42269

Lab Sample ID	18/08762/1	18/08762/3	18/08762/6						Units	Method ref
Client Sample No										
Client Sample ID	TT4	TT6	TT5							
Depth to Top	2.00	1.00	3.50							
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18							
Sample Type	Solid	Soil - ES	Soil - ES							
Sample Matrix Code	7	5A	5A							
% Stones >10mm$_A$	<0.1	9.5	0.9						% w/w	A-T-044
pH$_D$$^{M\#}$	9.78	9.16	8.54						pH	A-T-031s
Sulphate (water sol 2:1)$_D$$^{M\#}$	0.11	0.04	0.02						g/l	A-T-026s
Cyanide (total)$_A$$^{M\#}$	<1	<1	<1						mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2						mg/kg	A-T-050s
Organic matter$_D$$^{M\#}$	3.0	2.0	2.9						% w/w	A-T-032 OM
Arsenic$_D$$^{M\#}$	10	8	4						mg/kg	A-T-024s
Boron (water soluble)$_D$$^{M\#}$	<1.0	<1.0	<1.0						mg/kg	A-T-027s
Cadmium$_D$$^{M\#}$	3.1	0.8	1.3						mg/kg	A-T-024s
Copper$_D$$^{M\#}$	52	11	25						mg/kg	A-T-024s
Chromium$_D$$^{M\#}$	18	9	25						mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1						mg/kg	A-T-040s
Lead$_D$$^{M\#}$	413	50	137						mg/kg	A-T-024s
Mercury$_D$	<0.17	<0.17	<0.17						mg/kg	A-T-024s
Nickel$_D$$^{M\#}$	13	12	29						mg/kg	A-T-024s
Selenium$_D$$^{\#}$	<1	<1	<1						mg/kg	A-T-024s
Zinc$_D$$^{M\#}$	161	21	60						mg/kg	A-T-024s

Envirolab Job Number: 18/08762

Client Project Name: St Johns Manchester Ph2

Client Project Ref: 42269

Lab Sample ID	18/08762/1	18/08762/3	18/08762/6						Units	Method ref
Client Sample No										
Client Sample ID	TT4	TT6	TT5							
Depth to Top	2.00	1.00	3.50							
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18							
Sample Type	Solid	Soil - ES	Soil - ES							
Sample Matrix Code	7	5A	5A							
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD	NAD							A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A							

Envirolab Job Number: 18/08762

Client Project Name: St Johns Manchester Ph2

Client Project Ref: 42269

Lab Sample ID	18/08762/1	18/08762/3	18/08762/6						Units	Method ref
Client Sample No										
Client Sample ID	TT4	TT6	TT5							
Depth to Top	2.00	1.00	3.50							
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18							
Sample Type	Solid	Soil - ES	Soil - ES							
Sample Matrix Code	7	5A	5A							
PAH-16MS										
Acenaphthene$_A^{M\#}$	0.08	<0.01	<0.01						mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	0.14	<0.01	<0.01						mg/kg	A-T-019s
Anthracene$_A^{M\#}$	0.41	<0.02	<0.02						mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	4.03	<0.04	<0.04						mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	5.95	<0.04	<0.04						mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	7.42	<0.05	<0.05						mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	4.18	<0.05	<0.05						mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	2.33	<0.07	<0.07						mg/kg	A-T-019s
Chrysene$_A^{M\#}$	4.27	<0.06	<0.06						mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	1.06	<0.04	<0.04						mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	5.56	<0.08	<0.08						mg/kg	A-T-019s
Fluorene$_A^{M\#}$	0.07	<0.01	<0.01						mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	4.77	<0.03	<0.03						mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	0.13	<0.03	<0.03						mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	1.04	<0.03	<0.03						mg/kg	A-T-019s
Pyrene$_A^{M\#}$	5.75	<0.07	<0.07						mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	47.2	<0.08	<0.08						mg/kg	A-T-019s

Envirolab Job Number: 18/08762

Client Project Name: St Johns Manchester Ph2

Client Project Ref: 42269

Lab Sample ID	18/08762/1	18/08762/3	18/08762/6						Units	Method ref
Client Sample No										
Client Sample ID	TT4	TT6	TT5							
Depth to Top	2.00	1.00	3.50							
Depth To Bottom										
Date Sampled	16-Oct-18	16-Oct-18	16-Oct-18							
Sample Type	Solid	Soil - ES	Soil - ES							
Sample Matrix Code	7	5A	5A							
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	1	<1	<1						mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	2	<1	<1						mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	3	<1	<1						mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	9	<1	<1						mg/kg	A-T-055s
Ali >C21-C35$_A$	61	1	1						mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A$	78	1	1						mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	2	<1	<1						mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	3	<1	<1						mg/kg	A-T-055s
Aro >C12-C16$_A$	9	<1	<1						mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	39	1	<1						mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	411	5	6						mg/kg	A-T-055s
Total Aromatics >C5-C35$_A$	466	7	6						mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	544	8	7						mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s

REPORT NOTES

General:
This report shall not be reproduced, except in full, without written approval from Envirolab.
All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.
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.

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: Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF

Project: St Johns Manchester Ph2

Clients Project No: 42269

Project No: 18/08762

Date Instructions Received: 24/10/2018 (am)

Cool Box Temperatures (°C): 15.3

Lab Sample ID	18/08762/1	18/08762/3	18/08762/6
Client Sample No			
Client Sample ID/Depth	TT4 2.00m	TT6 1.00m	TT5 3.50m
Date Sampled	16/10/18	16/10/18	16/10/18
Deviation Code			
F	✓	✓	✓

Key

F *Maximum holding time exceeded between sampling date and analysis for analytes listed below*

HOLDING TIME EXCEEDANCES

Lab Sample ID	18/08762/1	18/08762/3	18/08762/6
Client Sample No			
Client Sample ID/Depth	TT4 2.00m	TT6 1.00m	TT5 3.50m
Date Sampled	16/10/18	16/10/18	16/10/18
Cyanide (total)	✓	✓	✓

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.

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Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/09025
Issue Number: 1 **Date:** 07 November, 2018

Client:
Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

Project Manager: Hannah Hadwin
Project Name: St Johns Manchester Ph2
Project Ref: 42269
Order No: 45517
Date Samples Received: 26/10/18
Date Instructions Received: 30/10/18
Date Analysis Completed: 06/11/18

Prepared by:

Melanie Marshall
Laboratory Coordinator

Approved by:

Richard Wong
Client Manager

Envirolab Job Number: 18/09025

Client Project Name: St Johns Manchester Ph2

Client Project Ref: 42269

Lab Sample ID	18/09025/1	18/09025/2							Units	Method ref
Client Sample No										
Client Sample ID	RBH21	RBH22								
Depth to Top	0.50	0.50								
Depth To Bottom										
Date Sampled	26-Oct-18	25-Oct-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	4A	4A								
% Stones >10mm$_A$	53.3	47.7							% w/w	A-T-044
pH$_D^{M\#}$	11.70	11.89							pH	A-T-031s
Sulphate (water sol 2:1)$_D^{M\#}$	0.04	0.06							g/l	A-T-026s
Cyanide (total)$_A^{M\#}$	<1	<1							mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2							mg/kg	A-T-050s
Organic matter$_D^{M\#}$	1.0	0.4							% w/w	A-T-032 OM
Arsenic$_D^{M\#}$	<1	<1							mg/kg	A-T-024s
Boron (water soluble)$_D^{M\#}$	<1.0	<1.0							mg/kg	A-T-027s
Cadmium$_D^{M\#}$	<0.5	<0.5							mg/kg	A-T-024s
Copper$_D^{M\#}$	9	15							mg/kg	A-T-024s
Chromium$_D^{M\#}$	6	7							mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1							mg/kg	A-T-040s
Lead$_D^{M\#}$	21	27							mg/kg	A-T-024s
Mercury$_D$	0.33	0.30							mg/kg	A-T-024s
Nickel$_D^{M\#}$	5	5							mg/kg	A-T-024s
Selenium$_D^{\#}$	<1	<1							mg/kg	A-T-024s
Zinc$_D^{M\#}$	25	33							mg/kg	A-T-024s

Envirolab Job Number: 18/09025

Client Project Name: St Johns Manchester Ph2

Client Project Ref: 42269

Lab Sample ID	18/09025/1	18/09025/2							Units	Method ref
Client Sample No										
Client Sample ID	RBH21	RBH22								
Depth to Top	0.50	0.50								
Depth To Bottom										
Date Sampled	26-Oct-18	25-Oct-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	4A	4A								
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_A^{\#}$	NAD	NAD								A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A								

Envirolab Job Number: 18/09025

Client Project Name: St Johns Manchester Ph2

Client Project Ref: 42269

Lab Sample ID	18/09025/1	18/09025/2							Units	Method ref
Client Sample No										
Client Sample ID	RBH21	RBH22								
Depth to Top	0.50	0.50								
Depth To Bottom										
Date Sampled	26-Oct-18	25-Oct-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	4A	4A								
PAH-16MS										
Acenaphthene$_A^{M\#}$	14	0.34							mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.10	0.02							mg/kg	A-T-019s
Anthracene$_A^{M\#}$	9.79	0.49							mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	7.05	0.76							mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	3.78	0.55							mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	4.36	0.70							mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	1.30	0.24							mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	1.88	0.25							mg/kg	A-T-019s
Chrysene$_A^{M\#}$	7.55	0.76							mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	0.45	0.06							mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	18.4	1.84							mg/kg	A-T-019s
Fluorene$_A^{M\#}$	11.6	0.29							mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	1.66	0.28							mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	79.5	0.40							mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	51.2	1.93							mg/kg	A-T-019s
Pyrene$_A^{M\#}$	15.3	1.62							mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	228	10.5							mg/kg	A-T-019s

Envirolab Job Number: 18/09025

Client Project Name: St Johns Manchester Ph2

Client Project Ref: 42269

Lab Sample ID	18/09025/1	18/09025/2							Units	Method ref
Client Sample No										
Client Sample ID	RBH21	RBH22								
Depth to Top	0.50	0.50								
Depth To Bottom										
Date Sampled	26-Oct-18	25-Oct-18								
Sample Type	Soil - ES	Soil - ES								
Sample Matrix Code	4A	4A								
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	<1	<1							mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1							mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	1							mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	2	2							mg/kg	A-T-055s
Ali >C21-C35$_A$	18	29							mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A$	21	32							mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	2	2							mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	2	2							mg/kg	A-T-055s
Aro >C12-C16$_A$	8	6							mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	23	16							mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	55	48							mg/kg	A-T-055s
Total Aromatics >C5-C35$_A$	90	74							mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	112	106							mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01							mg/kg	A-T-022s

REPORT NOTES

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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.

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: Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF

Project: St Johns Manchester Ph2

Clients Project No: 42269

Project No: 18/09025

Date Instructions Received: 30/10/2018 (am)

Cool Box Temperatures (°C): 8.2

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
Units 7 & 8 Sandpits Business Park
Mottram Road, Hyde, Cheshire, SK14 3AR

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 18/09265
Issue Number: 1 **Date:** 14 November, 2018

Client:
Ian Farmer Associates (Warrington)
14/15 Rufford Court
Hardwick Grange
Warrington
WA1 4RF

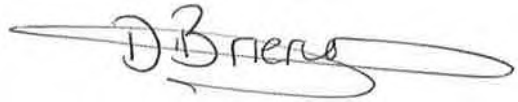
Project Manager: Hannah Hadwin
Project Name: St Johns Manchester ph2
Project Ref: 42269
Order No: 45569
Date Samples Received: 01/11/18
Date Instructions Received: 06/11/18
Date Analysis Completed: 13/11/18

Prepared by:



Melanie Marshall
Laboratory Coordinator

Approved by:



Danielle Brierley
Client Manager

Envirolab Job Number: 18/09265

Client Project Name: St Johns Manchester ph2

Client Project Ref: 42269

Lab Sample ID	18/09265/1	18/09265/2	18/09265/4						Units	Method ref
Client Sample No										
Client Sample ID	RBH19	RBH20	RBH14							
Depth to Top	0.50	0.50	0.65							
Depth To Bottom										
Date Sampled	31-Oct-18	31-Oct-18	01-Nov-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4A	4A	4A							
% Stones >10mm$_A$	29.3	8.3	9.9						% w/w	A-T-044
pH$_D$$^{M\#}$	8.00	8.79	8.00						pH	A-T-031s
Sulphate (water sol 2:1)$_D$$^{M\#}$	0.06	0.06	0.05						g/l	A-T-026s
Cyanide (total)$_A$$^{M\#}$	<1	<1	<1						mg/kg	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2						mg/kg	A-T-050s
Organic matter$_D$$^{M\#}$	5.9	1.6	4.5						% w/w	A-T-032 OM
Arsenic$_D$$^{M\#}$	8	10	23						mg/kg	A-T-024s
Boron (water soluble)$_D$$^{M\#}$	<1.0	<1.0	<1.0						mg/kg	A-T-027s
Cadmium$_D$$^{M\#}$	1.8	1.0	1.4						mg/kg	A-T-024s
Copper$_D$$^{M\#}$	27	30	37						mg/kg	A-T-024s
Chromium$_D$$^{M\#}$	11	13	21						mg/kg	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1						mg/kg	A-T-040s
Lead$_D$$^{M\#}$	76	835	100						mg/kg	A-T-024s
Mercury$_D$	<0.17	1.23	0.17						mg/kg	A-T-024s
Nickel$_D$$^{M\#}$	23	12	14						mg/kg	A-T-024s
Selenium$_D$$^{\#}$	<1	<1	<1						mg/kg	A-T-024s
Zinc$_D$$^{M\#}$	36	89	102						mg/kg	A-T-024s

Envirolab Job Number: 18/09265

Client Project Name: St Johns Manchester ph2

Client Project Ref: 42269

Lab Sample ID	18/09265/1	18/09265/2	18/09265/4						Units	Method ref
Client Sample No										
Client Sample ID	RBH19	RBH20	RBH14							
Depth to Top	0.50	0.50	0.65							
Depth To Bottom										
Date Sampled	31-Oct-18	31-Oct-18	01-Nov-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4A	4A	4A							
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{A}^{\#}$	NAD	NAD	NAD							A-T-045
Asbestos ACM - Suitable for Water Absorption Test?	N/A	N/A	N/A							

Envirolab Job Number: 18/09265

Client Project Name: St Johns Manchester ph2

Client Project Ref: 42269

Lab Sample ID	18/09265/1	18/09265/2	18/09265/4						Units	Method ref
Client Sample No										
Client Sample ID	RBH19	RBH20	RBH14							
Depth to Top	0.50	0.50	0.65							
Depth To Bottom										
Date Sampled	31-Oct-18	31-Oct-18	01-Nov-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4A	4A	4A							
PAH-16MS										
Acenaphthene$_A^{M\#}$	<0.01	0.01	0.99						mg/kg	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	<0.01	0.01						mg/kg	A-T-019s
Anthracene$_A^{M\#}$	<0.02	0.03	0.70						mg/kg	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04	0.12	1.48						mg/kg	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.04	0.11	0.96						mg/kg	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.05	0.15	1.20						mg/kg	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05	0.10	0.54						mg/kg	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	<0.07	0.40						mg/kg	A-T-019s
Chrysene$_A^{M\#}$	<0.06	0.15	1.58						mg/kg	A-T-019s
Dibenzo(ah)anthracene$_A^{M\#}$	<0.04	<0.04	0.14						mg/kg	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08	0.22	4.39						mg/kg	A-T-019s
Fluorene$_A^{M\#}$	<0.01	<0.01	0.62						mg/kg	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	<0.03	0.10	0.59						mg/kg	A-T-019s
Naphthalene$_A^{M\#}$	<0.03	<0.03	0.16						mg/kg	A-T-019s
Phenanthrene$_A^{M\#}$	0.04	0.12	3.25						mg/kg	A-T-019s
Pyrene$_A^{M\#}$	<0.07	0.22	4.03						mg/kg	A-T-019s
Total PAH-16MS$_A^{M\#}$	<0.08	1.33	21						mg/kg	A-T-019s

Envirolab Job Number: 18/09265

Client Project Name: St Johns Manchester ph2

Client Project Ref: 42269

Lab Sample ID	18/09265/1	18/09265/2	18/09265/4						Units	Method ref
Client Sample No										
Client Sample ID	RBH19	RBH20	RBH14							
Depth to Top	0.50	0.50	0.65							
Depth To Bottom										
Date Sampled	31-Oct-18	31-Oct-18	01-Nov-18							
Sample Type	Soil - ES	Soil - ES	Soil - ES							
Sample Matrix Code	4A	4A	4A							
TPH CWG										
Ali >C5-C6$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C6-C8$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Ali >C8-C10$_A^{M\#}$	<1	<1	11						mg/kg	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	55						mg/kg	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	<1	120						mg/kg	A-T-055s
Ali >C16-C21$_A^{M\#}$	<1	1	184						mg/kg	A-T-055s
Ali >C21-C35$_A$	6	11	50						mg/kg	A-T-055s
Total Aliphatics >C5-C35$_A$	6	12	421						mg/kg	A-T-055s
Aro >C5-C7$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
Aro >C8-C10$_A^{M\#}$	<1	<1	1						mg/kg	A-T-055s
Aro >C10-C12$_A^{M\#}$	<1	<1	21						mg/kg	A-T-055s
Aro >C12-C16$_A$	<1	2	66						mg/kg	A-T-055s
Aro >C16-C21$_A^{M\#}$	5	3	113						mg/kg	A-T-055s
Aro >C21-C35$_A^{M\#}$	29	22	118						mg/kg	A-T-055s
Total Aromatics >C5-C35$_A$	35	27	320						mg/kg	A-T-055s
TPH (Ali & Aro >C5-C35)$_A$	42	39	741						mg/kg	A-T-055s
BTEX - Benzene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.01	<0.01						mg/kg	A-T-022s

REPORT NOTES

General:
This report shall not be reproduced, except in full, without written approval from Envirolab.
All samples contained within this report, and any received with the same delivery, will be disposed of one month after the date of this report.
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.

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: Ian Farmer Associates (Warrington), 14/15 Rufford Court, Hardwick Grange, Warrington, WA1 4RF

Project: St Johns Manchester ph2

Clients Project No: 42269

Project No: 18/09265

Date Instructions Received: 06/11/2018 (am)

Cool Box Temperatures (°C): 10.1, 15.4

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.

Appendix D – Geotechnical Laboratory Testing Results

- Ian farmer Associates, Geotechnical Analysis Results:
  - Test Report 42206/A/B
  - Test Report 42269

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IAN FARMER ASSOCIATES
Unit 4, Faraday Close, Pattinson North Industrial Estate, Washington, NE38 8QJ. Tel: 0191 482 8500 Fax: 0191 482 8520
washington@ianfarmer.co.uk www.ianfarmer.co.uk

F.A.O.

Test Report - 42206 / 3

Site:	St John's Masterplan
Job Number:	42206
Originating Client:	Curtins Consulting
Originating Reference:	42206
Date Sampled:	25/07/2018
Date Scheduled:	01/08/2018
Date Testing Started:	08/08/2018
Date Testing Finished:	21/08/2018
Remarks:	

Authorised By:

Tim Robinson
Quality Technician

Date: 22/08/2018

Constructionline
Ian Farmer Associates (1998) Limited Registered in England and Wales. No. 3661447.
Registered Office. Spring Lodge 172 Chester Road, Helsby, Frodsham, England, WA6 0AR.
Offices in: Cornwall (01872) 261775. Coventry (024) 7630 3422. Harpenden (01582) 460018. Llanelli (01554) 566566.
Newcastle upon Tyne (0191) 482 8500. Motherwell (01698) 230231. Warrington (01925) 855440. Washington (0191) 482 8500.
AGS

Site: St John's Masterplan **Job Number:** 42206

Client: Curtins Consulting **Page:** 2

ROCK INDEX TESTS - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock description / Rock type	Natural Water Content[1] %	Caliper[2] Dry density Mg/m³	Caliper[2] Porosity %	Buoyancy[3] Dry density Mg/m³	Buoyancy[3] Porosity %	Natural Bulk density Mg/m³	Remarks
RBH02	13.20	C20	Red/Brown SANDSTONE	13.3			1.98	26.7	2.24	
RBH02	17.12	C44	Red/Brown SANDSTONE	11.0			2.04	24.7	2.27	
RBH02	26.32	C46	Red/Brown SANDSTONE	11.9			1.97	26.7	2.20	
RBH02	33.25	C34	Red/Brown SANDSTONE	13.6			1.96	27.6	2.23	
RBH02	39.25	C39	Red/Brown SANDSTONE	13.4			1.94	28.0	2.20	
RBH03	13.40	C11	Red/Brown SANDSTONE	9.7			2.09	21.2	2.29	
RBH03	19.12	C16	Red/Brown SANDSTONE	10.9			2.06	22.5	2.29	
RBH03	29.20	C24	Red/Brown SANDSTONE	11.1			1.87	30.6	2.08	
RBH03	35.01	C29	Red/Brown SANDSTONE	10.1			2.10	23.5	2.31	
RBH04	9.70	C15	Red/Brown SANDSTONE	12.6			1.98	26.3	2.23	
RBH04	12.70	C18	Red/Brown SANDSTONE	5.3			1.92	28.0	2.02	
RBH04	17.34	C23	Red/Brown SANDSTONE	5.9			2.22	17.0	2.35	
RBH04	24.25	C30	Red/Brown SANDSTONE	9.6			1.95	28.3	2.13	
RBH04	29.10	C35	Red/Brown SANDSTONE	9.5			2.06	23.6	2.25	
RBH04	36.10	C40	Red/Brown SANDSTONE	10.6			1.97	26.0	2.18	

Notes
1. ISRM p87 test 1, water content at 105 ± 3 °C, specimen as received at the laboratory
2. ISRM p87 test 2, Porosity/density determination using saturation and caliper
3. ISRM p88 test 3, Porosity/density determination using saturation and buoyancy
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 conrent 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 conrent of a rock sample

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Laboratory Test Report 42206 / 3

Site: St John's Masterplan **Job Number:** 42206

Client: Curtins Consulting **Page:** 3

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3				Remarks
				Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
RBH02	10.20	C17	Red/Brown SANDSTONE	101.7	124.2	*1.2	1.94	12.7	as received	0.3444	AC	0.9	
RBH02	13.20	C20	Red/Brown SANDSTONE	100.9	156.3	*1.5	2.22	11.8	as received	0.3501	AC	0.9	
RBH02	14.34	C22	Red/Brown SANDSTONE	101.6	242.0	*2.4	2.24	9.5	as received	0.3454	AC	5.9	
RBH02	18.32	C27	Red/Brown SANDSTONE	100.4	207.6	*2.1	2.17	13.2	as received	0.3534	AC	5.8	
RBH02	22.56	C44	Red/Brown SANDSTONE	101.4	223.2	*2.2	2.21	12.7	as received	0.3469	AC	10.6	
RBH02	26.32	C46	Red/Brown SANDSTONE	100.6	116.1	*1.2	2.25	11.9	as received	0.3523	AC	3.9	
RBH02	30.91	C32	Red/Brown SANDSTONE	101.8	243.6	*2.4	2.22	11.3	as received	0.3440	AC	12.0	
RBH02	33.25	C34	Red/Brown SANDSTONE	100.7	208.0	*2.1	2.30	8.3	as received	0.3513	AC	13.1	
RBH02	35.40	C36	Red/Brown SANDSTONE	101.0	201.3	*2	2.25	11.0	as received	0.3496	AC	8.8	
RBH02	39.25	C39	Red/Brown SANDSTONE	99.3	169.7	*1.7	2.21	11.1	as received	0.3616	S	4.6	
RBH03	10.50	C8	Red/Brown SANDSTONE	101.1	96.7	*1	2.19	11.0	as received	0.3487	AC	8.3	
RBH03	12.40	C10	Red/Brown SANDSTONE	100.9	79.1	*0.8	2.18	12.1	as received	0.3503	AC	4.9	
RBH03	14.30	C12	Red/Brown SANDSTONE	100.9	99.8	*1	2.19	9.5	as received	0.3502	AC	6.3	
RBH03	16.52	C	Red/Brown SANDSTONE	101.2	226.5	*2.2	0.22	9.7	as received	0.3484	AC	10.8	
RBH03	17.06	C37	Red/Brown SANDSTONE	99.8	143.7	*1.4	2.24	11.3	as received	0.3582	AC	7.1	
RBH03	19.12	C16	Red/Brown SANDSTONE	101.3	127.8	*1.3	2.15	4.5	as received	0.3475	AC	13.3	
RBH03	22.00	C18	Red/Brown SANDSTONE	101.0	125.1	*1.2	2.20	10.5	as received	0.3498	AC	7.9	
RBH03	26.90	C21	Red/Brown SANDSTONE	101.5	226.4	*2.2	2.19	12.2	as received	0.3459	S	6.4	
RBH03	30.42	C25	Red/Brown SANDSTONE	101.5	300.8	3	2.35	10.2	as received	0.3463	AC	11.7	
RBH03	33.90	C28	Red/Brown SANDSTONE	102.1	294.6	2.9	2.30	9.5	as received	0.3419	AC	18.6	
RBH04	14.56	C20	Red/Brown SANDSTONE	100.0	186.7	*1.9	2.23	11.9	as received	0.3562	AC	1.3	
RBH04	15.90	C22	Red/Brown SANDSTONE	101.3	186.0	*1.8	2.22	11.9	as received	0.3476	S	1.8	
RBH04	18.78	C25	Red/Brown SANDSTONE	101.4	217.6	*2.1	2.21	11.4	as received	0.3465	AC	10.7	

Notes
1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS
2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density
3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials
above notes apply unless annotated otherwise in the remarks

*Denotes length diameter ratio outside ISRM specification

Mode of failure :
S - Single shear MS - multiple shear
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

IAN FARMER ASSOCIATES

Laboratory Test Report 42206 / 3

Site: St John's Masterplan **Job Number:** 42206

Client: Curtins Consulting **Page:** 4

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3				Remarks
				Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
RBH04	22.03	C28	Red/Brown SANDSTONE	99.7	223.6	*2.2	2.25	11.0	as received	0.3590	AC	6.4	
RBH04	25.74	C32	Red/Brown SANDSTONE	101.7	207.9	*2	2.16	11.8	as received	0.3448	AC	11.6	
RBH04	30.07	C36	Red/Brown SANDSTONE	101.6	175.2	*1.7	2.28	9.7	as received	0.3453	AC	15.6	
RBH04	32.60	C38	Red/Brown SANDSTONE	101.6	158.1	*1.6	2.24	15.4	as received	0.3452	AC	8.0	

Notes
1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS
2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density
3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials
above notes apply unless annotated otherwise in the remarks

*Denotes length diameter ratio outside ISRM specification

Mode of failure :
S - Single shear MS - multiple shear
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

IAN FARMER ASSOCIATES

Laboratory Test Report	42206 / 3

Site: St John's Masterplan **Job Number:** 42206

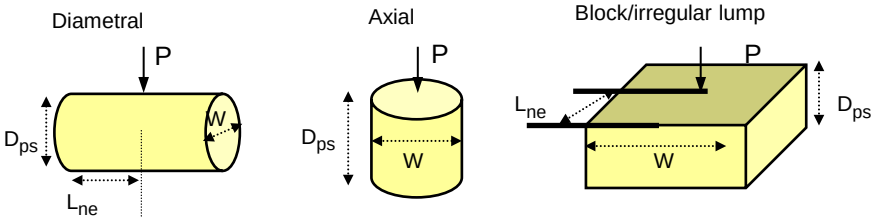
Client: Curtins Consulting **Page:** 5

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	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH02	8.95	C16	Red/Brown SANDSTONE As received	D	PL	YES	70.0	98.8	98.8	95.8	0.1	98.8	0.01	0.02	
RBH02	8.95	C16	Red/Brown SANDSTONE As received	A	PD	YES		98.7	69.5	63.5	0.5	93.5	0.06	0.08	
RBH02	11	C18	Red/Brown SANDSTONE As received	D	PL	YES	52.7	101.6	101.6	99.6	0.1	101.6	0.01	0.02	
RBH02	11	C18	Red/Brown SANDSTONE As received	A	PD	YES		101.3	50.9	47.9	0.1	81.0	0.01	0.01	
RBH02	12.07	C19	Red/Brown SANDSTONE As received	D	PL	YES	67.4	101.5	101.5	102.5	0.1	101.5	0.01	0.02	
RBH02	12.07	C19	Red/Brown SANDSTONE As received	A	PD	YES		101.2	69.7	67.7	0.1	94.8	0.01	0.01	
RBH02	14	C21	Red/Brown SANDSTONE As received	D	PL	YES	83.3	102.0	102.0	99.0	0.4	102.0	0.04	0.06	
RBH02	14	C21	Red/Brown SANDSTONE As received	A	PD	YES		101.1	81.0	79.0	0.1	102.1	0.01	0.01	
RBH02	15.5	C23	Red/Brown SANDSTONE As received	D	PL	YES	68.3	101.7	101.7	99.7	0.5	101.7	0.05	0.07	
RBH02	15.5	C23	Red/Brown SANDSTONE As received	A	PD	YES		101.7	65.8	62.8	0.4	92.3	0.05	0.06	
RBH02	15.97	C24	Red/Brown SANDSTONE As received	A	PD	YES		96.8	89.1	80.1	0.1	104.8	0.01	0.01	
RBH02	17.12	C44	Red/Brown SANDSTONE Saturated	A	PD	YES		99.6	85.2	81.2	0.2	104.0	0.02	0.03	
RBH02	18	C26	Red/Brown SANDSTONE As received	D	PL	YES	78.2	100.2	100.2	98.2	0.8	100.2	0.08	0.11	
RBH02	18	C26	Red/Brown SANDSTONE As received	A	PD	YES		100.9	107.4	96.4	1.4	117.4	0.10	0.15	
RBH02	20	C28	Red/Brown SANDSTONE As received	A	PD	YES		100.0	71.8	65.8	0.3	95.6	0.03	0.04	
RBH02	20.94	C29	Red/Brown SANDSTONE As received	A	PD	YES		99.5	56.8	53.8	0.3	84.8	0.04	0.05	
RBH02	23.92	C45	Red/Brown SANDSTONE As received	D	PL	YES	55.3	101.4	101.4	98.4	1.1	101.4	0.11	0.15	
RBH02	23.92	C45	Red/Brown SANDSTONE As received	A	PD	YES		101.3	57.2	48.2	1.6	85.9	0.22	0.28	
RBH02	27.99	C30	Red/Brown SANDSTONE As received	D	PL	YES	44.5	100.9	100.9	97.9	0.1	100.9	0.01	0.02	
RBH02	27.99	C30	Red/Brown SANDSTONE As received	A	PD	YES		101.0	48.6	47.6	0.1	79.1	0.02	0.02	

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)

IAN FARMER ASSOCIATES

Laboratory Test Report 42206 / 3

Site: St John's Masterplan **Job Number:** 42206

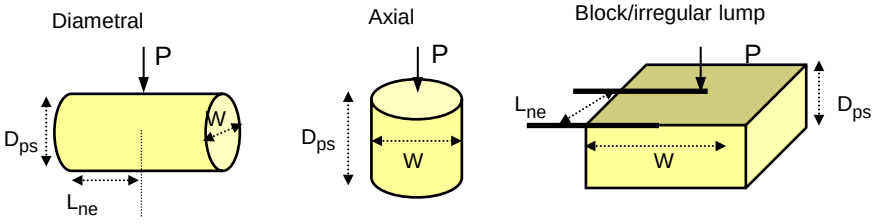
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Point Load Strength Index Tests
Summary of Results

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	
RBH02	29.35	C31	Red/Brown SANDSTONE As received	D	PL	YES	97.8	100.9	100.9	98.9	1.1	100.9	0.11	0.15	
RBH02	29.35	C31	Red/Brown SANDSTONE As received	A	PD	YES		100.7	102.5	96.5	1.1	114.7	0.09	0.12	
RBH02	31.82	C33	Red/Brown SANDSTONE As received	D	PL	YES	67.9	100.3	100.3	98.3	1.2	100.3	0.12	0.17	
RBH02	31.82	C33	Red/Brown SANDSTONE As received	A	PD	YES		101.2	73.1	70.1	1.0	97.0	0.10	0.14	
RBH02	34.02	C35	Red/Brown SANDSTONE As received	A	PD	YES		100.7	64.0	59.0	1.0	90.6	0.12	0.15	
RBH02	36.31	C37	Red/Brown SANDSTONE As received	D	PL	YES	59.7	99.7	99.7	98.7	0.7	99.7	0.07	0.10	
RBH02	36.31	C37	Red/Brown SANDSTONE As received	A	PD	YES		100.3	59.5	42.5	0.9	87.2	0.12	0.16	
RBH02	38.04	C38	Red/Brown SANDSTONE As received	D	PL	YES	69.5	100.0	100.0	97.0	1.1	100.0	0.11	0.14	
RBH02	38.04	C38	Red/Brown SANDSTONE As received	A	PD	YES		100.6	111.6	97.6	3.0	119.5	0.21	0.31	
RBH03	9.6	C7	Red/Brown SANDSTONE As received	D	PL	YES	52.7	101.3	101.3	98.3	0.6	101.3	0.05	0.07	
RBH03	9.6	C7	Red/Brown SANDSTONE As received	A	PD	YES		101.4	56.8	50.8	0.9	85.6	0.13	0.16	
RBH03	11.3	C9	Red/Brown SANDSTONE As received	D	PL	YES	63.3	101.5	101.5	98.5	0.6	101.5	0.06	0.08	
RBH03	11.3	C9	Red/Brown SANDSTONE As received	A	PD	YES		101.2	73.7	68.7	1.4	97.4	0.14	0.19	
RBH03	13.4	C11	Red/Brown SANDSTONE As received	A	PD	YES		101.1	92.2	66.2	1.1	108.9	0.09	0.13	
RBH03	15.4	C13	Red/Brown SANDSTONE As received	D	PL	YES	96.5	101.2	101.2	99.2	0.5	101.2	0.05	0.07	
RBH03	15.4	C13	Red/Brown SANDSTONE As received	A	PD	YES		101.2	109.6	98.6	1.6	118.8	0.11	0.16	
RBH03	18	C15	Red/Brown SANDSTONE As received	D	PL	YES	96.8	100.8	100.8	97.8	0.5	100.8	0.04	0.06	
RBH03	18	C15	Red/Brown SANDSTONE As received	A	PD	YES		100.7	86.1	77.1	1.2	105.1	0.11	0.15	
RBH03	20	C17	Red/Brown SANDSTONE As received	D	PL	YES	107.4	101.3	101.3	98.3	0.5	101.3	0.05	0.06	
RBH03	20	C17	Red/Brown SANDSTONE As received	A	PD	YES		101.2	115.4	104.4	1.5	121.9	0.10	0.15	

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)

Site: St John's Masterplan **Job Number:** 42206

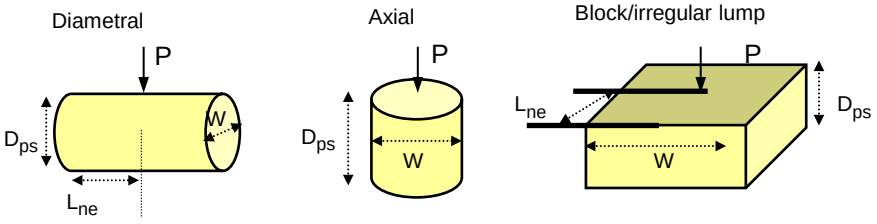
Client: Curtins Consulting **Page:** 7

Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM: Type (D, A, I, B)	Test Type see ISRM: Direction (PL, PD or U)	Failure Valid (Y/N)	Dimensions: Lne mm	Dimensions: W mm	Dimensions: Dps mm	Dimensions: Dps' mm	Force P kN	Equivalent diameter, De mm	Point Load Strength Index: Is . MPa	Point Load Strength Index: Is (50) MPa	Remarks (including water content if measured)
RBH03	24.3	C19	Red/Brown SANDSTONE As received	D	PL	YES	76.2	101.2	101.2	99.2	0.5	101.2	0.05	0.07	
RBH03	24.3	C19	Red/Brown SANDSTONE As received	A	PD	YES		101.2	80.6	59.6	0.7	101.9	0.07	0.10	
RBH03	26.1	C20	Red/Brown SANDSTONE As received	D	PL	YES	80.1	101.5	101.5	99.5	0.6	101.5	0.06	0.08	
RBH03	26.1	C20	Red/Brown SANDSTONE As received	A	PD	YES		101.1	83.5	78.5	1.3	103.7	0.12	0.17	
RBH03	28.04	C22	Red/Brown SANDSTONE As received	D	PL	YES	88.2	101.8	101.8	98.8	0.9	101.8	0.09	0.12	
RBH03	28.04	C22	Red/Brown SANDSTONE As received	A	PD	YES		101.7	89.4	81.4	1.9	107.6	0.17	0.23	
RBH03	28.94	C23	Red/Brown SADNSTONE As received	D	PL	YES	24.9	101.3	101.3	99.3	0.3	101.3	0.03	0.05	
RBH03	28.94	C23	Red/Brown SADNSTONE As received	A	PD	YES		101.2	85.8	77.8	1.3	105.2	0.11	0.16	
RBH03	29.2	C24	Red/Brown SADNSTONE As received	D	PL	YES	78.7	101.8	101.8	99.8	1.7	101.8	0.17	0.23	
RBH03	29.2	C24	Red/Brown SADNSTONE As received	A	PD	YES		101.8	73.9	67.9	2.7	97.8	0.28	0.38	
RBH03	31.3	C26	Red/Brown SADNSTONE As received	D	PL	YES	68.1	100.3	100.3	92.3	1.8	100.3	0.18	0.24	
RBH03	31.3	C26	Red/Brown SADNSTONE As received	A	PD	YES		101.4	101.7	85.7	2.2	114.5	0.17	0.24	
RBH03	32.5	C27	Red/Brown SADNSTONE As received	A	PD	YES		99.9	82.6	76.6	2.5	102.5	0.24	0.33	
RBH03	35.01	C29	Red/Brown SADNSTONE As received	D	PL	YES	64.7	101.5	101.5	98.5	0.8	101.5	0.08	0.10	
RBH03	35.01	C29	Red/Brown SADNSTONE As received	A	PD	YES		101.1	66.0	59.0	2.4	92.1	0.29	0.38	
RBH03	36.3	C30	Red/Brown SANDSTONE As received	A	PD	YES		101.0	111.1	102.1	0.7	119.5	0.05	0.07	
RBH03	37.95	C31	Red/Brown SANDSTONE As received	A	PD	YES		100.5	87.7	78.7	2.7	106.0	0.24	0.34	
RBH03	39.35	C32	Red/Brown SANDSTONE As received	D	PL	YES	82.0	101.1	101.1	99.1	1.5	101.1	0.15	0.20	
RBH03	39.35	C32	Red/Brown SANDSTONE As received	A	PD	YES		101.6	98.0	83.0	3.4	112.6	0.26	0.38	
RBH03	39.7	C33	Red/Brown SANDSTONE As received	A	PD	YES		100.7	100.7	94.7	3.7	113.6	0.29	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)

Site: St John's Masterplan **Job Number:** 42206

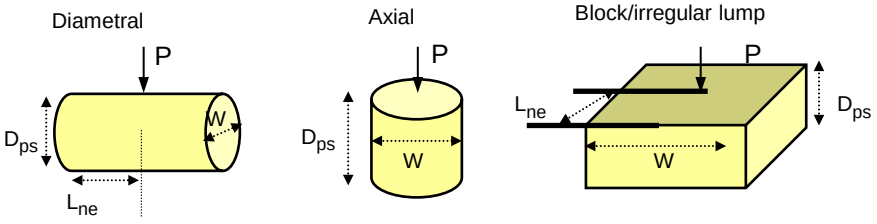
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH04	9.27	C14	Red/Brown SANDSTONE As received	D	PL	YES	63.0	99.0	99.0	95.0	0.1	99.0	0.01	0.02	
RBH04	9.27	C14	Red/Brown SANDSTONE As received	A	PD	YES		99.4	77.5	68.5	0.3	99.1	0.03	0.03	
RBH04	9.7	C15	Red/Brown SANDSTONE As received	D	PL	YES	54.7	100.5	100.5	98.5	0.2	100.5	0.02	0.02	
RBH04	9.7	C15	Red/Brown SANDSTONE As received	A	PD	YES		100.0	57.0	52.0	0.2	85.2	0.02	0.03	
RBH04	11.05	C16	Red/Brown SANDSTONE As received	A	PD	YES		97.9	90.2	83.2	0.5	106.0	0.04	0.06	
RBH04	12.35	C17	Red/Brown SADNSTONE As received	D	PL	YES	74.2	97.9	97.9	94.9	0.3	97.9	0.03	0.04	
RBH04	12.35	C17	Red/Brown SADNSTONE As received	A	PD	YES		98.0	69.3	59.3	0.6	93.0	0.07	0.09	
RBH04	12.7	C18	Red/Brown SANDSTONE As received	A	PD	YES		99.1	79.1	62.1	1.2	99.9	0.12	0.16	
RBH04	13.85	C19	Red/Brown SADNSTONE As received	D	PL	YES	65.5	101.0	101.0	99.0	0.2	101.0	0.02	0.03	
RBH04	13.85	C19	Red/Brown SADNSTONE As received	A	PD	YES		101.4	92.6	85.6	0.3	109.3	0.03	0.04	
RBH04	15.1	C21	Red/Brown SADNSTONE As received	D	PL	YES	56.8	100.7	100.7	98.7	0.1	100.7	0.01	0.01	
RBH04	15.1	C21	Red/Brown SADNSTONE As received	A	PD	YES		101.2	66.6	55.6	0.3	92.7	0.04	0.05	
RBH04	17.34	C23	Red/Brown SADNSTONE As received	D	PL	YES	100.0	101.5	101.5	97.5	1.2	101.5	0.12	0.16	
RBH04	17.34	C23	Red/Brown SADNSTONE As received	A	PD	YES		101.6	67.4	57.4	2.7	93.4	0.31	0.41	
RBH04	18.1	C24	Red/Brown SADNSTONE As received	D	PL	YES	85.7	100.6	100.6	97.6	0.4	100.6	0.04	0.06	
RBH04	18.1	C24	Red/Brown SADNSTONE As received	A	PD	YES		99.9	84.3	81.3	0.6	103.6	0.06	0.08	
RBH04	19.92	C26	Red/Brown SANDSTONE As received	D	PL	YES	76.6	100.6	100.6	98.6	0.5	100.6	0.05	0.07	
RBH04	19.92	C26	Red/Brown SANDSTONE As received	A	PD	YES		100.9	76.5	71.5	1.8	99.1	0.18	0.25	
RBH04	21.31	C27	Red/Brown SANDSTONE As received	A	PD	YES		99.4	93.6	81.6	1.2	108.8	0.10	0.14	
RBH04	22.93	C29	Red/Brown SANDSTONE As received	D	PL	YES	56.9	100.4	100.4	98.4	0.3	100.4	0.03	0.04	

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)

IAN FARMER ASSOCIATES

Laboratory Test Report 42206 / 3

Site: St John's Masterplan **Job Number:** 42206

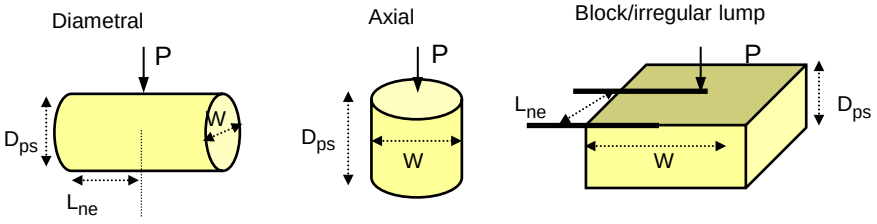
Client: Curtins Consulting **Page:** 9

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	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH04	22.93	C29	Red/Brown SANDSTONE As received	A	PD	YES		100.8	72.0	65.0	1.1	96.1	0.12	0.17	
RBH04	24.25	C30	Red/Brown SANDSTONE As received	D	PL	YES	98.7	100.9	100.9	98.9	0.5	100.9	0.05	0.07	
RBH04	24.25	C30	Red/Brown SANDSTONE As received	A	PD	YES		100.7	86.5	71.5	2.6	105.3	0.23	0.32	
RBH04	24.94	C31	Red/Brown SANDSTONE As received	D	PL	YES	83.9	100.8	100.8	98.8	1.9	100.8	0.18	0.25	
RBH04	24.94	C31	Red/Brown SANDSTONE As received	A	PD	YES		100.8	94.6	89.6	2.0	110.2	0.17	0.24	
RBH04	27.09	C33	Red/Brown SADNSTONE As received	D	PL	YES	78.4	101.3	101.3	97.3	0.7	101.3	0.07	0.09	
RBH04	27.09	C33	Red/Brown SADNSTONE As received	A	PD	YES		101.4	53.4	54.4	1.2	83.0	0.17	0.22	
RBH04	28.04	C34	Red/Brown SADNSTONE As received	D	PL	YES	83.4	100.6	100.6	98.6	0.5	100.6	0.05	0.07	
RBH04	28.04	C34	Red/Brown SADNSTONE As received	A	PD	YES		101.5	95.6	85.6	1.7	111.1	0.14	0.20	
RBH04	29.1	C35	Red/Brown SADNSTONE As received	D	PL	YES	42.2	99.3	99.3	97.3	0.2	99.3	0.02	0.03	
RBH04	29.1	C35	Red/Brown SADNSTONE As received	A	PD	YES		99.5	46.2	41.2	1.4	76.5	0.24	0.29	
RBH04	31.05	C37	Red/Brown SADNSTONE As received	A	PD	YES		100.2	79.3	65.3	1.5	100.6	0.15	0.21	
RBH04	33.87	C39	Red/Brown SADNSTONE As received	D	PL	YES	86.8	99.9	99.9	96.9	1.5	99.9	0.15	0.21	
RBH04	33.87	C39	Red/Brown SADNSTONE As received	A	PD	YES		97.0	113.7	102.7	1.4	118.5	0.10	0.15	
RBH04	36.1	C40	Red/Brown SANDSTONE As received	D	PL	YES	63.0	100.2	100.2	98.2	0.2	100.2	0.02	0.03	
RBH04	36.1	C40	Red/Brown SANDSTONE As received	A	PD	YES		100.1	68.9	58.9	0.3	93.7	0.04	0.05	
RBH04	38	C42	Red/Brown SANDSTONE As received	D	U	YES	28.7	101.2	101.2	93.2	0.0	101.2	0.00	0.01	
RBH04	39.5	C41	Red/Brown SANDSTONE As received	A	PD	YES		99.6	90.1	71.1	0.3	106.9	0.03	0.04	

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)

IAN FARMER ASSOCIATES

Test Report - 42206 / 3

Site:	St John's Masterplan
Job Number:	42206
Originating Client:	Curtins Consulting

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Date: 22/08/2018

IAN FARMER ASSOCIATES
Unit 4, Faraday Close, Pattinson North Industrial Estate, Washington, NE38 8QJ. Tel: 0191 482 8500 Fax: 0191 482 8520
washington@ianfarmer.co.uk www.ianfarmer.co.uk

F.A.O.

Test Report - 42206A / 2

Site:	St John's Masterplan
Job Number:	42206A
Originating Client:	Curtins Consulting
Originating Reference:	42206
Date Sampled:	30/07/2018
Date Scheduled:	02/08/2018
Date Testing Started:	08/08/2018
Date Testing Finished:	14/08/2018
Remarks:	

Authorised By:

Tim Robinson
Quality Technician

Date: 20/08/2018

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Laboratory Test Report 42206A / 2

Site: St John's Masterplan **Job Number:** 42206A

Client: Curtins Consulting **Page:** 2

ROCK INDEX TESTS - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock description / Rock type	Natural Water Content[1] %	Caliper[2] Dry density Mg/m³	Caliper[2] Porosity %	Buoyancy[3] Dry density Mg/m³	Buoyancy[3] Porosity %	Natural Bulk density Mg/m³	Remarks
BH04B	11.72	C6	Red/Brown SANDSTONE	12.9			1.94	27.3	2.19	
BH04B	14.90	C14	Red/Brown SANDSTONE	9.9			2.21	18.9	2.43	
BH04B	19.00	C19	Red/Brown SANDSTONE	10.7			2.08	21.7	2.31	
BH04B	24.25	C26	Red/Brown SANDSTONE	12.5			1.93	27.3	2.17	
RBH06	11.29	C13	Red/Brown SANDSTONE	12.0			2.00	24.2	2.24	
RBH06	17.16	C24	Red/Brown SANDSTONE	11.8			1.99	26.3	2.22	
RBH06	22.59	C34	Red/Brown SANDSTONE	12.3			1.97	26.4	2.21	
RBH06	27.16	C42	Red/Brown SANDSTONE	11.2			2.05	23.7	2.28	
RBH06	31.34	C46	Red/Brown SANDSTONE	8.9			2.10	20.5	2.29	
RBH06	37.00	C49	Red/Brown SANDSTONE	10.5			2.09	21.1	2.31	
RBH06	43.00	C53	Red/Brown SANDSTONE	10.6			2.05	23.8	2.27	
RBH06	51.07	C57	Red/Brown SANDSTONE	10.2			2.03	23.3	2.24	

Notes
1. ISRM p87 test 1, water content at 105 ± 3 °C, specimen as received at the laboratory
2. ISRM p87 test 2, Porosity/density determination using saturation and caliper
3. ISRM p88 test 3, Porosity/density determination using saturation and buoyancy
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 conrent 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 conrent of a rock sample

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Laboratory Test Report 42206A / 2

Site: St John's Masterplan **Job Number:** 42206A

Client: Curtins Consulting **Page:** 3

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3				Remarks
				Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
BH04B	9.66	C2	Red/Brown SANDSTONE	101.5	104.8	*1	2.12	10.8	as received	0.3460	AC	8.8	
BH04B	11.72	C6	Red/Brown SANDSTONE	100.6	149.4	*1.5	2.21	11.4	as received	0.3526	AC	14.5	
BH04B	13.05	C11	Red/Brown SANDSTONE	101.5	108.5	*1.1	2.19	10.5	as received	0.3460	AC	8.6	
BH04B	14.90	C14	Red/Brown SANDSTONE	100.7	178.0	*1.8	2.24	7.0	as received	0.3512	S	8.9	
BH04B	18.26	C18	Red/Brown SANDSTONE	100.9	124.8	*1.2	2.23	11.3	as received	0.3499	AC	9.1	
BH04B	20.14	C21	Red/Brown SANDSTONE	101.2	215.1	*2.1	2.29	8.5	as received	0.3482	AC	12.2	
BH04B	20.73	C22	Red/Brown SANDSTONE	101.4	146.0	*1.4	1.95	9.6	as received	0.3468	AC	7.7	
RBH06	12.47	C15	Red/Brown SANDSTONE	100.5	101.6	*1	2.14	13.4	as received	0.3528	AC	3.4	
RBH06	14.00	C18	Red/Brown SANDSTONE	99.7	107.1	*1.1	2.26	11.2	as received	0.3586	AC	6.3	
RBH06	15.10	C21	Red/Brown SANDSTONE	100.8	112.4	*1.1	2.20	11.8	as received	0.3507	AC	3.9	
RBH06	17.16	C24	Red/Brown SANDSTONE	99.7	107.4	*1.1	2.21	9.7	as received	0.3589	AC	9.2	
RBH06	19.09	C27	Red/Brown SANDSTONE	101.2	207.0	*2	2.22	10.0	as received	0.3479	AC	15.5	
RBH06	21.56	C31	Red/Brown SANDSTONE	100.1	193.6	*1.9	2.22	11.8	as received	0.3561	AC	13.0	
RBH06	22.59	C34	Red/Brown SANDSTONE	100.2	226.0	*2.3	2.25	10.4	as received	0.3552	AC	11.0	
RBH06	24.06	C38	Red/Brown SANDSTONE	100.7	198.8	*2	2.19	12.3	as received	0.3519	S	8.3	
RBH06	25.76	C40	Red/Brown SANDSTONE	100.3	172.8	*1.7	2.21	11.1	as received	0.3546	AC	10.5	
RBH06	27.16	C42	Red/Brown SANDSTONE	100.4	218.3	*2.2	2.19	10.9	as received	0.3535	AC	10.7	
RBH06	29.00	C44	Red/Brown SANDSTONE	100.3	203.6	*2	2.27	10.7	as received	0.3546	AC	9.6	
RBH06	30.21	C45	Red/Brown SANDSTONE	100.7	196.9	*2	2.31	9.4	as received	0.3514	AC	26.0	
RBH06	31.34	C46	Red/Brown SANDSTONE	100.7	240.7	*2.4	2.33	7.4	as received	0.3519	AC	14.3	
RBH06	35.73	C48	Red/Brown SANDSTONE	100.1	183.9	*1.8	2.38	8.1	as received	0.3558	AC	13.7	
RBH06	38.00	C50	Red/Brown SANDSTONE	99.9	250.5	2.5	2.35	8.9	as received	0.3575	AC	20.8	
RBH06	41.47	C52	Red/Brown SANDSTONE	101.0	298.6	3	2.33	8.8	as received	0.3497	AC	25.0	

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

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

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

above notes apply unless annotated otherwise in the remarks

*Denotes length diameter ratio outside ISRM specification

Mode of failure :

S - Single shear MS - multiple shear

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

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Laboratory Test Report 42206A / 2

Site: St John's Masterplan **Job Number:** 42206A

Client: Curtins Consulting **Page:** 4

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3				Remarks
				Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
RBH06	43.00	C53	Red/Brown SANDSTONE	101.2	238.9	*2.4	2.26	9.2	as received	0.3480	AC	16.3	
RBH06	46.47	C55	Red/Brown SANDSTONE	100.8	299.9	3	2.38	5.5	as received	0.3511	AC	16.9	
RBH06	51.07	C57	Red/Brown SANDSTONE	101.2	245.4	*2.4	2.27	8.4	as received	0.3482	AC	13.8	

Notes
1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS
2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density
3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials
above notes apply unless annotated otherwise in the remarks

*Denotes length diameter ratio outside ISRM specification

Mode of failure :
S - Single shear MS - multiple shear
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

IAN FARMER ASSOCIATES

Laboratory Test Report	42206A / 2

Site: St John's Masterplan **Job Number:** 42206A

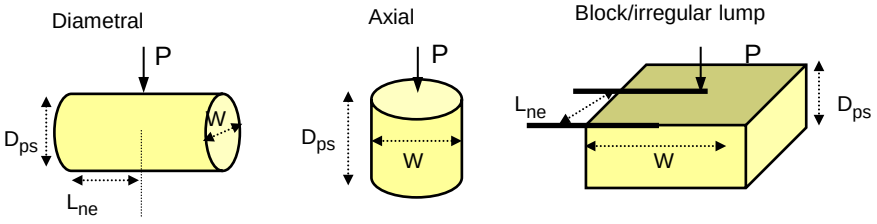
Client: Curtins Consulting **Page:** 5

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	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
BH04B	8.5	C1	Red/Brown SANDSTONE As received	D	PL	YES	44.7	99.6	99.6	95.6	0.9	99.6	0.09	0.12	
BH04B	8.5	C1	Red/Brown SANDSTONE As received	A	PD	YES		101.3	46.9	41.9	1.8	77.8	0.30	0.36	
BH04B	10.77	C4	Red/Brown SANDSTONE As received	D	PL	YES	52.1	99.0	99.0	96.0	0.1	99.0	0.01	0.02	
BH04B	10.77	C4	Red/Brown SANDSTONE As received	A	PD	YES		99.1	63.0	59.0	0.9	89.1	0.11	0.15	
BH04B	12.31	C8	Red/Brown SANDSTONE As received	D	PL	YES	50.1	101.0	101.0	99.0	0.7	101.0	0.07	0.10	
BH04B	12.31	C8	Red/Brown SANDSTONE As received	A	PD	YES		100.7	49.7	46.7	1.2	79.8	0.18	0.23	
BH04B	14.1	C12	Red/Brown SANDSTONE As received	D	PL	YES	52.2	100.5	100.5	97.5	0.9	100.5	0.09	0.12	
BH04B	14.1	C12	Red/Brown SANDSTONE As received	A	PD	YES		100.6	44.4	38.4	1.6	75.4	0.28	0.34	
BH04B	16	C16	Red/Brown SANDSTONE As received	D	PL	YES	81.9	100.6	100.6	95.6	0.8	100.6	0.07	0.10	
BH04B	16	C16	Red/Brown SANDSTONE As received	A	PD	YES		100.4	75.6	68.6	1.9	98.3	0.20	0.27	
BH04B	17	C17	Red/Brown SANDSTONE As received	D	PL	YES	82.3	101.1	101.1	96.1	1.0	101.1	0.09	0.13	
BH04B	17	C17	Red/Brown SANDSTONE As received	A	PD	YES		101.2	74.3	41.3	2.4	97.8	0.25	0.33	
BH04B	19	C19	Red/Brown SANDSTONE As received	D	PL	YES	100.9	101.5	101.5	96.5	0.8	101.5	0.08	0.11	
BH04B	19	C19	Red/Brown SANDSTONE As received	A	PD	YES		101.5	90.4	83.4	0.5	108.1	0.04	0.06	
BH04B	21.55	C23	Red/Brown SANDSTONE As received	D	PL	YES	51.8	100.7	100.7	98.7	1.4	100.7	0.14	0.19	
BH04B	21.55	C23	Red/Brown SANDSTONE As received	A	PD	YES		100.6	70.1	62.1	2.1	94.7	0.24	0.32	
BH04B	23.14	C24	Red/Brown SANDSTONE As received	D	PL	YES	64.9	100.7	100.7	96.7	0.3	100.7	0.03	0.04	
BH04B	23.14	C24	Red/Brown SANDSTONE As received	A	PD	YES		100.3	109.6	91.6	0.2	118.3	0.01	0.02	
BH04B	24.04	C25	Red/Brown SANDSTONE As received	D	PL	YES	76.0	100.4	100.4	96.4	1.2	100.4	0.12	0.16	
BH04B	24.04	C25	Red/Brown SANDSTONE As received	A	PD	YES		101.4	74.0	58.0	2.4	97.7	0.25	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)

Site: St John's Masterplan **Job Number:** 42206A

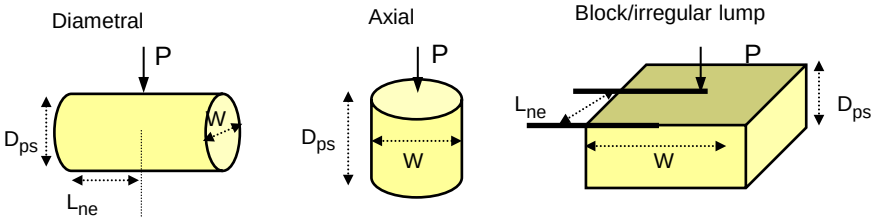
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM: Type (D, A, I, B)	Test Type see ISRM: Direction (PL, PD or U)	Failure Valid (Y/N)	Dimensions: Lne mm	Dimensions: W mm	Dimensions: Dps mm	Dimensions: Dps' mm	Force P kN	Equivalent diameter, De mm	Point Load Strength Index: Is . MPa	Point Load Strength Index: Is (50) MPa	Remarks (including water content if measured)
RBH06	8	C10	Red/Brown SANDSTONE As received	D	PL	YES	46.5	98.9	98.9	95.9	0.4	98.9	0.04	0.05	
RBH06	8	C10	Red/Brown SANDSTONE As received	A	PD	YES		98.2	57.7	53.7	0.6	84.9	0.08	0.10	
RBH06	9.63	C11	Red/Brown SANDSTONE As received	D	PL	YES	47.2	98.8	98.8	92.8	0.2	98.8	0.03	0.03	
RBH06	9.63	C11	Red/Brown SANDSTONE As received	A	PD	YES		98.0	55.7	51.7	0.7	83.4	0.10	0.13	
RBH06	11.29	C13	Red/Brown SANDSTONE As received	D	PL	YES	53.2	101.3	101.3	97.3	0.3	101.3	0.03	0.04	
RBH06	11.29	C13	Red/Brown SANDSTONE As received	A	PD	YES		101.3	82.0	70.0	0.7	102.8	0.07	0.09	
RBH06	13	C16	Red/Brown SANDSTONE As received	D	PL	YES	49.9	100.4	100.4	97.4	0.4	100.4	0.04	0.05	
RBH06	13	C16	Red/Brown SANDSTONE As received	A	PD	YES		100.2	52.5	45.5	1.1	81.8	0.17	0.21	
RBH06	14.17	C19	Red/Brown SANDSTONE As received	A	PD	YES		99.6	58.3	54.3	0.2	86.0	0.03	0.04	
RBH06	16.55	C22	Red/Brown SANDSTONE As received	D	PL	YES	40.5	99.5	99.5	96.5	0.4	99.5	0.04	0.06	
RBH06	16.55	C22	Red/Brown SANDSTONE As received	A	PD	YES		98.6	47.6	43.6	0.8	77.3	0.14	0.17	
RBH06	18.06	C25	Red/Brown SANDSTONE As received	D	PL	YES	50.0	95.8	95.8	91.8	0.2	95.8	0.03	0.03	
RBH06	18.06	C25	Red/Brown SANDSTONE As received	A	PD	YES		98.9	57.2	50.2	0.9	84.8	0.12	0.16	
RBH06	20.21	C29	Red/Brown SANDSTONE As received	D	PL	YES	55.7	99.6	99.6	96.6	0.7	99.6	0.07	0.10	
RBH06	20.21	C29	Red/Brown SANDSTONE As received	A	PD	YES		100.3	53.7	49.7	1.3	82.8	0.19	0.23	
RBH06	21	C30	Red/Brown SANDSTONE As received	D	PL	YES	83.4	100.8	100.8	98.8	1.0	100.8	0.10	0.14	
RBH06	21	C30	Red/Brown SANDSTONE As received	A	PD	YES		100.9	79.4	68.4	3.0	101.0	0.29	0.40	
RBH06	23.6	C37	Red/Brown SANDSTONE As received	D	PL	YES	83.7	100.1	100.1	97.1	0.6	100.1	0.06	0.08	
RBH06	23.6	C37	Red/Brown SANDSTONE As received	A	PD	YES		100.1	72.5	63.5	1.6	96.1	0.18	0.24	
RBH06	25	C39	Red/Brown SANDSTONE As received	D	PL	YES	64.3	100.9	100.9	97.9	0.9	100.9	0.09	0.13	

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)

Site: St John's Masterplan **Job Number:** 42206A

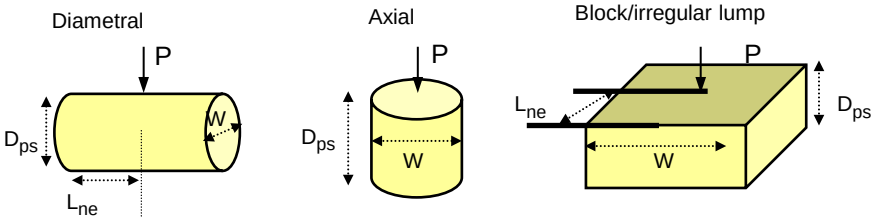
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM: Type (D, A, I, B)	Test Type see ISRM: Direction (PL, PD or U)	Failure Valid (Y/N)	Dimensions: Lne mm	Dimensions: W mm	Dimensions: Dps mm	Dimensions: Dps' mm	Force P kN	Equivalent diameter, De mm	Point Load Strength Index: Is . MPa	Point Load Strength Index: Is (50) MPa	Remarks (including water content if measured)
RBH06	25	C39	Red/Brown SANDSTONE As received	A	PD	YES		101.0	53.0	43.0	0.6	82.5	0.09	0.12	
RBH06	26.71	C41	Red/Brown SANDSTONE As received	D	PL	YES	63.7	100.4	100.4	99.4	0.7	100.4	0.07	0.09	
RBH06	26.71	C41	Red/Brown SANDSTONE As received	A	PD	YES		100.2	60.7	50.7	1.1	88.0	0.15	0.19	
RBH06	28.07	C43	Red/Brown SANDSTONE As received	D	PL	YES	78.3	100.5	100.5	97.5	0.4	100.5	0.04	0.05	
RBH06	28.07	C43	Red/Brown SANDSTONE As received	A	PD	YES		100.5	71.4	66.4	1.5	95.6	0.17	0.23	
RBH06	33.31	C47	Red/Brown SANDSTONE As received	D	PL	YES	89.7	99.9	99.9	96.9	0.9	99.9	0.09	0.13	
RBH06	33.31	C47	Red/Brown SANDSTONE As received	A	PD	YES		100.3	89.6	82.6	2.2	107.0	0.19	0.27	
RBH06	37	C49	Red/Brown SANDSTONE As received	D	PL	YES	87.3	99.8	99.8	96.8	0.9	99.8	0.09	0.13	
RBH06	37	C49	Red/Brown SANDSTONE As received	A	PD	YES		99.6	66.1	60.1	1.4	91.6	0.17	0.22	
RBH06	40.03	C51	Red/Brown SANDSTONE As received	D	PL	YES	74.1	100.4	100.4	98.4	1.7	100.4	0.17	0.23	
RBH06	40.03	C51	Red/Brown SANDSTONE As received	A	PD	YES		100.0	97.0	88.0	2.4	111.1	0.19	0.28	
RBH06	45	C54	Red/Brown SANDSTONE As received	D	PL	YES	87.5	100.7	100.7	98.7	1.4	100.7	0.13	0.18	
RBH06	45	C54	Red/Brown SANDSTONE As received	A	PD	YES		100.9	83.0	78.0	2.2	103.2	0.20	0.28	
RBH06	49.07	C56	Red/Brown SANDSTONE As received	D	PL	YES	74.9	100.8	100.8	98.8	0.5	100.8	0.04	0.06	
RBH06	49.07	C56	Red/Brown SANDSTONE As received	A	PD	YES		100.7	70.7	65.7	0.9	95.2	0.10	0.13	
RBH06	53.25	C58	Red/Brown SANDSTONE As received	D	PL	YES	57.5	100.8	100.8	95.8	1.0	100.8	0.10	0.14	
RBH06	53.25	C58	Red/Brown SANDSTONE As received	A	PD	YES		100.4	43.7	38.7	0.8	74.7	0.14	0.17	
RBH06	54.87	C59	Red/Brown SANDSTONE As received	D	PL	YES	65.3	100.5	100.5	97.5	0.7	100.5	0.07	0.10	
RBH06	54.87	C59	Red/Brown SANDSTONE As received	A	PD	YES		100.9	71.5	51.5	2.0	95.8	0.22	0.29	

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)

IAN FARMER ASSOCIATES

Test Report - 42206A / 2

Site: St John's Masterplan

Job Number: 42206A

Originating Client: Curtins Consulting

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Date: 20/08/2018

IAN FARMER ASSOCIATES
Unit 4, Faraday Close, Pattinson North Industrial Estate, Washington, NE38 8QJ. Tel: 0191 482 8500 Fax: 0191 482 8520
washington@ianfarmer.co.uk www.ianfarmer.co.uk

F.A.O.

Test Report - 42206B / 1

Site:	St John's Masterplan
Job Number:	42206B
Originating Client:	Curtins Consulting
Originating Reference:	42206
Date Sampled:	02/08/2018
Date Scheduled:	13/08/2018
Date Testing Started:	17/08/2018
Date Testing Finished:	29/08/2018
Remarks:	

Authorised By:

Tim Robinson
Quality Technician

Date: 30/08/2018

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AGS

Site: St John's Masterplan **Job Number:** 42206B

Client: Curtins Consulting **Page:** 2

ROCK INDEX TESTS - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock description / Rock type	Natural Water Content1 %	Caliper2 Dry density Mg/m3	Caliper2 Porosity %	Buoyancy3 Dry density Mg/m3	Buoyancy3 Porosity %	Natural Bulk density Mg/m3	Remarks
BH02	13.16	C23	Red SANDSTONE	12.0			2.05	24.3	2.30	
BH02	18.19	C28	Red SANDSTONE	11.2			2.05	23.5	2.27	
BH02	24.30	C38	Red SANDSTONE	9.5			2.04	23.1	2.23	
BH03	11.19	C19	Red SANDSTONE	10.5			1.98	24.1	2.19	
BH03	16.98	C23	Red SANDSTONE	10.6			2.00	23.3	2.21	
BH03	24.38	C30	Red SANDSTONE	11.2			1.91	27.3	2.12	
RBH05	10.28	C19	Red SANDSTONE	9.9			2.05	22.6	2.25	
RBH05	16.17	C28	Red SANDSTONE	13.6			1.88	29.4	2.13	
RBH05	22.00	C37	Red SANDSTONE	12.4			1.91	27.6	2.15	
RBH05	28.18	C43	Red SANDSTONE	7.9			2.06	21.7	2.23	
RBH05	32.19	C47	Red SANDSTONE	8.1			2.01	21.4	2.17	
RBH05	36.38	C50	Red SANDSTONE	10.9			2.13	18.9	2.37	
RBH05	39.50	C52	Red SANDSTONE	11.0			1.96	25.6	2.17	

Notes 1. ISRM p87 test 1, water content at 105 ± 3 oC, specimen as received at the laboratory

2. ISRM p87 test 2, Porosity/density determination using saturation and caliper

3. ISRM p88 test 3, Porosity/density determination using saturation and buoyancy

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 conrent 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 conrent of a rock sample

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Laboratory Test Report 42206B / 1

Site: St John's Masterplan **Job Number:** 42206B

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UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3				Remarks
				Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
BH02	13.16	C23	Red/Brown SANDSTONE	99.2	60.4	*0.6	2.19	11.6	as received	0.3623	AC	7.4	
BH02	17.13	C27	Red/Brown SANDSTONE	100.7	69.1	*0.7	2.30	8.4	as received	0.3629	AC	21.7	
BH02	18.19	C28	Red/Brown SANDSTONE	100.4	83.4	*0.8	2.21	11.2	as received	0.3537	AC	12.0	
BH02	21.00	C31	Red/Brown SANDTONE	100.2	201.0	*2	2.22	11.7	as received	0.3552	S	8.4	
BH02	22.56	C37	Red/Brown SANDSTONE	100.3	218.1	*2.2	2.27	10.5	as received	0.3543	S	8.7	
BH02	24.30	C38	Red/Brown SANDSTONE	101.8	259.6	2.6	2.26	9.5	as received	0.3442	AC	7.3	
BH03	10.15	C18	Red/Brown SANDSTONE	100.0	94.3	*0.9	2.24	10.1	as received	0.3566	AC	14.7	
BH03	12.28	C20	Red/Brown SANDSTONE	100.7	154.2	*1.5	2.22	10.8	as received	0.3516	AC	14.7	
BH03	13.16	C20	Red/Brown SANDTONE	100.7	199.4	*2	2.27	11.1	as received	0.3519	S	17.2	
BH03	18.29	C24	Red/Brown SANDTONE	100.3	149.6	*1.5	2.32	9.4	as received	0.3544	AC	23.9	
BH03	19.06	C25	Red/Brown SANDSTONE	100.6	192.3	*1.9	2.31	10.3	as received	0.3523	AC	14.5	
BH03	20.89	C27	Red/Brown SANDSTONE	100.5	263.4	2.6	2.31	10.2	as received	0.3530	S	12.6	
BH03	23.01	C29	Red/Brown SANDSTONE	101.3	274.7	2.7	2.18	11.9	as received	0.3475	S	11.9	
BH03	24.38	C30	Red/Brown SANDSTONE	100.6	250.3	2.5	2.22	11.2	as received	0.3522	AC	14.6	
RBH05	12.57	C23	Red/Brown SANDSTONE	101.0	76.0	*0.8	2.24	9.9	as received	0.3492	AC	7.1	
RBH05	14.09	C24	Red/Brown SANDSTONE	100.4	118.1	*1.2	2.16	12.4	as received	0.3540	AC	6.5	
RBH05	16.17	C28	Red/Brown SANDSTONE	101.7	221.4	*2.2	2.14	12.3	as received	0.3447	S	10.6	
RBH05	19.10	C32	Red/Brown SANDSTONE	100.8	228.0	*2.3	2.36	7.7	as received	0.3510	S	13.1	
RBH05	22.00	C37	Red/Brown SANDSTONE	101.3	128.7	*1.3	2.19	37.7	as received	0.3476	AC	5.8	
RBH05	23.05	C38	Red/Brown SANDSTONE	99.7	131.2	*1.3	2.29	9.9	as received	0.3584	AC	10.6	
RBH05	24.61	C40	Red/Brown SANDSTONE	100.2	219.8	*2.2	2.34	8.5	as received	0.3554	AC	8.5	
RBH05	26.00	C41	Red/Brown SANDSTONE	100.7	244.9	*2.4	2.28	10.1	as received	0.3518	S	11.0	
RBH05	28.18	C43	Red/Brown SANDSTONE	100.8	168.4	*1.7	2.23	9.3	as received	0.3505	AC	7.0	

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

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

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

above notes apply unless annotated otherwise in the remarks

*Denotes length diameter ratio outside ISRM specification

Mode of failure :

S - Single shear MS - multiple shear

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

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Laboratory Test Report 42206B / 1

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UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3				Remarks
				Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
RBH05	31.19	C46	Red/Brown SANDSTONE	100.8	254.2	2.5	2.32	8.6	as received	0.3509	AC	18.5	
RBH05	35.20	C49	Red/Brown SANDSTONE	100.3	78.0	*0.8	2.44	6.2	as received	0.3541	AC	35.6	
RBH05	38.04	C51	Red/Brown SANDSTONE	100.4	103.0	*1	2.26	9.7	as received	0.3535	AC	1.8	
RBH05	39.50	C52	Red/Brown SANDSTONE	100.5	276.2	2.7	2.24	9.8	as received	0.3533	AC	8.0	

Notes
1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS
2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density
3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials
above notes apply unless annotated otherwise in the remarks

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S - Single shear MS - multiple shear
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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

Site: St John's Masterplan **Job Number:** 42206B

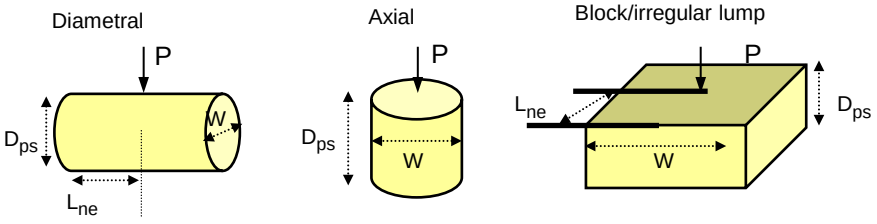
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM: Type (D, A, I, B)	Test Type see ISRM: Direction (PL, PD or U)	Failure Valid (Y/N)	Dimensions: Lne mm	Dimensions: W mm	Dimensions: Dps mm	Dimensions: Dps' mm	Force P kN	Equivalent diameter, De mm	Point Load Strength Index: Is . MPa	Point Load Strength Index: Is (50) MPa	Remarks (including water content if measured)
BH02	8.43	C20	Red/Brown SANDSTONE As received	D	PL	YES	39.5	100.1	100.1	98.1	0.2	100.1	0.02	0.03	
BH02	8.43	C20	Red/Brown SANDSTONE As received	A	PD	YES		101.3	69.5	59.5	0.6	94.6	0.07	0.09	
BH02	10.1	C21	Red/Brown SANDSTONE As received	A	PD	YES		100.3	57.2	49.2	0.3	85.5	0.05	0.06	
BH02	11.91	C22	Red/Brown SANDSTONE As received	D	PL	YES	34.7	98.9	98.9	95.9	0.1	98.9	0.01	0.01	
BH02	11.91	C22	Red/Brown SANDSTONE As received	A	PD	YES		98.3	81.3	75.3	0.4	100.9	0.04	0.05	
BH02	14.13	C34	Red/Brown SANDSTONE As received	D	PL	YES	39.9	99.9	99.9	96.9	1.0	99.9	0.10	0.13	
BH02	14.13	C34	Red/Brown SANDSTONE As received	A	PD	YES		98.7	98.8	86.8	1.3	111.4	0.10	0.15	
BH02	15.07	C25	Red/Brown SANDSTONE As received	D	PL	YES		100.7	100.7	94.7	1.6	100.7	0.16	0.21	
BH02	16.22	C26	Red/Brown SANDSTONE As received	D	PL	YES	84.3	99.7	99.7	90.7	0.3	99.7	0.03	0.04	
BH02	16.22	C26	Red/Brown SANDSTONE As received	A	PD	YES		99.6	86.9	69.9	0.3	105.0	0.03	0.04	
BH02	19	C29	Red/Brown SANDSTONE As received	D	PL	YES	41.5	100.9	100.9	98.9	0.3	100.9	0.03	0.04	
BH02	19	C29	Red/Brown SANDSTONE As received	A	PD	YES		100.5	46.5	44.5	0.5	77.2	0.08	0.09	
BH02	20	C30	Red/Brown SANDSTONE As received	D	PL	YES	40.1	99.2	99.2	97.2	0.3	99.2	0.03	0.04	
BH02	20	C30	Red/Brown SANDSTONE As received	A	PD	YES		99.2	49.2	44.2	0.5	78.8	0.07	0.09	
BH02	22	C36	Red/Brown SANDSTONE As received	D	PL	YES	46.1	98.9	98.9	94.9	0.4	98.9	0.04	0.05	
BH02	22	C36	Red/Brown SANDSTONE As received	A	PD	YES		99.1	53.2	47.2	0.3	81.9	0.04	0.05	
BH02	23.83	C39	Red/Brown SANDSTONE As received	D	PL	YES	37.7	99.9	99.9	95.9	0.3	99.9	0.03	0.05	
BH02	23.83	C39	Red/Brown SANDSTONE As received	A	PD	YES		100.0	38.8	33.8	0.6	70.3	0.13	0.15	
BH03	8.52	C16	Red/Brown SANDSTONE As received	D	PL	YES	70.2	100.8	100.8	97.8	0.7	100.8	0.07	0.10	
BH03	8.52	C16	Red/Brown SANDSTONE As received	A	PD	YES		98.8	58.9	64.9	1.2	86.1	0.16	0.20	

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)

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Laboratory Test Report | 42206B / 1

Site: St John's Masterplan | **Job Number:** 42206B

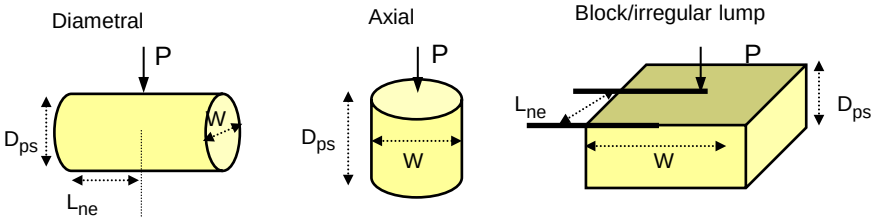
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Point Load Strength Index Tests
Summary of Results

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	
BH03	9.56	C17	Red/Brown SANDSTONE As received	D	PL	YES	75.8	99.9	99.9	96.9	0.4	99.9	0.04	0.05	
BH03	9.56	C17	Red/Brown SANDSTONE As received	A	PD	YES		98.7	70.9	62.9	1.0	94.4	0.12	0.15	
BH03	11.19	C19	Red/Brown SANDSTONE As received	D	PL	YES	47.0	100.1	100.1	98.1	0.4	100.1	0.04	0.05	
BH03	11.19	C19	Red/Brown SANDSTONE As received	A	PD	YES		100.5	55.2	51.2	0.9	84.1	0.13	0.17	
BH03	14.03	C21	Red/Brown SANDSTONE As received	A	PD	YES		97.0	68.2	62.2	1.9	91.7	0.23	0.30	
BH03	16.08	C22	Red/Brown SANDSTONE As received	D	PL	YES	65.6	100.0	100.0	96.0	1.4	100.0	0.14	0.19	
BH03	16.08	C22	Red/Brown SANDSTONE As received	A	PD	YES		99.5	62.3	55.3	1.4	88.8	0.18	0.23	
BH03	16.98	C23	Red/Brown SANDSTONE As received	D	PL	YES	60.4	100.8	100.8	98.8	1.0	100.8	0.09	0.13	
BH03	16.98	C23	Red/Brown SANDSTONE As received	A	PD	YES		100.2	58.6	53.6	2.1	86.5	0.28	0.35	
BH03	19.9	C26	Red/Brown SANDSTONE As received	D	PL	YES	65.5	100.4	100.4	100.4	1.2	100.4	0.12	0.16	
BH03	19.9	C26	Red/Brown SANDSTONE As received	A	PD	YES		100.7	70.1	70.1	2.4	94.7	0.26	0.35	
BH03	21.83	C28	Red/Brown SANDSTONE As received	D	PL	YES	98.7	101.1	101.1	101.1	1.2	101.1	0.12	0.16	
BH03	21.83	C28	Red/Brown SANDSTONE As received	A	PD	YES		101.0	107.8	107.8	3.0	117.7	0.22	0.32	
BH03	24.83	C30	Red/Brown SANDSTONE As received	D	PL	YES	49.2	100.3	100.3	97.3	0.8	100.3	0.08	0.10	
BH03	24.83	C30	Red/Brown SANDSTONE As received	A	PD	YES		100.4	61.2	55.2	3.5	88.5	0.45	0.58	
RBH05	8.54	C16	Red/Brown SANDSTONE As received	D	PL	YES	44.7	100.4	100.4	96.4	0.6	100.4	0.06	0.09	
RBH05	8.54	C16	Red/Brown SANDSTONE As received	A	PD	YES		100.7	79.8	61.8	0.8	101.2	0.08	0.11	
RBH05	9.51	C17	Red/Brown SANDSTONE As received	A	PD	YES		99.8	58.7	53.7	0.9	86.3	0.12	0.15	
RBH05	10.28	C19	Red/Brown SANDSTONE As received	D	PL	YES	37.9	100.8	100.8	96.8	0.9	100.8	0.08	0.11	
RBH05	10.28	C19	Red/Brown SANDSTONE As received	A	PD	YES		100.8	35.8	20.8	1.0	67.8	0.22	0.25	

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)

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Laboratory Test Report | 42206B / 1

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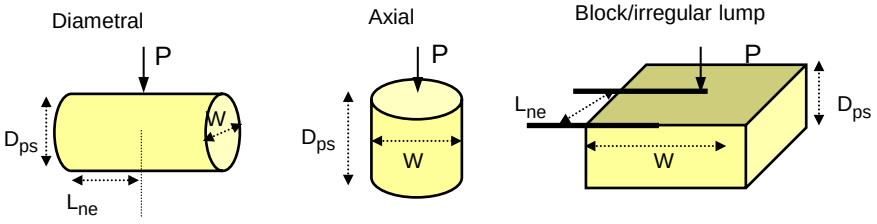
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Point Load Strength Index Tests
Summary of Results

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	
RBH05	11.37	C20	Red/Brown SANDSTONE As received	A	PD	YES		95.4	124.6	117.6	1.1	123.0	0.08	0.11	
RBH05	12.05	C21	Red/Brown SANDSTONE As received	D	PL	YES	61.8	96.6	96.6	93.6	0.1	96.6	0.01	0.02	
RBH05	14.93	C26	Red/Brown SANDSTONE As received	D	PL	YES	34.3	101.7	101.7	97.7	0.5	101.7	0.05	0.06	
RBH05	14.93	C26	Red/Brown SANDSTONE As received	A	PD	YES		102.0	52.2	50.2	0.4	82.3	0.06	0.08	
RBH05	17.77	C30	Red/Brown SANDSTONE As received	D	PL	YES	94.1	101.1	101.1	97.1	0.7	101.1	0.07	0.09	
RBH05	17.77	C30	Red/Brown SANDSTONE As received	A	PD	YES		101.0	116.0	110.0	1.3	122.2	0.09	0.13	
RBH05	20.06	C34	Red/Brown SANDSTONE As received	D	PL	YES	44.0	100.3	100.3	98.3	0.3	100.3	0.03	0.05	
RBH05	20.06	C34	Red/Brown SANDSTONE As received	A	PD	YES		101.4	62.8	58.8	1.7	90.0	0.20	0.27	
RBH05	21	C35	Red/Brown SANDSTONE As received	A	PD	YES		100.2	63.3	60.3	0.5	89.8	0.06	0.08	
RBH05	23.9	C39	Red/Brown SANDSTONE As received	D	PL	YES	43.0	100.4	100.4	96.4	0.6	100.4	0.06	0.08	
RBH05	23.9	C39	Red/Brown SANDSTONE As received	A	PD	YES		100.5	55.1	49.1	0.7	83.9	0.10	0.12	
RBH05	26.88	C42	Red/Brown SANDSTONE As received	D	PL	YES	57.2	100.3	100.3	98.3	0.9	100.3	0.09	0.12	
RBH05	26.88	C42	Red/Brown SANDSTONE As received	A	PD	YES		100.6	55.5	50.5	1.2	84.3	0.17	0.22	
RBH05	28.9	C44	Red/Brown SANDSTONE As received	A	PD	YES		101.0	67.7	22.7	0.3	93.3	0.04	0.05	
RBH05	29.88	C45	Red/Brown SANDSTONE As received	D	PL	YES	47.9	100.4	100.4	97.4	1.0	100.4	0.10	0.13	
RBH05	29.88	C45	Red/Brown SANDSTONE As received	A	PD	YES		100.6	51.8	46.8	1.1	81.5	0.16	0.20	
RBH05	32.19	C47	Red/Brown SANDSTONE As received	D	PL	YES	42.3	99.7	99.7	95.7	0.3	99.7	0.03	0.04	
RBH05	32.19	C47	Red/Brown SANDSTONE As received	A	PD	YES		99.9	57.4	52.4	1.1	85.4	0.15	0.20	
RBH05	34	C48	Red/Brown SANDSTONE As received	D	PL	YES	46.4	101.2	101.2	99.2	1.4	101.2	0.14	0.19	
RBH05	34	C48	Red/Brown SANDSTONE As received	A	PD	YES		100.8	52.9	49.9	2.0	82.4	0.30	0.37	

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
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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)

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Laboratory Test Report 42206B / 1

Site: St John's Masterplan **Job Number:** 42206B

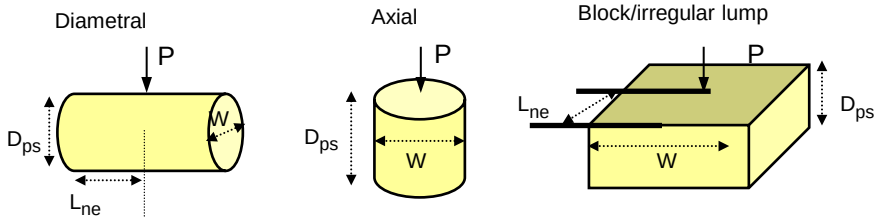
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Point Load Strength Index Tests
Summary of Results

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	
RBH05	36.38	C50	Red/Brown SANDSTONE As received	D	PL	YES	47.3	100.3	100.3	98.3	1.2	100.3	0.12	0.16	
RBH05	36.38	C50	Red/Brown SANDSTONE As received	A	PD	YES		101.3	54.6	49.6	1.5	83.9	0.21	0.27	

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)
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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)

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Test Report - 42206B / 1

Site: St John's Masterplan

Job Number: 42206B

Originating Client: Curtins Consulting

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Date: 30/08/2018

ISRM - Suggested Methods : Part 2 : Received 1983

Strength of Rock Material in Triaxial Compression: Revised Version

Borehole Ref.:	BH02
Sample Ref.:	32
Depth (m):	11.70-11.81

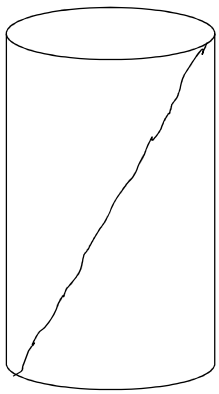
Description:
Medium strong orangish brown fine to medium grained SANDSTONE.
Moderately weathered

LF0879C (1000kN) compression frame used

Diameter	53.60 mm
Height	108.30 mm
Bulk Density	2.02 Mg/m³
Dry Density	1.96 Mg/m³
Water Content	3.2 %

Degree of Saturation: 22.7 %. Specific Gravity: 2.72 Mg/m³ (Assumed)

Failure Sketch



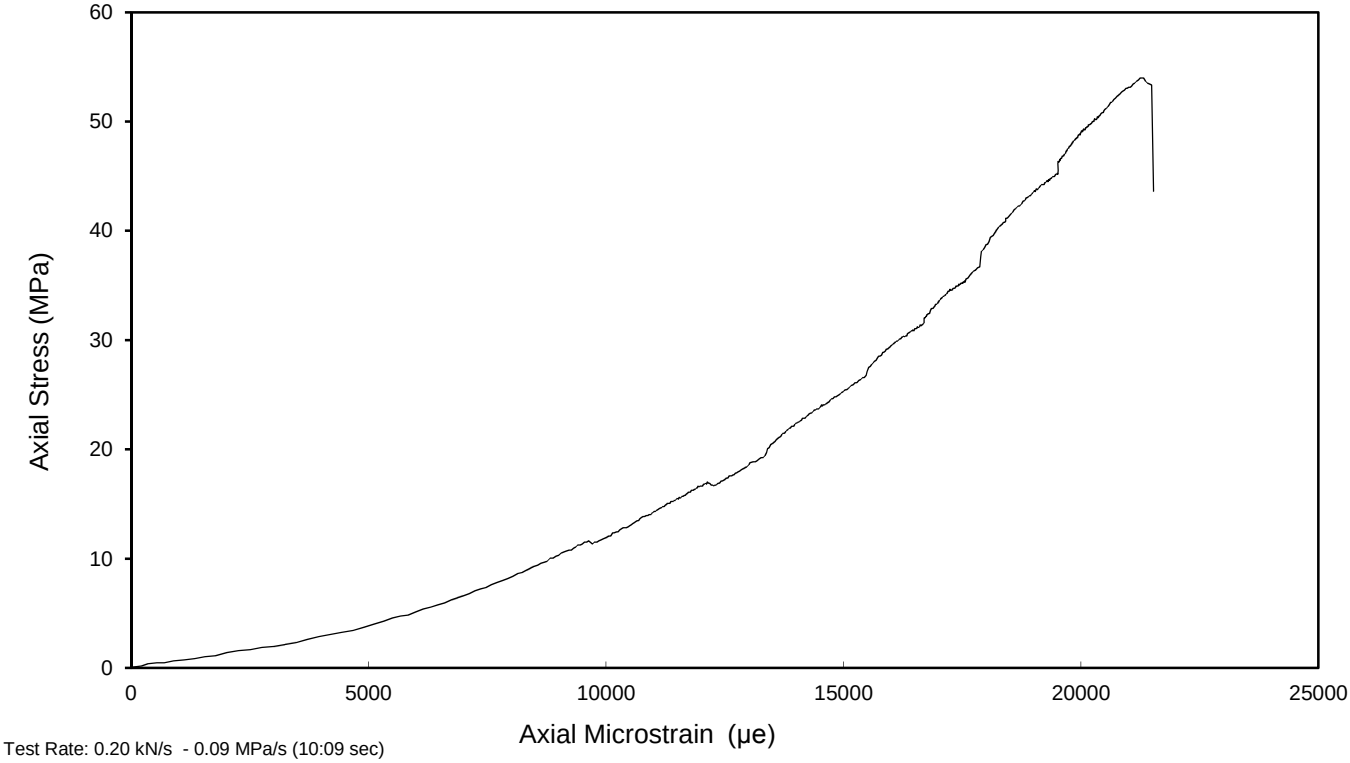
Solid lines for material failures.
Dashed lines for apparent weakness failure.

Date tested: 22/08/2018

Sample type	C

Results

Confining Pressure	Axial Strength
1.00 MPa	19.7 MPa
2.00 MPa	26.5 MPa
3.00 MPa	31.3 MPa
4.00 MPa	36.7 MPa
6.00 MPa	45.1 MPa
8.00 MPa	54 MPa



Test Rate: 0.20 kN/s - 0.09 MPa/s (10:09 sec)

Note: The dimensional requirements of Flatness (<0.02 mm), Perpendicularity (<0.05 / 50 mm) and Straightness (0.3 mm deviation) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number:

GEO / 27859

Project Name:

ST JOHN'S MASTERPLAN
42206

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ISRM - Suggested Methods : Part 2 : Received 2007

Strength of Rock Materials in Triaxial Compression: Revised Version

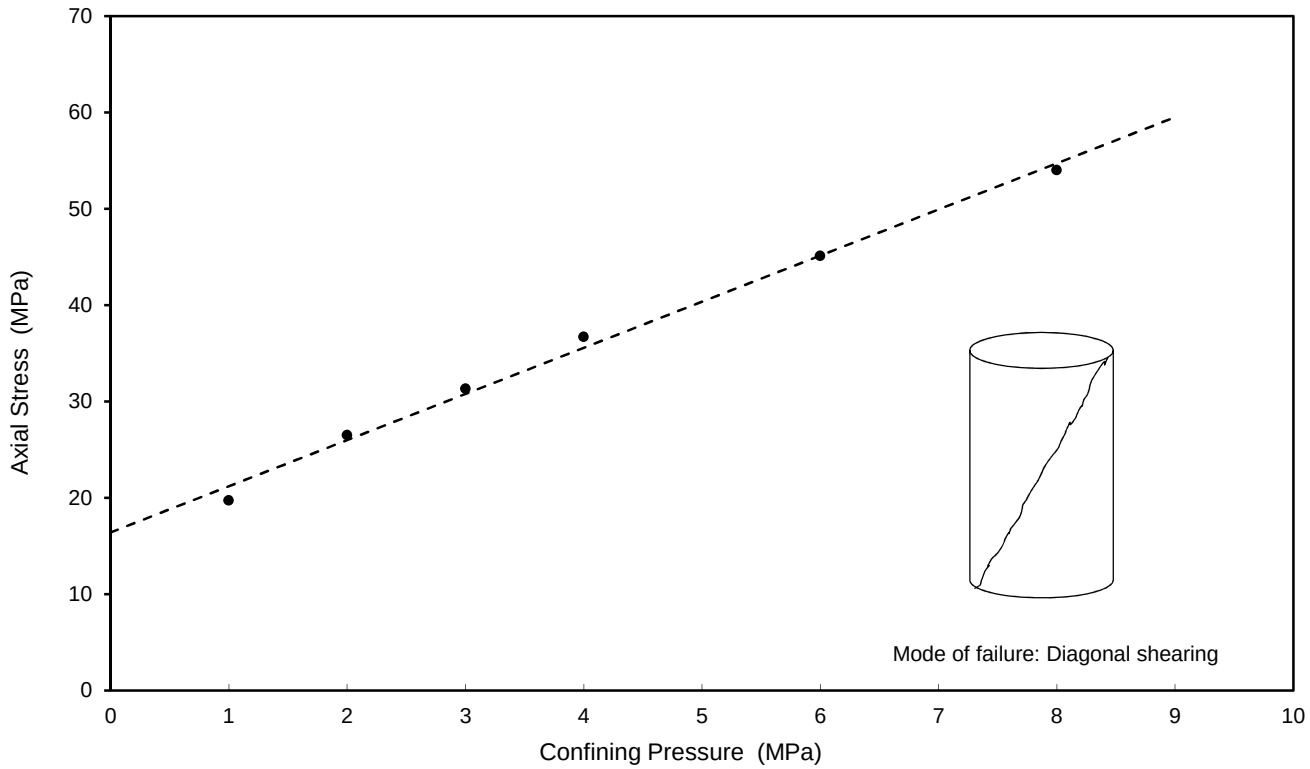
Description: Medium strong orangish brown fine to medium grained SANDSTONE. Moderately weathered

Test Type **Type II - Multiple failure state test** Date Tested: 22-08-18

Borehole Ref.		BH02	BH02	BH02	BH02	BH02	BH02
Sample Ref.		32	32	32	32	32	32
Depth (m)		11.70-11.81	11.70-11.81	11.70-11.81	11.70-11.81	11.70-11.81	11.70-11.81
Diameter	(mm)	53.60	53.60	53.60	53.60	53.60	53.60
Height	(mm)	108.30	108.30	108.30	108.30	108.30	108.30
Bulk Density	(Mg/m³)	2.02	2.02	2.02	2.02	2.02	2.02
Dry Density	(Mg/m³)	1.96	1.96	1.96	1.96	1.96	1.96
Water Content	(%)	3.2	3.2	3.2	3.2	3.2	3.2
Confining Pressure	(MPa)	**1.00**	**2.00**	**3.00**	**4.00**	**6.00**	**8.00**
Axial Strength	(MPa)	**19.70**	**26.50**	**31.30**	**36.70**	**45.10**	**54.00**

Gradient of Slope, m **4.788** Internal Friction Angle, φ **40.9 º**

Ordinate of Slope, b **16 MPa** Apparent Cohesion, c **4 MPa**



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C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number: **GEO / 27859**

Project Name: **ST JOHN'S MASTERPLAN 42206**

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ISRM - Suggested Methods : Part 2 : Received 1983

Strength of Rock Material in Triaxial Compression: Revised Version

Borehole Ref.:	BH03
Sample Ref.:	32
Depth (m):	12.50-12.69

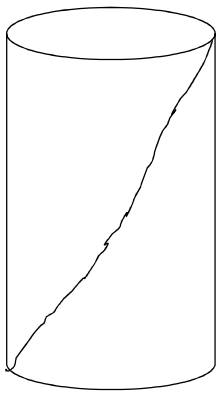
Description:
Medium strong orangish brown fine to medium grained SANDSTONE. Slightly to moderately weathered

LF0879C (1000kN) compression frame used

Diameter	53.60 mm
Height	108.40 mm
Bulk Density	2.19 Mg/m³
Dry Density	2.14 Mg/m³
Water Content	2.7 %

Degree of Saturation: 26.3 %. Specific Gravity: 2.72 Mg/m³ (Assumed)

Failure Sketch



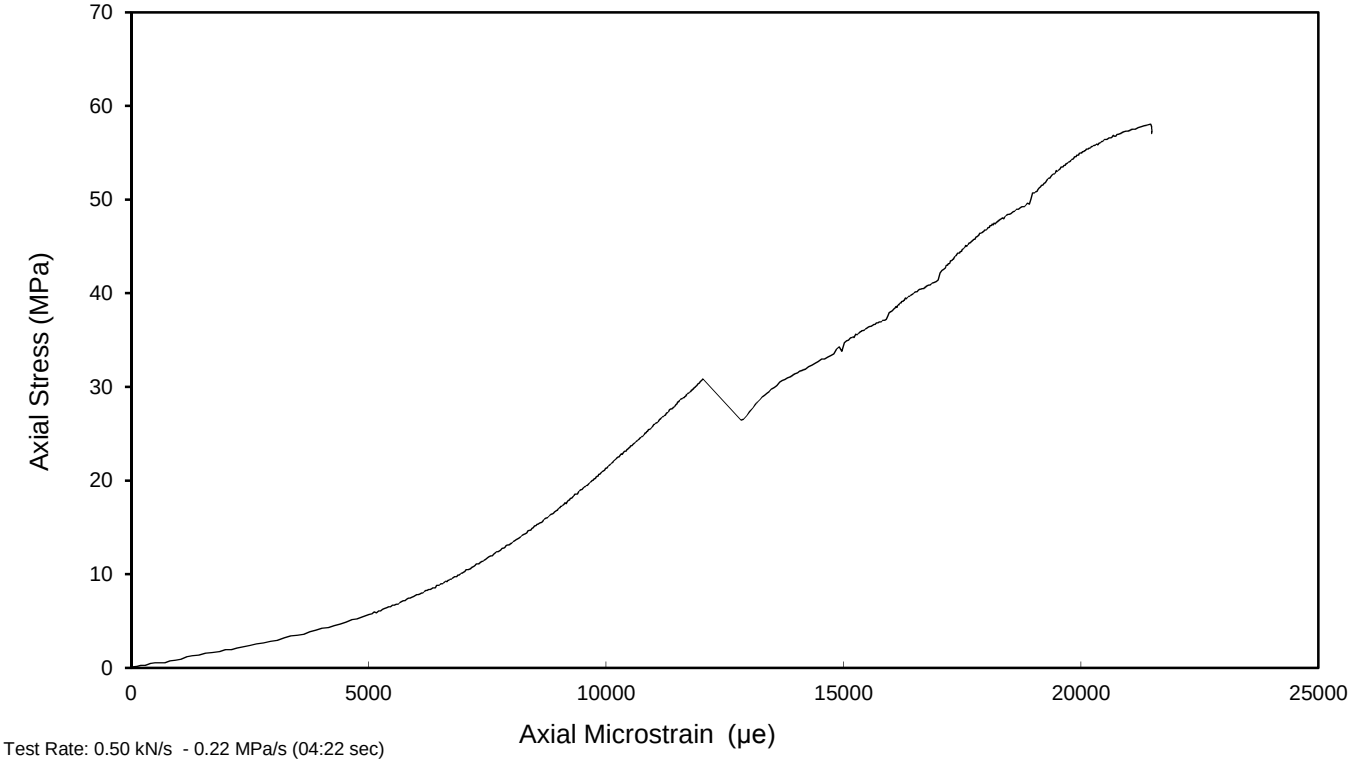
Solid lines for material failures.
Dashed lines for apparent weakness failure.

Date tested: 21/08/2018

Sample type	C

Results

Confining Pressure	Axial Strength
1.00 MPa	30.1 MPa
2.00 MPa	33.7 MPa
3.00 MPa	37.1 MPa
4.00 MPa	41.2 MPa
6.00 MPa	49.9 MPa
8.00 MPa	58.1 MPa



Test Rate: 0.50 kN/s - 0.22 MPa/s (04:22 sec)

Note: The dimensional requirements of Flatness (<0.02 mm), Perpendicularity (<0.05 / 50 mm) and Straightness (0.3 mm deviation) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number:

GEO / 27859

Project Name:

ST JOHN'S MASTERPLAN
42206

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ISRM - Suggested Methods : Part 2 : Received 2007

Strength of Rock Materials in Triaxial Compression: Revised Version

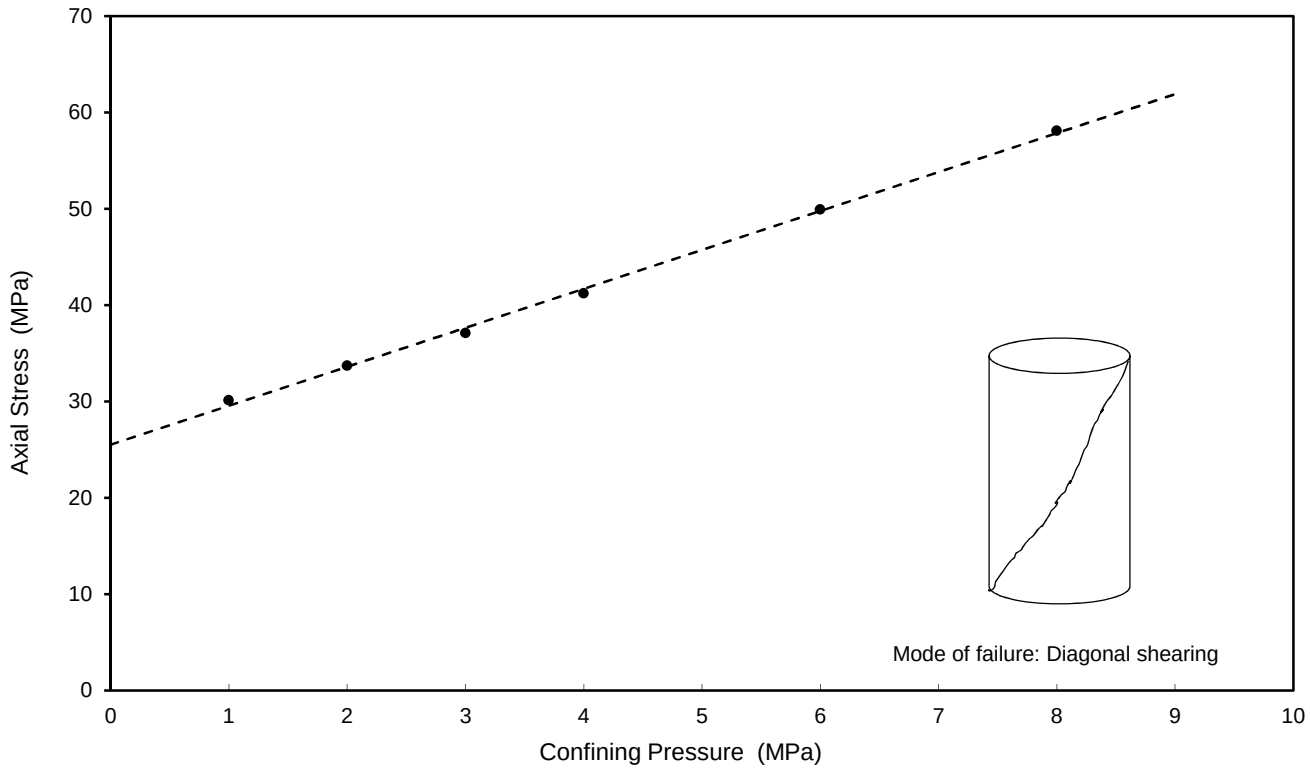
Description: Medium strong orangish brown fine to medium grained SANDSTONE. Slightly to moderately weathered

Test Type **Type II - Multiple failure state test** Date Tested: 21-08-18

Borehole Ref.		BH03	BH03	BH03	BH03	BH03	BH03
Sample Ref.		32	32	32	32	32	32
Depth (m)		12.50-12.69	12.50-12.69	12.50-12.69	12.50-12.69	12.50-12.69	12.50-12.69
Diameter	(mm)	53.60	53.60	53.60	53.60	53.60	53.60
Height	(mm)	108.40	108.40	108.40	108.40	108.40	108.40
Bulk Density	(Mg/m³)	2.19	2.19	2.19	2.19	2.19	2.19
Dry Density	(Mg/m³)	2.14	2.14	2.14	2.14	2.14	2.14
Water Content	(%)	2.7	2.7	2.7	2.7	2.7	2.7
Confining Pressure	(MPa)	**1.00**	**2.00**	**3.00**	**4.00**	**6.00**	**8.00**
Axial Strength	(MPa)	**30.10**	**33.70**	**37.10**	**41.20**	**49.90**	**58.10**

Gradient of Slope, m **4.041** Internal Friction Angle, φ **37.1 º**

Ordinate of Slope, b **26 MPa** Apparent Cohesion, c **6 MPa**



Checked and Approved by

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C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number: **GEO / 27859**

Project Name: **ST JOHN'S MASTERPLAN 42206**

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ISRM - Suggested Methods : Part 2 : Received 1983

Strength of Rock Material in Triaxial Compression: Revised Version

Borehole Ref.:	BH04B
Sample Ref.:	7
Depth (m):	12.03-12.17

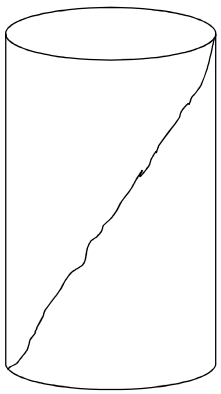
Description:
Medium strong orangish brown fine to medium grained SANDSTONE.
Moderately weathered

LF0879C (1000kN) compression frame used

Diameter	54.00 mm
Height	108.20 mm
Bulk Density	2.01 Mg/m³
Dry Density	1.96 Mg/m³
Water Content	2.5 %

Degree of Saturation: 17.6 %. Specific Gravity: 2.72 Mg/m³ (Assumed)

Failure Sketch



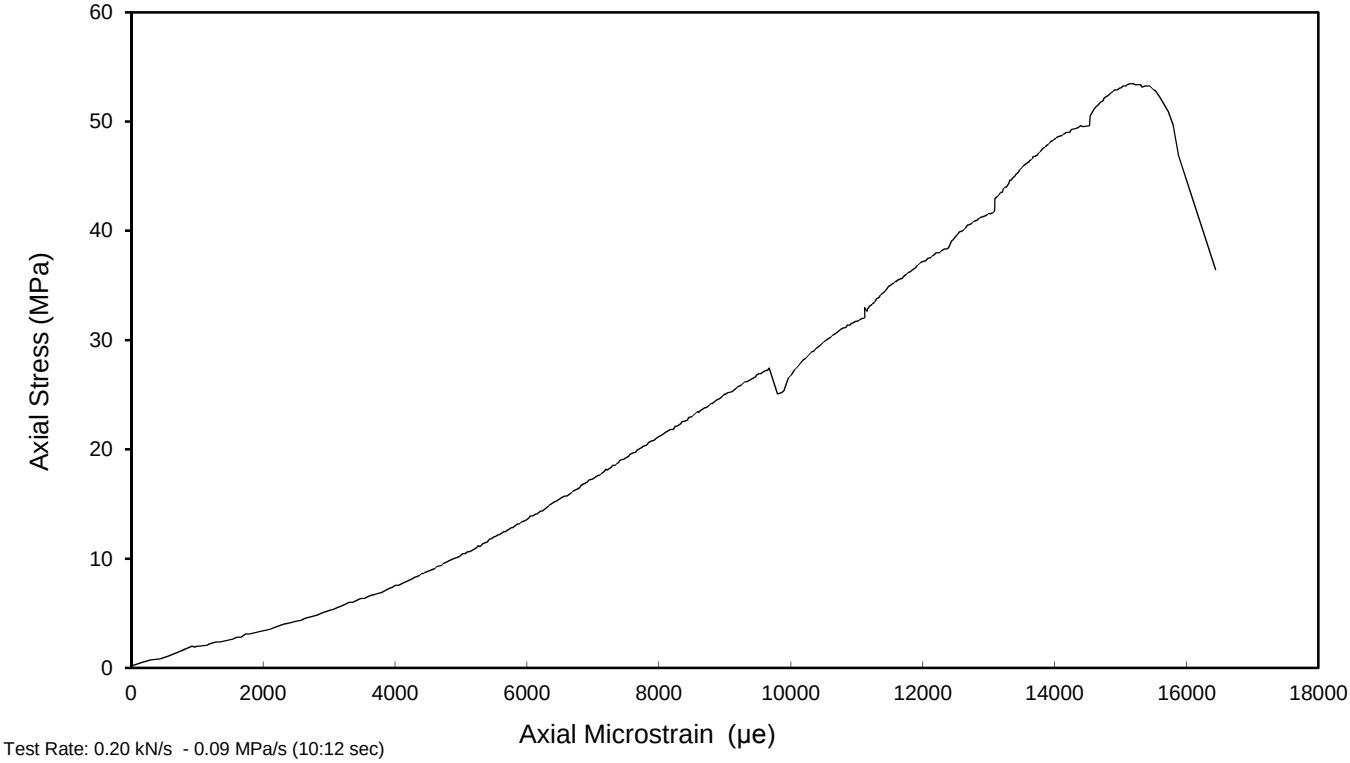
Solid lines for material failures.
Dashed lines for apparent weakness failure.

Date tested: 22/08/2018

Sample type	C

Results

Confining Pressure	Axial Strength
1.00 MPa	27.4 MPa
2.00 MPa	32 MPa
3.00 MPa	38.3 MPa
4.00 MPa	41.6 MPa
6.00 MPa	49.5 MPa
8.00 MPa	53.4 MPa



Test Rate: 0.20 kN/s - 0.09 MPa/s (10:12 sec)

Note: The dimensional requirements of Flatness (<0.02 mm), Perpendicularity (<0.05 / 50 mm) and Straightness (0.3 mm deviation) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number:

GEO / 27859

Project Name:

ST JOHN'S MASTERPLAN
42206

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ISRM - Suggested Methods : Part 2 : Received 2007

Strength of Rock Materials in Triaxial Compression: Revised Version

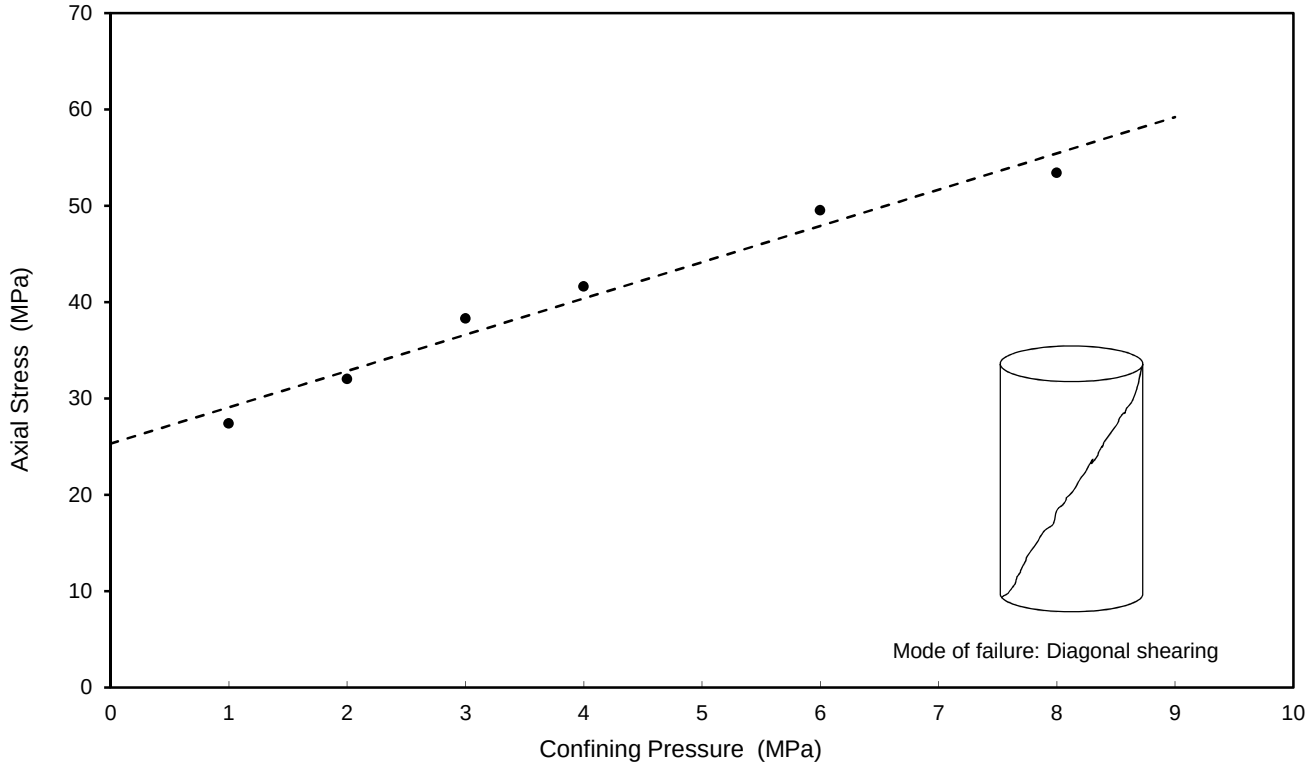
Description: Medium strong orangish brown fine to medium grained SANDSTONE. Moderately weathered

Test Type **Type II - Multiple failure state test** Date Tested: 22-08-18

Borehole Ref.		BH04B	BH04B	BH04B	BH04B	BH04B	BH04B
Sample Ref.		7	7	7	7	7	7
Depth (m)		12.03-12.17	12.03-12.17	12.03-12.17	12.03-12.17	12.03-12.17	12.03-12.17
Diameter	(mm)	54.00	54.00	54.00	54.00	54.00	54.00
Height	(mm)	108.20	108.20	108.20	108.20	108.20	108.20
Bulk Density	(Mg/m³)	2.01	2.01	2.01	2.01	2.01	2.01
Dry Density	(Mg/m³)	1.96	1.96	1.96	1.96	1.96	1.96
Water Content	(%)	2.5	2.5	2.5	2.5	2.5	2.5
Confining Pressure	(MPa)	**1.00**	**2.00**	**3.00**	**4.00**	**6.00**	**8.00**
Axial Strength	(MPa)	**27.40**	**32.00**	**38.30**	**41.60**	**49.50**	**53.40**

Gradient of Slope, m **3.768** Internal Friction Angle, φ **35.5 º**

Ordinate of Slope, b **25 MPa** Apparent Cohesion, c **7 MPa**



Checked and Approved by

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C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number: **GEO / 27859**

Project Name: **ST JOHN'S MASTERPLAN 42206**

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ISRM - Suggested Methods : Part 2 : Received 1983

Strength of Rock Material in Triaxial Compression: Revised Version

Borehole Ref.:	RBH03
Sample Ref.:	
Depth (m):	11.00-11.20

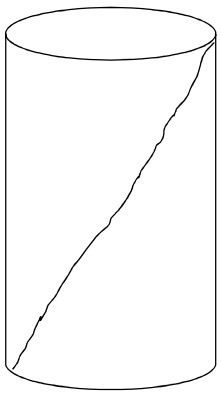
Description:
Medium strong orangish brown fine to medium grained SANDSTONE.
Moderately weathered

LF0879C (1000kN) compression frame used

Diameter	53.90 mm
Height	108.10 mm
Bulk Density	1.99 Mg/m³
Dry Density	1.87 Mg/m³
Water Content	6.5 %

Degree of Saturation: 39.2 %. Specific Gravity: 2.72 Mg/m³ (Assumed)

Failure Sketch



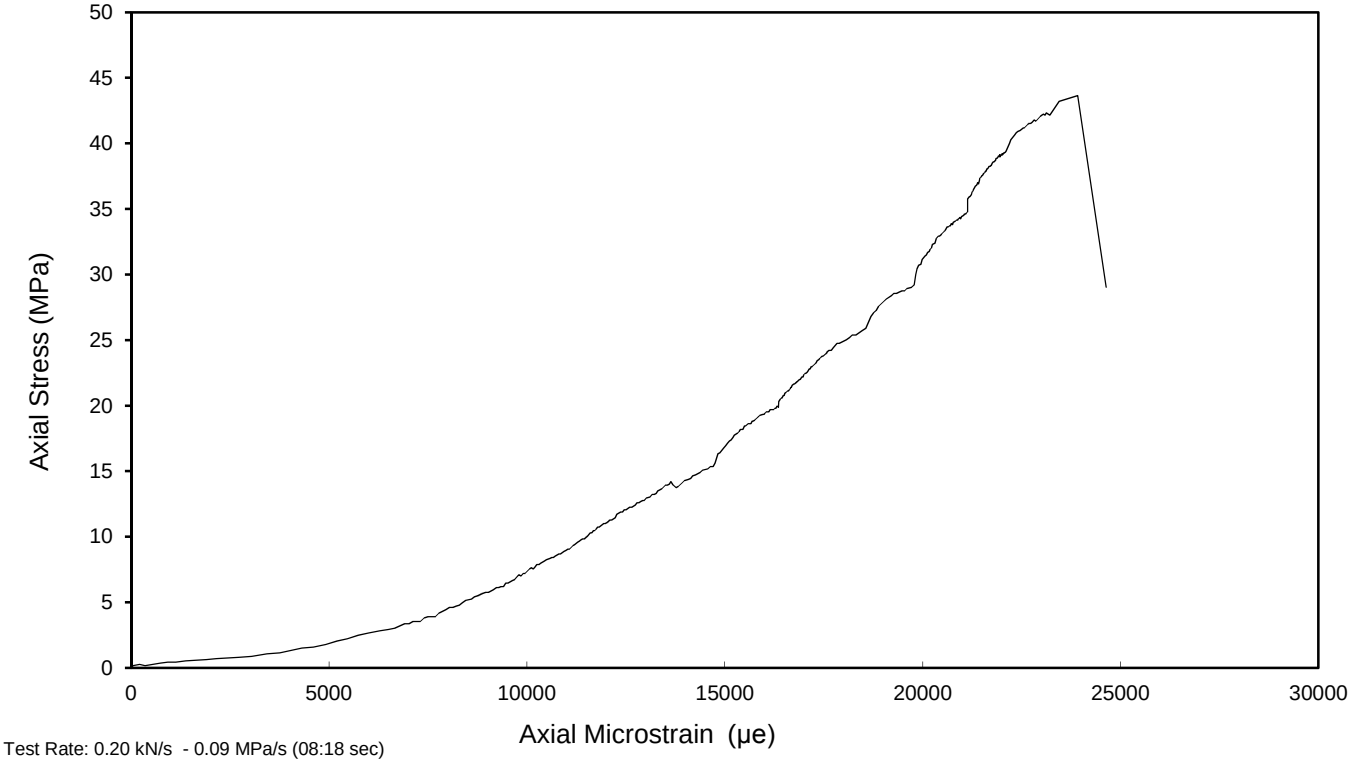
Solid lines for material failures.
Dashed lines for apparent weakness failure.

Date tested: 21/08/2018

Sample type	C

Results

Confining Pressure	Axial Strength
1.00 MPa	15.1 MPa
2.00 MPa	19.7 MPa
3.00 MPa	25.4 MPa
4.00 MPa	29.1 MPa
6.00 MPa	34.8 MPa
8.00 MPa	43.7 MPa



Test Rate: 0.20 kN/s - 0.09 MPa/s (08:18 sec)

Note: The dimensional requirements of Flatness (<0.02 mm), Perpendicularity (<0.05 / 50 mm) and Straightness (0.3 mm deviation) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number:

GEO / 27859

Project Name:

ST JOHN'S MASTERPLAN
42206

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ISRM - Suggested Methods : Part 2 : Received 2007

Strength of Rock Materials in Triaxial Compression: Revised Version

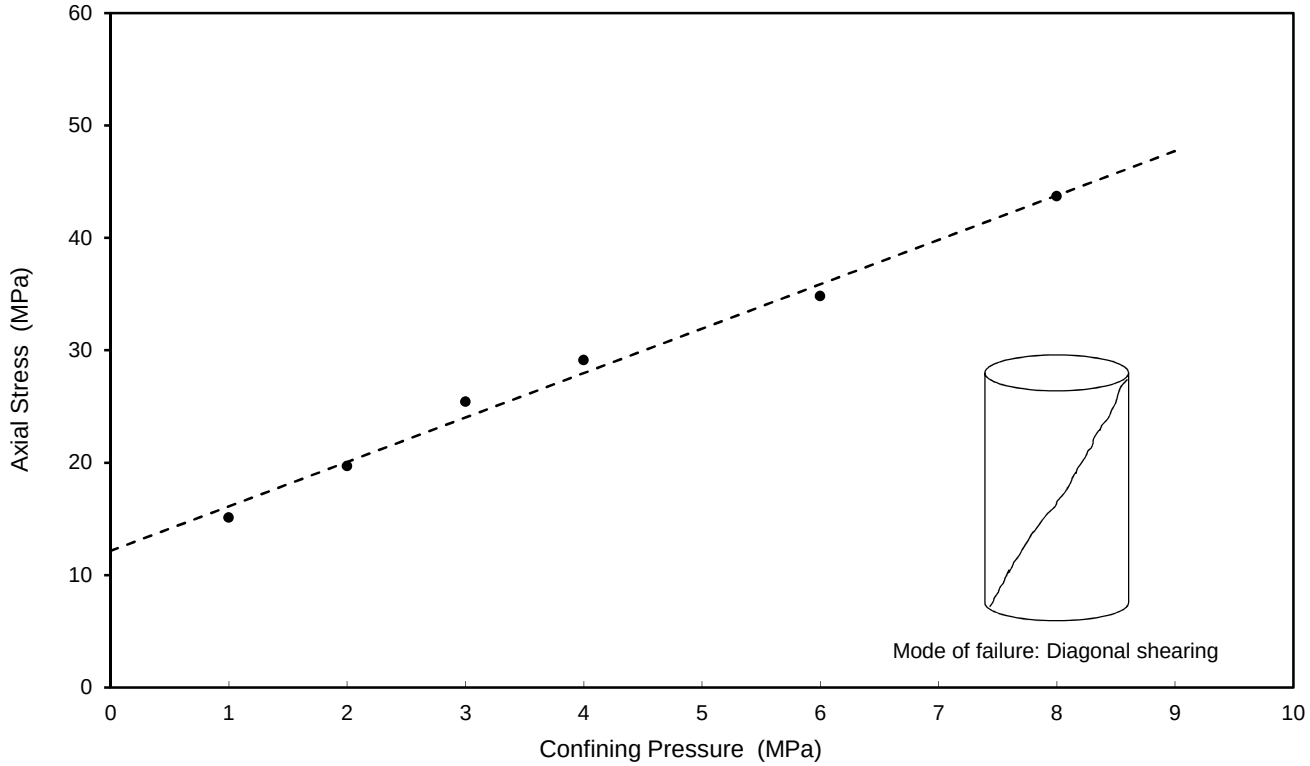
Description: Medium strong orangish brown fine to medium grained SANDSTONE. Moderately weathered

Test Type **Type II - Multiple failure state test** Date Tested: 21-08-18

Borehole Ref.		RBH03	RBH03	RBH03	RBH03	RBH03	RBH03
Sample Ref.							
Depth (m)		11.00-11.20	11.00-11.20	11.00-11.20	11.00-11.20	11.00-11.20	11.00-11.20
Diameter	(mm)	53.90	53.90	53.90	53.90	53.90	53.90
Height	(mm)	108.10	108.10	108.10	108.10	108.10	108.10
Bulk Density	(Mg/m³)	1.99	1.99	1.99	1.99	1.99	1.99
Dry Density	(Mg/m³)	1.87	1.87	1.87	1.87	1.87	1.87
Water Content	(%)	6.5	6.5	6.5	6.5	6.5	6.5
Confining Pressure	(MPa)	**1.00**	**2.00**	**3.00**	**4.00**	**6.00**	**8.00**
Axial Strength	(MPa)	**15.10**	**19.70**	**25.40**	**29.10**	**34.80**	**43.70**

Gradient of Slope, m **3.950** Internal Friction Angle, φ **36.6 º**

Ordinate of Slope, b **12 MPa** Apparent Cohesion, c **3 MPa**



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C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number: **GEO / 27859**

Project Name: **ST JOHN'S MASTERPLAN 42206**

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ISRM - Suggested Methods : Part 2 : Received 1983

Strength of Rock Material in Triaxial Compression: Revised Version

Borehole Ref.:	RBH04
Sample Ref.:	
Depth (m):	16.29-16.50

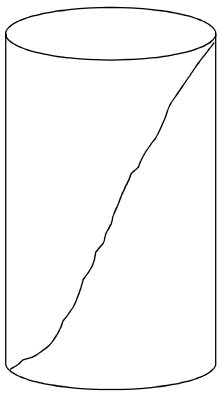
Description:
Medium strong orangish brown fine to medium grained SANDSTONE.
Moderately weathered

LF0879C (1000kN) compression frame used

Diameter	53.80 mm
Height	107.88 mm
Bulk Density	2.05 Mg/m³
Dry Density	1.90 Mg/m³
Water Content	7.9 %

Degree of Saturation: 49.8 %. Specific Gravity: 2.72 Mg/m³ (Assumed)

Failure Sketch



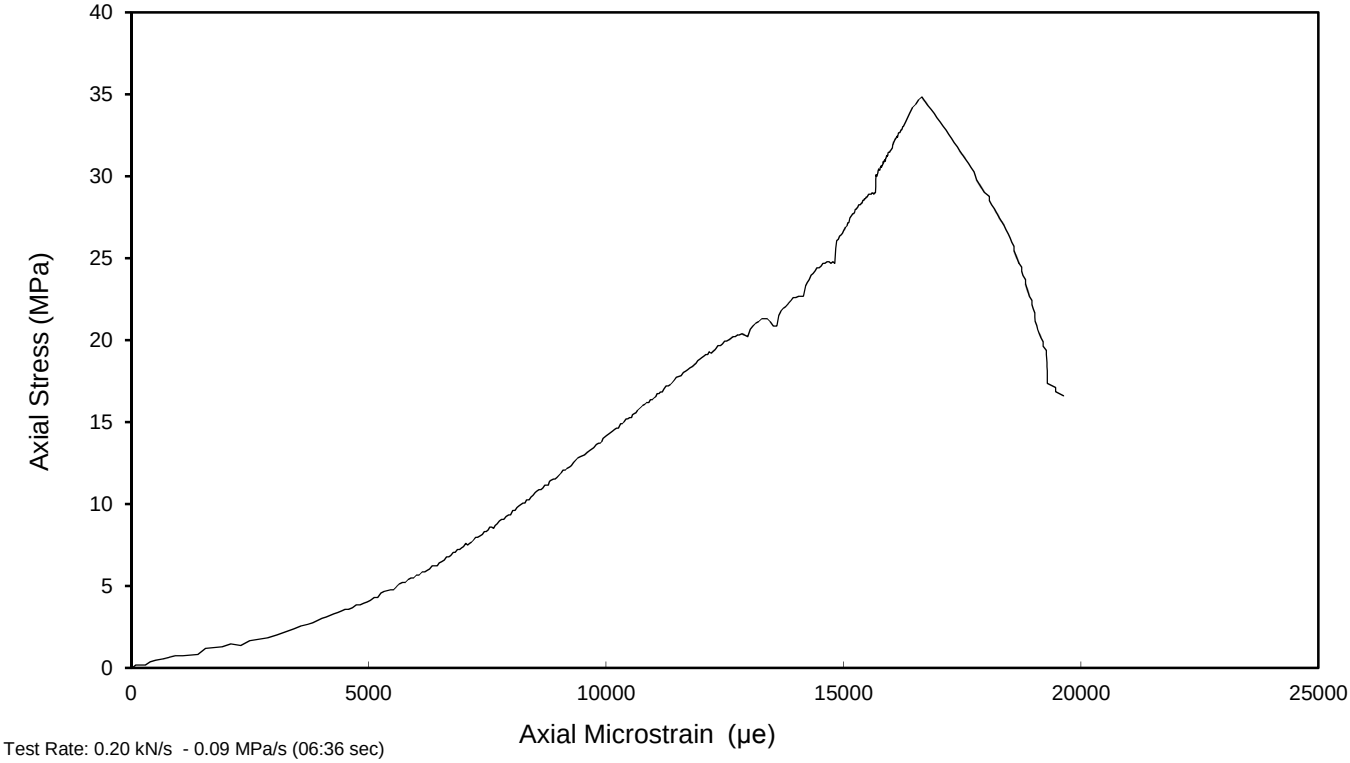
Solid lines for material failures.
Dashed lines for apparent weakness failure.

Date tested: 21/08/2018

Sample type	C

Results

Confining Pressure	Axial Strength
1.00 MPa	20.4 MPa
2.00 MPa	21.4 MPa
3.00 MPa	22.7 MPa
4.00 MPa	24.8 MPa
6.00 MPa	29.1 MPa
8.00 MPa	34.8 MPa



Test Rate: 0.20 kN/s - 0.09 MPa/s (06:36 sec)

Note: The dimensional requirements of Flatness (<0.02 mm), Perpendicularity (<0.05 / 50 mm) and Straightness (0.3 mm deviation) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number:

GEO / 27859

Project Name:

ST JOHN'S MASTERPLAN
42206

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ISRM - Suggested Methods : Part 2 : Received 2007

Strength of Rock Materials in Triaxial Compression: Revised Version

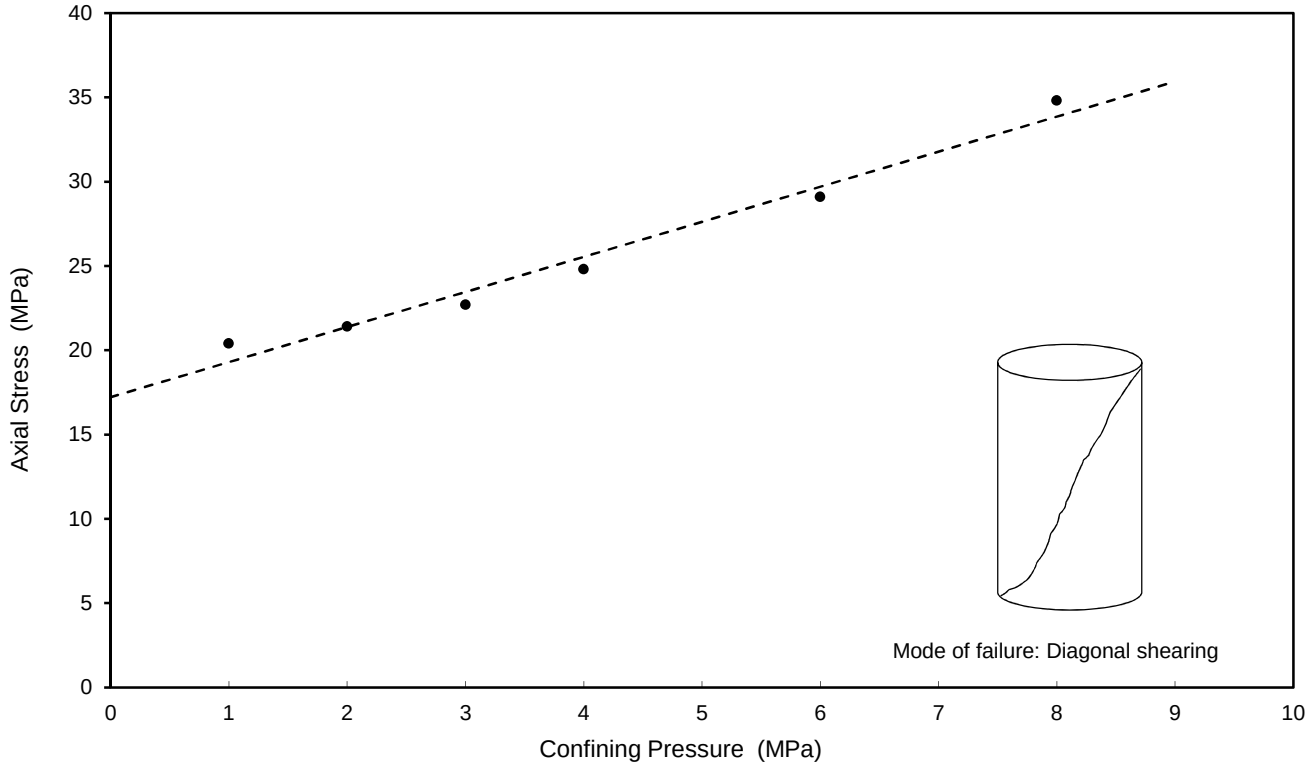
Description: Medium strong orangish brown fine to medium grained SANDSTONE. Moderately weathered

Test Type **Type II - Multiple failure state test** Date Tested: 21-08-18

Borehole Ref.		RBH04	RBH04	RBH04	RBH04	RBH04	RBH04
Sample Ref.							
Depth (m)		16.29-16.50	16.29-16.50	16.29-16.50	16.29-16.50	16.29-16.50	16.29-16.50
Diameter	(mm)	53.80	53.80	53.80	53.80	53.80	53.80
Height	(mm)	107.88	107.88	107.88	107.88	107.88	107.88
Bulk Density	(Mg/m³)	2.05	2.05	2.05	2.05	2.05	2.05
Dry Density	(Mg/m³)	1.90	1.90	1.90	1.90	1.90	1.90
Water Content	(%)	7.9	7.9	7.9	7.9	7.9	7.9
Confining Pressure	(MPa)	**1.00**	**2.00**	**3.00**	**4.00**	**6.00**	**8.00**
Axial Strength	(MPa)	**20.40**	**21.40**	**22.70**	**24.80**	**29.10**	**34.80**

Gradient of Slope, m **2.079** Internal Friction Angle, φ **20.5 º**

Ordinate of Slope, b **17 MPa** Apparent Cohesion, c **6 MPa**



Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number: **GEO / 27859**

Project Name: **ST JOHN'S MASTERPLAN 42206**

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ISRM - Suggested Methods : Part 2 : Received 1983

Strength of Rock Material in Triaxial Compression: Revised Version

Borehole Ref.:	RBH05
Sample Ref.:	27
Depth (m):	15.91-16.00

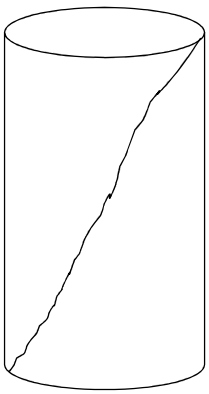
Description:
Medium strong orangish brown fine to medium grained SANDSTONE.
Moderately weathered

LF0879C (1000kN) compression frame used

Diameter	37.80 mm
Height	79.70 mm
Bulk Density	2.01 Mg/m³
Dry Density	1.92 Mg/m³
Water Content	4.9 %

Degree of Saturation: 31.6 %. Specific Gravity: 2.72 Mg/m³ (Assumed)

Failure Sketch



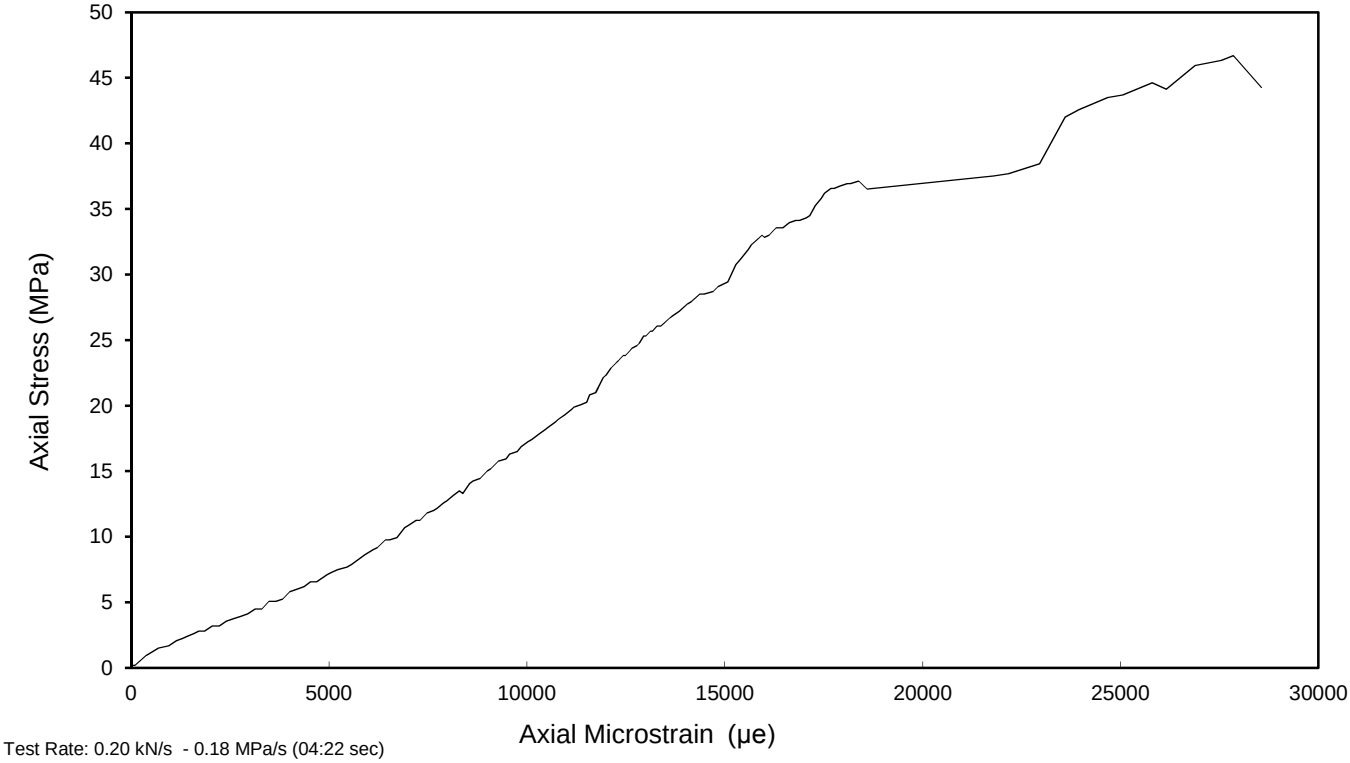
Date tested: 21/08/2018

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

Sample type	C

Results

Confining Pressure	Axial Strength
1.00 MPa	20.1 MPa
2.00 MPa	28.5 MPa
3.00 MPa	34.3 MPa
4.00 MPa	36.9 MPa
6.00 MPa	44.6 MPa
8.00 MPa	46.7 MPa



Test Rate: 0.20 kN/s - 0.18 MPa/s (04:22 sec)

Note: The dimensional requirements of Flatness (<0.02 mm), Perpendicularity (<0.05 / 50 mm) and Straightness (0.3 mm deviation) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number:

GEO / 27859

Project Name:

ST JOHN'S MASTERPLAN
42206

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ISRM - Suggested Methods : Part 2 : Received 2007

Strength of Rock Materials in Triaxial Compression: Revised Version

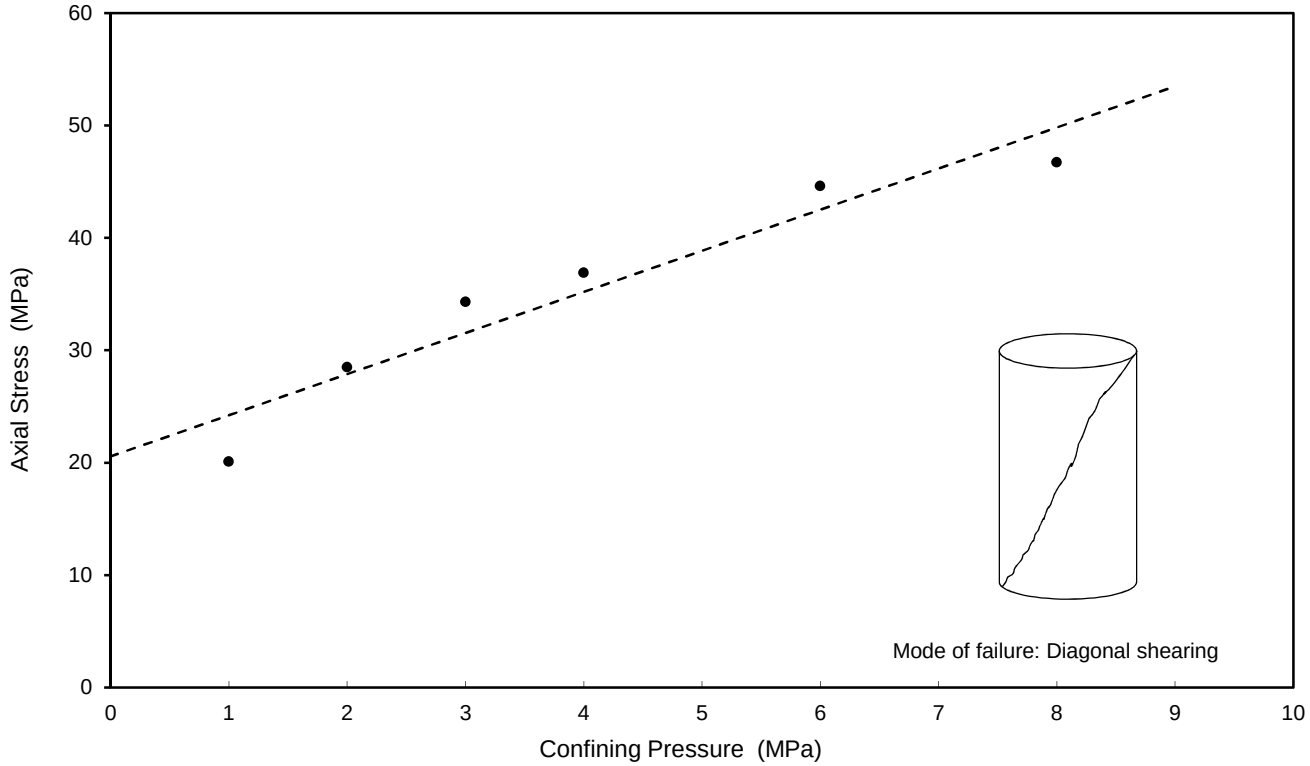
Description: Medium strong orangish brown fine to medium grained SANDSTONE. Moderately weathered

Test Type **Type II - Multiple failure state test** Date Tested: 21-08-18

Borehole Ref.		RBH05	RBH05	RBH05	RBH05	RBH05	RBH05
Sample Ref.		27	27	27	27	27	27
Depth (m)		15.91-16.00	15.91-16.00	15.91-16.00	15.91-16.00	15.91-16.00	15.91-16.00
Diameter	(mm)	37.80	37.80	37.80	37.80	37.80	37.80
Height	(mm)	79.70	79.70	79.70	79.70	79.70	79.70
Bulk Density	(Mg/m³)	2.01	2.01	2.01	2.01	2.01	2.01
Dry Density	(Mg/m³)	1.92	1.92	1.92	1.92	1.92	1.92
Water Content	(%)	4.9	4.9	4.9	4.9	4.9	4.9

Confining Pressure	(MPa)	**1.00**	**2.00**	**3.00**	**4.00**	**6.00**	**8.00**
Axial Strength	(MPa)	**20.10**	**28.50**	**34.30**	**36.90**	**44.60**	**46.70**

Gradient of Slope, m **3.659**
Ordinate of Slope, b **21 MPa**
Internal Friction Angle, φ **34.8 º**
Apparent Cohesion, c **5 MPa**



Checked and Approved by
CC
C Clergeaud (Snr. Geol.)
Date: 06/09/2018

Project Number:
GEO / 27859
Project Name:
ST JOHN'S MASTERPLAN
42206

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ISRM - Suggested Methods : Part 2 : Received 1983

Strength of Rock Material in Triaxial Compression: Revised Version

Borehole Ref.:	RBH05
Sample Ref.:	36
Depth (m):	21.80-21.86

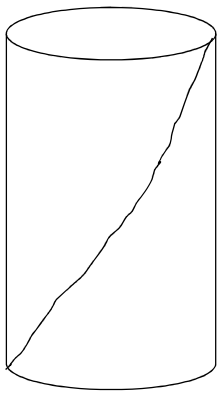
Description:
Medium strong orangish brown fine to medium grained SANDSTONE.
Moderately weathered

LF0879C (1000kN) compression frame used

Diameter	37.80 mm
Height	76.10 mm
Bulk Density	1.96 Mg/m³
Dry Density	1.87 Mg/m³
Water Content	4.8 %

Degree of Saturation: 29.1 %. Specific Gravity: 2.72 Mg/m³ (Assumed)

Failure Sketch



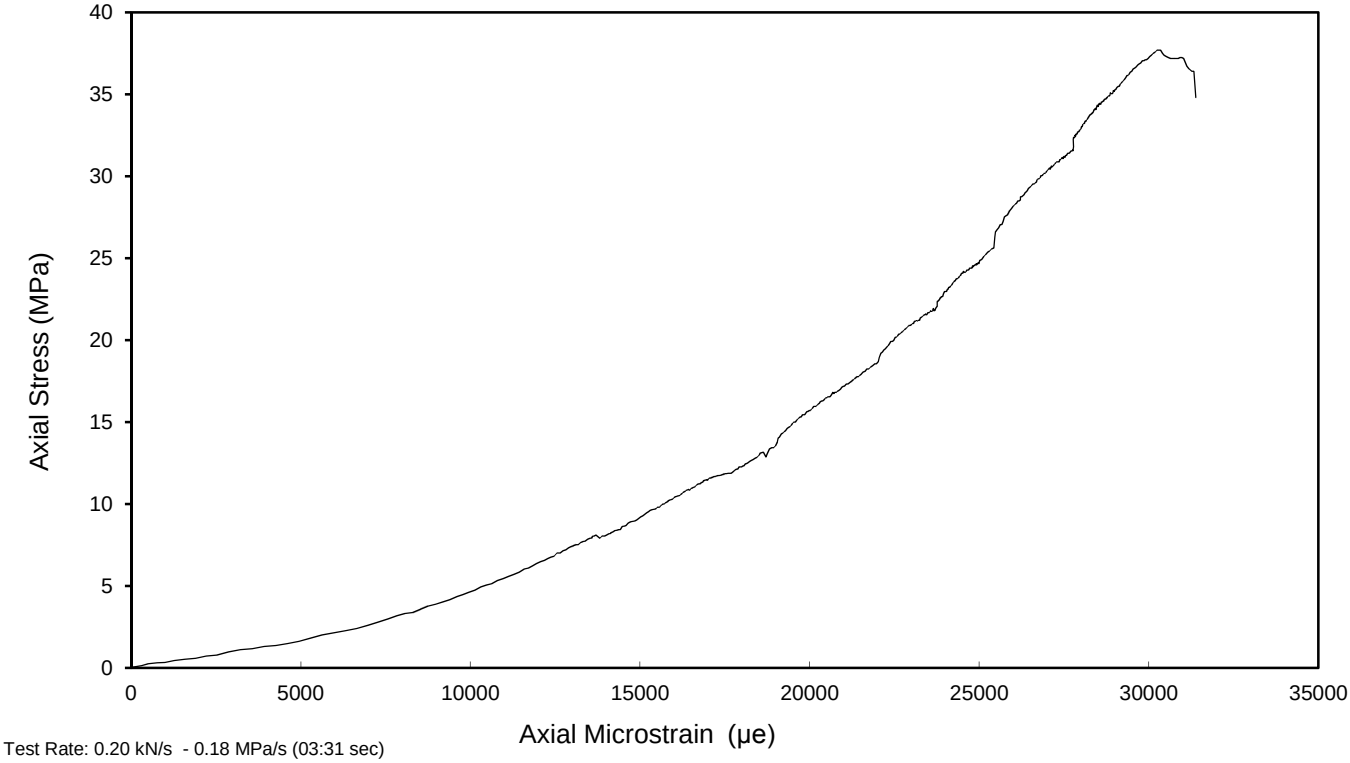
Solid lines for material failures.
Dashed lines for apparent weakness failure.

Date tested: 21/08/2018

Sample type	C

Results

Confining Pressure	Axial Strength
1.00 MPa	13.2 MPa
2.00 MPa	18.6 MPa
3.00 MPa	22 MPa
4.00 MPa	25.6 MPa
6.00 MPa	31.6 MPa
8.00 MPa	37.7 MPa



Test Rate: 0.20 kN/s - 0.18 MPa/s (03:31 sec)

Note: The dimensional requirements of Flatness (<0.02 mm), Perpendicularity (<0.05 / 50 mm) and Straightness (0.3 mm deviation) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number:

GEO / 27859

Project Name:

ST JOHN'S MASTERPLAN
42206

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ISRM - Suggested Methods : Part 2 : Received 2007

Strength of Rock Materials in Triaxial Compression: Revised Version

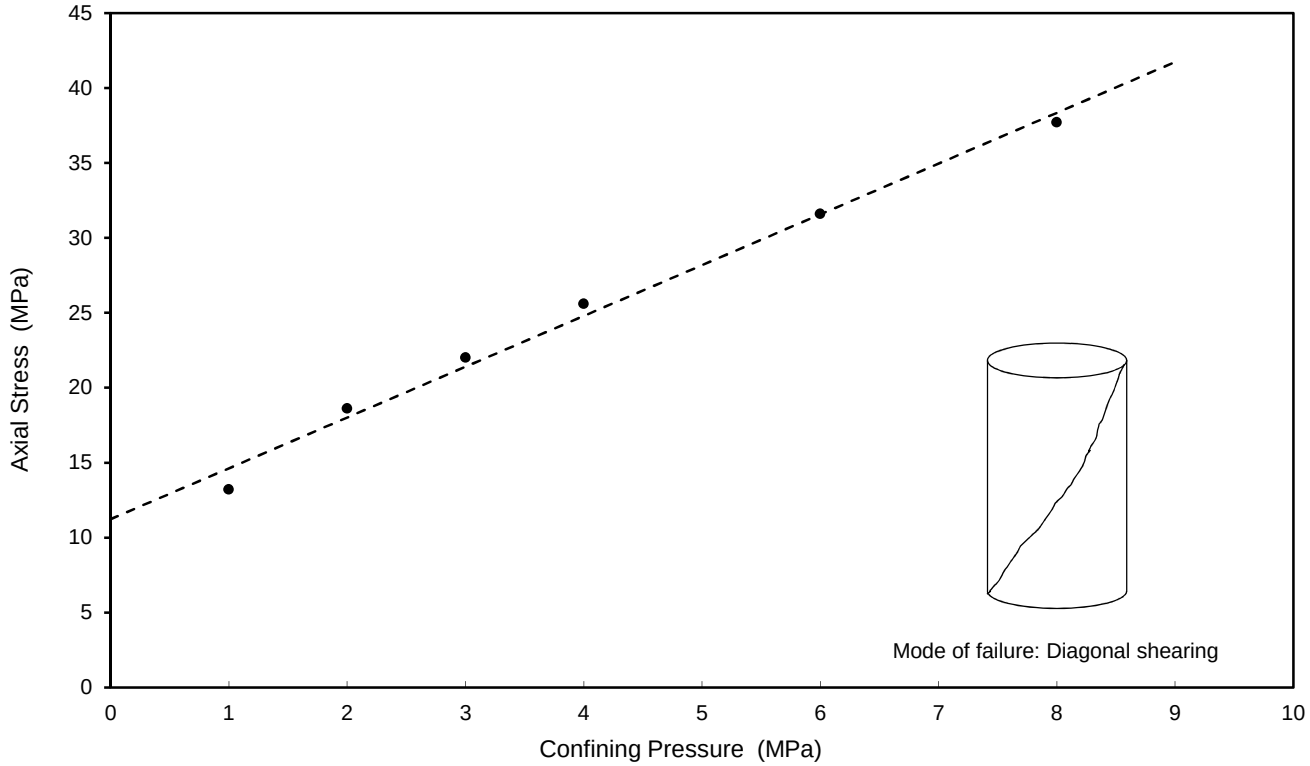
Description: Medium strong orangish brown fine to medium grained SANDSTONE. Moderately weathered

Test Type **Type II - Multiple failure state test** Date Tested: 21-08-18

Borehole Ref.		RBH05	RBH05	RBH05	RBH05	RBH05	RBH05
Sample Ref.		36	36	36	36	36	36
Depth (m)		21.80-21.86	21.80-21.86	21.80-21.86	21.80-21.86	21.80-21.86	21.80-21.86
Diameter	(mm)	37.80	37.80	37.80	37.80	37.80	37.80
Height	(mm)	76.10	76.10	76.10	76.10	76.10	76.10
Bulk Density	(Mg/m³)	1.96	1.96	1.96	1.96	1.96	1.96
Dry Density	(Mg/m³)	1.87	1.87	1.87	1.87	1.87	1.87
Water Content	(%)	4.8	4.8	4.8	4.8	4.8	4.8
Confining Pressure	(MPa)	**1.00**	**2.00**	**3.00**	**4.00**	**6.00**	**8.00**
Axial Strength	(MPa)	**13.20**	**18.60**	**22.00**	**25.60**	**31.60**	**37.70**

Gradient of Slope, m **3.388** Internal Friction Angle, φ **33.0 º**

Ordinate of Slope, b **11 MPa** Apparent Cohesion, c **3 MPa**



Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number:

GEO / 27859

Project Name:

ST JOHN'S MASTERPLAN

42206

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ISRM - Suggested Methods : Part 2 : Received 1983

Strength of Rock Material in Triaxial Compression: Revised Version

Borehole Ref.:	RBH06
Sample Ref.:	26
Depth (m):	18.16

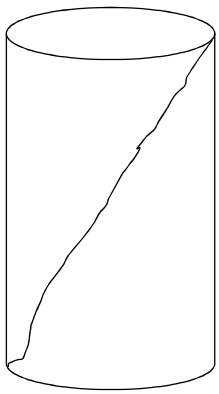
Description:
Medium strong orangish brown fine to medium grained SANDSTONE.
Moderately weathered

LF0879C (1000kN) compression frame used

Diameter	37.60 mm
Height	76.10 mm
Bulk Density	1.96 Mg/m³
Dry Density	1.88 Mg/m³
Water Content	4.4 %

Degree of Saturation: 26.9 %. Specific Gravity: 2.72 Mg/m³ (Assumed)

Failure Sketch



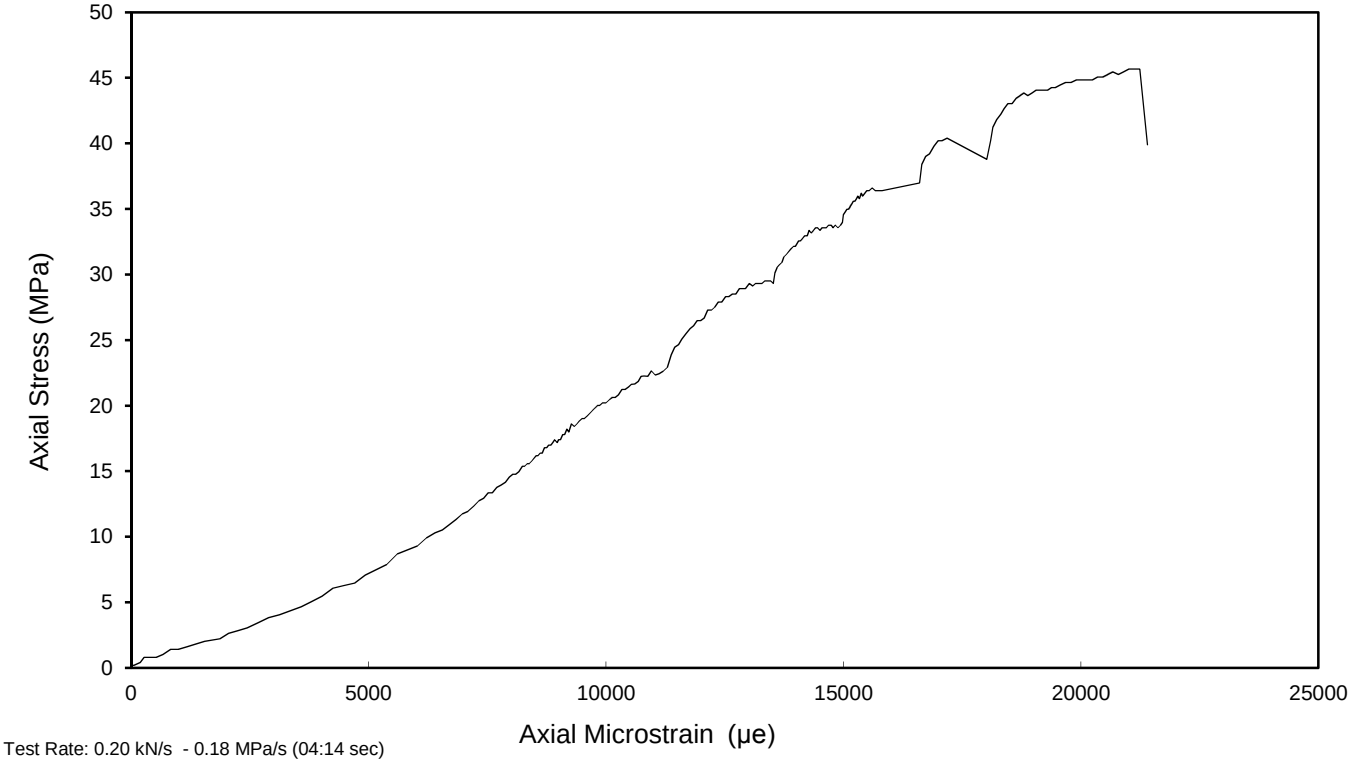
Solid lines for material failures.
Dashed lines for apparent weakness failure.

Date tested: 22/08/2018

Sample type	C

Results

Confining Pressure	Axial Strength
1.00 MPa	22.6 MPa
2.00 MPa	29.5 MPa
3.00 MPa	33.7 MPa
4.00 MPa	36.4 MPa
6.00 MPa	40.4 MPa
8.00 MPa	45.7 MPa



Test Rate: 0.20 kN/s - 0.18 MPa/s (04:14 sec)

Note: The dimensional requirements of Flatness (<0.02 mm), Perpendicularity (<0.05 / 50 mm) and Straightness (0.3 mm deviation) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number:

GEO / 27859

Project Name:

ST JOHN'S MASTERPLAN
42206

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ISRM - Suggested Methods : Part 2 : Received 2007

Strength of Rock Materials in Triaxial Compression: Revised Version

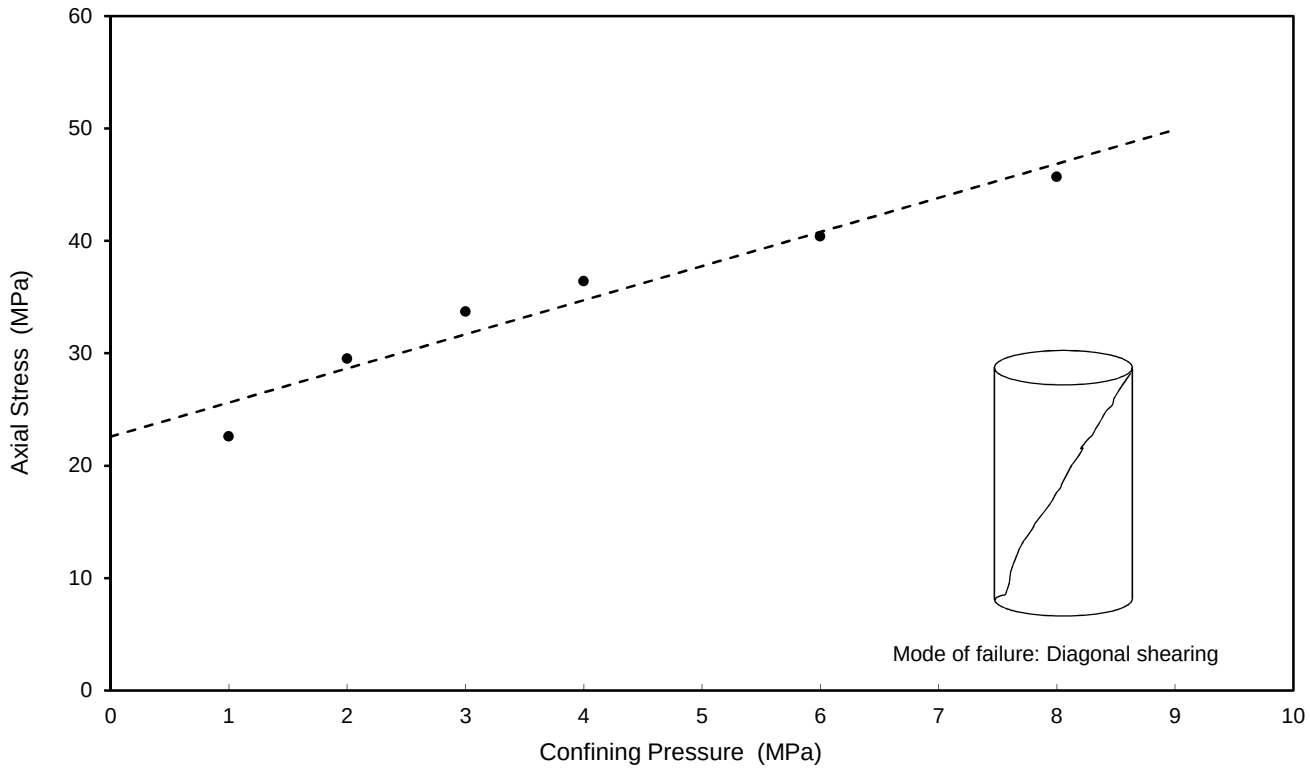
Description: Medium strong orangish brown fine to medium grained SANDSTONE. Moderately weathered

Test Type **Type II - Multiple failure state test** Date Tested: 22-08-18

Borehole Ref.		RBH06	RBH06	RBH06	RBH06	RBH06	RBH06
Sample Ref.		26	26	26	26	26	26
Depth (m)		18.16	18.16	18.16	18.16	18.16	18.16
Diameter	(mm)	37.60	37.60	37.60	37.60	37.60	37.60
Height	(mm)	76.10	76.10	76.10	76.10	76.10	76.10
Bulk Density	(Mg/m³)	1.96	1.96	1.96	1.96	1.96	1.96
Dry Density	(Mg/m³)	1.88	1.88	1.88	1.88	1.88	1.88
Water Content	(%)	4.4	4.4	4.4	4.4	4.4	4.4
Confining Pressure	(MPa)	**1.00**	**2.00**	**3.00**	**4.00**	**6.00**	**8.00**
Axial Strength	(MPa)	**22.60**	**29.50**	**33.70**	**36.40**	**40.40**	**45.70**

Gradient of Slope, m **3.032** Internal Friction Angle, φ **30.3 º**

Ordinate of Slope, b **23 MPa** Apparent Cohesion, c **6 MPa**



Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 06/09/2018

Project Number: **GEO / 27859**

Project Name: **ST JOHN'S MASTERPLAN 42206**

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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	BH02
Sample No:	C39
Depth (m):	10.68

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 2-4.
Debris is abundant sand and fine to medium gravel.

Specimen Details

Type of shear plane		Pre existing plane of weakness: Joint
Preparation		Rock core encapsulated avoiding shear-plane then positioned in shearbox with shear-plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	93.2
Maximum Width	*mm*	55.2
Area	*mm²*	4612.0

Shearing Stage

Normal stress	*kPa*	500	1000	2500
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Maximum shear stress	*kPa*	352.8	538.9	1207.2
Horizontal displacement at MSS	*mm*	6.3	11.6	21.7
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	322.5	477.3	1113.8
Final cumulative displacement	*mm*	38.9		

Duration	*day(s)*	1

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**124**
Angle of Shearing Resistance	*degrees*	**23.5**
Residual Condition:		
Apparent Cohesion	*kPa*	**102**
Angle of Shearing Resistance	*degrees*	**22.0**

Notes:

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 07/09/2018

Project Number: **GEO / 27859**

Project Name: **St John's Masterplan**
Project Ref: 42206

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ISRM Suggested Method

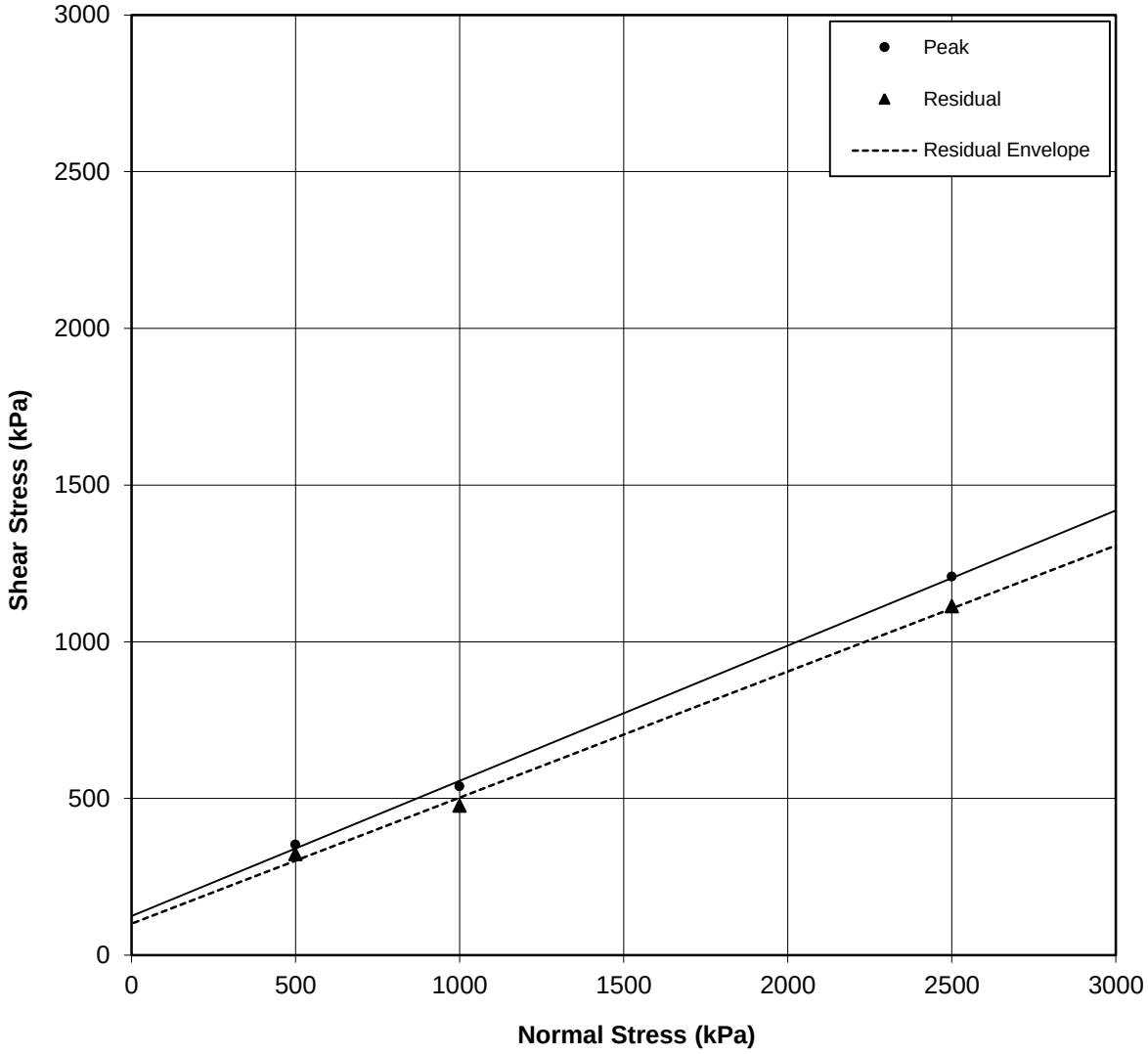
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	BH02
Sample No:	C39
Depth (m):	10.68

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 2-4.
Debris is abundant sand and fine to medium gravel.

Shear Stress v Normal Stress



Peak: c' = 124 Φ' = 23.5 °

Residual: c' = 102 Φ' = 22 °

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 07/09/2018

Project Number: **GEO / 27859**

Project Name: **St John's Masterplan**
Project Ref: 42206

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ISRM Suggested Method

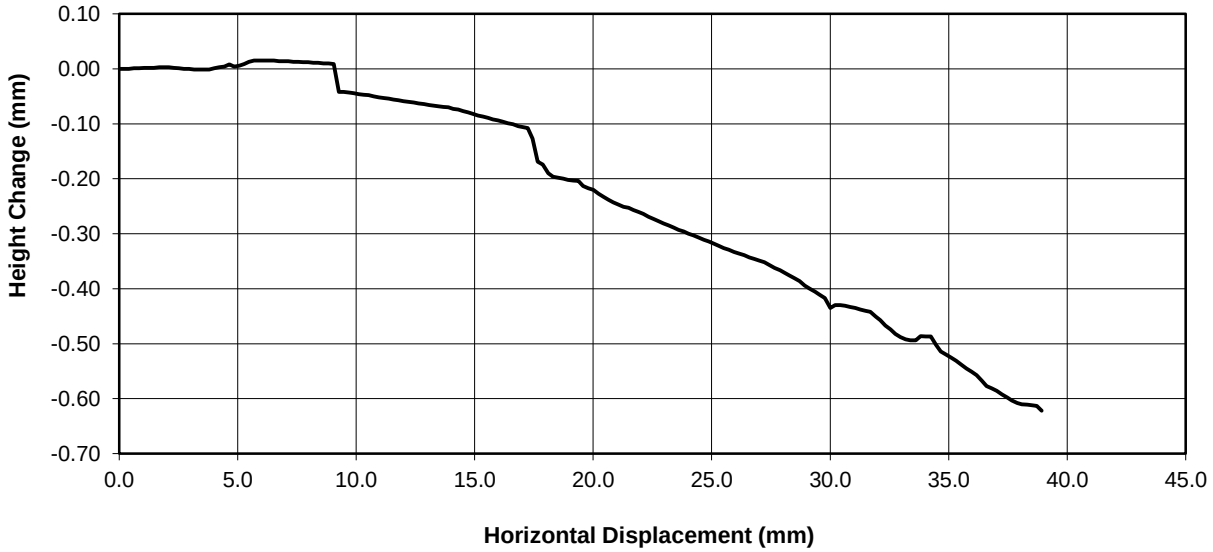
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

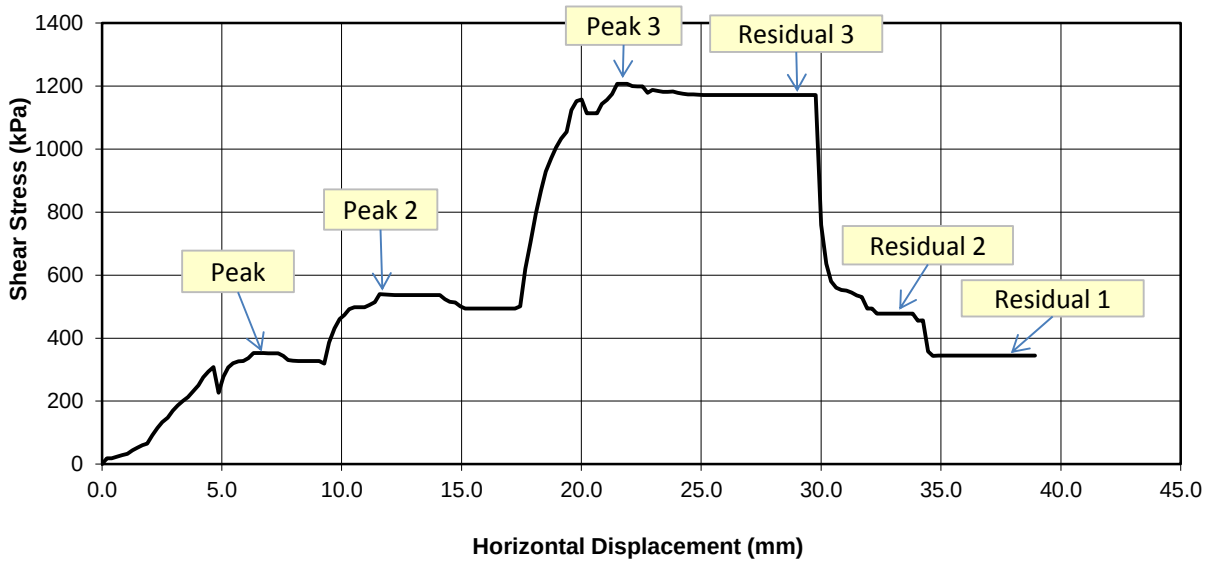
Borehole No:	BH02
Sample No:	C39
Depth (m):	10.68

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 2-4.
Debris is abundant sand and fine to medium gravel.

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



Checked and Approved by SRA S R Allen (Senior Tech) Date: 07/09/2018	Project Number: **GEO / 27859** Project Name: **St John's Masterplan** **Project Ref: 42206**	GEOLABS®

ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	BH03
Sample No:	C31
Depth (m):	11.53

Description:

Medium strong orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material. Joint roughness coefficient = 10-12. Debris is fine to coarse sub-angular gravel and sand.

Specimen Details

Type of shear plane		Pre existing plane of weakness: Joint
Preparation		Rock core encapsulated avoiding shear-plane then positioned in shearbox with shear-plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	52.9
Maximum Width	*mm*	48.8
Area	*mm²*	2122.7

Shearing Stage

Normal stress	*kPa*	500	1000	2500
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Maximum shear stress	*kPa*	705.2	1022.1	1747.3
Horizontal displacement at MSS	*mm*	4.7	6.0	9.7
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	445.1	608.2	911.0
Final cumulative displacement	*mm*	21.2		
Duration	*day(s)*	1		

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**475**
Angle of Shearing Resistance	*degrees*	**27.0**
Residual Condition:		
Apparent Cohesion	*kPa*	**354**
Angle of Shearing Resistance	*degrees*	**12.5**

Notes:

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 29/08/2018

Project Number:

GEO / 27859

Project Name:

St John's Masterplan

Project Ref: 42206

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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

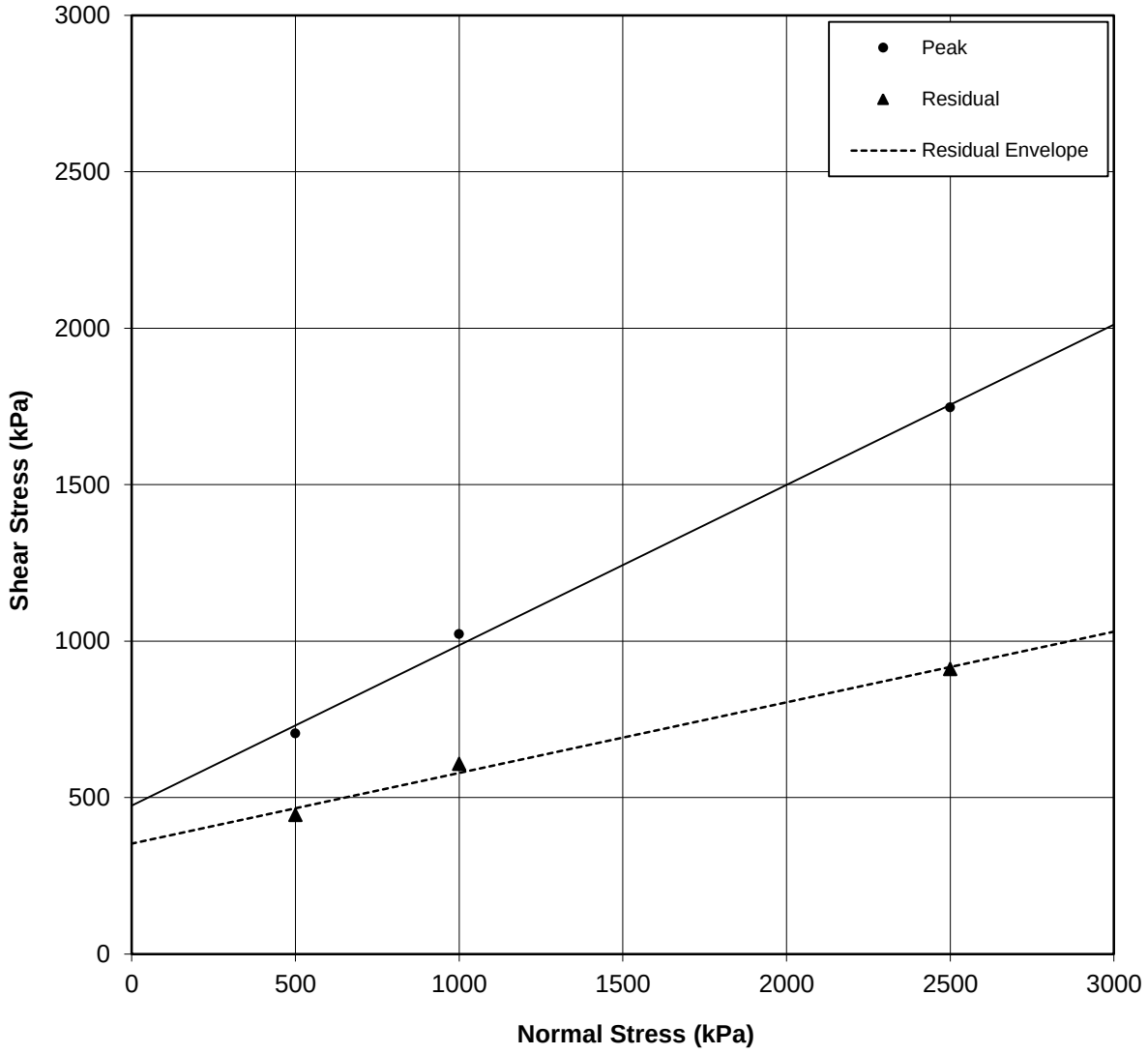
(large shearbox apparatus)

Borehole No:	BH03
Sample No:	C31
Depth (m):	11.53

Description:

Medium strong orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material. Joint roughness coefficient = 10-12. Debris is fine to coarse sub-angular gravel and sand.

Shear Stress v Normal Stress



Peak: c' = 475 Φ' = 27 °

Residual: c' = 354 Φ' = 12.5 °

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 29/08/2018

Project Number:

GEO / 27859

Project Name:

St John's Masterplan

Project Ref: 42206

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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

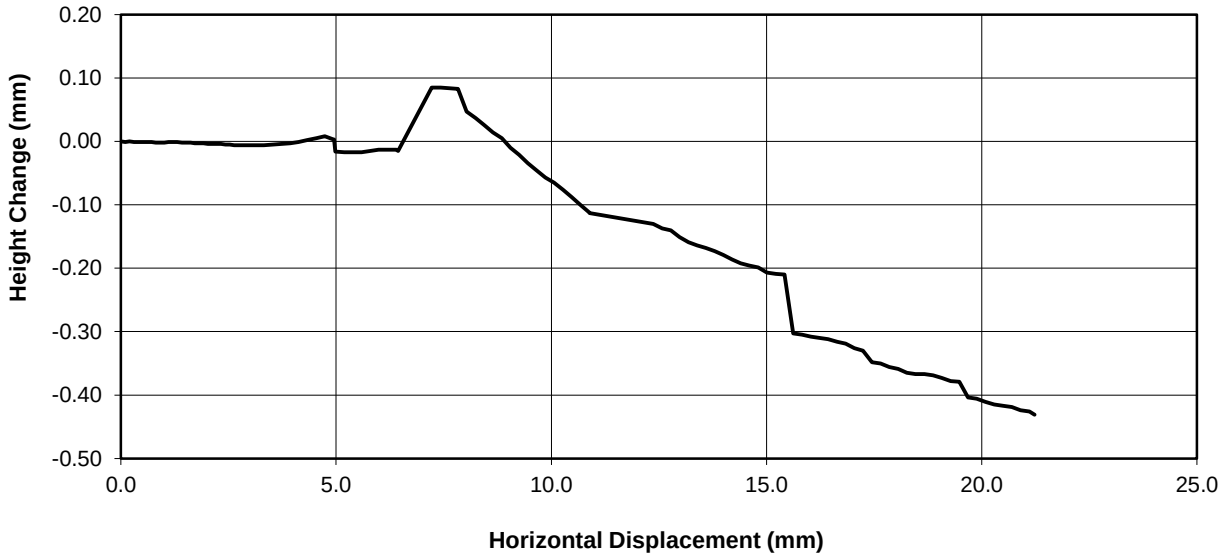
(large shearbox apparatus)

Borehole No:	BH03
Sample No:	C31
Depth (m):	11.53

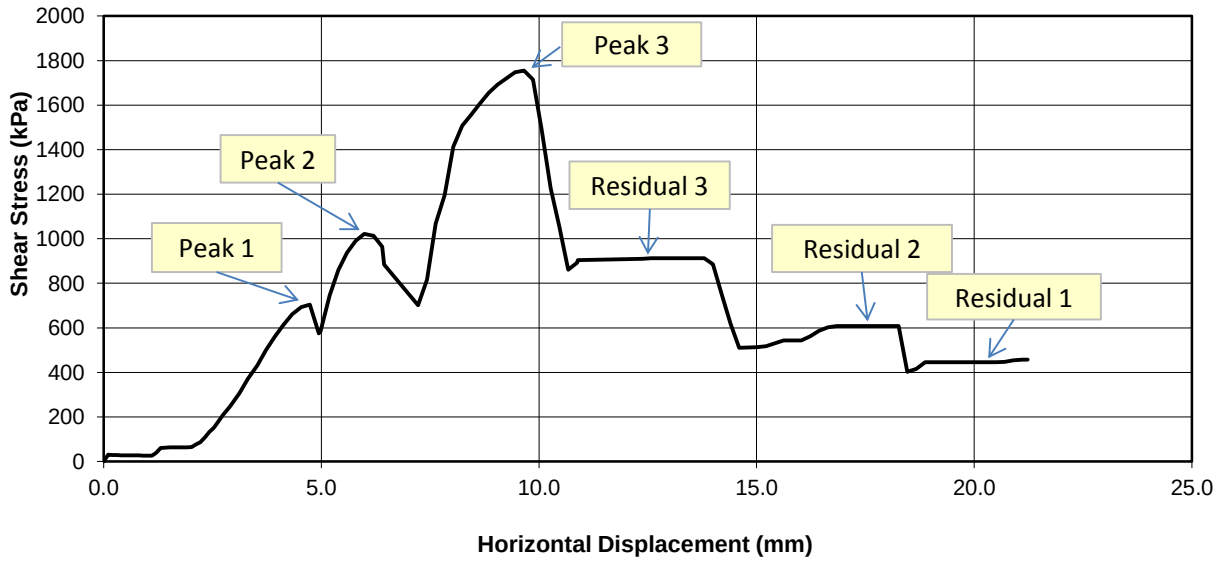
Description:

Medium strong orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material. Joint roughness coefficient = 10-12. Debris is fine to coarse sub-angular gravel and sand.

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 29/08/2018

Project Number:

GEO / 27859

Project Name:

St John's Masterplan

Project Ref: 42206

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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	BH04B
Sample No:	C13
Depth (m):	14.50

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 6-8.
Debris is negligible.

Specimen Details

Type of shear plane		Pre existing plane of weakness: Joint
Preparation		Rock core encapsulated avoiding shear-plane then positioned in shearbox with shear-plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	52.0
Maximum Width	*mm*	51.7
Area	*mm²*	2137.4

Shearing Stage

Normal stress	*kPa*	100	200	500
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Maximum shear stress	*kPa*	118.0	215.6	515.0
Horizontal displacement at MSS	*mm*	1.5	4.1	11.9
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	95.0	171.6	428.6
Final cumulative displacement	*mm*	30.7		
Duration	*day(s)*	1		

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**18**
Angle of Shearing Resistance	*degrees*	**45.0**
Residual Condition:		
Apparent Cohesion	*kPa*	**8**
Angle of Shearing Resistance	*degrees*	**40.0**

Notes:

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 03/09/2018

Project Number:

GEO / 27859

Project Name:

St John's Masterplan

Project Ref: 42206

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ISRM Suggested Method

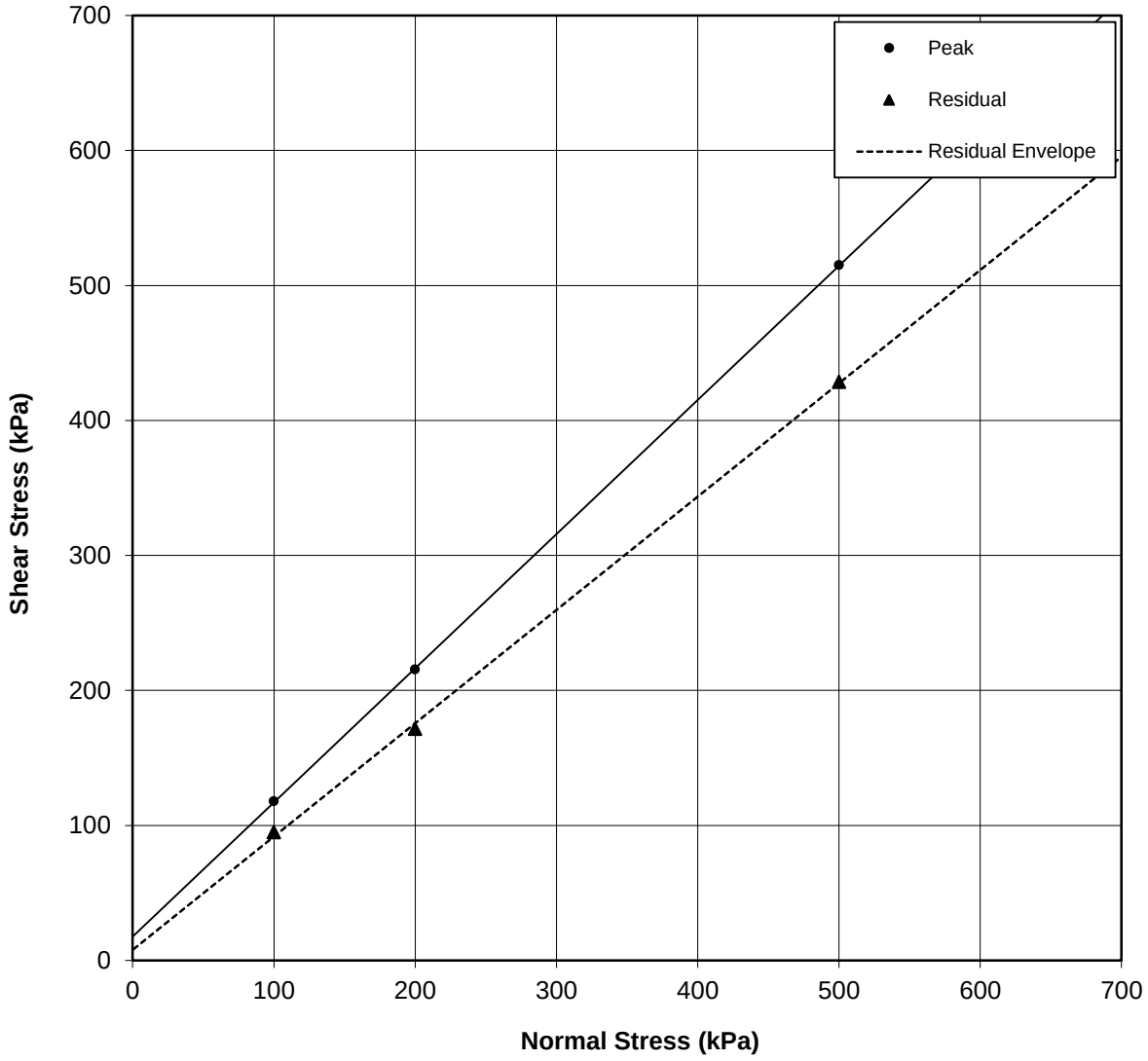
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	BH04B
Sample No:	C13
Depth (m):	14.50

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 6-8.
Debris is negligible.

Shear Stress v Normal Stress



Peak: c' = 18 Φ' = 45 °

Residual: c' = 8 Φ' = 40 °

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 03/09/2018

Project Number: **GEO / 27859**

Project Name: **St John's Masterplan**
Project Ref: 42206

GEOLABS®

ISRM Suggested Method

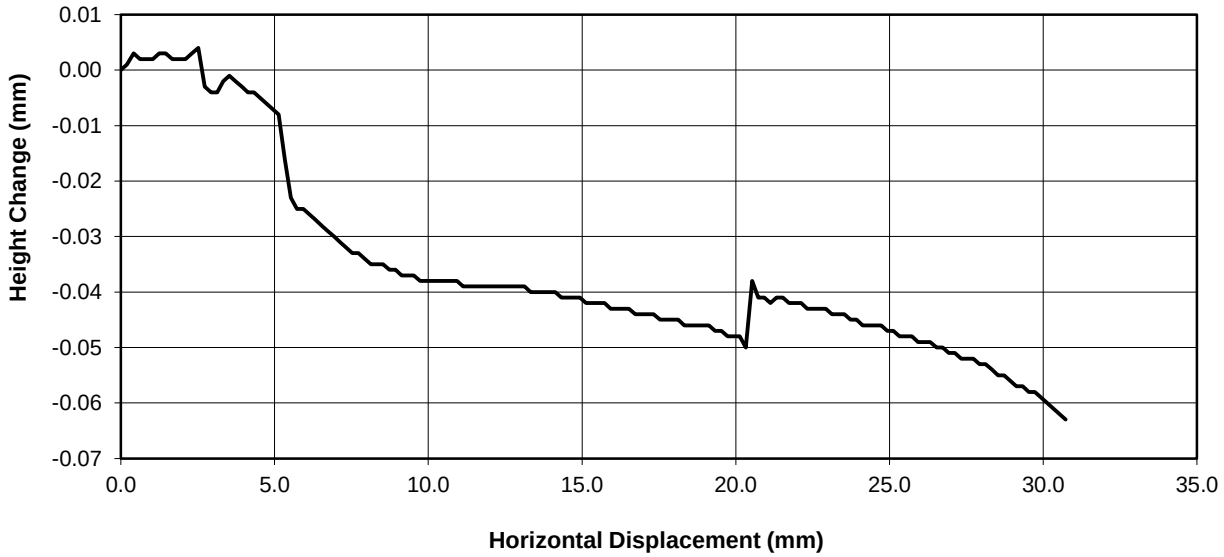
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

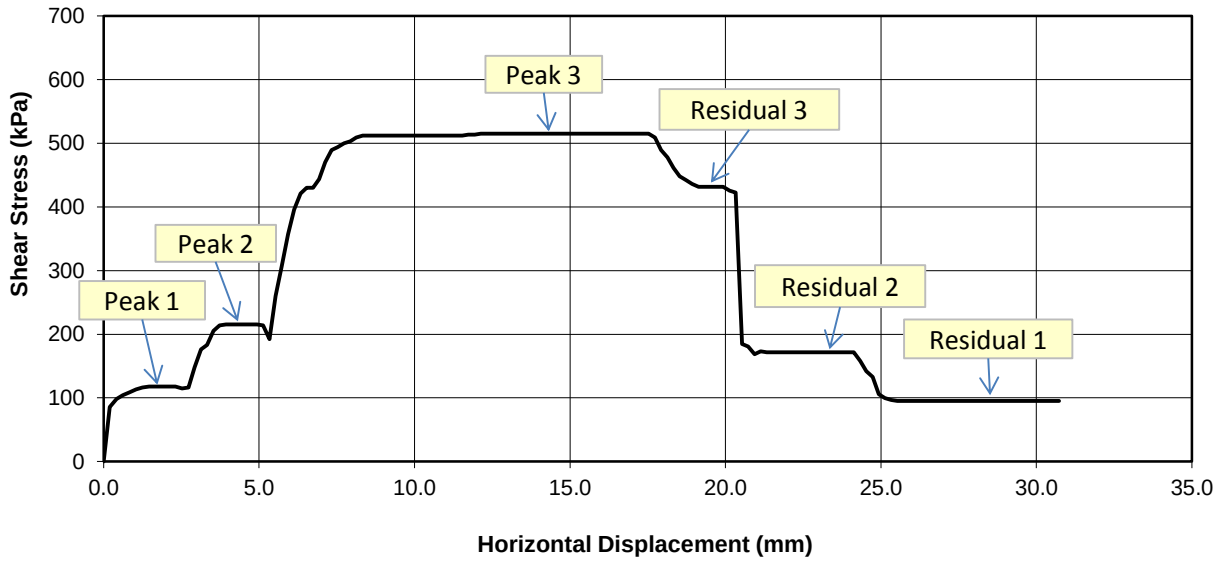
Borehole No:	BH04B
Sample No:	C13
Depth (m):	14.50

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 6-8.
Debris is negligible.

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 03/09/2018

Project Number:

GEO / 27859

Project Name:

St John's Masterplan
Project Ref: 42206

GEOLABS®

ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH02
Depth (m):	12.80

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 6-8.
Debris is abundant sand and fine to coarse gravel.

Specimen Details

Type of shear plane		Pre existing plane of weakness: Joint
Preparation		Rock core encapsulated avoiding shear-plane then positioned in shearbox with shear-plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	51.2
Maximum Width	*mm*	38.6
Area	*mm²*	1606.1

Shearing Stage

Normal stress	*kPa*	100	200	500
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Maximum shear stress	*kPa*	110.1	186.9	425.5
Horizontal displacement at MSS	*mm*	2.0	8.1	12.4
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	77.5	140.7	314.0
Final cumulative displacement	*mm*	29.5		

Duration	*day(s)*	1

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**30**
Angle of Shearing Resistance	*degrees*	**38.5**
Residual Condition:		
Apparent Cohesion	*kPa*	**21**
Angle of Shearing Resistance	*degrees*	**30.5**

Notes:

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 31/08/2018

Project Number:

GEO / 27859

Project Name:

St John's Masterplan

Project Ref: 42206

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ISRM Suggested Method

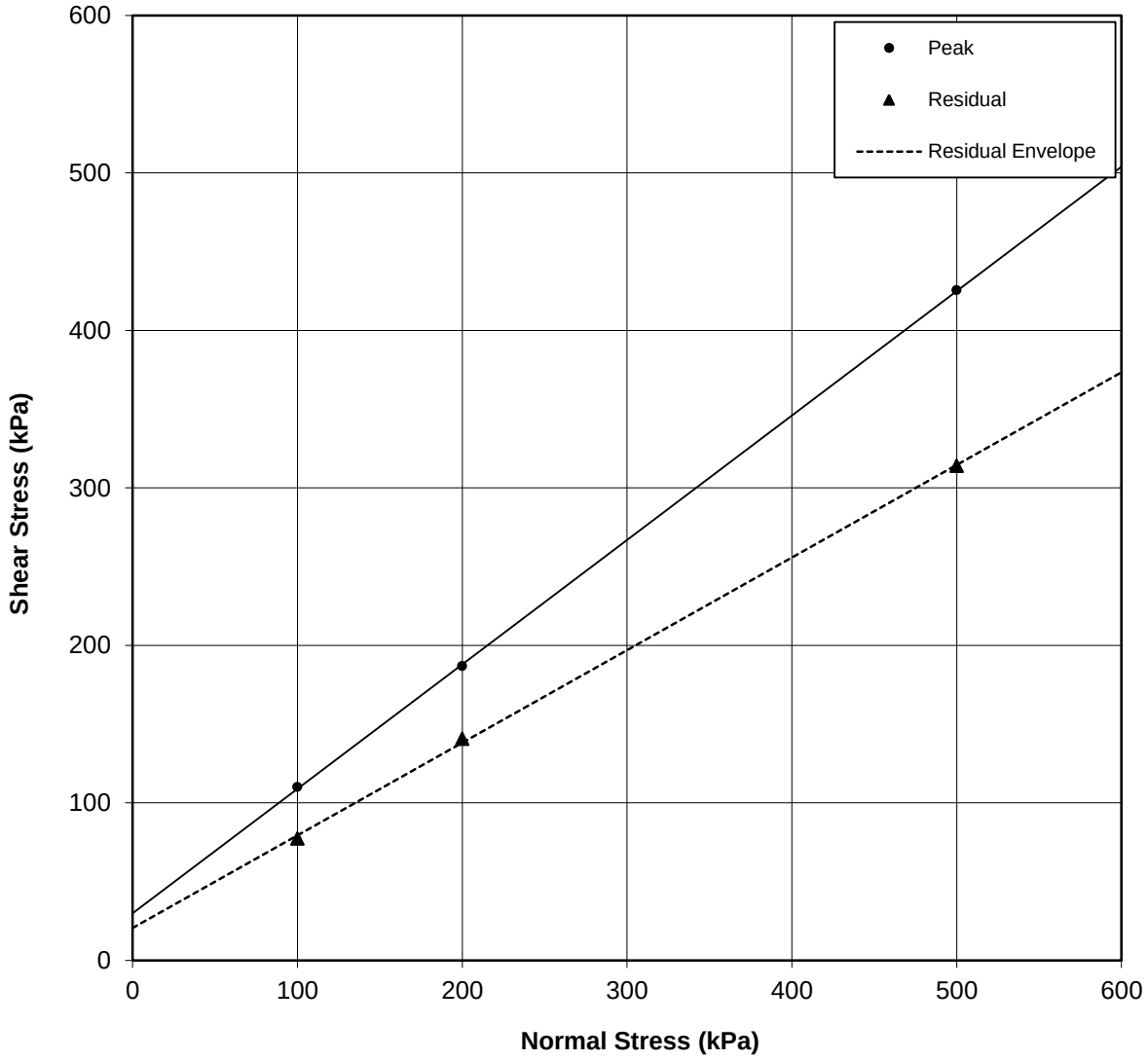
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH02
Depth (m):	12.80

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 6-8.
Debris is abundant sand and fine to coarse gravel.

Shear Stress v Normal Stress



Peak: c' = 30 Φ' = 38.5 °

Residual: c' = 21 Φ' = 30.5 °

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 31/08/2018

Project Number: **GEO / 27859**

Project Name: **St John's Masterplan**
Project Ref: 42206

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ISRM Suggested Method

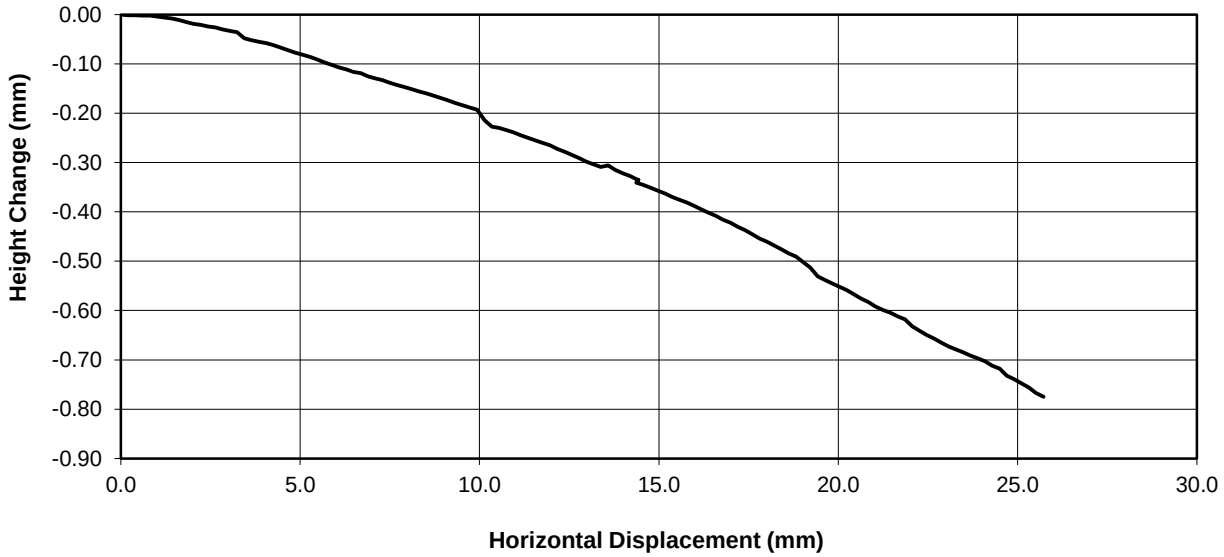
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

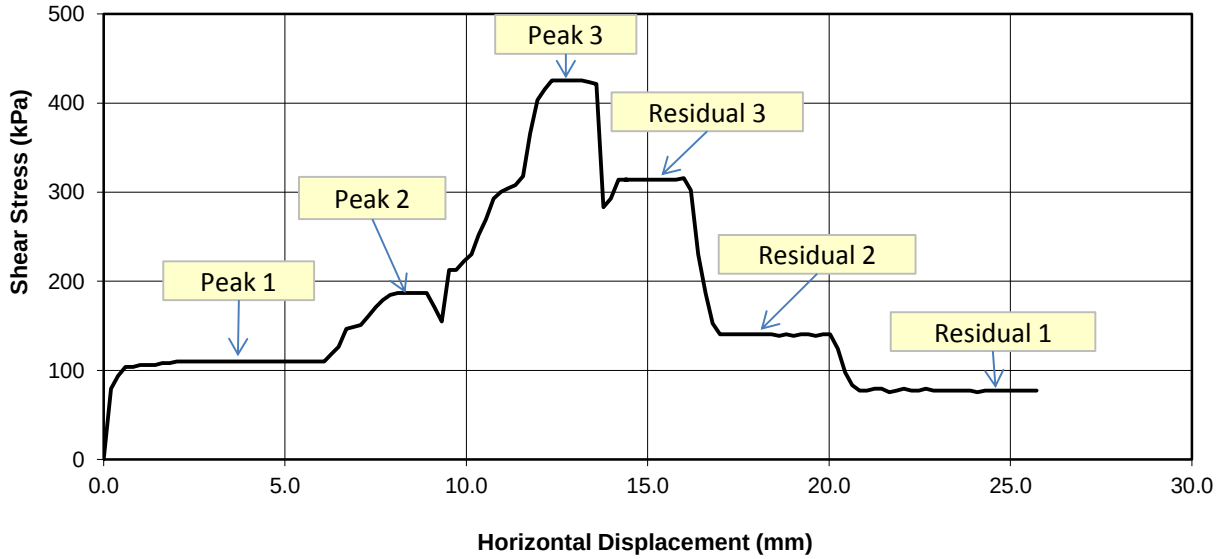
Borehole No:	RBH02
Depth (m):	12.80

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 6-8.
Debris is abundant sand and fine to coarse gravel.

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



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S R Allen (Senior Tech)

Date: 31/08/2018

Project Number: **GEO / 27859**

Project Name: **St John's Masterplan**
Project Ref: 42206

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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH03
Depth (m):	17.06

Description:
Medium strong to weak orangish brown fine to medum grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 6-8.
Debris is sand and fine to medium sub-angular gravel.

Specimen Details

Type of shear plane		Pre existing plane of weakness: Joint
Preparation		Rock core encapsulated avoiding shear-plane then positioned in shearbox with shear-plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	49.8
Maximum Width	*mm*	47.2
Area	*mm²*	1908.4

Shearing Stage

Normal stress	*kPa*	500	1000	2500
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Maximum shear stress	*kPa*	674.9	841.0	1277.5
Horizontal displacement at MSS	*mm*	5.9	7.7	11.1
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	383.2	455.0	671.5
Final cumulative displacement	*mm*	25.3		
Duration	*day(s)*	1		

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**533**
Angle of Shearing Resistance	*degrees*	**16.5**
Residual Condition:		
Apparent Cohesion	*kPa*	**311**
Angle of Shearing Resistance	*degrees*	**8.0**

Notes:

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Date: 30/08/2018

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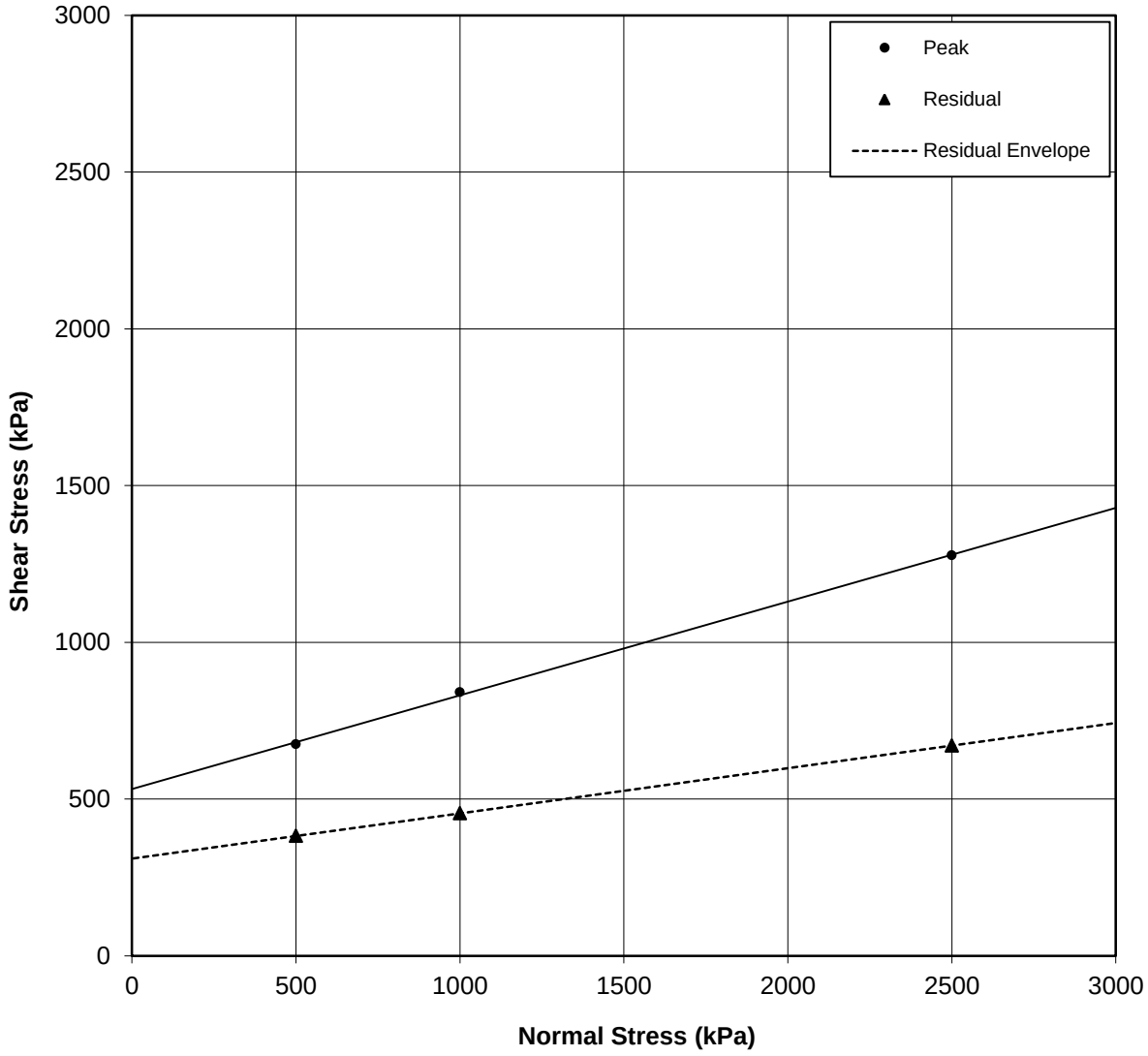
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH03
Depth (m):	17.06

Description:
Medium strong to weak orangish brown fine to medum grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 6-8.
Debris is sand and fine to medium sub-angular gravel.

Shear Stress v Normal Stress



Peak: c' = 533 Φ' = 16.5 °

Residual: c' = 311 Φ' = 8 °

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Project Number:

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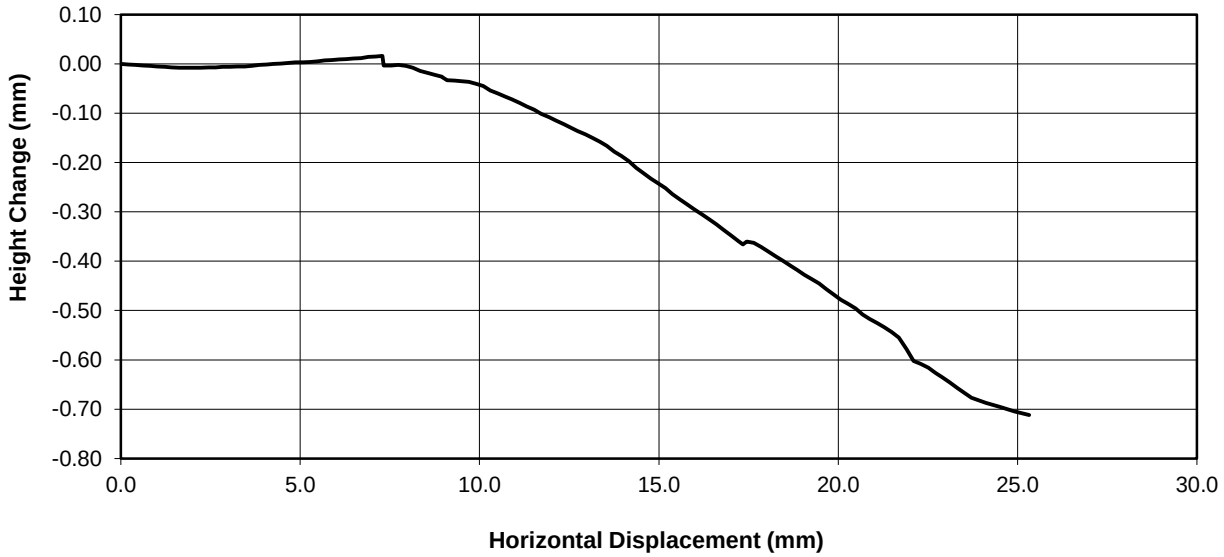
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

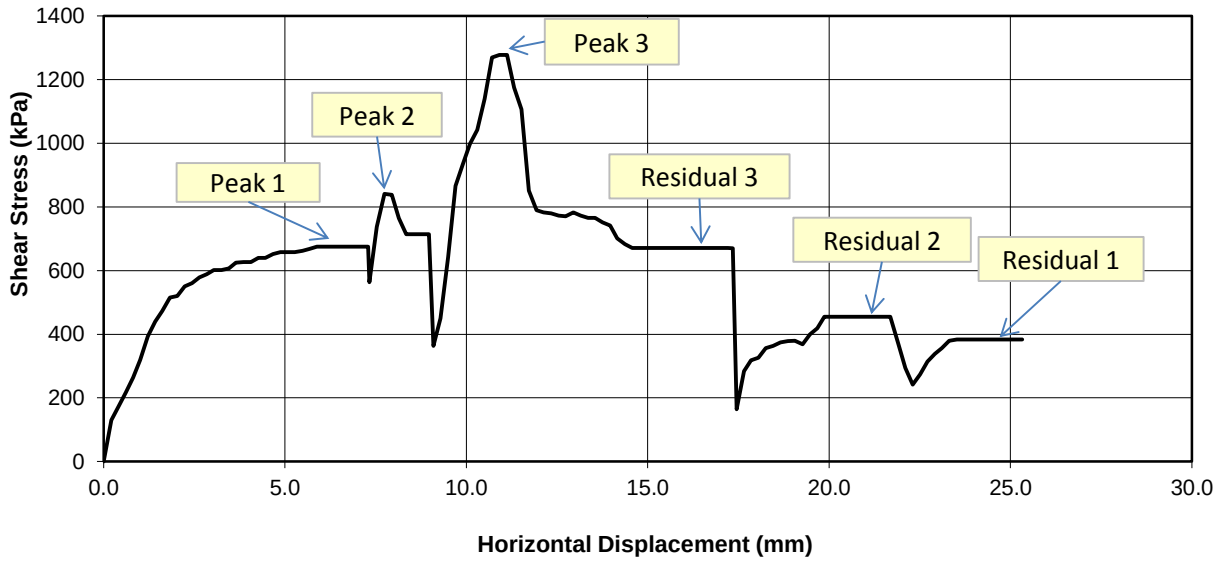
Borehole No:	RBH03
Depth (m):	17.06

Description:
Medium strong to weak orangish brown fine to medum grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 6-8.
Debris is sand and fine to medium sub-angular gravel.

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH04
Depth (m):	12.90

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 2-4.
Debris is sand and fine sub-rounded gravel.

Specimen Details

Type of shear plane		Pre existing plane of weakness: Joint
Preparation		Rock core encapsulated avoiding shear-plane then positioned in shearbox with shear-plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	48.1
Maximum Width	*mm*	46.2
Area	*mm²*	1728.5

Shearing Stage

Normal stress	*kPa*	500	1000	2500
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Maximum shear stress	*kPa*	441.5	579.8	752.4
Horizontal displacement at MSS	*mm*	2.2	3.9	5.6
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	277.3	369.5	522.7
Final cumulative displacement	*mm*	15.3		
Duration	*day(s)*	1		

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**396**
Angle of Shearing Resistance	*degrees*	**8.5**
Residual Condition:		
Apparent Cohesion	*kPa*	**233**
Angle of Shearing Resistance	*degrees*	**6.5**

Notes:

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S R Allen (Senior Tech)

Date: 30/08/2018

Project Number:

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St John's Masterplan

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ISRM Suggested Method

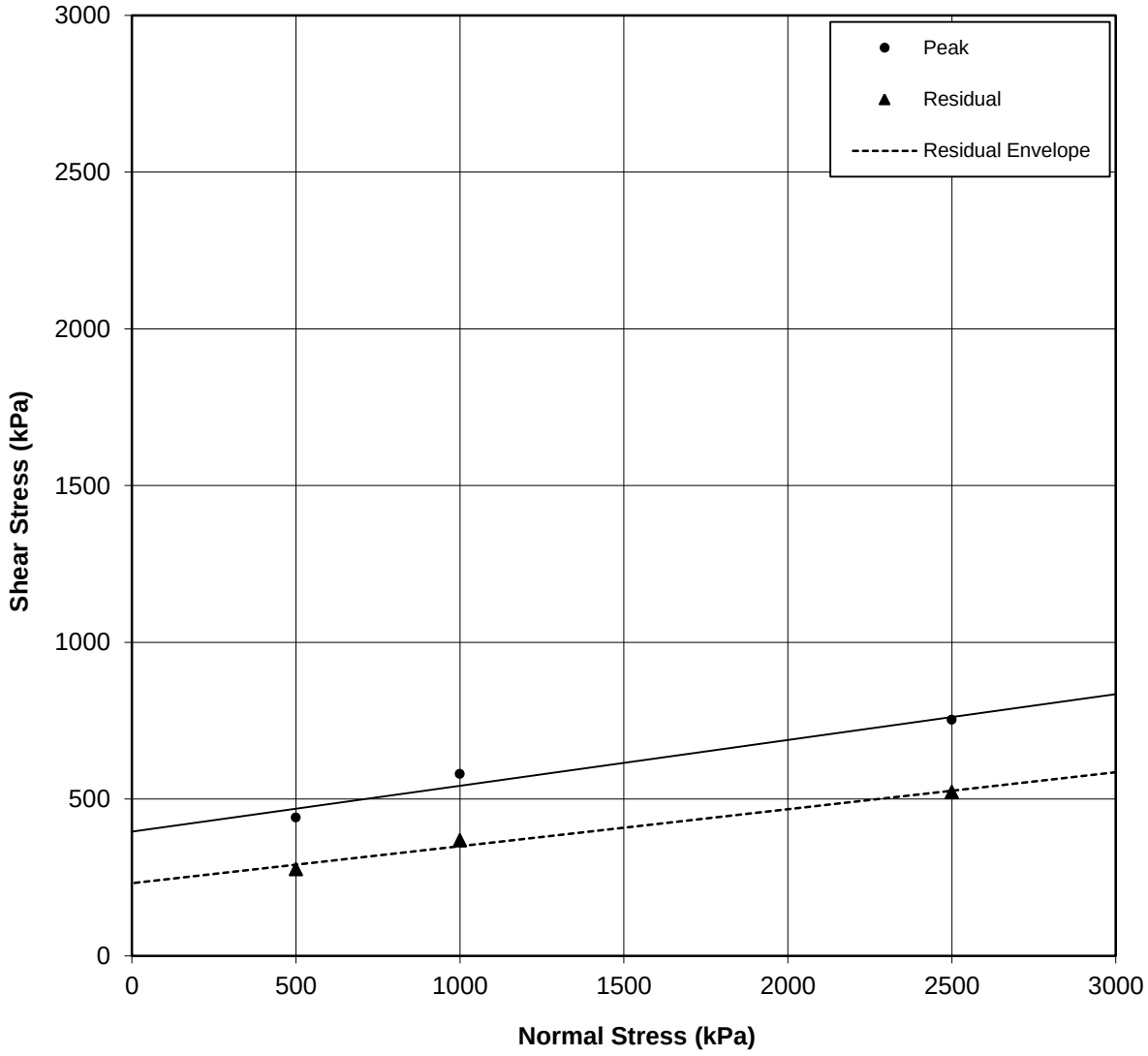
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH04
Depth (m):	12.90

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 2-4.
Debris is sand and fine sub-rounded gravel.

Shear Stress v Normal Stress



Peak: c' = 396 Φ' = 8.5 °

Residual: c' = 233 Φ' = 6.5 °

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S R Allen (Senior Tech)

Date: 30/08/2018

Project Number:

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Project Name:

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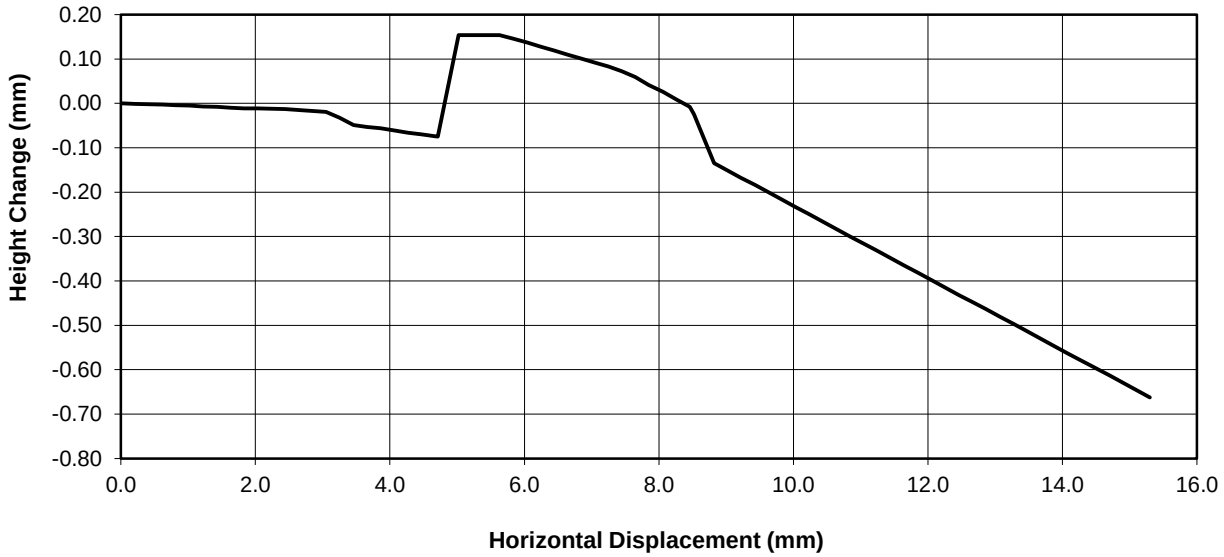
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

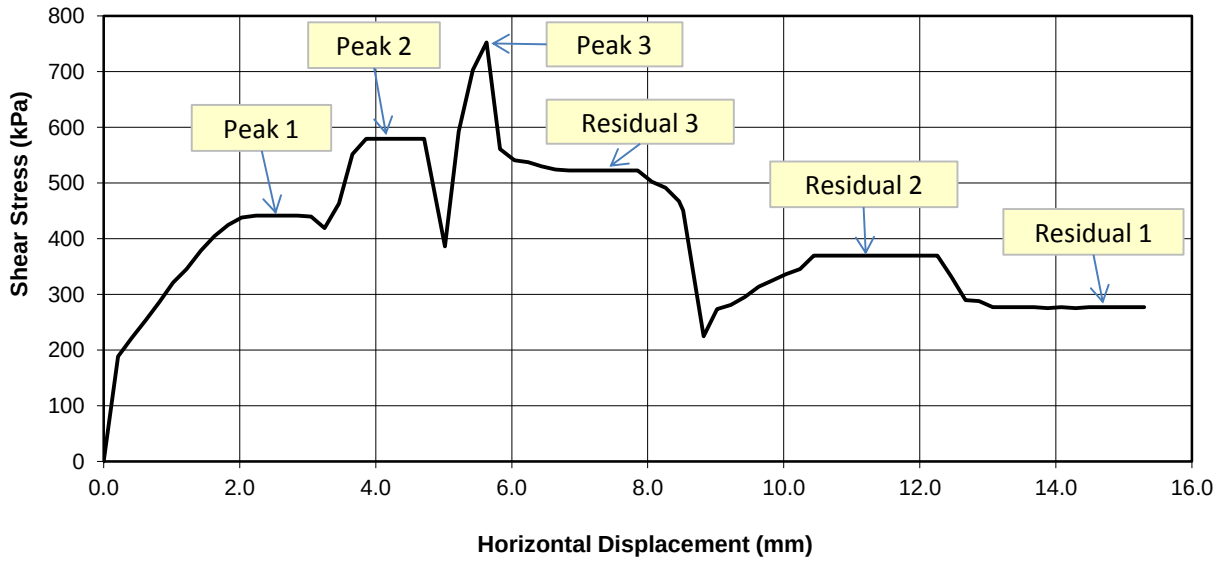
Borehole No:	RBH04
Depth (m):	12.90

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 2-4.
Debris is sand and fine sub-rounded gravel.

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH05
Sample No:	C22
Depth (m):	12.27

Description:
Medium strong to weak orangish brown fine to medium SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 4-6.
Debris is abundant sand and fine to coarse gravel.

Specimen Details

Type of shear plane		Pre existing plane of weakness: Joint
Preparation		Rock core encapsulated avoiding shear-plane then positioned in shearbox with shear-plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	47.1
Maximum Width	*mm*	45.4
Area	*mm²*	1671.0

Shearing Stage

Normal stress	*kPa*	100	200	500
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Maximum shear stress	*kPa*	172.0	221.4	366.9
Horizontal displacement at MSS	*mm*	3.1	5.5	8.6
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	158.6	191.1	296.1
Final cumulative displacement	*mm*	24.9		
Duration	*day(s)*	1		

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**124**
Angle of Shearing Resistance	*degrees*	**26.0**
Residual Condition:		
Apparent Cohesion	*kPa*	**123**
Angle of Shearing Resistance	*degrees*	**19.0**

Notes:

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Date: 31/08/2018

Project Number:

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Project Name:

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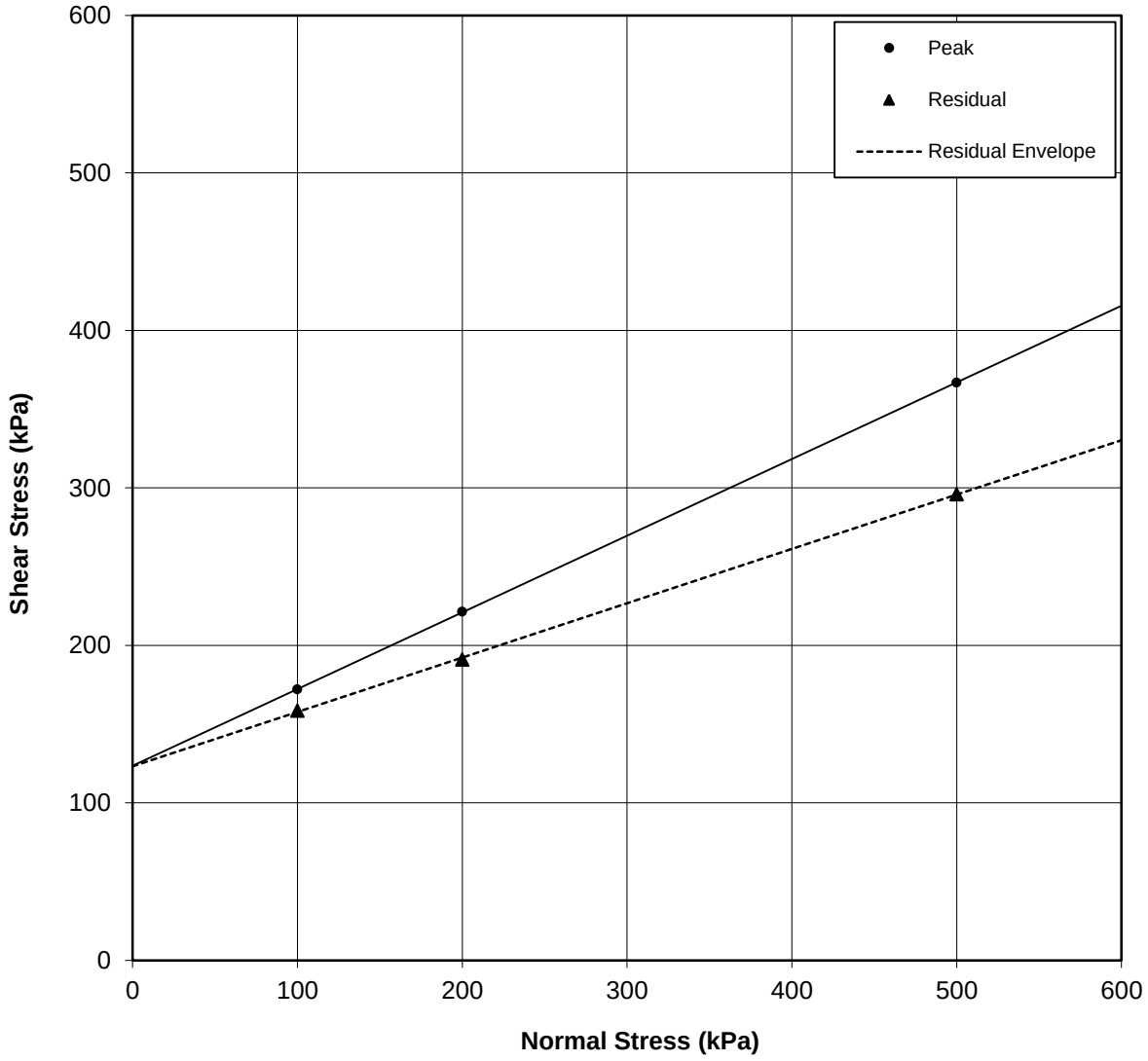
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH05
Sample No:	C22
Depth (m):	12.27

Description:
Medium strong to weak orangish brown fine to medium SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 4-6.
Debris is abundant sand and fine to coarse gravel.

Shear Stress v Normal Stress



Peak: c' = 124 Φ' = 26 °

Residual: c' = 123 Φ' = 19 °

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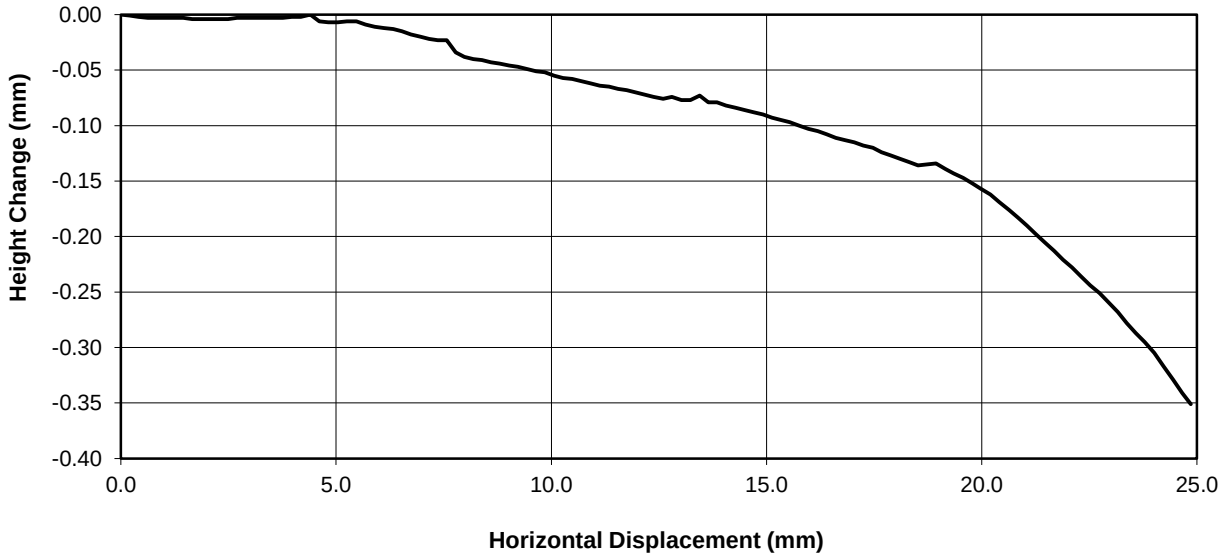
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

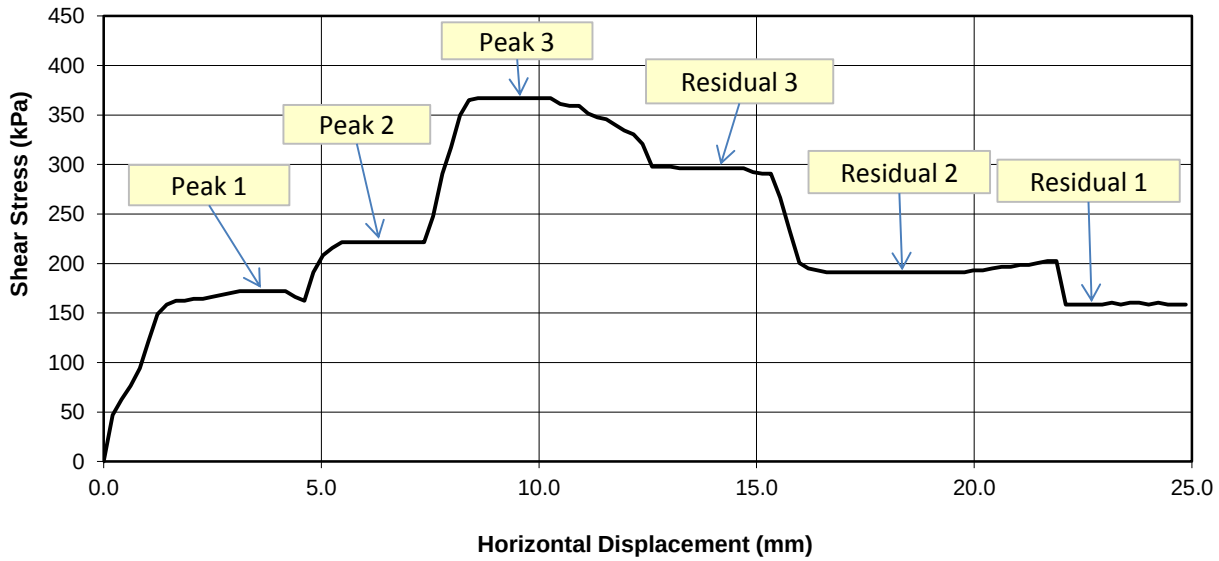
Borehole No:	RBH05
Sample No:	C22
Depth (m):	12.27

Description:
Medium strong to weak orangish brown fine to medium SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 4-6.
Debris is abundant sand and fine to coarse gravel.

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH05
Sample No:	C31
Depth (m):	18.40

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 4-6.
Debris is sand and fine to medium gravel.

Specimen Details

Type of shear plane		Pre existing plane of weakness: Joint
Preparation		Rock core encapsulated avoiding shear-plane then positioned in shearbox with shear-plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	53.4
Maximum Width	*mm*	46.1
Area	*mm²*	1907.4

Shearing Stage

Normal stress	*kPa*	100	200	500
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Maximum shear stress	*kPa*	140.6	180.7	319.7
Horizontal displacement at MSS	*mm*	1.5	3.6	6.9
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	85.0	123.3	261.1
Final cumulative displacement	*mm*	23.3		
Duration	*day(s)*	1		

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**93**
Angle of Shearing Resistance	*degrees*	**24.5**
Residual Condition:		
Apparent Cohesion	*kPa*	**38**
Angle of Shearing Resistance	*degrees*	**24.0**

Notes:

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S R Allen (Senior Tech)

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Project Number:

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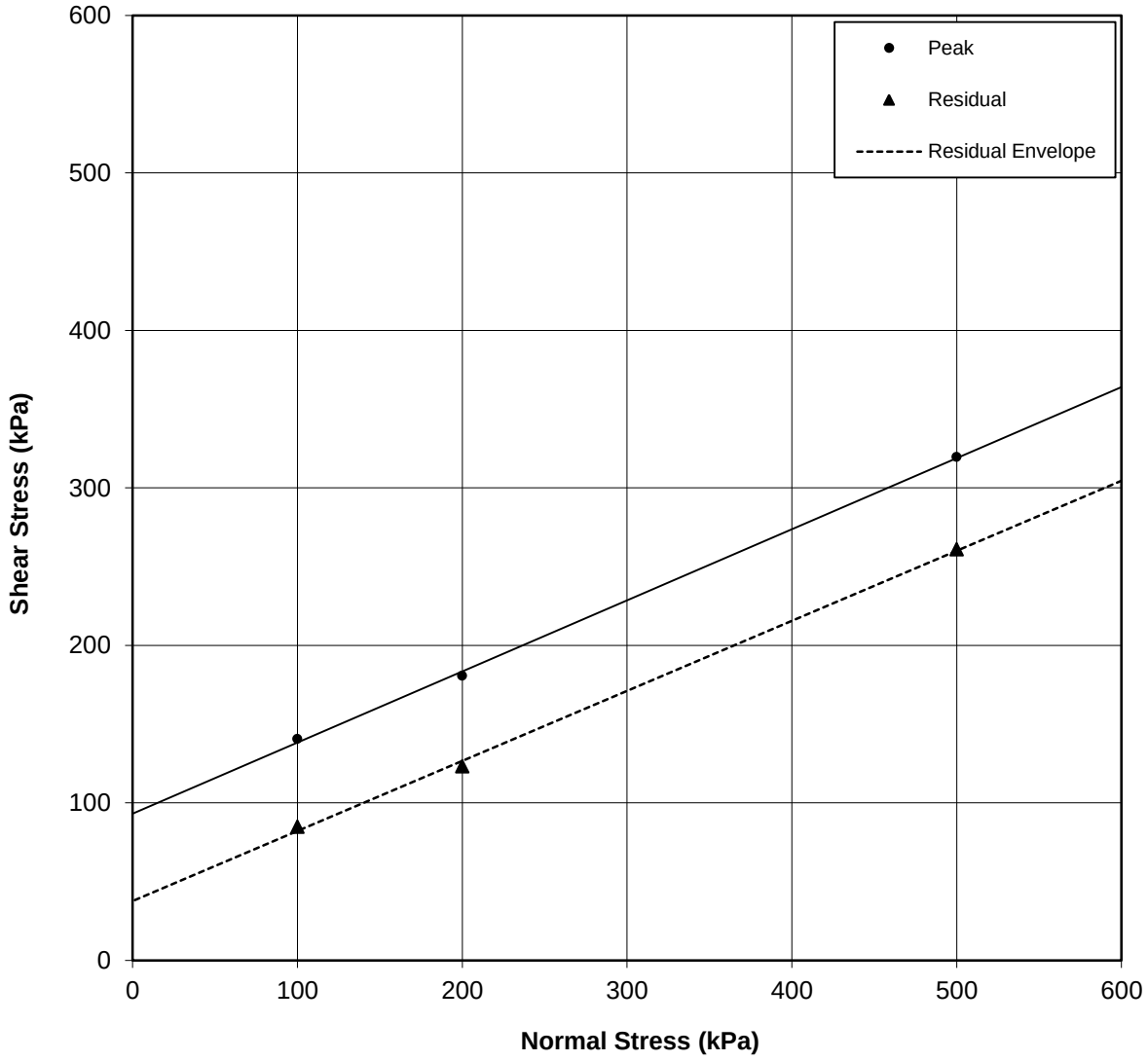
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH05
Sample No:	C31
Depth (m):	18.40

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 4-6.
Debris is sand and fine to medium gravel.

Shear Stress v Normal Stress



Peak: c' = 93 Φ' = 24.5 °

Residual: c' = 38 Φ' = 24 °

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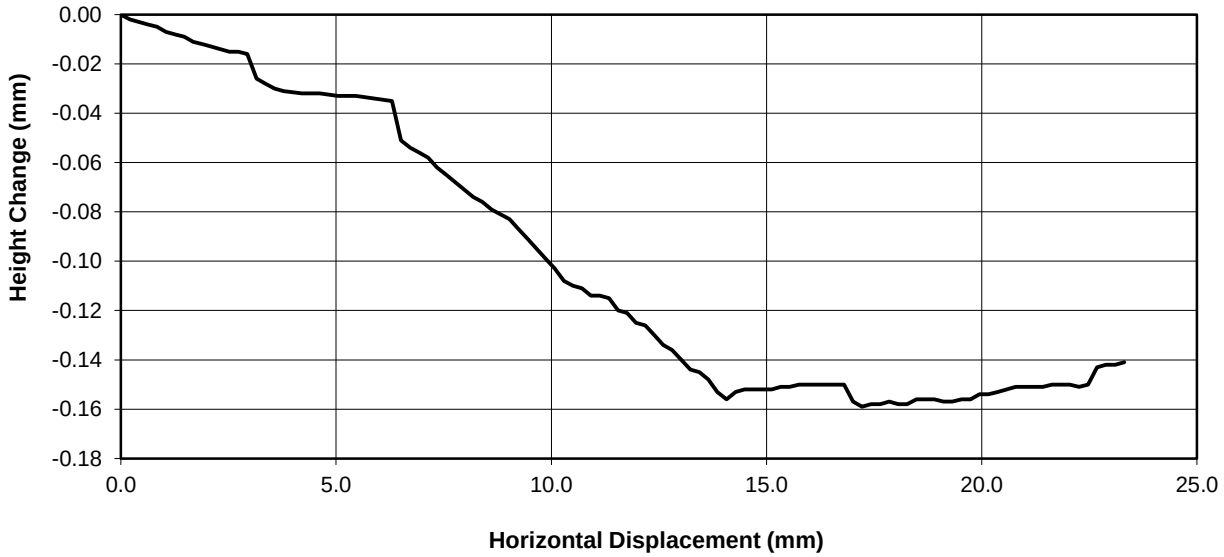
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

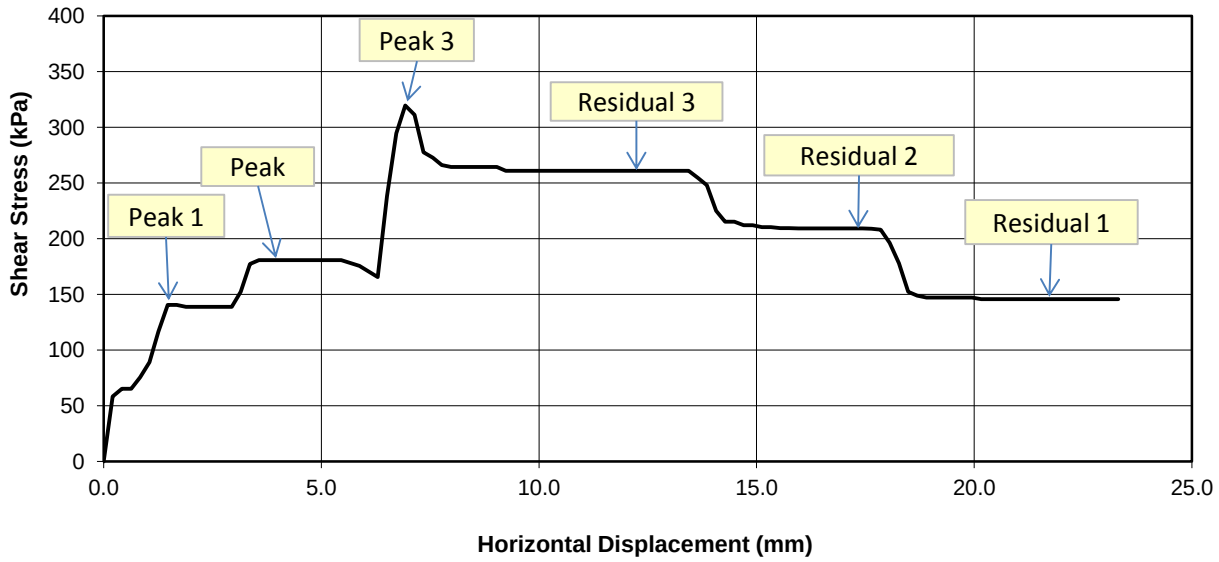
Borehole No:	RBH05
Sample No:	C31
Depth (m):	18.40

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered.
Natural shear plane with no infill material.
Joint roughness coefficient = 4-6.
Debris is sand and fine to medium gravel.

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH06
Sample No:	C23
Depth (m):	16.63

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 2-4.
Debris is abundant sand and fine to coarse gravel.[1]

Specimen Details

Type of shear plane		Pre existing plane of weakness: Joint
Preparation		Rock core encapsulated avoiding shear-plane then positioned in shearbox with shear-plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	52.0
Maximum Width	*mm*	50.4
Area	*mm²*	2114.1

Shearing Stage

Normal stress	*kPa*	500	1000	2500
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Maximum shear stress	*kPa*	577.7	600.2 [1]	579.2 [1]
Horizontal displacement at MSS	*mm*	3.5	6.1	15.6
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	392.7	339.9 [1]	579.2 [1]
Final cumulative displacement	*mm*	16.6		
Duration	*day(s)*	1		

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**n/a [1]**
Angle of Shearing Resistance	*degrees*	**n/a [1]**
Residual Condition:		
Apparent Cohesion	*kPa*	**n/a [1]**
Angle of Shearing Resistance	*degrees*	**n/a [1]**

Notes: *[1] Specimen disintegrated during shearing rendering the 2nd and 3rd stage shear strengths unreliable.*

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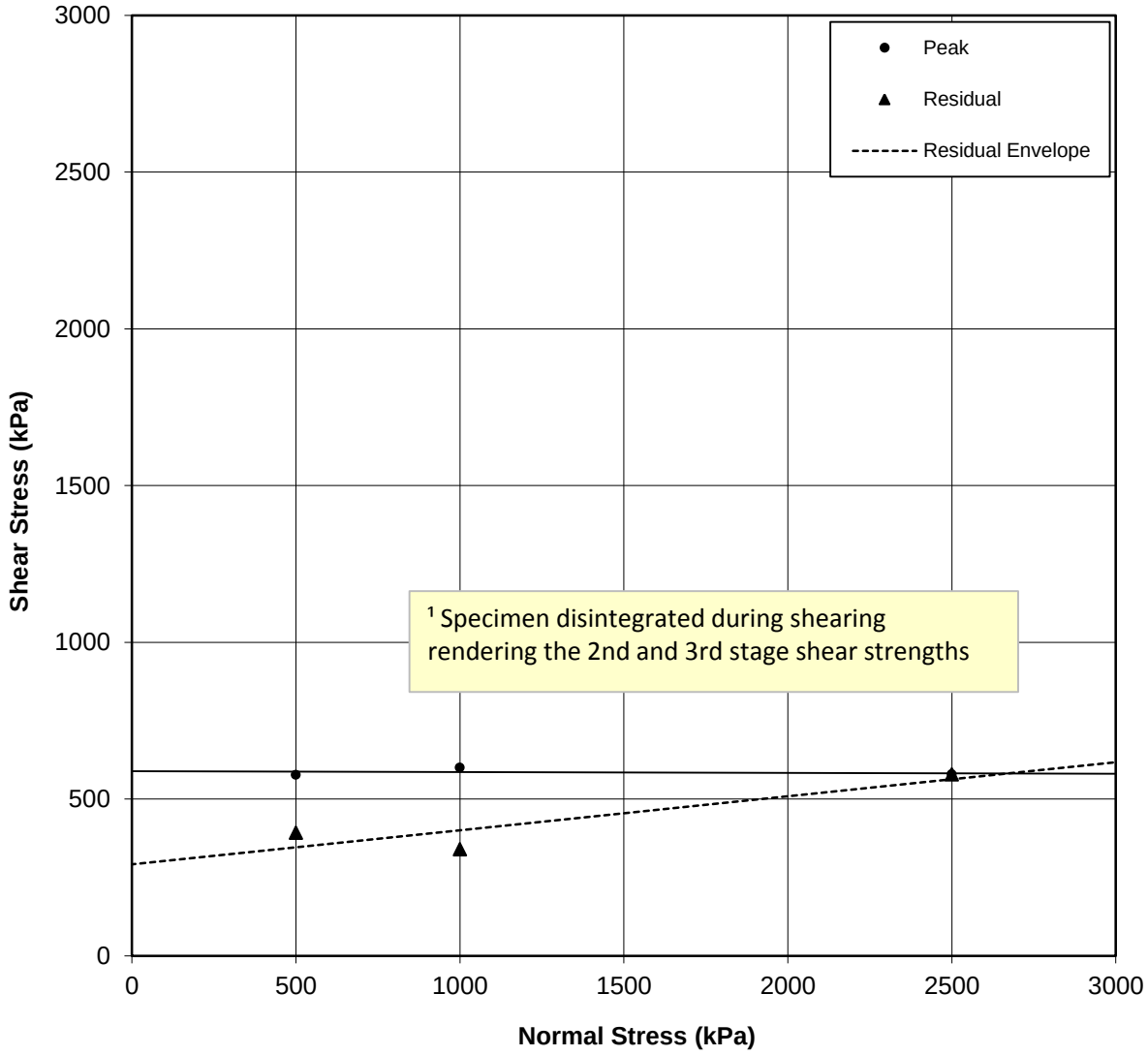
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH06
Sample No:	C23
Depth (m):	16.63

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 2-4.
Debris is abundant sand and fine to coarse gravel.[1]

Shear Stress v Normal Stress



Peak: c' = n/a Φ' = n/a

Residual: c' = n/a Φ' = n/a

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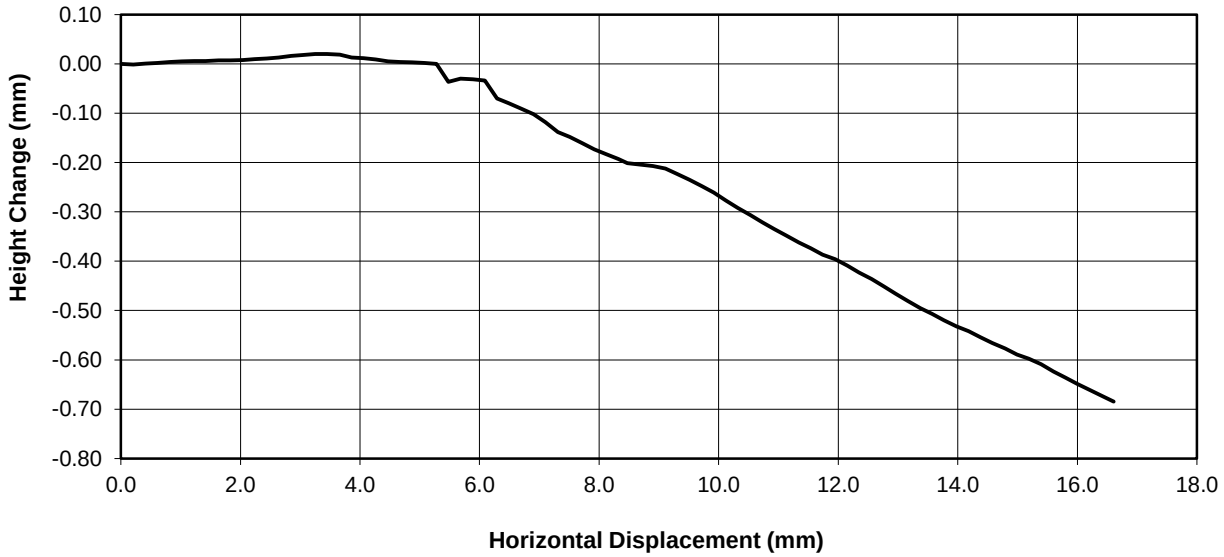
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

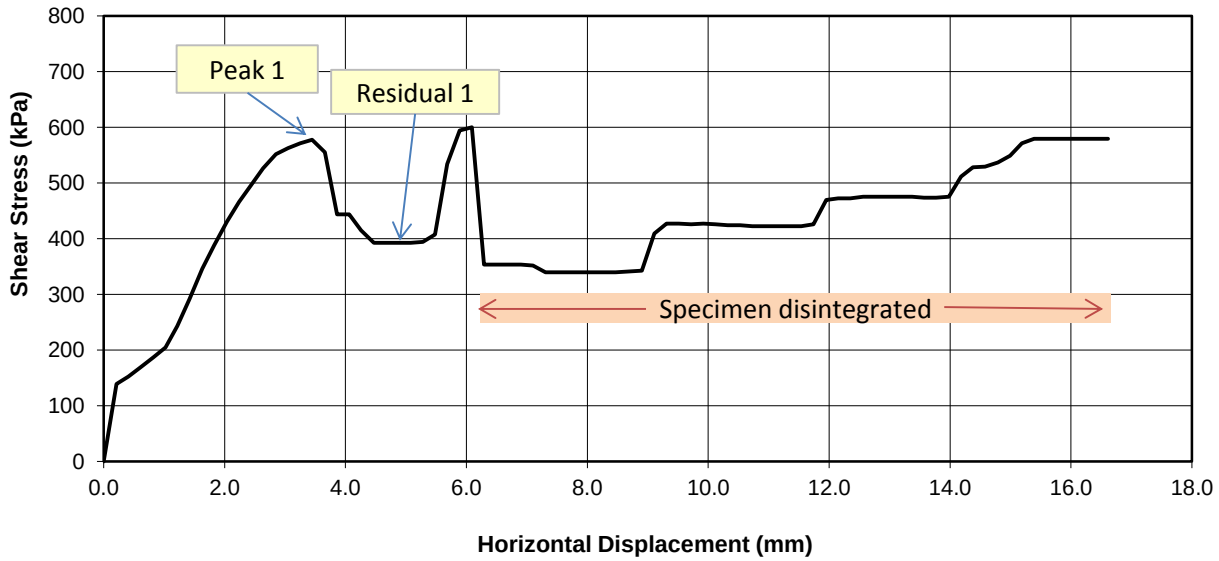
Borehole No:	RBH06
Sample No:	C23
Depth (m):	16.63

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 2-4.
Debris is abundant sand and fine to coarse gravel.[1]

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH06
Sample No:	C35
Depth (m):	23.00

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 4-6.
Debris is fine to sub-angular coarse gravel and sand.

Specimen Details

Type of shear plane		Pre existing plane of weakness: Joint
Preparation		Rock core encapsulated avoiding shear-plane then positioned in shearbox with shear-plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	54.1
Maximum Width	*mm*	49.7
Area	*mm²*	2125.1

Shearing Stage

Normal stress	*kPa*	1500	3000	6000
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Maximum shear stress	*kPa*	719.3	1132.4	1926.0
Horizontal displacement at MSS	*mm*	2.9	4.1	5.7
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	374.1	641.8	770.2
Final cumulative displacement	*mm*	15.0		
Duration	*day(s)*	1		

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**323**
Angle of Shearing Resistance	*degrees*	**15.0**
Residual Condition:		
Apparent Cohesion	*kPa*	**310**
Angle of Shearing Resistance	*degrees*	**4.5**

Notes:

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 29/08/2018

Project Number:

GEO / 27859

Project Name:

St John's Masterplan

Project Ref: 42206

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ISRM Suggested Method

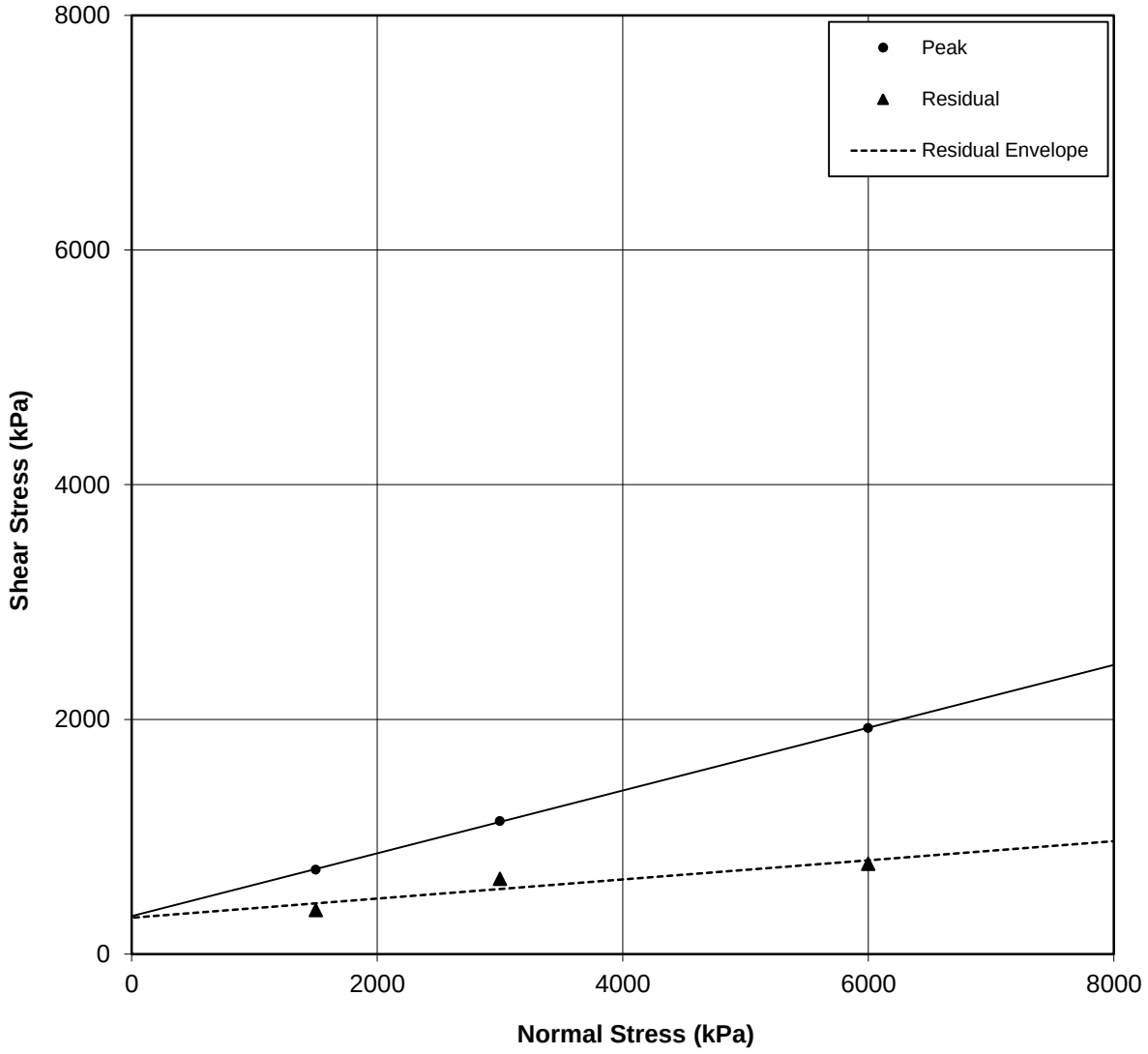
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH06
Sample No:	C35
Depth (m):	23.00

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 4-6.
Debris is fine to sub-angular coarse gravel and sand.

Shear Stress v Normal Stress



Peak: c' = 323 Φ' = 15 °

Residual: c' = 310 Φ' = 4.5 °

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 29/08/2018

Project Number: **GEO / 27859**

Project Name: **St John's Masterplan**

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ISRM Suggested Method

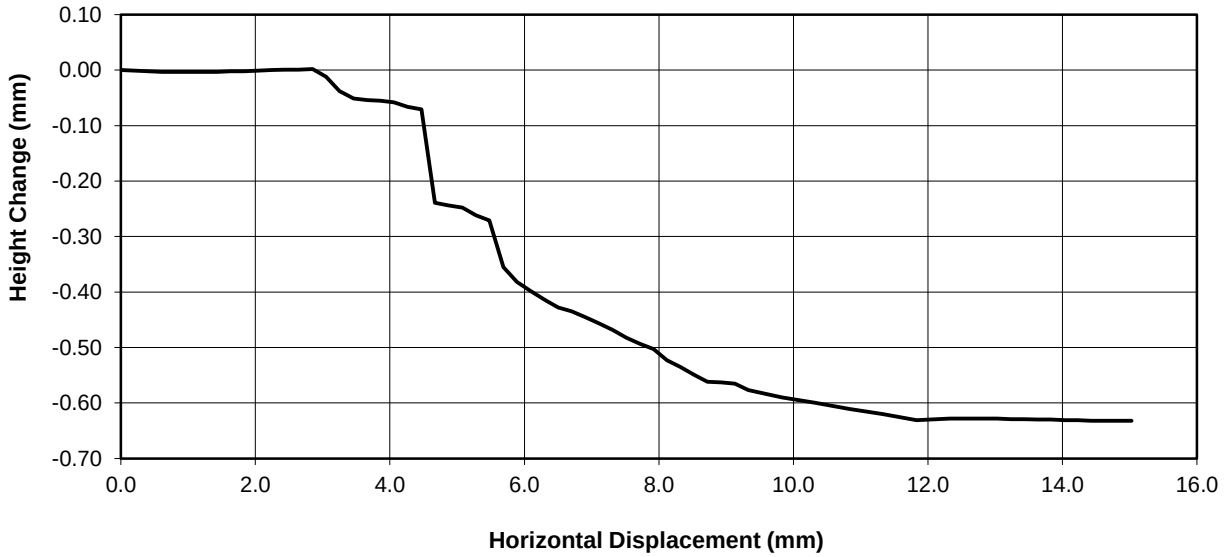
Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

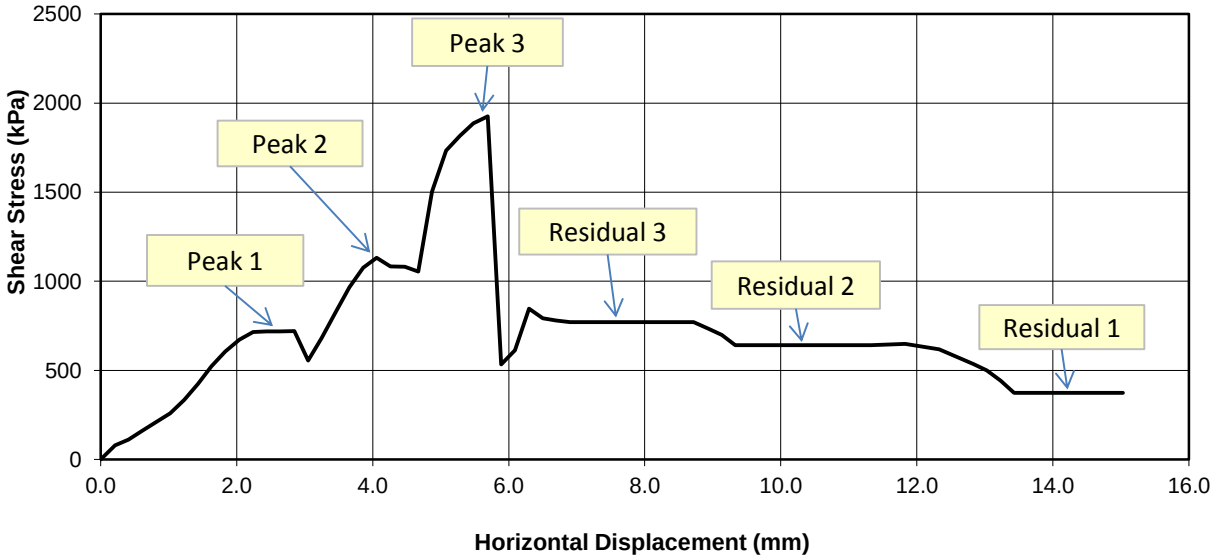
Borehole No:	RBH06
Sample No:	C35
Depth (m):	23.00

Description:
Medium strong to weak orangish brown fine to medium grained SANDSTONE. Moderately weathered. Natural shear plane with no infill material.
Joint roughness coefficient = 4-6.
Debris is fine to sub-angular coarse gravel and sand.

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 29/08/2018

Project Number:

GEO / 27859

Project Name:

St John's Masterplan
Project Ref: 42206

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ISRM - Suggested Methods : 2007

INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Sample details				Indirect Tensile Strength test (LF0879C (1000kN) compression frame used)											
Borehole Ref.	Sample Ref.	Depth (m)	Description	D. Tested	Sample Diameter (mm)	Sample Width (mm)	Degree of Saturation (%)	Water Content (%)	Specific Gravity* (Mg/m³)	Stress Rate (N/s)	Test Duration (min:sec)	Failure Sketch	Failure Load (kN)	Tensile Strength (MPa)	Remarks
BH02	33	13.30-13.42	Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered	13/08/18	99.60	50.00	81.9	12.0	2.72 (a)	200	00:14		2.90	0.37	
BH03	34	16.34-16.48	Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered	13/08/18	100.20	48.90	82.6	11.4	2.72 (a)	200	00:21		4.10	0.532	
BH04B	3	9.82-9.90	Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered	13/08/18	98.50	50.20	80.3	11.6	2.72 (a)	200	00:25		5.00	0.643	
RBH02		13.85-14.00	Very weak reddish brown fine grained SANDSTONE. High reaction to HCl. Moderately weathered	13/08/18	100.90	50.90	92.6	10.5	2.72 (a)	200	00:19		3.80	0.471	
RBH03		15.11-15.30	Very weak reddish brown fine grained SANDSTONE. High reaction to HCl. Moderately weathered	13/08/18	101.30	50.50	95.4	6.9	2.72 (a)	200	00:36		7.30	0.908	
RBH04		16.92-17.34	Very weak reddish brown fine grained SANDSTONE. High reaction to HCl. Moderately weathered	13/08/18	101.40	50.90	90.5	7.1	2.72 (a)	200	00:45		8.90	1.1	
RBH05	18	10.00-10.10	Very weak reddish brown fine grained SANDSTONE. High reaction to HCl. Moderately weathered	13/08/18	99.90	49.80	75.4	9.2	2.72 (a)	200	00:16		3.30	0.422	
RBH05	29	17.38-17.59	Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered	13/08/18	100.50	49.00	81.9	12.0	2.72 (a)	200	00:23		4.60	0.594	
RBH06	17	13.82	Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered	13/08/18	100.10	50.30	92.4	11.6	2.72 (a)	200	00:20		3.90	0.493	
RBH06	33	21.80-21.89	Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered	13/08/18	100.30	51.20	91.1	12.3	2.72 (a)	200	00:35		6.90	0.855	

* Specific Gravity: (a) assumed or (m) measured/supplied by client.

* Load rate: 200 N/s

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 15/08/2018

Project Number:

GEO / 27859

Project Name:

ST JOHNS MASTERPLAN

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UKAS TESTING 1982

ISRM - Suggested Methods : 2007

INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	BH02
Sample Ref.:	33
Depth (m):	13.30-13.42

Description:
Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered

Sample Details

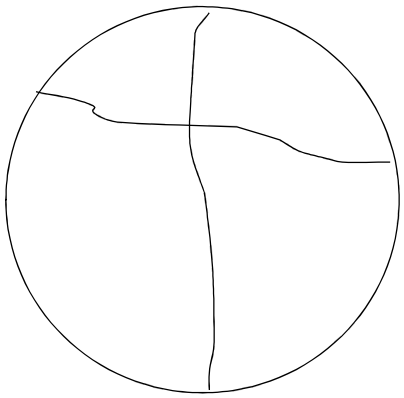
Diameter	99.60 mm
Thickness	50.00 mm
Thickness / Diameter Ratio	0.50
Bulk Density	2.18 Mg/m³
Dry Density	1.95 Mg/m³
Water Content	12.0 %
Specific Gravity (Assumed)	2.72 Mg/m³
Degree of Saturation	81.9 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:14 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Wedge fracture



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 13/08/2018

Failure Load
2.90 kN

Tensile Strength
0.37 MPa

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 15/08/2018

Project Number:

GEO / 27859

Project Name:

ST JOSEPH'S MASTERPLAN

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ISRM - Suggested Methods : 2007

INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	BH03
Sample Ref.:	34
Depth (m):	16.34-16.48

Description:
Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered

Sample Details

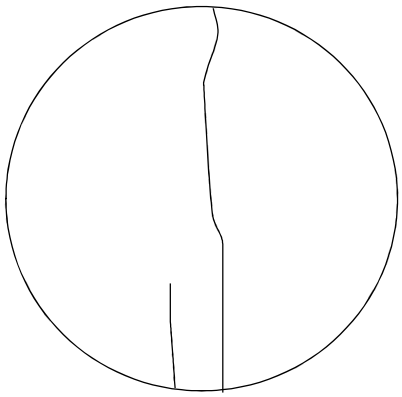
Diameter	100.20 mm
Thickness	48.90 mm
Thickness / Diameter Ratio	0.49
Bulk Density	2.20 Mg/m³
Dry Density	1.98 Mg/m³
Water Content	11.4 %
Specific Gravity (Assumed)	2.72 Mg/m³
Degree of Saturation	82.6 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:21 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Axial Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 13/08/2018

Failure Load
4.10 kN

Tensile Strength
0.532 MPa

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 15/08/2018

Project Number:

GEO / 27859

Project Name:

ST JOSEPH'S MASTERPLAN

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UKAS TESTING 1982

ISRM - Suggested Methods : 2007

INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	BH04B
Sample Ref.:	3
Depth (m):	9.82-9.90

Description:
Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered

Sample Details

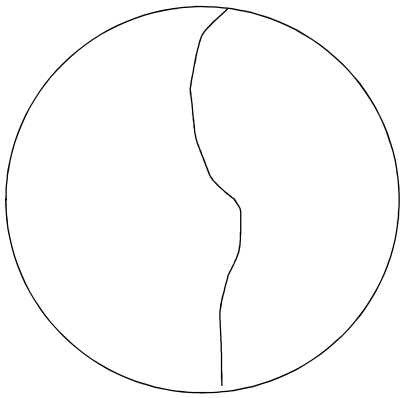
Diameter	98.50 mm
Thickness	50.20 mm
Thickness / Diameter Ratio	0.51
Bulk Density	2.18 Mg/m³
Dry Density	1.95 Mg/m³
Water Content	11.6 %
Specific Gravity (Assumed)	2.72 Mg/m³
Degree of Saturation	80.3 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:25 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Axial Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 13/08/2018

Failure Load
5.00 kN

Tensile Strength
0.643 MPa

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 15/08/2018

Project Number:

GEO / 27859

Project Name:

ST JOSEPH'S MASTERPLAN

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INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	RBH02
Sample Ref.:	
Depth (m):	13.85-14.00

Description:
Very weak reddish brown fine grained SANDSTONE. High reaction to HCl. Moderately weathered

Sample Details

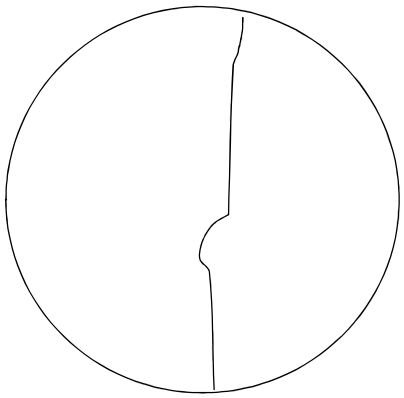
Diameter	100.90 mm
Thickness	50.90 mm
Thickness / Diameter Ratio	0.50
Bulk Density	2.30 Mg/m³
Dry Density	2.08 Mg/m³
Water Content	10.5 %
Specific Gravity (Assumed)	2.72 Mg/m³
Degree of Saturation	92.6 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:19 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Axial Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 13/08/2018

Failure Load
3.80 kN

Tensile Strength
0.471 MPa

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 15/08/2018

Project Number:

GEO / 27859

Project Name:

ST JOSEPH'S MASTERPLAN

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INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	RBH03
Sample Ref.:	
Depth (m):	15.11-15.30

Description:
Very weak reddish brown fine grained SANDSTONE. High reaction to HCl. Moderately weathered

Sample Details

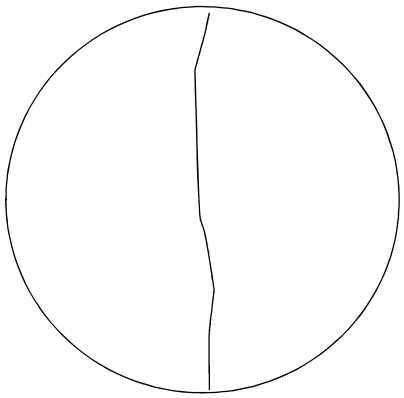
Diameter	101.30 mm
Thickness	50.50 mm
Thickness / Diameter Ratio	0.50
Bulk Density	2.43 Mg/m³
Dry Density	2.27 Mg/m³
Water Content	6.9 %
Specific Gravity (Assumed)	2.72 Mg/m³
Degree of Saturation	95.4 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:36 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Axial Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 13/08/2018

Failure Load
7.30 kN

Tensile Strength
0.908 MPa

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 15/08/2018

Project Number:

GEO / 27859

Project Name:

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INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	RBH04
Sample Ref.:	
Depth (m):	16.92-17.34

Description:
Very weak reddish brown fine grained SANDSTONE. High reaction to HCl. Moderately weathered

Sample Details

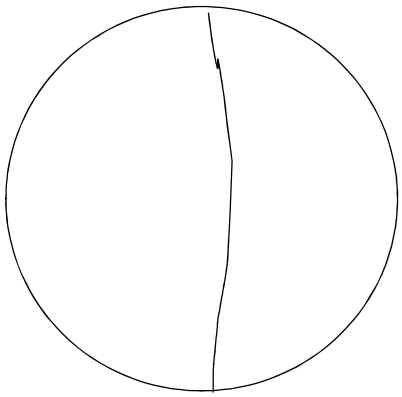
Diameter	101.40 mm
Thickness	50.90 mm
Thickness / Diameter Ratio	0.50
Bulk Density	2.40 Mg/m³
Dry Density	2.24 Mg/m³
Water Content	7.1 %
Specific Gravity (Assumed)	2.72 Mg/m³
Degree of Saturation	90.5 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:45 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Axial Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 13/08/2018

Failure Load
8.90 kN

Tensile Strength
1.1 MPa

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 15/08/2018

Project Number:

GEO / 27859

Project Name:

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INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	RBH05
Sample Ref.:	18
Depth (m):	10.00-10.10

Description:
Very weak reddish brown fine grained SANDSTONE. High reaction to HCl. Moderately weathered

Sample Details

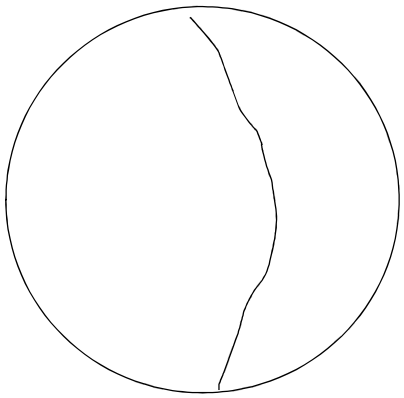
Diameter	99.90 mm
Thickness	49.80 mm
Thickness / Diameter Ratio	0.50
Bulk Density	2.23 Mg/m³
Dry Density	2.04 Mg/m³
Water Content	9.2 %
Specific Gravity (Assumed)	2.72 Mg/m³
Degree of Saturation	75.4 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:16 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Curved Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 13/08/2018

Failure Load
3.30 kN

Tensile Strength
0.422 MPa

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 15/08/2018

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ISRM - Suggested Methods : 2007

INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	RBH05
Sample Ref.:	29
Depth (m):	17.38-17.59

Description:
Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered

Sample Details

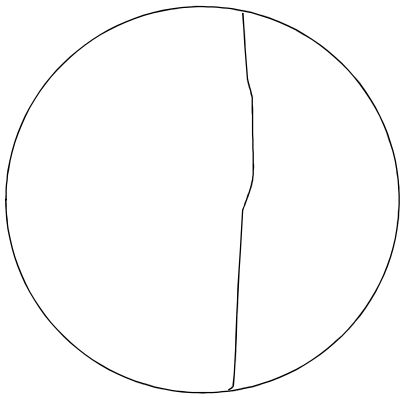
Diameter	100.50 mm
Thickness	49.00 mm
Thickness / Diameter Ratio	0.49
Bulk Density	2.18 Mg/m³
Dry Density	1.94 Mg/m³
Water Content	12.0 %
Specific Gravity (Assumed)	2.72 Mg/m³
Degree of Saturation	81.9 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:23 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Axial Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 13/08/2018

Failure Load
4.60 kN

Tensile Strength
0.594 MPa

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 15/08/2018

Project Number:

GEO / 27859

Project Name:

ST JOSEPH'S MASTERPLAN

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UKAS TESTING 1982

ISRM - Suggested Methods : 2007

INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	RBH06
Sample Ref.:	17
Depth (m):	13.82

Description:
Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered

Sample Details

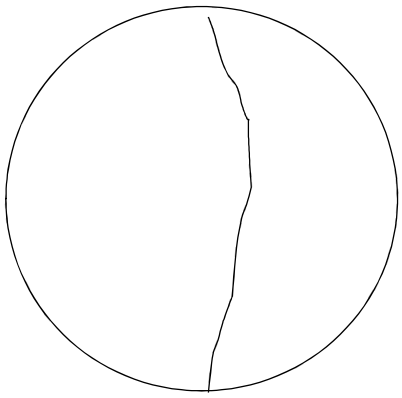
Diameter	100.10 mm
Thickness	50.30 mm
Thickness / Diameter Ratio	0.50
Bulk Density	2.26 Mg/m³
Dry Density	2.03 Mg/m³
Water Content	11.6 %
Specific Gravity (Assumed)	2.72 Mg/m³
Degree of Saturation	92.4 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:20 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Curved Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 13/08/2018

Failure Load
3.90 kN

Tensile Strength
0.493 MPa

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 15/08/2018

Project Number:

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UKAS TESTING 1982

ISRM - Suggested Methods : 2007

INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	RBH06
Sample Ref.:	33
Depth (m):	21.80-21.89

Description:
Very weak reddish brown fine to medium grained SANDSTONE. High reaction to HCl. Moderately weathered

Sample Details

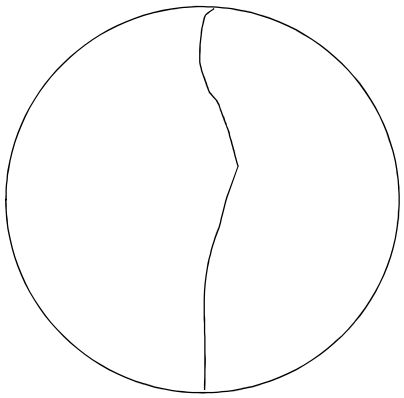
Diameter	100.30 mm
Thickness	51.20 mm
Thickness / Diameter Ratio	0.51
Bulk Density	2.23 Mg/m³
Dry Density	1.99 Mg/m³
Water Content	12.3 %
Specific Gravity (Assumed)	2.72 Mg/m³
Degree of Saturation	91.1 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:35 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Axial Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 13/08/2018

Failure Load
6.90 kN

Tensile Strength
0.855 MPa

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are not met.

Checked and Approved by

CC

C Clergeaud (Snr. Geol.)

Date: 15/08/2018

Project Number:

GEO / 27859

Project Name:

ST JOSEPH'S MASTERPLAN

42206

GEOLABS

UKAS TESTING 1982

ISRM - Suggested Methods : 2007-2014

SOUND VELOCITY TEST

Sample details									Travel Time		Sound velocity	
Borehole Ref.	Sample Ref.	Depth (m)	Description	D. Tested	Sample Diameter (mm)	Sample Length (mm)	Bulk Density (Mg/m³)	Water Content (%)	Compression wave (µs)	Shear wave (µs)	Compression V_p (m/s)	Shear V_s (m/s)
BH02	35	14.67-14.76	Very weak, thinly laminated, orangish brown SILTSTONE-MUDSTONE. Highly weathered	20/08/18	98.60	56.30	2.19	-	48.5	82.5	1161	682
BH03	33	14.40-14.52	Medium strong, orangish brown, fine to medium grained SANDSTONE. Moderately weathered	20/08/18	99.70	84.30	2.11	-	60.2	112.7	1400	748
BH04B	9	12.65-12.92	Medium strong, orangish brown, fine to medium grained SANDSTONE. Moderately weathered	20/08/18	101.10	227.70	2.17	-	126.5	219.4	1800	1038
RBH02		17.12-17.29	Medium strong, orangish brown, fine to medium grained SANDSTONE. Moderately weathered	20/08/18	101.30	141.50	2.13	-	86.3	150.5	1640	940
RBH02		15.12-15.26	Medium strong, orangish brown, fine to medium grained SANDSTONE. Moderately weathered	20/08/18	101.20	132.10	2.25	-	68.9	120.4	1917	1097
RBH03		13.87-14.09	Medium strong, orangish brown, fine to medium grained SANDSTONE. Moderately weathered	20/08/18	101.10	188.90	2.18	-	112.6	196.5	1678	961
RBH03		15.11-15.30	Medium strong, orangish brown, fine to medium grained SANDSTONE. Moderately weathered	20/08/18	101.40	163.10	2.34	-	91.8	160.7	1777	1015
RBH04		14.07-14.24	Medium strong, orangish brown, fine to medium grained SANDSTONE. Moderately weathered	20/08/18	100.90	130.60	2.17	-	78.4	140.7	1666	928
RBH04		16.92-17.34	Medium strong, orangish brown, fine to medium grained SANDSTONE. Moderately weathered	20/08/18	101.50	131.00	2.34	-	65.7	114.0	1994	1149
RBH05	25	14.44-14.58	Medium strong, orangish brown, fine to medium grained SANDSTONE. Moderately weathered	20/08/18	101.20	121.50	2.13	-	70.5	123.0	1723	988

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 29/08/2018

Project Number:

GEO / 27859

Project Name:

ST JOHN'S MASTERPLAN

42206

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ISRM - Suggested Methods : 2007-2014

SOUND VELOCITY TEST

Sample details									Travel Time		Sound velocity	
Borehole Ref.	Sample Ref.	Depth (m)	Description	D. Tested	Sample Diameter (mm)	Sample Length (mm)	Bulk Density (Mg/m³)	Water Content (%)	Compression wave (µs)	Shear wave (µs)	Compression V_p (m/s)	Shear V_s (m/s)
RBH05	33	19.72-19.81	Very weak, thinly laminated, orangish brown SILTSTONE-MUDSTONE. Highly to completely weathered	20/08/18	101.10	62.40	2.08	-	48.5	96.5	1287	647
RBH06	14	12.00-12.11	Medium strong, orangish brown, fine to medium grained SANDSTONE. Moderately weathered	20/08/18	93.40	63.20	2.04	-	50.3	98.4	1256	642
RBH06	28	20.00-20.20	Medium strong, orangish brown, fine to medium grained SANDSTONE. Moderately weathered	20/08/18	100.10	168.50	2.17	-	83.2	152.6	2025	1104

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 29/08/2018

Project Number:

GEO / 27859

Project Name:

ST JOSEPH'S MASTERPLAN

42206

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IAN FARMER ASSOCIATES
Unit 4, Faraday Close, Pattinson North Industrial Estate, Washington, NE38 8QJ. Tel: 0191 482 8500 Fax: 0191 482 8520
washington@ianfarmer.co.uk www.ianfarmer.co.uk

F.A.O.

Test Report - 42269R2 / 1

Site:	St John's Masterplan Phase 2
Job Number:	42269R2
Originating Client:	Curtins Consulting
Originating Reference:	42269
Date Sampled:	12/12/2018
Date Scheduled:	12/12/2018
Date Testing Started:	04/01/2019
Date Testing Finished:	09/01/2019

Remarks:

Authorised By:

Tim Robinson
Quality Technician

Date: 09/01/2019

Constructionline
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Registered Office. Spring Lodge 172 Chester Road, Helsby, Frodsham, England, WA6 0AR.
Offices in: Cornwall (01872) 261775. Coventry (024) 7630 3422. Harpenden (01582) 460018. Llanelli (01554) 566566.
Newcastle upon Tyne (0191) 482 8500. Motherwell (01698) 230231. Warrington (01925) 855440. Washington (0191) 482 8500.
AGS

Site: St John's Masterplan Phase 2 **Job Number:** 42269R2

Client: Curtins Consulting **Page:** 2

ROCK INDEX TESTS - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock description / Rock type	Natural Water Content1 %	Caliper2		Buoyancy3		Natural Bulk density Mg/m3	Remarks
					Dry density Mg/m3	Porosity %	Dry density Mg/m3	Porosity %		
RBH13	10.95	C3	Red/Brown SANDSTONE	11.2			1.93	22.1	2.15	
RBH13	16.41	C9	Red/Brown SANDSTONE	12.4			1.91	27.7	2.14	
RBH13	21.50	C14	Red/Brown SANDSTONE	10.1			2.10	20.1	2.31	
RBH13	25.50	C18	Red/Brown SANDSTONE	12.1			1.98	23.2	2.22	

Notes
1. ISRM p87 test 1, water content at 105 ± 3 oC, specimen as received at the laboratory
2. ISRM p87 test 2, Porosity/density determination using saturation and caliper
3. ISRM p88 test 3, Porosity/density determination using saturation and buoyancy
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 conrent 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 conrent of a rock sample

IAN FARMER ASSOCIATES

Laboratory Test Report 42269R2 / 1

Site: St John's Masterplan Phase 2 **Job Number:** 42269R2

Client: Curtins Consulting **Page:** 3

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3				Remarks
				Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
RBH13	11.76	C4	Red/Brown SANDSTONE	101.4	125.4	*1.2	2.27	10.6	as received	0.5067	AC	6.4	
RBH13	14.00	C6	Red/Brown SANDSTONE	101.6	161.4	*1.6	2.24	12.3	as received	0.5047	AC	2.6	
RBH13	17.28	C10	Red/Brown SANDSTONE	101.2	159.6	*1.6	2.28	11.4	as received	0.5083	AC	7.4	
RBH13	24.70	C17	Red/Brown SANDSTONE	101.3	165.2	*1.6	2.24	11.3	as received	0.5075	S	2.4	
RBH13	27.78	C20	Red/Brown SANDSTONE	101.3	111.3	*1.1	2.23	12.4	as received	0.5075	AC	7.6	
RBH13	33.45	C26	Red/Brown SANDSTONE	101.2	216.8	*2.1	2.24	12.1	as received	0.5080	AC	5.1	
RBH13	38.40	C31	Red/Brown SANSTONE	101.4	118.8	*1.2	2.28	10.4	as received	0.5064	AC	11.3	

Notes
1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS
2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density
3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials
above notes apply unless annotated otherwise in the remarks

*Denotes length diameter ratio outside ISRM specification

Mode of failure :
S - Single shear MS - multiple shear
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

Site: St John's Masterplan Phase 2 **Job Number:** 42269R2

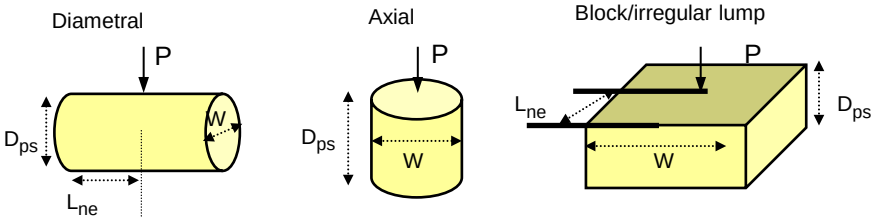
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM: Type (D, A, I, B)	Test Type see ISRM: Direction (PL, PD or U)	Failure Valid (Y/N)	Dimensions: Lne mm	Dimensions: W mm	Dimensions: Dps mm	Dimensions: Dps' mm	Force P kN	Equivalent diameter, De mm	Point Load Strength Index: Is . MPa	Point Load Strength Index: Is (50) MPa	Remarks (including water content if measured)
RBH13	8.85	C1	Red/Brown SANDSTONE As received	D	PL	YES	56.5	100.4	100.4	95.4	0.5	100.4	0.05	0.07	
RBH13	8.85	C1	Red/Brown SANDSTONE As received	A	PD	YES		100.6	58.3	55.3	1.1	86.4	0.15	0.19	
RBH13	9.74	C2	Red/Brown SANDSTONE As received	D	PL	YES	57.2	101.1	101.1	96.1	0.6	101.1	0.06	0.08	
RBH13	9.74	C2	Red/Brown SANDSTONE As received	A	PD	NO		102.0	77.8	67.8	0.6	100.5	0.06	0.08	
RBH13	10.95	C3	Red/Brown SANDSTONE As received	D	PL	YES	51.5	100.6	100.6	92.6	0.6	100.6	0.06	0.08	
RBH13	10.95	C3	Red/Brown SANDSTONE As received	A	PD	YES		101.4	72.8	67.8	1.0	97.0	0.11	0.14	
RBH13	12.94	C5	Red/Brown SANDSTONE As received	D	PL	YES	71.6	101.2	101.2	95.2	0.9	101.2	0.09	0.12	
RBH13	12.94	C5	Red/Brown SANDSTONE As received	A	PD	NO		100.2	84.4	74.4	2.0	103.8	0.19	0.26	
RBH13	14.88	C7	Red/Brown SANDSTONE As received	D	PL	YES	52.9	101.0	101.0	94.0	0.6	101.0	0.06	0.08	
RBH13	14.88	C7	Red/Brown SANDSTONE As received	A	PD	YES		101.0	53.3	44.3	1.1	82.8	0.16	0.20	
RBH13	15.86	C8	Red/Brown SANDSTONE As received	D	PL	YES	59.6	101.6	101.6	95.6	0.5	101.6	0.05	0.07	
RBH13	15.86	C8	Red/Brown SANDSTONE As received	A	PD	YES		101.6	69.6	64.6	1.0	94.8	0.12	0.15	
RBH13	16.41	C9	Red/Brown SANDSTONE As received	D	PL	YES	40.8	101.4	101.4	95.4	0.5	101.4	0.05	0.07	
RBH13	16.41	C9	Red/Brown SANDSTONE As received	A	PD	YES		102.0	42.8	37.8	0.9	74.6	0.17	0.20	
RBH13	18.45	C11	Red/Brown SANDSTONE As received	D	PL	YES	45.8	102.7	102.7	94.7	0.7	102.7	0.07	0.10	
RBH13	18.45	C11	Red/Brown SANDSTONE As received	A	PD	YES		101.5	58.7	51.7	1.2	87.1	0.15	0.20	
RBH13	19.55	C12	Red/Brown SANDSTONE As received	D	PL	YES	60.4	100.6	100.6	95.6	0.5	100.6	0.05	0.07	
RBH13	19.55	C12	Red/Brown SANDSTONE As received	A	PD	YES		100.7	77.7	70.7	1.3	99.9	0.13	0.18	
RBH13	20.58	C13	Red/Brown SANDSTONE As received	D	PL	YES	78.0	101.1	101.1	95.1	0.8	101.1	0.08	0.11	
RBH13	20.58	C13	Red/Brown SANDSTONE As received	A	PD	YES		101.2	100.3	88.3	1.5	113.7	0.12	0.17	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R2

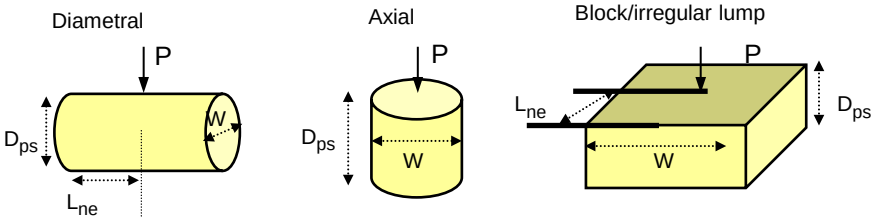
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH13	21.5	C14	Red/Brown SANDSTONE As received	D	PL	YES	90.1	102.3	102.3	97.3	2.1	102.3	0.20	0.28	
RBH13	21.5	C14	Red/Brown SANDSTONE As received	A	PD	YES		101.6	93.2	82.2	2.6	109.8	0.21	0.30	
RBH13	22.55	C15	Red/Brown SANDSTONE As received	A	PD	NO		101.0	51.4	46.4	0.2	81.3	0.02	0.03	
RBH13	23.38	C16	Red/Brown SANDSTONE As received	D	PL	YES	40.2	101.7	101.7	94.7	0.7	101.7	0.07	0.10	
RBH13	23.38	C16	Red/Brown SANDSTONE As received	A	PD	YES		101.7	58.8	51.8	2.0	87.3	0.26	0.33	
RBH13	25.5	C18	Red/Brown SANDSTONE As received	D	PL	YES	73.4	101.4	101.4	96.4	0.6	101.4	0.06	0.08	
RBH13	25.5	C18	Red/Brown SANDSTONE As received	A	PD	YES		101.1	66.5	59.5	1.7	92.5	0.20	0.26	
RBH13	26.6	C19	Red/Brown SANDSTONE As received	D	PL	YES	47.7	101.8	101.8	95.8	1.4	101.8	0.14	0.19	
RBH13	26.6	C19	Red/Brown SANDSTONE As received	A	PD	YES		101.9	47.7	35.7	1.7	78.6	0.28	0.34	
RBH13	28.56	C21	Red/Brown SANDSTONE As received	D	PL	YES	52.1	101.4	101.4	95.4	0.4	101.4	0.04	0.06	
RBH13	28.56	C21	Red/Brown SANDSTONE As received	A	PD	YES		101.9	72.3	39.3	2.7	96.9	0.29	0.39	
RBH13	29.5	C22	Red/Brown SANDSTONE As received	D	PL	YES	53.3	100.8	100.8	93.8	1.1	100.8	0.11	0.15	
RBH13	29.5	C22	Red/Brown SANDSTONE As received	A	PD	YES		101.3	53.3	43.3	2.0	82.9	0.29	0.37	
RBH13	30.29	C23	Red/Brown SANDSTONE As received	D	PL	YES	92.9	100.9	100.9	96.9	1.1	100.9	0.11	0.14	
RBH13	30.29	C23	Red/Brown SANDSTONE As received	A	PD	YES		101.7	100.8	89.8	2.1	114.2	0.16	0.23	
RBH13	31.5	C24	Red/Brown SANDSTONE As received	A	PD	YES		102.6	50.7	46.7	0.3	81.4	0.04	0.05	
RBH13	32.3	C25	Red/Brown SANDSTONE As received	A	PD	YES		100.2	35.3	30.3	1.0	67.1	0.23	0.26	
RBH13	34.66	C27	Red/Brown SANDSTONE As received	D	PL	YES	17.7	101.0	101.0	98.0	0.1	101.0	0.01	0.02	
RBH13	34.66	C27	Red/Brown SANDSTONE As received	A	PD	YES		102.2	32.3	11.3	0.7	64.8	0.17	0.19	
RBH13	35.84	C28	Red/Brown SANDSTONE As received	D	PL	YES	34.2	101.0	101.0	84.0	0.4	101.0	0.04	0.05	

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)

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Laboratory Test Report 42269R2 / 1

Site: St John's Masterplan Phase 2 **Job Number:** 42269R2

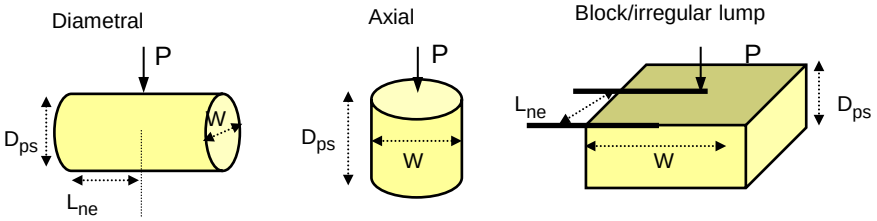
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH13	35.84	C28	Red/Brown SANDSTONE As received	A	PD	YES		99.6	28.1	10.1	0.7	59.6	0.20	0.22	
RBH13	36.75	C29	Red/Brown SANDSTONE As received	D	PL	YES	24.7	101.3	101.3	81.3	1.0	101.3	0.09	0.13	
RBH13	36.75	C29	Red/Brown SANDSTONE As received	A	PD	YES		100.9	29.6	11.6	0.7	61.7	0.18	0.19	
RBH13	37.4	C30	Red/Brown SANDSTONE As received	D	PL	YES	49.4	101.3	101.3	98.3	0.2	101.3	0.02	0.03	
RBH13	37.4	C30	Red/Brown SANDSTONE As received	A	PD	YES		101.3	40.4	37.4	0.8	72.2	0.15	0.18	

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)

IAN FARMER ASSOCIATES

Test Report - 42269R2 / 1

Site:	St John's Masterplan Phase 2
Job Number:	42269R2
Originating Client:	Curtins Consulting

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Date: 09/01/2019

IAN FARMER ASSOCIATES

Unit 4, Faraday Close, Pattinson North Industrial Estate, Washington, NE38 8QJ. Tel: 0191 482 8500 Fax: 0191 482 8520
washington@ianfarmer.co.uk www.ianfarmer.co.uk

F.A.O.

Test Report - 42269R3 / 1

Site:	St John's Masterplan Phase 2
Job Number:	42269R3
Originating Client:	Curtins Consulting
Originating Reference:	42269
Date Sampled:	12/12/2018
Date Scheduled:	13/12/2018
Date Testing Started:	02/01/2019
Date Testing Finished:	09/01/2019

Remarks:

Authorised By:

Tim Robinson
Quality Technician

Date: 09/01/2019

Constructionline

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AGS

Site: St John's Masterplan Phase 2 **Job Number:** 42269R3

Client: Curtins Consulting **Page:** 2

ROCK INDEX TESTS - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock description / Rock type	Natural Water Content1 %	Caliper2 Dry density Mg/m3	Caliper2 Porosity %	Buoyancy3 Dry density Mg/m3	Buoyancy3 Porosity %	Natural Bulk density Mg/m3	Remarks
RBH10	11.46	C6	Red/Brown SANDSTONE	3.9			2.03	17.9	2.11	
RBH10	17.52	C11	Red/Brown SANDSTONE	11.7			2.00	23.6	2.24	
RBH10	30.30	C21	Red/Brown SANDSTONE	10.2			2.05	22.7	2.26	

Notes 1. ISRM p87 test 1, water content at 105 ± 3 oC, specimen as received at the laboratory

2. ISRM p87 test 2, Porosity/density determination using saturation and caliper

3. ISRM p88 test 3, Porosity/density determination using saturation and buoyancy

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 conrent 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 conrent of a rock sample

Site: St John's Masterplan Phase 2 **Job Number:** 42269R3

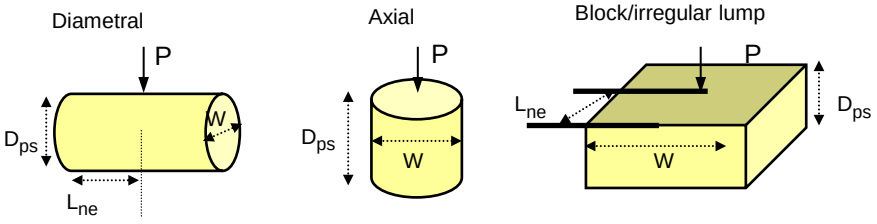
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH10	9.74	C5	Red/Brown SANDSTONE As received	D	PL	YES	93.9	95.5	95.5	94.5	0.2	95.5	0.02	0.02	
RBH10	9.74	C5	Red/Brown SANDSTONE As received	A	PD	YES		96.6	91.3	87.3	0.6	106.0	0.05	0.07	
RBH10	11.46	C6	Red/Brown SANDSTONE As received	A	PD	YES		95.5	38.3	36.3	0.4	68.2	0.09	0.11	
RBH10	12.44	C7	Red/Brown SANDSTONE As received	D	PL	YES	65.1	96.4	96.4	94.4	0.4	96.4	0.04	0.05	
RBH10	12.44	C7	Red/Brown SANDSTONE As received	A	PD	YES		96.3	59.9	53.9	0.7	85.7	0.10	0.13	
RBH10	12.83	C8	Red/Brown SANDSTONE As received	A	PD	YES		101.4	48.0	45.0	0.5	78.7	0.09	0.11	
RBH10	14.1	C9	Red/Brown SANDSTONE As received	D	PL	YES	29.6	98.7	98.7	92.7	0.2	98.7	0.02	0.03	
RBH10	14.1	C9	Red/Brown SANDSTONE As received	A	PD	YES		98.3	43.4	41.4	0.6	73.7	0.11	0.13	
RBH10	16.45	C10	Red/Brown SANDSTONE As received	D	PL	YES	39.0	101.0	101.0	99.0	0.5	101.0	0.05	0.06	
RBH10	16.45	C10	Red/Brown SANDSTONE As received	A	PD	YES		100.7	37.6	35.6	0.6	69.4	0.12	0.13	
RBH10	17.52	C11	Red/Brown SANDSTONE As received	A	PD	YES		101.8	49.5	42.5	1.1	80.1	0.16	0.20	
RBH10	18.47	C12	Red/Brown SANDSTONE As received	A	PD	YES		101.3	43.8	39.8	1.6	75.2	0.28	0.34	
RBH10	19.88	C13	Red/Brown SANDSTONE As received	A	PD	YES		99.6	30.9	23.9	1.2	62.6	0.32	0.35	
RBH10	20.6	C14	Red/Brown SANDSTONE As received	A	PD	YES		100.9	52.8	45.8	0.7	82.3	0.11	0.13	
RBH10	22	C15	Red/Brown SANDSTONE As received	D	PL	YES	38.7	92.0	92.0	85.0	0.7	92.0	0.09	0.11	
RBH10	22	C15	Red/Brown SANDSTONE As received	A	PD	YES		98.3	49.7	42.7	0.5	78.9	0.09	0.11	
RBH10	24.42	C16	Red/Brown SANDSTONE As received	D	PL	YES	44.1	100.4	100.4	93.4	1.3	100.4	0.13	0.17	
RBH10	24.42	C16	Red/Brown SANDSTONE As received	A	PD	YES		100.8	43.7	36.7	1.5	74.9	0.27	0.32	
RBH10	25.82	C17	Red/Brown SANDSTONE As received	D	PL	YES	66.2	101.5	101.5	97.5	1.0	101.5	0.10	0.13	
RBH10	25.82	C17	Red/Brown SANDSTONE As received	A	PD	YES		100.5	82.1	63.1	2.1	102.5	0.20	0.28	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R3

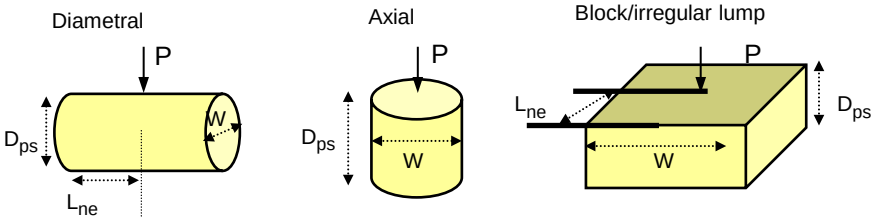
Client: Curtins Consulting **Page:** 4

Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM: Type (D, A, I, B)	Test Type see ISRM: Direction (PL, PD or U)	Failure Valid (Y/N)	Dimensions: Lne mm	Dimensions: W mm	Dimensions: Dps mm	Dimensions: Dps' mm	Force P kN	Equivalent diameter, De mm	Point Load Strength Index: Is . MPa	Point Load Strength Index: Is (50) MPa	Remarks (including water content if measured)
RBH10	26.9	C18	Red/Brown SANDSTONE As received	D	PL	YES	31.9	98.1	98.1	96.1	0.0	98.1	0.00	0.01	
RBH10	26.9	C18	Red/Brown SANDSTONE As received	A	PD	YES		99.2	26.2	23.2	0.9	57.5	0.27	0.28	
RBH10	27.93	C19	Red/Brown SANDSTONE As received	D	PL	YES	35.3	98.9	98.9	84.9	0.5	98.9	0.06	0.08	
RBH10	27.93	C19	Red/Brown SANDSTONE As received	A	PD	YES		98.4	46.3	30.3	1.5	76.2	0.26	0.32	
RBH10	29.9	C20	Red/Brown SANDSTONE As received	A	PD	YES		92.0	39.1	36.1	1.5	67.7	0.33	0.38	
RBH10	30.3	C21	Red/Brown SANDSTONE As received	D	PL	YES	35.4	100.1	100.1	98.1	0.8	100.1	0.08	0.10	
RBH10	30.3	C21	Red/Brown SANDSTONE As received	A	PD	YES		95.9	33.4	29.4	1.5	63.9	0.36	0.40	
RBH10	32	C22	Red/Brown SANDSTONE As received	A	PD	YES		96.5	100.9	97.9	1.8	111.4	0.15	0.21	
RBH10	34.88	C23	Red/Brown SANDSTONE As received	A	PD	YES		99.8	46.5	41.5	1.0	76.9	0.18	0.22	

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)

IAN FARMER ASSOCIATES

Test Report - 42269R3 / 1

Site:	St John's Masterplan Phase 2
Job Number:	42269R3
Originating Client:	Curtins Consulting

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

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Date: 09/01/2019

IAN FARMER ASSOCIATES
Unit 4, Faraday Close, Pattinson North Industrial Estate, Washington, NE38 8QJ. Tel: 0191 482 8500 Fax: 0191 482 8520
washington@ianfarmer.co.uk www.ianfarmer.co.uk

F.A.O.

Test Report - 42269R4 / 1

Site:	St John's Masterplan Phase 2
Job Number:	42269R4
Originating Client:	Curtins Consulting
Originating Reference:	42269
Date Sampled:	Not Given
Date Scheduled:	04/01/2019
Date Testing Started:	11/01/2019
Date Testing Finished:	29/01/2019

Remarks:

Authorised By:

Tim Robinson
Quality Technician

Date: 29/01/2019

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AGS

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

Client: Curtins Consulting **Page:** 2

ROCK INDEX TESTS - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock description / Rock type	Natural Water Content1 %	Caliper2 Dry density Mg/m3	Caliper2 Porosity %	Buoyancy3 Dry density Mg/m3	Buoyancy3 Porosity %	Natural Bulk density Mg/m3	Remarks
RBH11	9.00	C4	Red/Brown SANDSTONE	11.9			2.11	20.2	2.36	
RBH11	18.30	C12	Red/Brown SANDSTONE	12.3			2.04	20.8	2.29	
RBH11	29.30	C21	Red/Brown SANDSTONE	7.5			2.28	14.9	2.45	
RBH17	11.84	C6	Red/Brown SANDSTONE	9.2			2.12	16.6	2.31	
RBH17	23.20	C17	Red/Brown SANDSTONE	9.3			2.14	20.8	2.34	
RBH17	31.84	C26	Red/Brown SANDSTONE	7.9			2.19	19.9	2.37	
RBH18A	10.20	C3	Red/brown SANDSTONE	12.8			2.01	24.3	2.26	
RBH18A	16.85	C9	Red/Brown SANDSTONE	11.1			2.09	21.3	2.32	
RBH18A	25.25	C17	Red/brown SANDSTONE	12.3			2.03	23.6	2.28	
RBH18A	30.70	C22	Red/Brown SANDSTONE	11.4			2.07	23.0	2.30	
RBH19	12.15	C1	Red/Brown SANDSTONE	14.4			2.00	28.6	2.29	
RBH19	24.33	C7	Red/Brown SANDSTONE	10.0			2.13	20.2	2.35	
RBH19	32.90	C14	Red/Brown SANDSTONE	8.8			2.15	18.4	2.34	
RBH21	8.85	C6	Red/Brown SANDSTONE	13.8			1.97	26.5	2.24	
RBH21	15.50	C14	Red/Brown SANDSTONE	12.6			1.65	21.1	1.86	
RBH21	22.70	C22	Red/Brown SANDSTONE	12.9			2.13	21.3	2.41	
RBH21	31.00	C30	Red/Brown SANDSTONE	12.0			1.76	19.3	1.97	

Notes 1. ISRM p87 test 1, water content at 105 ± 3 oC, specimen as received at the laboratory

2. ISRM p87 test 2, Porosity/density determination using saturation and caliper

3. ISRM p88 test 3, Porosity/density determination using saturation and buoyancy

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 conrent 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 conrent of a rock sample

IAN FARMER ASSOCIATES

Laboratory Test Report 42269R4 / 1

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

Client: Curtins Consulting **Page:** 3

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3				Remarks
				Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
RBH11	11.55	C6	Red/Brown SANDSTONE	101.0	157.8	*1.6	2.29	10.5	as received	0.5102	AC	8.9	
RBH11	15.80	C10	Red/Brown SANDSTONE	101.1	86.7	*0.9	2.40	9.5	as received	0.5096	AC	0.3	
RBH11	20.60	C14	Red/Brown SANDSTONE	100.6	213.7	*2.1	2.33	8.6	as received	0.5150	AC	23.8	
RBH11	26.90	C19	Red/Brown SANDSTONE	101.6	103.5	*1	2.23	12.2	as received	0.5047	AC	5.2	
RBH11	32.05	C24	Red/Brown SANDSTONE	100.9	162.8	*1.6	2.30	10.8	as received	0.5117	S	3.0	
RBH11	36.95	C29	Red/Brown SANDSTONE	100.3	235.5	*2.3	2.37	7.5	as received	0.5176	AC	32.6	
RBH15	23.16	C12	Red/Brown SANDSTONE	101.1	213.9	*2.1	2.24	11.5	as received	0.5098	S	10.9	
RBH15	27.60	C16	Red/Brown SANDSTONE	101.3	181.2	*1.8	2.23	11.7	as received	0.5076	S	10.9	
RBH15	35.00	C22	Red/Brown SANDSTONE	100.8	195.8	*1.9	2.31	8.1	as received	0.5120	MS	14.9	
RBH15	40.00	C25	Red/Brown SANDSTONE	100.5	154.2	*1.5	2.28	10.2	as received	0.5160	S	5.4	
RBH17	10.00	C4	Red/brown SANDSTONE	101.1	137.6	*1.4	2.29	10.1	as received	0.5096	S	2.7	
RBH17	16.00	C10	Red/Brown SANDSTONE	99.9	114.6	*1.1	2.30	11.8	as received	0.5217	AC	5.6	
RBH17	20.10	C14	Red/Brown SANDTSONE	101.0	214.0	*2.1	2.22	11.9	as received	0.5101	AC	10.4	
RBH17	21.90	C16	Red/Brown SANDSTONE	101.2	171.7	*1.7	2.25	11.7	as received	0.5085	S	5.3	
RBH17	25.50	C20	Red/Brown SANDSTONE	101.1	210.5	*2.1	2.25	12.9	as received	0.5095	AC	9.4	
RBH17	30.84	C25	Red/Brown SANDSTONE	99.6	230.3	*2.3	2.24	10.9	as received	0.5245	AC	6.0	
RBH17	36.73	C30	Red/Brown SANDSTONE	100.9	201.6	*2	2.25	10.6	as received	0.5113	AC	5.4	
RBH18A	11.00	C4	Red/Brown SANDSTONE	101.5	78.7	*0.8	2.13	14.0	as received	0.5058	AC	0.9	
RBH18A	14.06	C6	Red/Brown SANDSTONE	101.6	136.3	*1.3	2.27	11.2	as received	0.5047	F	7.2	
RBH18A	22.25	C14	Red/Brown SANDSTONE	101.8	90.3	*0.9	2.84	9.3	as received	0.5024	AC	18.7	
RBH18A	26.10	C18	Red/Brown SANDSTONE	101.7	181.5	*1.8	2.30	10.5	as received	0.5033	S	1.4	
RBH18A	31.74	C23	Red/Brown SANDSTONE	101.8	156.4	*1.5	2.27	11.8	as received	0.5028	AC	2.9	
RBH18A	38.14	C28	Red/Brown SANDSTONE	101.7	209.5	*2.1	2.34	9.1	as received	1.7345	S	4.1	

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

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

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

above notes apply unless annotated otherwise in the remarks

*Denotes length diameter ratio outside ISRM specification

Mode of failure :

S - Single shear MS - multiple shear

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

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Laboratory Test Report 42269R4 / 1

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

Client: Curtins Consulting **Page:** 4

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3				Remarks
				Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
RBH19	23.50	C6	Red/Brown SANDSTONE	101.3	110.4	*1.1	2.25	11.6	as received	0.5073	AC	10.1	
RBH19	29.60	C11	Red/Brown SANDSTONE	101.2	84.7	*0.8	2.28	10.7	as received	0.5082	AC	18.0	
RBH19	34.20	C16	Red/Brown SANDSTONE	101.1	102.5	*1	2.17	13.8	as received	0.5095	AC	3.3	
RBH19	36.10	C18	Red/Brown SANDSTONE	101.2	146.1	*1.4	2.29	10.7	as received	0.5087	AC	20.9	
RBH21	11.20	C9	Red/Brown SANDSTONE	101.0	106.5	*1.1	2.20	13.9	as received	0.5108	AC	3.4	
RBH21	14.50	C13	Red/Brown SANDSTONE	101.1	110.5	*1.1	2.18	13.1	as received	0.5097	AC	2.6	
RBH21	17.10	C16	Red/broewn SANDSTONE	101.5	198.6	*2	2.25	11.2	as received	0.5052	AC	4.1	
RBH21	22.10	C21	Red/Brown SANDSTONE	101.3	128.4	*1.3	2.34	8.8	as received	0.5071	AC	10.3	
RBH21	27.80	C27	Red/Brown SANDSTONE	101.2	165.8	*1.6	2.30	8.0	as received	0.5086	AC	4.4	
RBH21	32.00	C31	Red/Brown SANDSTONE	101.7	144.5	*1.4	2.29	9.4	as received	0.5031	MS	7.2	
RBH21	35.15	C34	Red/Brown SANDSTONE	99.8	181.3	*1.8	2.22	10.5	as received	0.5224	S	2.9	

Notes
1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS
2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density
3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials
above notes apply unless annotated otherwise in the remarks

*Denotes length diameter ratio outside ISRM specification

Mode of failure :
S - Single shear MS - multiple shear
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

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

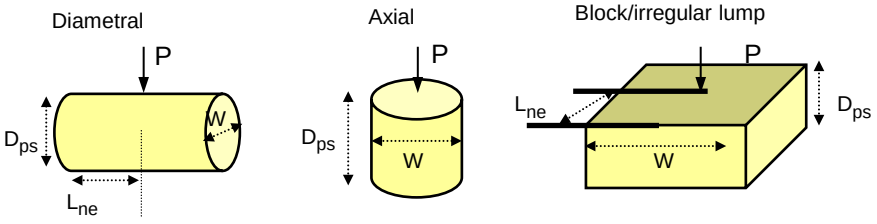
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH11	7.5	C3	Red/Brown SANDSTONE As received	D	PL	YES	33.2	100.0	100.0	97.0	0.2	100.0	0.02	0.02	
RBH11	7.5	C3	Red/Brown SANDSTONE As received	A	PD	YES		102.4	36.3	32.3	0.8	68.8	0.16	0.18	
RBH11	9	C4	Red/Brown SANDSTONE As received	A	PD	YES		99.1	39.9	37.9	0.3	71.0	0.07	0.08	
RBH11	10.72	C5	Red/Brown SANDSTONE As received	D	PL	YES	66.1	100.6	100.6	97.6	0.5	100.6	0.05	0.07	
RBH11	10.72	C5	Red/Brown SANDSTONE As received	A	PD	YES		102.1	83.5	74.5	0.9	104.2	0.09	0.12	
RBH11	13.05	C7	Red/Brown SANDSTONE As received	D	PL	YES	90.6	99.4	99.4	97.4	0.7	99.4	0.07	0.09	
RBH11	13.05	C7	Red/Brown SANDSTONE As received	A	PD	YES		99.6	85.8	78.8	1.8	104.3	0.17	0.24	
RBH11	14.15	C8	Red/Brown SANDSTONE As received	D	PL	YES	78.4	100.7	100.7	97.7	0.8	100.7	0.08	0.11	
RBH11	14.15	C8	Red/Brown SANDSTONE As received	A	PD	YES		100.6	94.6	89.6	1.1	110.0	0.09	0.13	
RBH11	15.3	C9	Red/Brown SANDSTONE As received	D	PL	YES	76.9	100.5	100.5	97.5	0.7	100.5	0.07	0.10	
RBH11	15.3	C9	Red/Brown SANDSTONE As received	A	PD	NO		100.8	77.7	64.7	1.9	99.9	0.19	0.26	
RBH11	17.14	C11	Red/Brown SANDSTONE As received	D	PL	YES	49.2	99.8	99.8	95.8	0.1	99.8	0.01	0.02	
RBH11	17.14	C11	Red/Brown SANDSTONE As received	A	PD	YES		100.2	68.2	64.2	0.7	93.3	0.08	0.11	
RBH11	18.3	C12	Red/Brown SANDSTONE As received	D	PL	YES	27.4	100.6	100.6	97.6	0.2	100.6	0.02	0.03	
RBH11	18.3	C12	Red/Brown SANDSTONE As received	A	PD	YES		99.2	29.9	27.9	0.3	61.5	0.07	0.08	
RBH11	19.4	C13	Red/Brown SANDSTONE As received	D	PL	YES	73.0	100.6	100.6	87.6	0.8	100.6	0.07	0.10	
RBH11	19.4	C13	Red/Brown SANDSTONE As received	A	PD	NO		100.6	73.5	66.5	2.4	97.0	0.25	0.34	
RBH11	21.9	C15	Red/Brown SANDSTONE As received	D	PL	YES	93.9	100.6	100.6	97.6	2.6	100.6	0.25	0.35	
RBH11	21.9	C15	Red/Brown SANDSTONE As received	A	PD	YES		101.2	98.0	87.0	4.7	112.4	0.37	0.54	
RBH11	23.4	C16	Red/Brown SANDSTONE As received	D	PL	YES	74.1	100.8	100.8	97.8	0.8	100.8	0.08	0.11	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

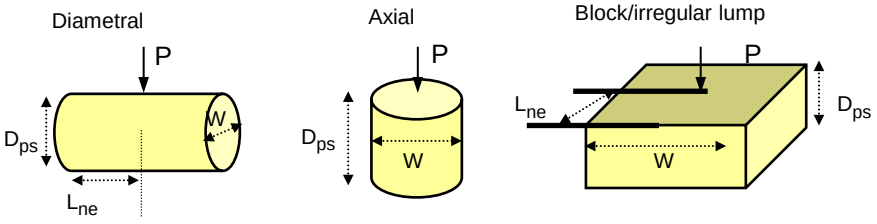
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH11	23.4	C16	Red/Brown SANDSTONE As received	A	PD	YES		101.4	69.0	62.0	1.1	94.4	0.12	0.16	
RBH11	24.9	C17	Red/Brown SANDSTONE As received	D	PL	YES	52.7	99.0	99.0	95.0	0.1	99.0	0.01	0.02	
RBH11	24.9	C17	Red/Brown SANDSTONE As received	A	PD	YES		100.6	49.8	45.8	0.2	79.8	0.03	0.04	
RBH11	26	C18	Red/Brown SANDSTONE As received	D	PL	YES	29.8	100.6	100.6	97.6	1.0	100.6	0.10	0.13	
RBH11	26	C18	Red/Brown SANDSTONE As received	A	PD	YES		97.8	70.0	64.0	0.8	93.3	0.10	0.13	
RBH11	28.2	C20	Red/Brown SANDSTONE As received	D	PL	YES	69.7	100.6	100.6	97.6	0.3	100.6	0.03	0.04	
RBH11	28.2	C20	Red/Brown SANDSTONE As received	A	PD	YES		103.6	48.0	46.0	0.2	79.6	0.03	0.03	
RBH11	29.3	C21	Red/Brown SANDSTONE As received	D	PL	YES	66.1	101.0	101.0	99.0	1.4	101.0	0.14	0.19	
RBH11	29.3	C21	Red/Brown SANDSTONE As received	A	PD	YES		101.4	82.8	75.8	3.1	103.4	0.29	0.40	
RBH11	30.2	C22	Red/Brown SANDSTONE As received	D	PL	YES	56.0	100.5	100.5	98.5	1.2	100.5	0.12	0.17	
RBH11	30.2	C22	Red/Brown SANDSTONE As received	A	PD	YES		100.5	42.8	38.8	2.3	74.0	0.42	0.51	
RBH11	31.4	C23	Red/Brown SANDSTONE As received	D	PL	YES	70.8	100.9	100.9	96.9	1.7	100.9	0.17	0.23	
RBH11	31.4	C23	Red/Brown SANDSTONE As received	A	PD	YES		102.7	82.1	65.1	5.6	103.6	0.52	0.72	
RBH11	33.3	C25	Red/Brown SANDSTONE As received	D	PL	YES	72.4	99.8	99.8	95.8	0.8	99.8	0.08	0.11	
RBH11	33.3	C25	Red/Brown SANDSTONE As received	A	PD	NO		99.6	52.1	47.1	1.0	81.3	0.15	0.19	
RBH11	34.4	C26	Red/Brown SANDSTONE As received	D	PL	YES	76.5	101.0	101.0	98.0	1.1	101.0	0.11	0.15	
RBH11	34.4	C26	Red/Brown SANDSTONE As received	A	PD	YES		101.2	51.0	41.0	1.9	81.1	0.28	0.35	
RBH11	35.06	C27	Red/Brown SANDSTONE As received	D	PL	YES	72.7	99.5	99.5	97.5	1.6	99.5	0.16	0.22	
RBH11	35.06	C27	Red/Brown SANDSTONE As received	A	PD	YES		99.1	46.3	41.3	2.5	76.5	0.42	0.51	
RBH11	36.1	C28	Red/Brown SANDSTONE As received	D	PL	YES	49.6	101.2	101.2	97.2	1.1	101.2	0.11	0.15	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

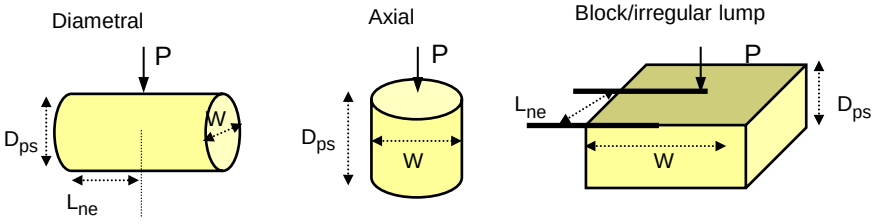
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM: Type (D, A, I, B)	Test Type see ISRM: Direction (PL, PD or U)	Failure Valid (Y/N)	Dimensions: Lne mm	Dimensions: W mm	Dimensions: Dps mm	Dimensions: Dps' mm	Force P kN	Equivalent diameter, De mm	Point Load Strength Index: Is . MPa	Point Load Strength Index: Is (50) MPa	Remarks (including water content if measured)
RBH11	36.1	C28	Red/Brown SANDSTONE As received	A	PD	YES		102.0	51.2	45.2	2.2	81.5	0.34	0.42	
RBH11	39	C30	Red/Brown SANDSTONE As received	D	PL	YES	42.8	99.2	99.2	96.2	1.0	99.2	0.10	0.13	
RBH11	39	C30	Red/Brown SANDSTONE As received	A	PD	YES		99.9	53.2	44.2	2.4	82.2	0.35	0.44	
RBH11	40	C31	Red/Brown SANDSTONE As received	D	PL	YES	65.9	99.4	99.4	96.4	1.0	99.4	0.10	0.13	
RBH11	40	C31	Red/Brown SANDSTONE As received	A	PD	YES		99.1	77.0	75.0	0.4	98.6	0.04	0.06	
RBH15	8.9	C1	Red/Brown SANDSTONE As received	A	PD	YES		100.7	50.6	46.6	0.4	80.5	0.06	0.07	
RBH15	10.54	C2	Red/Brown SANDSTONE As received	D	PL	YES	55.1	100.8	100.8	96.8	0.4	100.8	0.04	0.06	
RBH15	10.54	C2	Red/Brown SANDSTONE As received	A	PD	YES		100.4	63.6	57.6	1.1	90.1	0.14	0.18	
RBH15	11.3	C3	Red/Brown SANDSTONE As received	D	PL	YES	46.6	101.0	101.0	97.0	0.2	101.0	0.02	0.03	
RBH15	11.3	C3	Red/Brown SANDSTONE As received	A	PD	YES		100.7	45.9	42.9	6.8	76.8	1.15	1.40	
RBH15	12.62	C4	Red/Brown SANDSTONE As received	D	PL	YES	57.1	100.7	100.7	97.7	0.5	100.7	0.04	0.06	
RBH15	12.62	C4	Red/Brown SANDSTONE As received	A	PD	YES		100.5	60.7	56.7	0.8	88.1	0.11	0.14	
RBH15	13.65	C5	Red/Brown SANDSTONE As received	A	PD	YES		99.7	44.6	40.6	0.5	75.3	0.08	0.10	
RBH15	14.35	C6	Red/Brown SANDSTONE As received	D	PL	YES	91.3	100.0	100.0	97.0	0.5	100.0	0.05	0.07	
RBH15	14.35	C6	Red/Brown SANDSTONE As received	A	PD	YES		100.9	99.9	88.9	2.1	113.3	0.17	0.24	
RBH15	15.3	C7	Red/Brown SANDSTONE As received	D	PL	YES	52.5	100.8	100.8	97.8	1.1	100.8	0.11	0.15	
RBH15	15.3	C7	Red/Brown SANDSTONE As received	A	PD	YES		100.9	62.2	53.2	2.9	89.3	0.36	0.47	
RBH15	19.48	C8	Red/Brown SANDSTONE As received	A	PD	YES		101.1	54.8	49.8	2.0	84.0	0.28	0.36	
RBH15	20.2	C9	Red/Brown SANDSTONE As received	D	PL	YES	52.6	99.5	99.5	97.5	0.3	99.5	0.03	0.04	
RBH15	20.2	C9	Red/Brown SANDSTONE As received	A	PD	YES		99.0	61.4	57.4	10.5	88.0	1.36	1.76	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

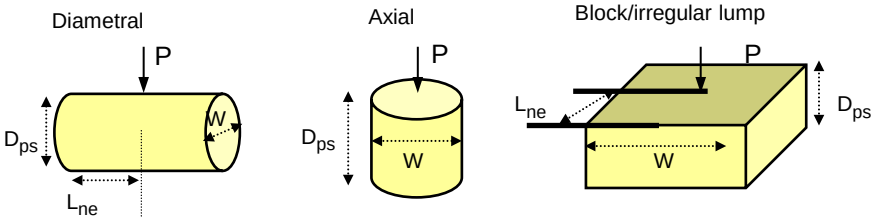
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH15	21.58	C10	Red/Brown SANDSTONE As received	D	PL	YES	57.7	98.6	98.6	95.6	0.5	98.6	0.05	0.07	
RBH15	21.58	C10	Red/Brown SANDSTONE As received	A	PD	YES		98.1	46.2	34.2	0.4	76.0	0.07	0.09	
RBH15	22.7	C11	Red/Brown SANDSTONE As received	D	PL	YES	61.9	99.9	99.9	96.9	0.8	99.9	0.08	0.11	
RBH15	22.7	C11	Red/Brown SANDSTONE As received	A	PD	YES		100.4	60.7	54.7	1.5	88.1	0.19	0.25	
RBH15	24.7	C13	Red/Brown SANDSTONE As received	D	PL	YES	36.9	101.0	101.0	99.0	0.7	101.0	0.07	0.10	
RBH15	24.7	C13	Red/Brown SANDSTONE As received	A	PD	YES		101.3	45.5	34.5	1.5	76.6	0.25	0.31	
RBH15	25.66	C14	Red/Brown SANDSTONE As received	D	PL	YES	63.8	101.2	101.2	96.2	1.0	101.2	0.10	0.13	
RBH15	25.66	C14	Red/Brown SANDSTONE As received	A	PD	YES		100.8	70.2	59.2	2.8	94.9	0.32	0.42	
RBH15	26.76	C15	Red/Brown SANDSTONE As received	D	PL	YES	34.2	101.3	101.3	99.3	0.2	101.3	0.02	0.02	
RBH15	26.76	C15	Red/Brown SANDSTONE As received	A	PD	YES		100.9	47.2	42.2	0.6	77.9	0.09	0.11	
RBH15	29.6	C17	Red/Brown SANDSTONE As received	D	PL	YES	38.2	99.6	99.6	96.6	1.0	99.6	0.10	0.13	
RBH15	29.6	C17	Red/Brown SANDSTONE As received	A	PD	YES		99.4	43.6	38.6	2.2	74.2	0.41	0.49	
RBH15	30.5	C18	Red/Brown SANDSTONE As received	D	PL	YES	68.2	98.2	98.2	95.2	0.8	98.2	0.08	0.11	
RBH15	30.5	C18	Red/Brown SANDSTONE As received	A	PD	YES		96.6	81.0	71.0	1.4	99.8	0.14	0.19	
RBH15	31.9	C19	Red/Brown SANDSTONE As received	D	PL	YES	32.9	100.8	100.8	97.8	0.1	100.8	0.01	0.01	
RBH15	31.9	C19	Red/Brown SANDSTONE As received	A	PD	YES		100.0	54.3	50.3	1.4	83.1	0.20	0.25	
RBH15	33.4	C20	Red/Brown SANDSTONE As received	D	PL	YES	23.6	97.3	97.3	94.3	0.1	97.3	0.01	0.02	
RBH15	33.4	C20	Red/Brown SANDSTONE As received	A	PD	YES		100.0	54.5	44.5	0.8	83.3	0.12	0.15	
RBH15	34.68	C21	Red/Brown SANDSTONE As received	D	PL	YES	69.0	100.4	100.4	97.4	1.6	100.4	0.16	0.21	
RBH15	34.68	C21	Red/Brown SANDSTONE As received	A	PD	YES		100.7	66.3	58.3	1.5	92.2	0.18	0.24	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

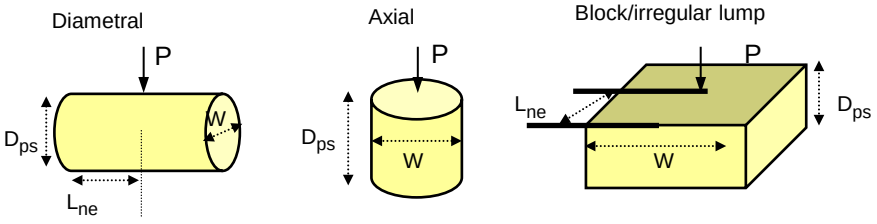
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Point Load Strength Index Tests
Summary of Results

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	
RBH15	37	C23	Red/Brown SANDSTONE As received	D	PL	YES	69.4	99.1	99.1	98.1	0.7	99.1	0.07	0.10	
RBH15	37	C23	Red/Brown SANDSTONE As received	A	PD	YES		98.8	72.2	64.2	2.4	95.3	0.26	0.35	
RBH15	38	C24	Red/Brown SANDSTONE As received	D	PL	YES	48.2	100.0	100.0	97.0	1.0	100.0	0.10	0.14	
RBH15	38	C24	Red/Brown SANDSTONE As received	A	PD	YES		101.7	47.7	43.7	1.3	78.6	0.22	0.27	
RBH17	9	C3	Red/Brown SANDSTONE As received	D	PL	YES	63.1	97.0	97.0	95.0	0.4	97.0	0.05	0.06	
RBH17	9	C3	Red/Brown SANDSTONE As received	A	PD	YES		96.0	63.7	59.7	0.7	88.2	0.09	0.11	
RBH17	11	C5	Red/Brown SANDSTONE As received	D	PL	YES	72.6	101.0	101.0	99.0	0.4	101.0	0.04	0.06	
RBH17	11	C5	Red/Brown SANDSTONE As received	A	PD	YES		101.0	88.2	82.2	1.6	106.5	0.14	0.20	
RBH17	11.84	C6	Red/Brown SANDSTONE As received	D	PL	YES	71.6	101.0	101.0	98.0	1.6	101.0	0.16	0.22	
RBH17	11.84	C6	Red/Brown SANDSTONE As received	A	PD	YES		101.1	65.3	59.3	1.3	91.7	0.15	0.20	
RBH17	12.9	C7	Red/Brown SANDSTONE As received	D	PL	YES	60.4	94.9	94.9	72.9	0.2	94.9	0.02	0.03	
RBH17	12.9	C7	Red/Brown SANDSTONE As received	A	PD	YES		95.9	71.5	68.5	0.3	93.4	0.04	0.05	
RBH17	14	C8	Red/Brown SANDSTONE As received	D	PL	YES	43.3	100.2	100.2	96.2	0.4	100.2	0.04	0.05	
RBH17	14	C8	Red/Brown SANDSTONE As received	A	PD	YES		100.4	73.3	67.3	1.1	96.8	0.11	0.15	
RBH17	15	C9	Red/Brown SANDSTONE As received	D	PL	YES	32.1	100.0	100.0	98.0	0.4	100.0	0.04	0.05	
RBH17	15	C9	Red/Brown SANDSTONE As received	A	PD	YES		100.7	43.0	39.0	0.5	74.2	0.08	0.10	
RBH17	17	C11	Red/Brown SANDSTONE As received	D	PL	YES	70.3	100.0	100.0	98.0	0.2	100.0	0.02	0.03	
RBH17	17	C11	Red/Brown SANDSTONE As received	A	PD	YES		100.6	81.1	73.1	0.8	101.9	0.07	0.10	
RBH17	18	C12	Red/Brown SANDSTONE As received	D	PL	YES	56.9	101.2	101.2	99.2	0.2	101.2	0.02	0.03	
RBH17	18	C12	Red/Brown SANDSTONE As received	A	PD	YES		100.7	76.9	61.9	1.6	99.3	0.16	0.22	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

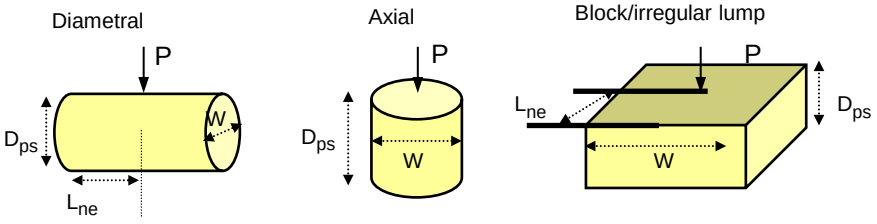
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Point Load Strength Index Tests
Summary of Results

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	
RBH17	19	C13	Red/Brown SANDSTONE As received	D	PL	YES	48.6	100.8	100.8	98.8	0.7	100.8	0.07	0.09	
RBH17	19	C13	Red/Brown SANDSTONE As received	A	PD	YES		101.0	46.9	37.9	1.8	77.7	0.30	0.36	
RBH17	21	C15	Red/Brown SANDSTONE As received	D	PL	YES	48.9	100.2	100.2	98.2	0.4	100.2	0.04	0.05	
RBH17	21	C15	Red/Brown SANDSTONE As received	A	PD	YES		101.4	54.9	51.9	0.3	84.2	0.05	0.06	
RBH17	23.2	C17	Red/Brown SANDSTONE As received	D	PL	YES	32.4	100.2	100.2	98.2	0.2	100.2	0.02	0.03	
RBH17	23.2	C17	Red/Brown SANDSTONE As received	A	PD	YES		100.5	46.9	41.9	0.4	77.5	0.06	0.07	
RBH17	24	C18	Red/Brown SANDSTONE As received	D	PL	YES	32.1	99.5	99.5	97.5	0.3	99.5	0.03	0.04	
RBH17	24	C18	Red/Brown SANDSTONE As received	A	PD	YES		100.3	50.2	47.2	0.3	80.0	0.04	0.05	
RBH17	25.1	C19	Red/Brown SANDSTONE As received	D	PL	YES	76.8	100.5	100.5	96.5	1.3	100.5	0.13	0.17	
RBH17	25.1	C19	Red/Brown SANDSTONE As received	A	PD	YES		101.5	97.5	85.5	2.2	112.2	0.17	0.25	
RBH17	27.3	C21	Red/Brown SANDSTONE As received	D	PL	YES	56.1	101.9	101.9	99.9	2.1	101.9	0.21	0.28	
RBH17	27.3	C21	Red/Brown SANDSTONE As received	A	PD	NO		101.9	111.6	97.6	1.8	120.3	0.12	0.18	
RBH17	28.13	C22	Red/Brown SANDSTONE As received	D	PL	YES	86.3	101.3	101.3	99.3	1.2	101.3	0.11	0.16	
RBH17	28.13	C22	Red/Brown SANDSTONE As received	A	PD	NO		101.6	93.5	86.5	1.1	110.0	0.09	0.14	
RBH17	29	C23	Red/Brown SANDSTONE As received	D	PL	YES	40.1	101.6	101.6	97.6	0.4	101.6	0.04	0.05	
RBH17	29	C23	Red/Brown SANDSTONE As received	A	PD	NO		101.0	56.0	54.0	0.5	84.9	0.07	0.08	
RBH17	30	C24	Red/Brown SANDSTONE As received	D	PL	YES	62.8	101.5	101.5	100.5	2.1	101.5	0.21	0.28	
RBH17	30	C24	Red/Brown SANDSTONE As received	A	PD	YES		101.3	74.5	64.5	2.7	98.0	0.28	0.38	
RBH17	31.84	C26	Red/Brown SANDSTONE As received	D	PL	YES	76.4	101.5	101.5	97.5	2.2	101.5	0.22	0.30	
RBH17	31.84	C26	Red/Brown SANDSTONE As received	A	PD	YES		101.3	83.5	75.5	4.1	103.8	0.38	0.52	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

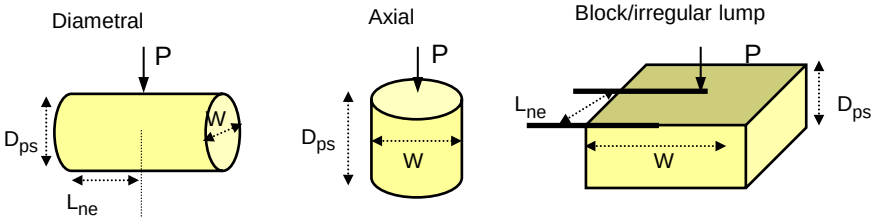
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Point Load Strength Index Tests
Summary of Results

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	
RBH17	33.25	C27	Red/Brown SANDSTONE As received	D	PL	YES	86.9	101.1	101.1	99.1	1.1	101.1	0.10	0.14	
RBH17	33.25	C27	Red/Brown SANDSTONE As received	A	PD	YES		98.0	99.9	93.9	1.2	111.7	0.09	0.14	
RBH17	34.8	C28	Red/Brown SANDSTONE As received	D	PL	YES	43.4	101.5	101.5	96.5	2.0	101.5	0.20	0.27	
RBH17	34.8	C28	Red/Brown SANDSTONE As received	A	PD	YES		101.6	41.9	39.9	2.3	73.6	0.42	0.50	
RBH17	36	C29	Red/Brown SANDSTONE As received	D	PL	YES	49.8	100.5	100.5	97.5	0.6	100.5	0.06	0.08	
RBH17	36	C29	Red/Brown SANDSTONE As received	A	PD	YES		100.7	41.5	36.5	0.7	73.0	0.13	0.16	
RBH17	38.2	C31	Red/Brown SANDSTONE As received	D	PL	YES	84.0	99.6	99.6	97.6	0.5	99.6	0.05	0.07	
RBH17	38.2	C31	Red/Brown SANDSTONE As received	A	PD	NO		99.8	110.2	105.2	1.6	118.4	0.12	0.17	
RBH17	39	C32	Red/Brown SANDSTONE As received	D	PL	YES	82.8	99.6	99.6	97.6	0.6	99.6	0.06	0.08	
RBH17	39	C32	Red/Brown SANDSTONE As received	A	PD	YES		100.0	89.6	86.6	0.3	106.8	0.03	0.04	
RBH17	40.2	C33	Red/Brown SANDSTONE As received	D	PL	YES	29.7	100.4	100.4	97.4	1.0	100.4	0.10	0.13	
RBH17	40.2	C33	Red/Brown SANDSTONE As received	A	PD	YES		103.2	57.9	52.9	1.3	87.2	0.17	0.22	
RBH18A	7.15	C1	Red/Brown SANDSTONE As received	D	PL	YES	29.3	101.1	101.1	98.1	0.3	101.1	0.03	0.04	
RBH18A	7.15	C1	Red/Brown SANDSTONE As received	A	PD	YES		100.7	29.0	28.0	0.5	61.0	0.14	0.15	
RBH18A	9	C2	Red/Brown SANDSTONE As received	D	PL	YES	51.6	100.3	100.3	97.3	0.6	100.3	0.06	0.08	
RBH18A	9	C2	Red/Brown SANDSTONE As received	A	PD	YES		98.1	62.2	59.2	1.2	88.1	0.16	0.21	
RBH18A	10.2	C3	Red/Brown SANDSOTNE As received	D	PL	YES	40.1	98.9	98.9	95.9	0.2	98.9	0.02	0.03	
RBH18A	10.2	C3	Red/Brown SANDSOTNE As received	A	PD	YES		99.3	55.8	52.8	0.3	84.0	0.04	0.05	
RBH18A	12.5	C5	Red/Brown SANDSOTNE As received	D	PL	YES	65.2	100.2	100.2	97.2	0.6	100.2	0.06	0.09	
RBH18A	12.5	C5	Red/Brown SANDSOTNE As received	A	PD	YES		101.0	69.5	62.5	1.1	94.5	0.12	0.16	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

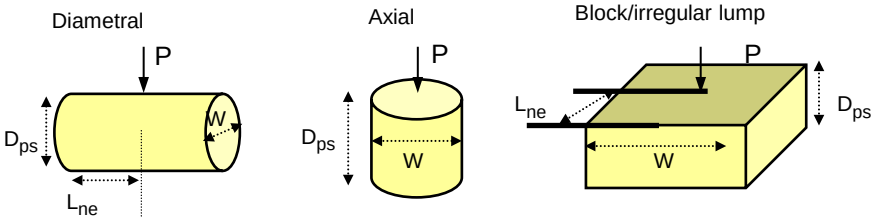
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH18A	15.38	C7	Red/Brown SANDSOTNE As received	A	PD	YES		100.8	46.8	45.8	0.0	77.5	0.01	0.01	
RBH18A	16.13	C8	Red/Brown SANDSOTNE As received	D	PL	YES	54.7	101.8	101.8	98.8	0.3	101.8	0.03	0.04	
RBH18A	16.13	C8	Red/Brown SANDSOTNE As received	A	PD	YES		101.7	54.1	49.1	0.4	83.7	0.06	0.07	
RBH18A	16.85	C9	Red/Brown SANDSOTNE As received	D	PL	YES	78.7	101.7	101.7	99.7	0.6	101.7	0.06	0.09	
RBH18A	16.85	C9	Red/Brown SANDSOTNE As received	A	PD	YES		101.4	90.7	85.7	1.0	108.2	0.09	0.12	
RBH18A	17.64	C10	Red/Brown SANDSTONE As received	D	PL	YES	75.8	101.6	101.6	100.6	0.1	101.6	0.01	0.01	
RBH18A	17.64	C10	Red/Brown SANDSTONE As received	A	PD	YES		101.6	94.0	79.0	2.7	110.3	0.22	0.31	
RBH18A	19.1	C11	Red/Brown SANDSTONE As received	D	PL	YES	70.5	101.1	101.1	100.1	0.1	101.1	0.01	0.01	
RBH18A	19.1	C11	Red/Brown SANDSTONE As received	A	PD	YES		101.5	102.5	97.5	0.4	115.0	0.03	0.05	
RBH18A	20.3	C12	Red/Brown SANDSTONE As received	D	PL	YES	44.6	101.7	101.7	99.7	0.1	101.7	0.01	0.01	
RBH18A	20.3	C12	Red/Brown SANDSTONE As received	A	PD	YES		101.7	48.7	46.7	0.1	79.4	0.01	0.02	
RBH18A	21.2	C13	Red/Brown SANDSTONE As received	D	PL	YES	45.9	100.7	100.7	97.7	0.3	100.7	0.03	0.04	
RBH18A	21.2	C13	Red/Brown SANDSTONE As received	A	PD	YES		101.2	52.5	49.5	0.2	82.2	0.04	0.04	
RBH18A	23.3	C15	Red/Brown SANDSTONE As received	D	PL	YES	72.8	100.5	100.5	98.5	0.2	100.5	0.02	0.03	
RBH18A	23.3	C15	Red/Brown SANDSTONE As received	A	PD	YES		100.5	83.0	77.0	0.5	103.0	0.04	0.06	
RBH18A	24.23	C16	Red/Brown SANDSTONE As received	D	PL	YES	42.7	101.8	101.8	99.8	0.1	101.8	0.01	0.01	
RBH18A	24.23	C16	Red/Brown SANDSTONE As received	A	PD	YES		102.5	59.9	56.9	0.6	88.4	0.08	0.10	
RBH18A	25.25	C17	Red/Brown SANDSTONE As received	D	PL	YES	52.4	101.5	101.5	99.5	0.2	101.5	0.02	0.03	
RBH18A	25.25	C17	Red/Brown SANDSTONE As received	A	PD	YES		100.7	71.3	67.3	0.5	95.6	0.05	0.07	
RBH18A	27.23	C19	Red/Brown SANDSTONE As received	D	PL	YES	67.2	100.9	100.9	97.9	0.1	100.9	0.01	0.01	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

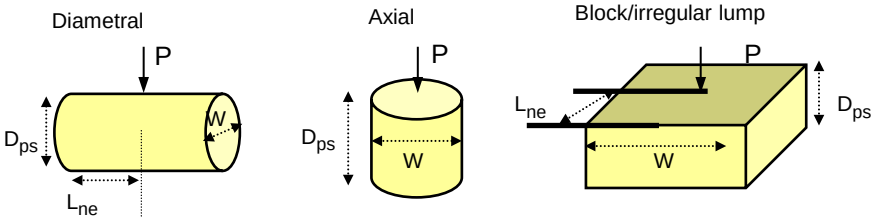
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH18A	27.23	C19	Red/Brown SANDSTONE As received	A	PD	YES		100.4	67.8	66.8	0.1	93.1	0.01	0.01	
RBH18A	28.3	C20	Red/Brown SANDSTONE As received	D	PL	YES	61.1	102.9	102.9	99.9	0.2	102.9	0.02	0.03	
RBH18A	28.3	C20	Red/Brown SANDSTONE As received	A	PD	YES		101.9	85.8	82.8	0.3	105.5	0.02	0.03	
RBH18A	29.1	C21	Red/Brown SANDSTONE As received	D	PL	YES	42.3	101.9	101.9	97.9	0.3	101.9	0.03	0.03	
RBH18A	29.1	C21	Red/Brown SANDSTONE As received	A	PD	YES		102.1	55.7	54.7	0.0	85.1	0.00	0.01	
RBH18A	30.7	C22	Red/Brown SANDSTONE As received	D	PL	YES	81.8	101.6	101.6	83.6	0.2	101.6	0.02	0.03	
RBH18A	30.7	C22	Red/Brown SANDSTONE As received	A	PD	YES		101.8	99.0	94.0	0.6	113.3	0.05	0.07	
RBH18A	32.9	C24	Red/Brown SANDSTONE As received	D	PL	YES	40.0	100.6	100.6	96.6	0.4	100.6	0.04	0.05	
RBH18A	32.9	C24	Red/Brown SANDSTONE As received	A	PD	YES		100.3	45.6	40.6	0.3	76.3	0.05	0.06	
RBH18A	34.2	C25	Red/Brown SANDSTONE As received	D	PL	YES	77.7	101.7	101.7	98.7	0.5	101.7	0.05	0.07	
RBH18A	34.2	C25	Red/Brown SANDSTONE As received	A	PD	YES		101.9	85.3	75.3	1.8	105.2	0.16	0.23	
RBH18A	35.74	C26	Red/Brown SANDSTONE As received	D	PL	YES	78.5	101.0	101.0	96.0	0.5	101.0	0.05	0.07	
RBH18A	35.74	C26	Red/Brown SANDSTONE As received	A	PD	YES		100.9	112.3	92.3	2.2	120.1	0.15	0.22	
RBH18A	37.09	C27	Red/Brown SANDSTONE As received	D	PL	YES	65.9	101.6	101.6	99.6	0.8	101.6	0.08	0.11	
RBH18A	37.09	C27	Red/Brown SANDSTONE As received	A	PD	YES		101.3	82.6	76.6	3.8	103.2	0.35	0.49	
RBH18A	39.4	C29	Red/Brown SANDSTONE As received	D	PL	YES	49.2	101.6	101.6	98.6	1.0	101.6	0.10	0.13	
RBH18A	39.4	C29	Red/Brown SANDSTONE As received	A	PD	YES		101.6	43.3	39.3	1.1	74.8	0.20	0.25	
RBH19	12.15	C1	Red/Brown SANDSTONE As received	D	PL	YES	53.6	99.0	99.0	97.0	0.1	99.0	0.01	0.01	
RBH19	12.15	C1	Red/Brown SANDSTONE As received	A	PD	YES		95.2	58.3	48.3	0.1	84.1	0.01	0.01	
RBH19	14.1	C2	Red/Brown SANDSTONE As received	A	PD	YES		100.6	56.4	52.4	0.4	85.0	0.06	0.08	

Test Type
D - Diametral, A - Axial, I - Irregular Lump, B - Block
Direction
PL - Parallel to planes of weakness
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Dps' - at failure (see ISRM note 6)
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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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

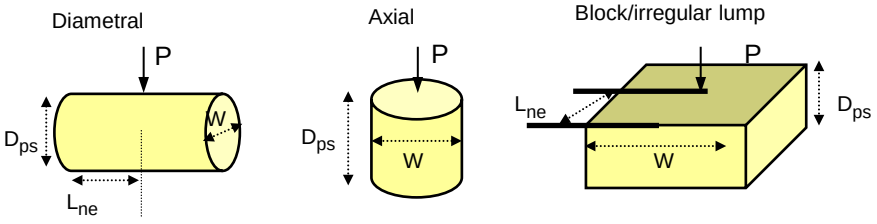
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH19	20.6	C3	Red/Brown SANDSTONE As received	A	PD	YES		103.2	47.8	44.8	0.2	79.3	0.03	0.03	
RBH19	21.4	C4	Red/Brown SANDSTONE As received	A	PD	YES		100.3	58.7	54.7	0.8	86.6	0.11	0.14	
RBH19	22.3	C5	Red/Brown SANDSTONE As received	D	PL	YES	95.4	101.3	101.3	98.3	0.6	101.3	0.06	0.08	
RBH19	22.3	C5	Red/Brown SANDSTONE As received	A	PD	YES		100.7	45.7	39.7	1.0	76.5	0.16	0.20	
RBH19	24.33	C7	Red/Brown SANDSTONE As received	D	PL	YES	70.1	100.9	100.9	96.9	1.0	100.9	0.10	0.14	
RBH19	24.33	C7	Red/Brown SANDSTONE As received	A	PD	YES		100.9	80.8	75.8	1.8	101.8	0.17	0.24	
RBH19	26.3	C8	Red/Brown SANDSTONE As received	D	PL	YES	47.0	101.1	101.1	97.1	1.5	101.1	0.15	0.20	
RBH19	26.3	C8	Red/Brown SANDSTONE Saturated	A	PD	YES		101.4	57.6	53.6	2.2	86.2	0.30	0.38	
RBH19	27.5	C9	Red/Brown SANDSTONE As received	D	PL	YES	82.7	101.0	101.0	97.0	0.6	101.0	0.06	0.08	
RBH19	27.5	C9	Red/Brown SANDSTONE As received	A	PD	YES		100.5	58.8	55.8	0.6	86.8	0.08	0.10	
RBH19	28.9	C10	Red/Brown SANDSTONE As received	D	PL	YES	42.7	100.7	100.7	96.7	1.3	100.7	0.13	0.18	
RBH19	28.9	C10	Red/Brown SANDSTONE As received	A	PD	YES		100.8	53.3	45.3	0.7	82.7	0.11	0.13	
RBH19	30.7	C12	Red/Brown SANDSTONE As received	A	PD	YES		100.5	39.8	35.8	0.8	71.4	0.15	0.18	
RBH19	31.36	C13	Red/Brown SANDSTONE As received	D	PL	YES	73.8	101.2	101.2	97.2	0.7	101.2	0.07	0.09	
RBH19	31.36	C13	Red/Brown SANDSTONE As received	A	PD	YES		101.3	92.0	82.0	2.4	108.9	0.20	0.28	
RBH19	32.9	C14	Red/Brown SANDSTONE As received	D	PL	YES	68.8	101.7	101.7	97.7	1.2	101.7	0.12	0.16	
RBH19	32.9	C14	Red/Brown SANDSTONE As received	A	PD	YES		102.0	73.8	68.8	3.0	97.9	0.32	0.43	
RBH19	33.7	C15	Red/Brown SANDSTONE As received	D	PL	NO	53.5	101.3	101.3	99.3	0.4	101.3	0.04	0.05	
RBH19	33.7	C15	Red/Brown SANDSTONE As received	A	PD	NO		100.3	115.5	109.5	1.5	121.4	0.10	0.15	
RBH19	35.6	C17	Red/Brown SANDSTONE As received	D	PL	YES	49.0	100.9	100.9	96.9	0.7	100.9	0.07	0.10	

Test Type
D - Diametral, A - Axial, I - Irregular Lump, B - Block
Direction
PL - Parallel to planes of weakness
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Dimensions
Dps - Distance between platens (platen separation)
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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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

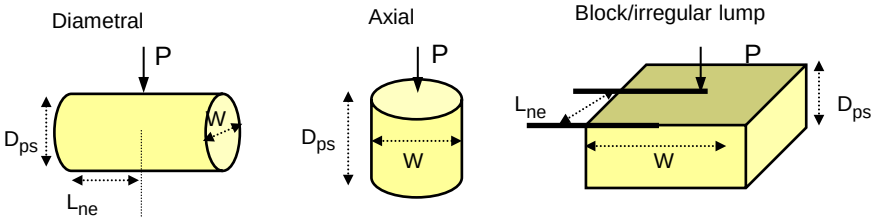
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH19	35.6	C17	Red/Brown SANDSTONE As received	A	PD	YES		100.7	51.9	43.9	0.9	81.6	0.14	0.17	
RBH19	37.3	C19	Red/Brown SANDSTONE As received	A	PD	YES		101.0	60.5	56.5	1.5	88.3	0.19	0.24	
RBH19	38.8	C20	Red/Brown SANDSTONE As received	D	PL	YES	56.7	100.6	100.6	96.6	0.4	100.6	0.04	0.06	
RBH19	38.8	C20	Red/Brown SANDSTONE As received	A	PD	YES		101.2	54.2	48.2	0.6	83.6	0.08	0.11	
RBH19	39.8	C21	Red/Brown SANDSTONE As received	D	PL	YES	92.6	99.9	99.9	96.9	0.2	99.9	0.02	0.02	
RBH19	39.8	C21	Red/Brown SANDSTONE As received	A	PD	YES		98.9	87.5	82.5	0.2	105.0	0.02	0.03	
RBH21	7	C4	Red/Brown SANDSTONE As received	D	PL	YES	48.4	101.7	101.7	97.7	0.3	101.7	0.03	0.04	
RBH21	7	C4	Red/Brown SANDSTONE As received	A	PD	YES		100.1	52.1	50.1	0.2	81.5	0.03	0.04	
RBH21	8	C5	Red/Brown SANDSTONE As received	D	PL	YES	31.5	100.0	100.0	98.0	0.2	100.0	0.02	0.03	
RBH21	8	C5	Red/Brown SANDSTONE As received	A	PD	YES		100.2	37.2	34.2	0.3	68.9	0.06	0.06	
RBH21	8.85	C6	Red/Brown SANDSTONE As received	D	PL	YES	59.4	100.1	100.1	97.1	0.1	100.1	0.01	0.01	
RBH21	8.85	C6	Red/Brown SANDSTONE As received	A	PD	YES		100.4	58.0	53.0	0.2	86.1	0.03	0.04	
RBH21	10.5	C7	Red/Brown SANDSTONE As received	D	PL	YES	42.0	94.8	94.8	91.8	0.1	94.8	0.01	0.02	
RBH21	10.5	C7	Red/Brown SANDSTONE As received	A	PD	YES		95.8	43.4	38.4	0.3	72.8	0.05	0.06	
RBH21	10.9	C8	Red/Brown SANDSTONE As received	D	PL	YES	62.1	100.3	100.3	97.3	0.3	100.3	0.03	0.04	
RBH21	10.9	C8	Red/Brown SANDSTONE As received	A	PD	YES		100.0	63.9	56.9	0.5	90.2	0.06	0.08	
RBH21	11.7	C10	Red/Brown SANDSTONE As received	D	PL	YES	62.0	99.9	99.9	97.9	0.1	99.9	0.01	0.02	
RBH21	11.7	C10	Red/Brown SANDSTONE As received	A	PD	YES		100.3	65.1	63.1	0.2	91.2	0.02	0.03	
RBH21	12.6	C11	Red/Brown SANDSTONE As received	D	PL	YES	77.2	100.8	100.8	97.8	0.3	100.8	0.03	0.04	
RBH21	12.6	C11	Red/Brown SANDSTONE As received	A	PD	YES		99.9	79.5	71.5	0.4	100.5	0.04	0.06	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

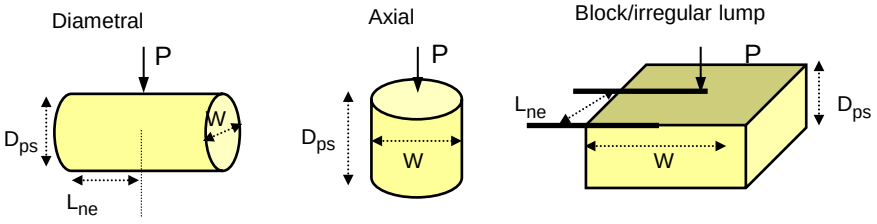
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH21	13.6	C12	Red/Brown SANDSTONE As received	D	PL	YES	53.1	98.4	98.4	95.4	0.2	98.4	0.02	0.03	
RBH21	13.6	C12	Red/Brown SANDSTONE As received	A	PD	YES		100.4	82.4	75.4	0.5	102.6	0.05	0.06	
RBH21	15.5	C14	Red/Brown SANDSTONE As received	A	PD	YES		98.6	92.6	71.6	0.1	107.8	0.01	0.01	
RBH21	16.39	C15	Red/Brown SANDSTONE As received	D	PL	YES	65.9	101.2	101.2	96.2	1.0	101.2	0.09	0.13	
RBH21	16.39	C15	Red/Brown SANDSTONE As received	A	PD	YES		101.2	72.8	66.8	0.8	96.8	0.09	0.12	
RBH21	18	C17	Red/Brown SANDSTONE As received	D	PL	YES	62.4	100.0	100.0	97.0	0.4	100.0	0.04	0.06	
RBH21	18	C17	Red/Brown SANDSTONE As received	A	PD	YES		100.4	67.6	64.6	0.6	92.9	0.07	0.09	
RBH21	19	C18	Red/Brown SANDSTONE As received	D	PL	YES	49.7	101.3	101.3	96.3	0.2	101.3	0.02	0.03	
RBH21	19	C18	Red/Brown SANDSTONE As received	A	PD	YES		102.0	66.1	62.1	0.9	92.6	0.11	0.14	
RBH21	19.92	C19	Red/Brown SANDSTONE As received	D	PL	YES	59.1	100.8	100.8	97.8	0.2	100.8	0.02	0.02	
RBH21	19.92	C19	Red/Brown SANDSTONE As received	A	PD	YES		100.8	71.5	66.5	0.4	95.8	0.05	0.06	
RBH21	20.78	C20	Red/Brown SANDSTONE As received	D	PL	NO	75.9	101.3	101.3	88.3	4.1	101.3	0.40	0.54	
RBH21	20.78	C20	Red/Brown SANDSTONE As received	A	PD	YES		100.9	67.1	62.1	1.8	92.9	0.21	0.28	
RBH21	22.7	C22	Red/Brown SANDSTONE As received	A	PD	NO		100.6	73.3	59.3	0.2	96.9	0.02	0.03	
RBH21	23.8	C23	Red/Brown SANDSTONE As received	A	PD	YES		100.6	73.9	72.9	0.0	97.3	0.00	0.00	
RBH21	24.9	C24	Red/Brown SANDSTONE As received	D	PL	YES	79.8	98.1	98.1	94.1	0.2	98.1	0.02	0.02	
RBH21	24.9	C24	Red/Brown SANDSTONE As received	A	PD	YES		98.6	89.2	81.2	0.2	105.8	0.02	0.03	
RBH21	26	C25	Red/Brown SANDSTONE As received	D	PL	YES	52.5	100.8	100.8	95.8	0.1	100.8	0.01	0.01	
RBH21	26	C25	Red/Brown SANDSTONE As received	A	PD	YES		101.6	59.1	49.1	0.0	87.5	0.01	0.01	
RBH21	27	C26	Red/Brown SANDSTONE As received	D	PL	YES	79.4	100.7	100.7	95.7	0.8	100.7	0.07	0.10	

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)

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Laboratory Test Report 42269R4 / 1

Site: St John's Masterplan Phase 2 **Job Number:** 42269R4

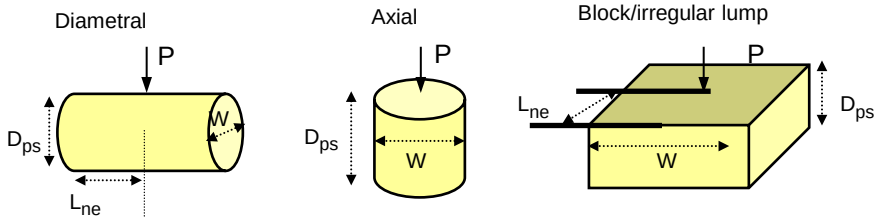
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH21	27	C26	Red/Brown SANDSTONE As received	A	PD	YES		100.5	59.8	53.8	0.6	87.5	0.08	0.11	
RBH21	28.95	C28	Red/Brown SANDSTONE As received	D	PL	YES	77.9	101.0	101.0	97.0	0.5	101.0	0.05	0.07	
RBH21	28.95	C28	Red/Brown SANDSTONE As received	A	PD	YES		100.9	43.4	38.4	0.6	74.7	0.11	0.13	
RBH21	29.8	C29	Red/Brown SANDSTONE As received	D	PL	YES	86.3	101.4	101.4	96.4	0.4	101.4	0.04	0.06	
RBH21	29.8	C29	Red/Brown SANDSTONE As received	A	PD	YES		101.8	114.9	111.9	0.3	122.0	0.02	0.03	
RBH21	31	C30	Red/Brown SANDSTONE As received	D	PL	YES	70.1	100.9	100.9	95.9	0.3	100.9	0.03	0.04	
RBH21	31	C30	Red/Brown SANDSTONE As received	A	PD	YES		101.2	83.7	74.7	0.9	103.8	0.09	0.12	
RBH21	32.26	C32	Red/Brown SANDSTONE As received	D	PL	YES	42.9	100.4	100.4	98.4	0.6	100.4	0.06	0.08	
RBH21	32.26	C32	Red/Brown SANDSTONE As received	A	PD	YES		100.0	101.0	98.0	1.1	113.4	0.08	0.12	
RBH21	33.9	C33	Red/Brown SANDSTONE As received	D	PL	YES	52.3	99.9	99.9	94.9	1.8	99.9	0.18	0.25	
RBH21	33.9	C33	Red/Brown SANDSTONE As received	A	PD	YES		100.4	63.9	56.9	1.2	90.4	0.14	0.19	

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)

IAN FARMER ASSOCIATES

Test Report - 42269R4 / 1

Site:	St John's Masterplan Phase 2
Job Number:	42269R4
Originating Client:	Curtins Consulting

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Date: 29/01/2019

IAN FARMER ASSOCIATES

Unit 4, Faraday Close, Pattinson North Industrial Estate, Washington, NE38 8QJ. Tel: 0191 482 8500 Fax: 0191 482 8520
washington@ianfarmer.co.uk www.ianfarmer.co.uk

F.A.O.

Test Report - 42269R5 / 1

Site:	St John's Masterplan Phase 2
Job Number:	42269R5
Originating Client:	Curtins Consulting
Originating Reference:	42269
Date Sampled:	Not Given
Date Scheduled:	07/01/2019
Date Testing Started:	22/01/2019
Date Testing Finished:	28/01/2019
Remarks:	

Authorised By:

Tim Robinson
Quality Technician

Date: 29/01/2019

Constructionline

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AGS

Site: St John's Masterplan Phase 2 **Job Number:** 42269R5

Client: Curtins Consulting **Page:** 2

ROCK INDEX TESTS - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock description / Rock type	Natural Water Content1 %	Caliper2		Buoyancy3		Natural Bulk density Mg/m3	Remarks
					Dry density Mg/m3	Porosity %	Dry density Mg/m3	Porosity %		
RBH16	8.33	c5	Red/Brown SANDSTONE	10.2			2.03	22.5	2.24	
RBH16	18.50	c15	Red/Brown SANDSTONE	11.4			2.08	20.8	2.31	
RBH16	26.50	c23	Red/Brown SANDSTONE	10.9			2.00	25.7	2.22	
RBH20	9.30	c3	Red/Brown SANDSTONE	12.5			1.84	29.9	2.06	
RBH20	16.96	c11	Red/Brown SANDSTONE	14.8			1.89	31.1	2.17	
RBH20	24.00	c18	Red/Brown SANDSTONE	9.6			2.13	17.2	2.34	

Notes
1. ISRM p87 test 1, water content at 105 ± 3 oC, specimen as received at the laboratory
2. ISRM p87 test 2, Porosity/density determination using saturation and caliper
3. ISRM p88 test 3, Porosity/density determination using saturation and buoyancy
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 conrent 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 conrent of a rock sample

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Laboratory Test Report 42269R5 / 1

Site: St John's Masterplan Phase 2 **Job Number:** 42269R5

Client: Curtins Consulting **Page:** 3

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Hole No.	Depth m	Sample	Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3				Remarks
				Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Stress Rate MPa/s	Mode of failure	UCS MPa	
RBH16	9.46	c6	Red/Brown SANDSTONE	100.9	149.4	*1.5	2.21	11.7	as received	0.5115	AC	5.4	
RBH16	12.10	c9	Red/Brown SANDSTONE	101.2	138.2	*1.4	2.24	10.9	as received	0.5082	AC	7.9	
RBH16	23.50	c20	Red/Brown SANDSTONE	101.1	188.9	*1.9	2.26	10.6	as received	0.5098	S	7.0	
RBH16	27.30	c24	Red/Brown SANDSTONE	101.5	182.9	*1.8	2.37	7.7	as received	0.5055	S	14.6	
RBH16	32.00	c29	Red/Brown SANDSTONE	101.8	245.6	*2.4	2.25	10.1	as received	0.5025	MS	12.4	
RBH16	38.40	c34	Red/Brown SANDSTONE	101.9	247.1	*2.4	2.26	10.2	as received	0.5020	S	11.0	
RBH20	10.90	c5	Red/Brown SANDSTONE	100.5	84.5	*0.8	2.18	12.1	as received	0.5160	AC	1.3	
RBH20	15.75	c10	Red/Brown SANDSTONE	98.3	130.8	*1.3	2.19	9.7	as received	0.5384	AC	0.7	
RBH20	20.20	c14	Red/Brown SANDSTONE	101.6	142.7	*1.4	2.17	12.5	as received	0.5049	AC	1.6	
RBH20	24.73	c19	Red/Brown SANDSTONE	101.5	177.5	*1.7	2.27	7.2	as received	0.5053	AC	13.9	
RBH20	29.10	c23	Red/Brown SANDSTONE	101.6	197.2	*1.9	2.24	11.2	as received	0.5046	AC	3.0	
RBH20	36.27	c28	Red/Brown SANDSTONE	101.1	156.3	*1.5	2.20	11.6	as received	0.5097	AC	8.5	
RBH20	39.92	c32	Red/Brown SANDSTONE	100.9	174.4	*1.7	2.29	10.6	as received	0.5117	S	10.6	

Notes
1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS
2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density
3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials
above notes apply unless annotated otherwise in the remarks

*Denotes length diameter ratio outside ISRM specification

Mode of failure :
S - Single shear MS - multiple shear
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

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Laboratory Test Report 42269R5 / 1

Site: St John's Masterplan Phase 2 **Job Number:** 42269R5

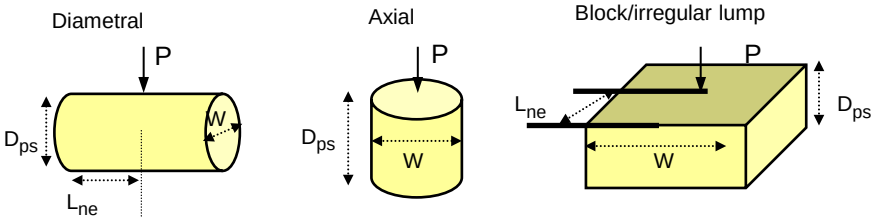
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH16	7.3	c4	Red/Brown SANDSTONE As received	D	PL	YES	67.9	99.9	99.9	96.9	0.2	99.9	0.02	0.03	
RBH16	7.3	c4	Red/Brown SANDSTONE As received	A	PD	YES		98.7	66.4	60.4	0.5	91.4	0.06	0.08	
RBH16	8.33	c5	Red/Brown SANDSTONE As received	D	PL	YES	53.5	100.9	100.9	98.9	0.3	100.9	0.03	0.03	
RBH16	8.33	c5	Red/Brown SANDSTONE As received	A	PD	YES		100.2	58.5	54.5	1.4	86.4	0.19	0.25	
RBH16	10.5	c7	Red/Brown SANDSTONE As received	D	PL	YES	72.5	100.4	100.4	96.4	0.5	100.4	0.05	0.07	
RBH16	10.5	c7	Red/Brown SANDSTONE As received	A	PD	YES		101.5	87.7	80.7	0.9	106.5	0.08	0.11	
RBH16	11.45	c8	Red/Brown SANDSTONE As received	D	PL	YES	58.7	101.8	101.8	99.8	0.2	101.8	0.02	0.03	
RBH16	11.45	c8	Red/Brown SANDSTONE As received	A	PD	YES		102.5	62.4	54.4	0.6	90.3	0.08	0.10	
RBH16	13.6	c10	Red/Brown SANDSTONE As received	D	PL	YES	72.0	101.8	101.8	98.8	0.7	101.8	0.07	0.10	
RBH16	13.6	c10	Red/Brown SANDSTONE As received	A	PD	YES		101.4	85.3	68.3	1.9	105.0	0.17	0.24	
RBH16	14.4	c11	Red/Brown SANDSTONE As received	D	PL	YES	35.6	101.8	101.8	97.8	0.5	101.8	0.05	0.06	
RBH16	14.4	c11	Red/Brown SANDSTONE As received	A	PD	YES		101.5	53.8	49.8	0.7	83.4	0.10	0.12	
RBH16	15.51	c12	Red/Brown SANDSTONE As received	D	PL	YES	80.5	101.2	101.2	98.2	0.7	101.2	0.07	0.09	
RBH16	15.51	c12	Red/Brown SANDSTONE As received	A	PD	YES		101.2	91.3	86.3	1.4	108.5	0.12	0.17	
RBH16	16.75	c13	Red/Brown SANDSTONE As received	D	PL	YES	75.3	101.7	101.7	98.7	0.2	101.7	0.02	0.03	
RBH16	16.75	c13	Red/Brown SANDSTONE As received	A	PD	YES		101.3	77.4	74.4	0.5	99.9	0.05	0.07	
RBH16	17.5	c14	Red/Brown SANDSTONE As received	D	PL	YES	66.9	101.5	101.5	98.5	0.3	101.5	0.03	0.05	
RBH16	17.5	c14	Red/Brown SANDSTONE As received	A	PD	YES		101.7	81.7	81.7	0.5	102.8	0.04	0.06	
RBH16	18.5	c15	Red/Brown SANDSTONE As received	D	PL	YES	85.6	102.1	102.1	98.1	0.4	102.1	0.04	0.05	
RBH16	18.5	c15	Red/Brown SANDSTONE As received	A	PD	YES		101.4	97.2	88.2	0.9	112.0	0.07	0.10	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R5

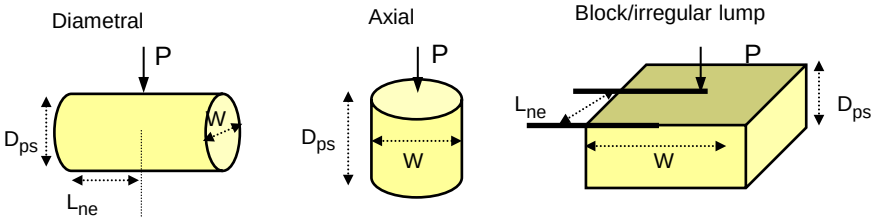
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH16	19.4	c16	Red/Brown SANDSTONE As received	D	PL	YES	45.1	101.3	101.3	96.3	0.2	101.3	0.02	0.03	
RBH16	19.4	c16	Red/Brown SANDSTONE As received	A	PD	YES		101.4	46.6	43.6	0.3	77.6	0.05	0.06	
RBH16	20.5	c17	Red/Brown SANDSTONE As received	A	PD	YES		101.0	68.6	63.6	0.4	93.9	0.04	0.06	
RBH16	21.4	c18	Red/Brown SANDSTONE As received	D	PL	YES	69.2	101.1	101.1	97.1	0.3	101.1	0.03	0.05	
RBH16	21.4	c18	Red/Brown SANDSTONE As received	A	PD	YES		101.7	106.3	95.3	1.3	117.3	0.09	0.14	
RBH16	22.6	c19	Red/Brown SANDSTONE As received	D	PL	YES	76.9	101.7	101.7	98.7	0.6	101.7	0.05	0.07	
RBH16	22.6	c19	Red/Brown SANDSTONE As received	A	PD	YES		101.7	85.5	80.5	0.7	105.2	0.07	0.09	
RBH16	24.7	c21	Red/Brown SANDSTONE As received	D	PL	YES	68.5	101.7	101.7	97.7	0.5	101.7	0.05	0.06	
RBH16	24.7	c21	Red/Brown SANDSTONE As received	A	PD	YES		101.6	68.3	57.3	3.3	94.0	0.37	0.49	
RBH16	25.8	c22	Red/Brown SANDSTONE As received	A	PD	YES		101.0	60.4	53.4	1.1	88.1	0.14	0.18	
RBH16	26.5	c23	Red/Brown SANDSTONE As received	D	PL	YES	81.1	101.4	101.4	99.4	0.6	101.4	0.06	0.08	
RBH16	26.5	c23	Red/Brown SANDSTONE As received	A	PD	YES		101.4	115.2	106.2	1.7	121.9	0.12	0.17	
RBH16	28.5	c25	Red/Brown SANDSTONE As received	D	PL	YES	74.3	101.1	101.1	97.1	1.5	101.1	0.14	0.20	
RBH16	28.5	c25	Red/Brown SANDSTONE As received	A	PD	NO		100.7	110.8	104.8	2.6	119.2	0.18	0.27	
RBH16	29.6	c26	Red/Brown SANDSTONE As received	D	PL	YES	76.2	101.8	101.8	97.8	0.9	101.8	0.09	0.13	
RBH16	29.6	c26	Red/Brown SANDSTONE As received	A	PD	YES		101.8	94.1	79.1	2.5	110.4	0.20	0.29	
RBH16	30.4	c27	Red/Brown SANDSTONE As received	D	PL	YES	73.3	101.6	101.6	98.6	1.2	101.6	0.12	0.16	
RBH16	30.4	c27	Red/Brown SANDSTONE As received	A	PD	YES		101.4	84.6	72.6	3.3	104.5	0.30	0.41	
RBH16	31.5	c28	Red/Brown SANDSTONE As received	D	PL	YES	100.7	101.3	101.3	98.3	2.8	101.3	0.27	0.37	
RBH16	31.5	c28	Red/Brown SANDSTONE As received	A	PD	YES		101.4	105.5	92.5	4.8	116.7	0.35	0.51	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R5

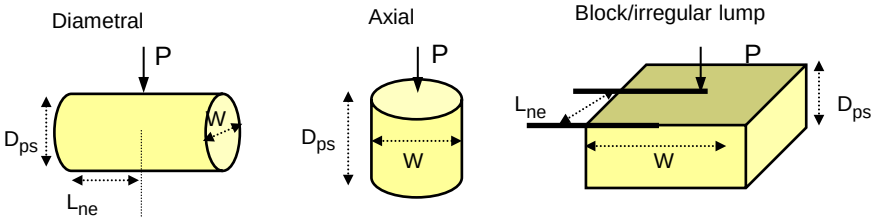
Client: Curtins Consulting **Page:** 6

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	Equivalent diameter, De	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	kN	mm	Is . MPa	Is (50) MPa	
RBH16	33.48	c30	Red/Brown SANDSTONE As received	D	PL	YES	73.9	101.4	101.4	96.4	1.6	101.4	0.16	0.22	
RBH16	33.48	c30	Red/Brown SANDSTONE As received	A	PD	YES		101.6	95.7	84.7	2.7	111.3	0.22	0.32	
RBH16	35	c31	Red/Brown SANDSTONE As received	D	PL	YES	64.9	101.4	101.4	97.4	0.9	101.4	0.09	0.12	
RBH16	35	c31	Red/Brown SANDSTONE As received	A	PD	YES		101.8	62.9	58.9	1.2	90.3	0.15	0.19	
RBH16	36.45	c32	Red/Brown SANDSTONE As received	D	PL	YES	62.5	101.4	101.4	98.4	2.2	101.4	0.22	0.30	
RBH16	36.45	c32	Red/Brown SANDSTONE As received	A	PD	YES		101.6	54.1	49.1	1.2	83.7	0.17	0.22	
RBH16	37.45	c33	Red/Brown SANDSTONE As received	D	PL	YES	56.3	100.9	100.9	96.9	1.5	100.9	0.15	0.20	
RBH16	37.45	c33	Red/Brown SANDSTONE As received	A	PD	YES		101.7	53.4	48.4	1.2	83.1	0.18	0.23	
RBH16	40	c35	Red/Brown SANDSTONE As received	D	PL	YES	81.5	101.7	101.7	98.7	1.1	101.7	0.10	0.14	
RBH16	40	c35	Red/Brown SANDSTONE As received	A	PD	YES		101.8	96.0	87.0	2.2	111.5	0.18	0.26	
RBH20	7.1	c1	Red/Brown SANDSTONE As received	A	PD	YES		98.9	68.3	59.3	0.4	92.7	0.04	0.05	
RBH20	8	c2	Red/Brown SANDSTONE As received	D	PL	YES	56.1	99.3	99.3	97.3	0.1	99.3	0.01	0.02	
RBH20	8	c2	Red/Brown SANDSTONE As received	A	PD	YES		99.2	61.3	57.3	0.1	88.0	0.02	0.02	
RBH20	9.3	c3	Red/Brown SANDSTONE As received	D	PL	YES	63.4	100.1	100.1	96.1	0.4	100.1	0.04	0.06	
RBH20	9.3	c3	Red/Brown SANDSTONE As received	A	PD	YES		99.8	82.3	74.3	0.9	102.2	0.08	0.11	
RBH20	10.3	c4	Red/Brown SANDSTONE As received	D	PL	YES	97.8	100.4	100.4	97.4	0.3	100.4	0.03	0.04	
RBH20	10.3	c4	Red/Brown SANDSTONE As received	A	PD	YES		101.3	58.5	51.5	1.0	86.8	0.13	0.17	
RBH20	12.2	c6	Red/Brown SANDSTONE As received	D	PL	YES	59.8	95.5	95.5	93.5	0.1	95.5	0.01	0.01	
RBH20	12.2	c6	Red/Brown SANDSTONE As received	A	PD	YES		96.9	51.9	48.9	0.1	80.0	0.02	0.02	
RBH20	13.38	c7	Red/Brown SANDSTONE As received	D	PL	YES	61.1	101.3	101.3	96.3	1.0	101.3	0.10	0.13	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R5

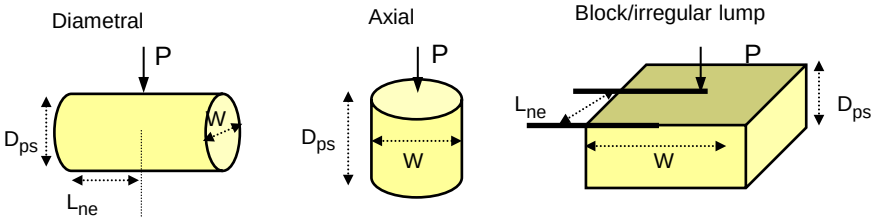
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Point Load Strength Index Tests
Summary of Results

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	
RBH20	13.38	c7	Red/Brown SANDSTONE As received	A	PD	YES		101.7	66.3	60.3	1.3	92.7	0.15	0.20	
RBH20	14.25	c8	Red/Brown SANDSTONE As received	D	PL	YES	48.7	99.7	99.7	95.7	0.3	99.7	0.03	0.03	
RBH20	14.25	c8	Red/Brown SANDSTONE As received	A	PD	YES		99.1	51.0	48.0	0.2	80.2	0.03	0.03	
RBH20	15.3	c9	Red/Brown SANDSTONE As received	D	PL	YES	52.2	99.2	99.2	97.2	0.2	99.2	0.02	0.03	
RBH20	15.3	c9	Red/Brown SANDSTONE As received	A	PD	YES		99.2	70.4	64.4	0.7	94.3	0.08	0.10	
RBH20	16.96	c11	Red/Brown SANDSTONE As received	D	PL	YES	62.2	96.5	96.5	94.5	0.1	96.5	0.01	0.01	
RBH20	16.96	c11	Red/Brown SANDSTONE As received	A	PD	YES		96.4	96.1	95.1	0.1	108.6	0.01	0.01	
RBH20	18	c12	Red/Brown SANDSTONE As received	D	PL	YES	64.2	99.9	99.9	96.9	0.2	99.9	0.02	0.02	
RBH20	18	c12	Red/Brown SANDSTONE As received	A	PD	YES		100.8	49.3	44.3	0.1	79.5	0.02	0.03	
RBH20	19.2	c13	Red/Brown SANDSTONE As received	D	PL	YES	57.1	101.0	101.0	96.0	0.2	101.0	0.02	0.02	
RBH20	19.2	c13	Red/Brown SANDSTONE As received	A	PD	YES		102.0	48.8	44.8	0.2	79.6	0.03	0.04	
RBH20	21	c15	Red/Brown SANDSTONE As received	A	PD	YES		100.9	39.9	33.9	0.2	71.6	0.05	0.05	
RBH20	22	c16	Red/Brown SANDSTONE As received	D	PL	YES	57.2	99.6	99.6	97.6	0.3	99.6	0.03	0.04	
RBH20	22	c16	Red/Brown SANDSTONE As received	A	PD	YES		99.2	55.9	52.9	0.2	84.0	0.03	0.04	
RBH20	22.85	c17	Red/Brown SANDSTONE As received	D	PL	YES	61.9	101.6	101.6	97.6	0.7	101.6	0.06	0.09	
RBH20	22.85	c17	Red/Brown SANDSTONE As received	A	PD	YES		101.3	61.2	56.2	0.7	88.9	0.09	0.11	
RBH20	24	c18	Red/Brown SANDSTONE As received	D	PL	YES	86.1	101.7	101.7	97.7	1.5	101.7	0.15	0.20	
RBH20	24	c18	Red/Brown SANDSTONE As received	A	PD	YES		101.6	110.5	104.5	1.7	119.6	0.12	0.18	
RBH20	26.03	c20	Red/Brown SANDSTONE As received	D	PL	YES	46.3	101.2	101.2	97.2	0.5	101.2	0.05	0.06	
RBH20	26.03	c20	Red/Brown SANDSTONE As received	A	PD	YES		101.8	60.0	56.0	0.9	88.2	0.12	0.15	

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)

Site: St John's Masterplan Phase 2 **Job Number:** 42269R5

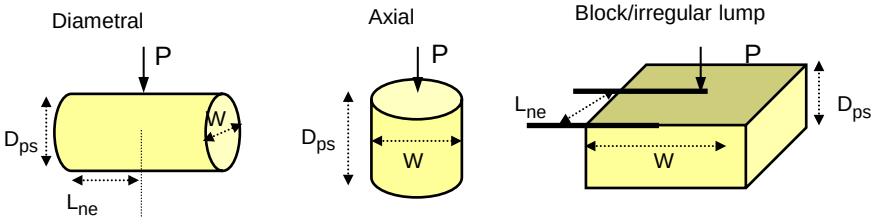
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Point Load Strength Index Tests
Summary of Results

Borehole No.	Depth m	Sample	Rock Type and Test condition	Test Type see ISRM: Type (D, A, I, B)	Test Type see ISRM: Direction (PL, PD or U)	Failure Valid (Y/N)	Dimensions: Lne mm	Dimensions: W mm	Dimensions: Dps mm	Dimensions: Dps' mm	Force P kN	Equivalent diameter, De mm	Point Load Strength Index: Is . MPa	Point Load Strength Index: Is (50) MPa	Remarks (including water content if measured)
RBH20	27.3	c21	Red/Brown SANDSTONE As received	D	PL	YES	81.8	101.2	101.2	99.2	0.5	101.2	0.05	0.07	
RBH20	27.3	c21	Red/Brown SANDSTONE As received	A	PD	YES		101.4	88.5	78.5	1.1	106.9	0.10	0.14	
RBH20	28.3	c22	Red/Brown SANDSTONE As received	D	PL	YES	48.1	101.2	101.2	98.2	0.1	101.2	0.01	0.01	
RBH20	28.3	c22	Red/Brown SANDSTONE As received	A	PD	YES		101.2	69.1	67.1	0.3	94.3	0.04	0.05	
RBH20	30.4	c24	Red/Brown SANDSTONE As received	D	PL	YES	56.1	100.6	100.6	98.6	0.3	100.6	0.03	0.04	
RBH20	30.4	c24	Red/Brown SANDSTONE As received	A	PD	YES		100.8	55.0	52.0	0.4	84.0	0.06	0.07	
RBH20	31.4	c25	Red/Brown SANDSTONE As received	D	PL	YES	72.6	101.7	101.7	98.7	0.3	101.7	0.03	0.03	
RBH20	31.4	c25	Red/Brown SANDSTONE As received	A	PD	YES		101.3	70.9	67.9	0.4	95.6	0.04	0.05	
RBH20	32	c26	Red/Brown SANDSTONE As received	D	PL	YES	77.0	100.7	100.7	97.7	0.2	100.7	0.02	0.03	
RBH20	32	c26	Red/Brown SANDSTONE As received	A	PD	YES		100.0	77.9	71.9	0.6	99.6	0.06	0.08	
RBH20	34.7	c27	Red/Brown SANDSTONE As received	D	PL	YES	77.1	100.4	100.4	97.4	0.4	100.4	0.04	0.05	
RBH20	34.7	c27	Red/Brown SANDSTONE As received	A	PD	YES		100.5	64.3	59.3	0.4	90.7	0.05	0.06	
RBH20	37.25	c29	Red/Brown SANDSTONE As received	A	PD	YES		101.2	60.2	54.2	2.0	88.1	0.26	0.33	
RBH20	38.4	c30	Red/Brown SANDSTONE As received	D	PL	YES	45.3	100.1	100.1	97.1	0.3	100.1	0.03	0.04	
RBH20	38.4	c30	Red/Brown SANDSTONE As received	A	PD	YES		100.2	64.6	60.6	0.3	90.8	0.04	0.05	
RBH20	39	c31	Red/Brown SANDSTONE As received	D	PL	YES	61.9	99.7	99.7	96.7	0.7	99.7	0.07	0.10	
RBH20	39	c31	Red/Brown SANDSTONE As received	A	PD	YES		101.3	49.5	45.5	0.6	79.9	0.09	0.12	

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)

IAN FARMER ASSOCIATES

Test Report - 42269R5 / 1

Site:	St John's Masterplan Phase 2
Job Number:	42269R5
Originating Client:	Curtins Consulting

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Date: 29/01/2019

ISRM Suggested Methods – Rock Characterization Testing and Monitoring 1974 - 2006 In-house Technical Procedure TP35

DETERMINATION OF POINT LOAD STRENGTH ON ROCK

Sample details				Point Load test											
Borehole Ref.	Sample Ref.	Depth (m)	Description	D. Tested	Test type & Direction		Sample width W (mm)	Platen separation (mm)		Water Content (%)	Equiv. Diameter D_e (mm)	Failure Load P (kN)	I_s P/De^2 (MPa)	Correction Factor F	Point Load Index $I_{s(50)}$ (MPa)
								Start D	End D'						
RBH15	-	17.58-17.80	Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered	30/01/19	D	R	100.0	100.4	98.3		99.3	0.88	0.09	1.36	0.12

(*) Sample failed on weakness

Test type and direction: **D** - Diametral **A** - Axial **B** - Block **L** - Irregular lump **Pd** - Perpendicular to planes of weakness **R** - Random or unknown orientation **Pl** - Parallel to planes of weakness

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 04/02/2019

Project Number:

GEO / 28564

Project Name:

ST JOHN'S MASTERPLAN PH2

42269

GEOLABS®

UKAS TESTING 1982

ISRM Suggested Methods – Rock Characterization Testing and Monitoring 1974 - 2006

UNIAXIAL COMPRESSIVE STRENGTH OF ROCK MATERIALS

Sample details				Density				Uniaxial Compression Test (LF0879C (1000kN) compression frame used)							
								Mean after prep.							
Borehole Ref.	Sample Ref.	Depth (m)	Description	MC (%)	Degree of Saturation (%)	Bulk (Mg/m³)	Dry (Mg/m³)	Diameter (mm)	Height (mm)	H/D Ratio	Load at Failure (kN)	UCS (MPa) 3 sig. fig.	Failure Sketch	D. Tested	Remarks
RBH15	-	16.60-16.80	Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered	9.5	93.9	2.32	2.12	101.50	203.50	2.0	157.8	19.5		30/01/19	

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

CC

C Clergeaud (Snr. Geologist)

Date: 04/02/2019

Project Number:

GEO / 28564

Project Name:

ST JOHN'S MASTERPLAN PH2

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UKAS TESTING 1982

ISRM Suggested Methods – Rock Characterization Testing and Monitoring 1974 - 2006

Unconfined Compressive Strength

Borehole Ref.:	RBH15
Sample Ref.:	-
Depth (m):	16.60-16.80

Description:
Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered

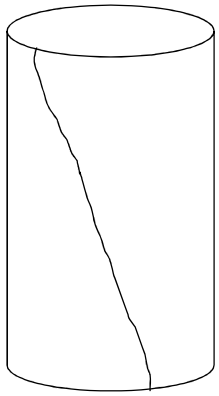
LF0879C (1000kN) compression frame used

Diameter	101.50 mm
Height	203.50 mm
Bulk Density	2.32 Mg/m³
Dry Density	2.12 Mg/m³
Water Content	9.5 %

Degree of Saturation: 93.9 % Specific Gravity: 2.7 Mg/m³ (Assumed)

Failure Sketch

Mode of failure: Diagonal shearing



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

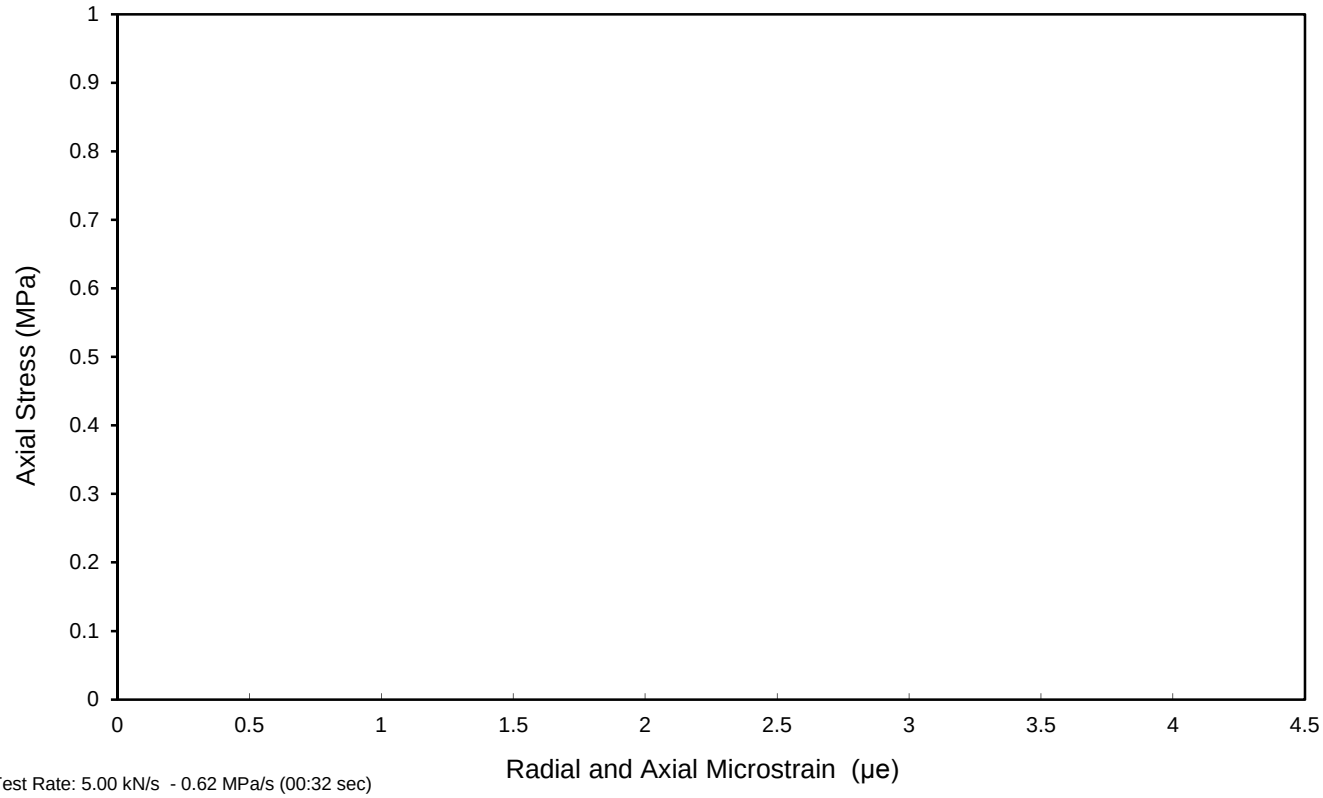
Angle of foliation/Horizontal: n/a
Angle of shear plane/Horizontal: 65°

Sample type	C

Date tested: 30/01/2019

Test results

Unconfined Compressive Strength	19.5 MPa
Young's Modulus (tangential at 50% failure load)	n/a
Poisson's Ratio (tangential at 50% failure load)	n/a
Young's Modulus (secant at 10% failure load)	n/a
Poisson's Ratio (secant at 10% failure load)	n/a



Test Rate: 5.00 kN/s - 0.62 MPa/s (00:32 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: 04/02/2019

Project Number:

GEO / 28564

Project Name:

ST JOHN'S MASTERPLAN PH2

42269

GEOLABS®

ISRM Suggested Methods – Rock Characterization Testing and Monitoring 1974 - 2006

Strength of Rock Materials in Triaxial Compression: Revised Version

Borehole Ref.:	RBH21
Sample Ref.:	
Depth (m):	17.70-18.00

Description:
Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered

Procedure Type II - Multiple failure state test

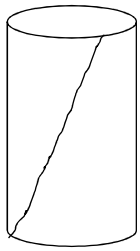
LF0879C (1000kN) compression frame used

Diameter	53.70 mm
Height	109.70 mm
Bulk Density	2.12 Mg/m³
Dry Density	1.90 Mg/m³
Water Content	11 %

Degree of Saturation: 93.9 % Specific Gravity: 2.7 Mg/m³ (Assumed)

Failure Sketch

Mode of failure: Diagonal shearing

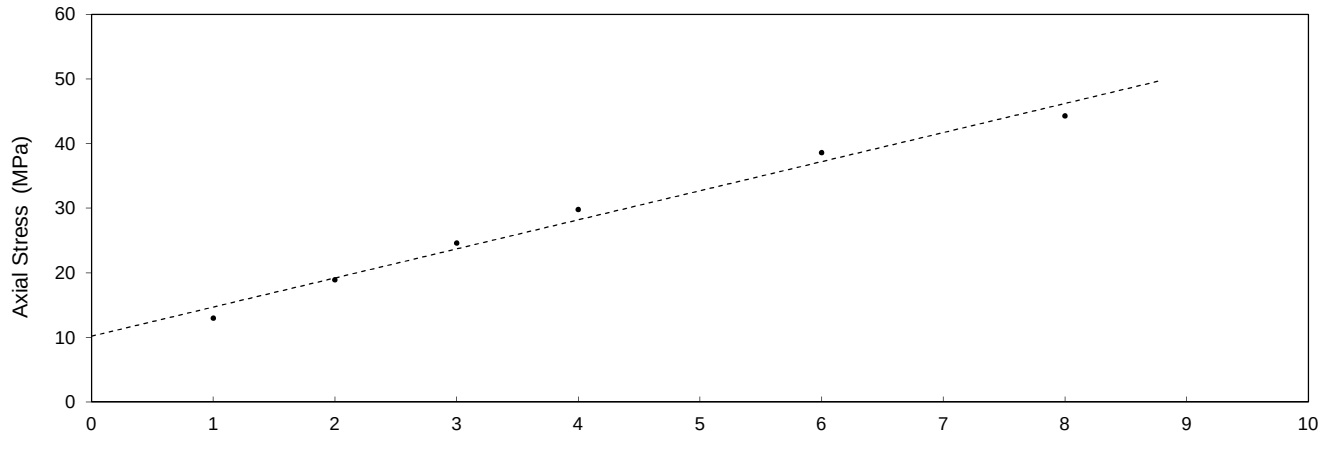


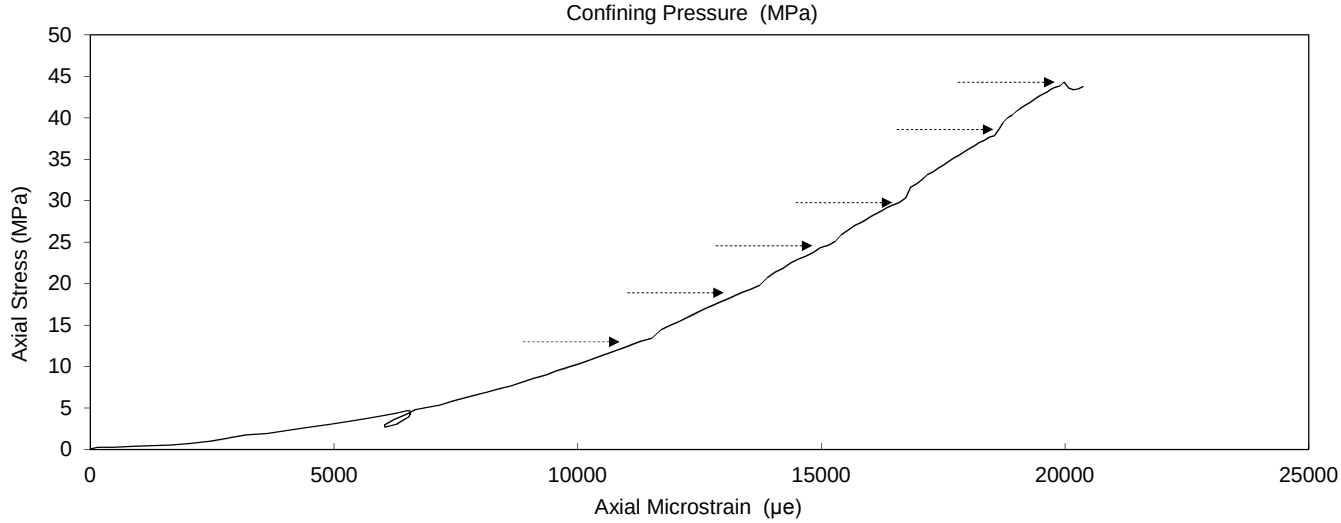
Solid lines for material failures.
Dashed lines for apparent weakness failure.

Date tested: 31-01-2019

Confining Pressure (MPa)	1.000	2.000	3.000	4.000	6.000	8.000
Axial Strength (MPa)	13.00	18.90	24.60	29.80	38.60	44.30

Gradient of Slope, m **4.500**
Ordinate of Slope, b **10 MPa**
Internal Friction Angle, φ **39.5 º**
Apparent Cohesion, c **2 MPa**





Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 04/02/2019

Project Number:

GEO / 28564

Project Name:

ST JOHN'S MASTERPLAN PH2

42269

GEOLABS®

ISRM Suggested Methods – Rock Characterization Testing and Monitoring 1974 - 2006

Strength of Rock Materials in Triaxial Compression: Revised Version

Borehole Ref.:	RBH15
Sample Ref.:	
Depth (m):	18

Description:
Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered

Procedure Type II - Multiple failure state test

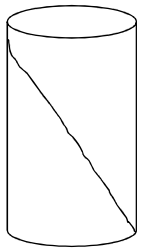
LF0879C (1000kN) compression frame used

Diameter	53.50 mm
Height	108.50 mm
Bulk Density	2.20 Mg/m³
Dry Density	1.98 Mg/m³
Water Content	11 %

Degree of Saturation: 93.9 % Specific Gravity: 2.7 Mg/m³ (Assumed)

Failure Sketch

Mode of failure: Diagonal shearing

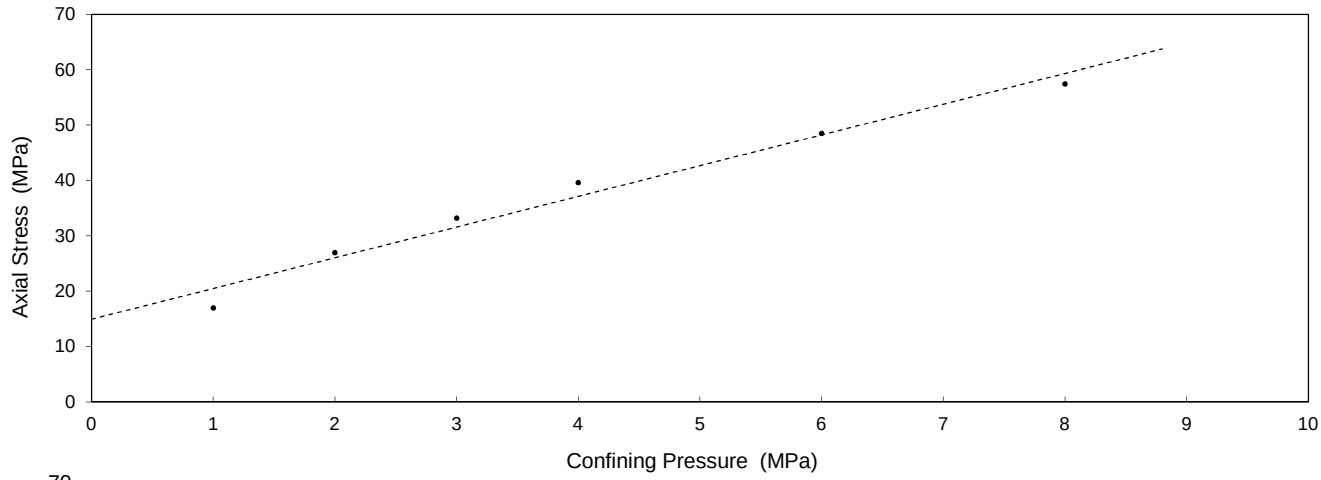


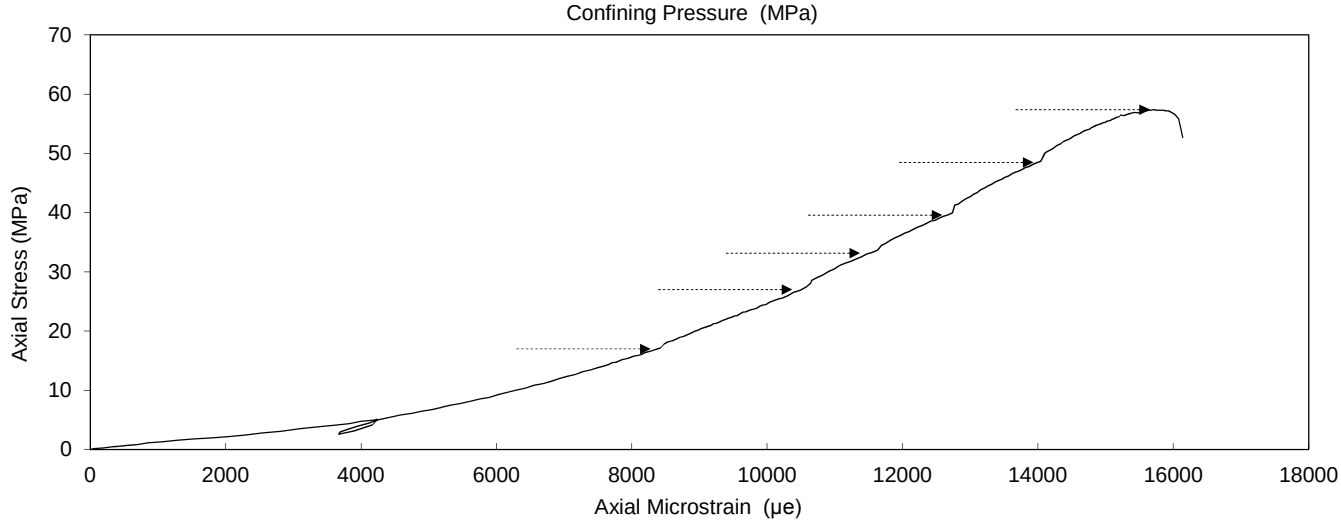
Solid lines for material failures.
Dashed lines for apparent weakness failure.

Date tested: 31-01-2019

Confining Pressure (MPa)	1.000	2.000	3.000	4.000	6.000	8.000
Axial Strength (MPa)	17.00	27.00	33.20	39.60	48.50	57.40

Gradient of Slope, m **5.541**
Ordinate of Slope, b **15 MPa**
Internal Friction Angle, φ **44.0 º**
Apparent Cohesion, c **3 MPa**





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ISRM Suggested Methods – Rock Characterization Testing and Monitoring 1974 - 2006

Strength of Rock Materials in Triaxial Compression: Revised Version

Borehole Ref.:	RBH16
Sample Ref.:	
Depth (m):	14.75

Description:
Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered

Procedure Type II - Multiple failure state test

LF0879C (1000kN) compression frame used

Diameter	53.80 mm
Height	109.60 mm
Bulk Density	2.17 Mg/m³
Dry Density	1.98 Mg/m³
Water Content	9.5 %

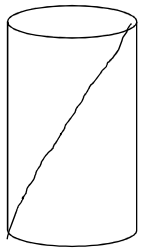
Degree of Saturation: 93.9 % Specific Gravity: 2.7 Mg/m³ (Assumed)

Confining Pressure (MPa)	1.000	2.000	3.000	4.000	6.000	8.000
Axial Strength (MPa)	12.70	20.70	28.20	33.70	42.40	51.40

Gradient of Slope, m **5.374**
Ordinate of Slope, b **10 MPa**
Internal Friction Angle, φ **43.3 º**
Apparent Cohesion, c **2 MPa**

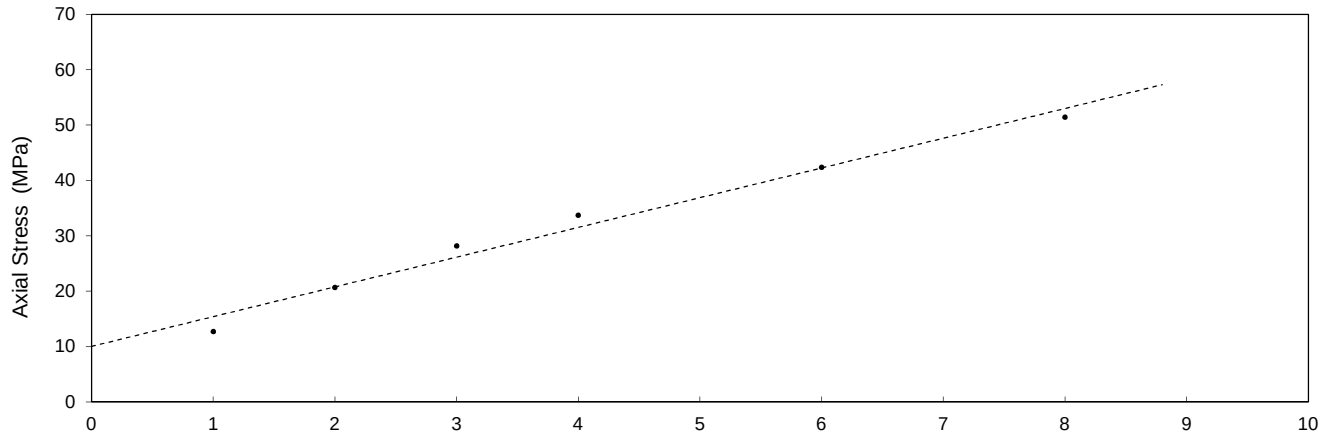
Failure Sketch

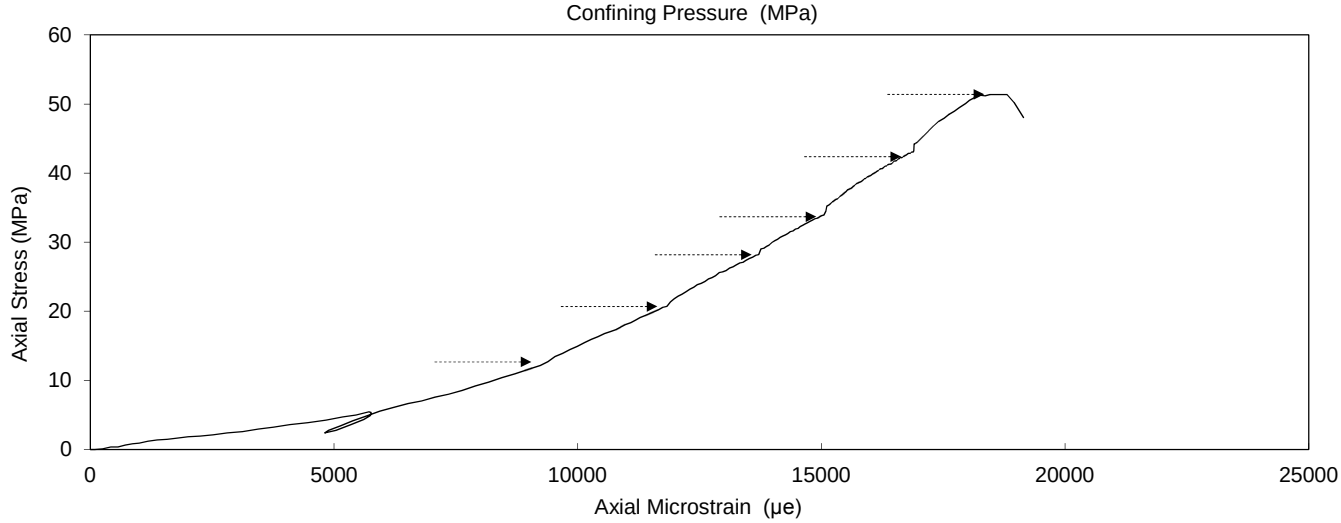
Mode of failure: Diagonal shearing



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

Date tested: 31-01-2019





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ISRM Suggested Methods – Rock Characterization Testing and Monitoring 1974 - 2006

Strength of Rock Materials in Triaxial Compression: Revised Version

Borehole Ref.:	RBH18
Sample Ref.:	
Depth (m):	15.10-15.35

Description:
Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately to highly weathered

Procedure Type II - Multiple failure state test

LF0879C (1000kN) compression frame used

Diameter	53.50 mm
Height	106.90 mm
Bulk Density	2.11 Mg/m³
Dry Density	1.86 Mg/m³
Water Content	14 %

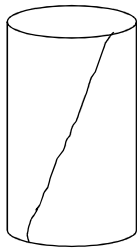
Degree of Saturation: 93.9 % Specific Gravity: 2.7 Mg/m³ (Assumed)

Confining Pressure (MPa)	1.000	2.000	3.000	4.000	6.000	8.000
Axial Strength (MPa)	6.14	12.60	19.20	23.60	32.10	36.20

Gradient of Slope, m **4.299**
Ordinate of Slope, b **4 MPa**
Internal Friction Angle, φ **38.5 º**
Apparent Cohesion, c **1 MPa**

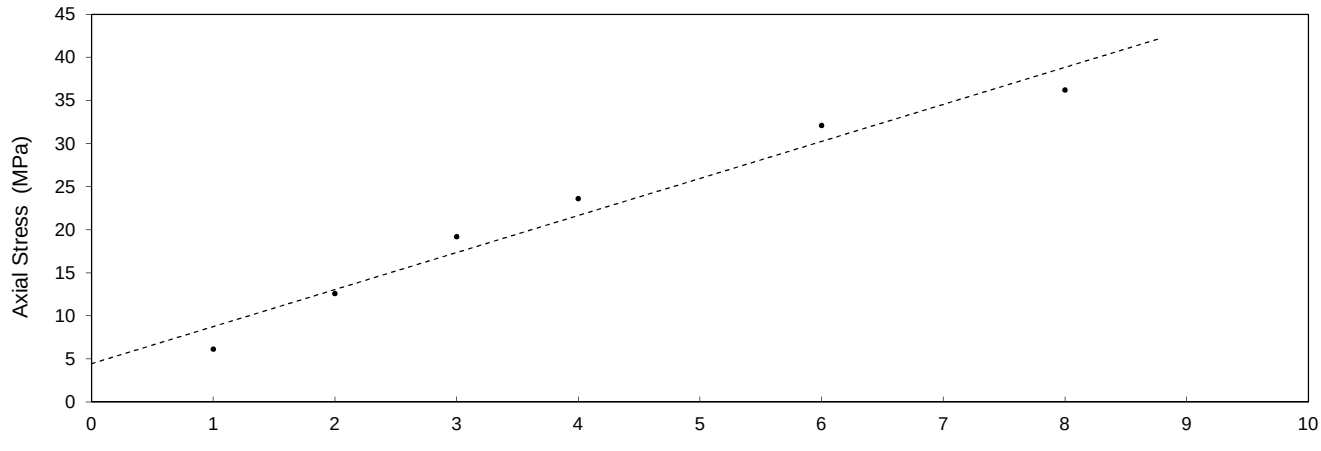
Failure Sketch

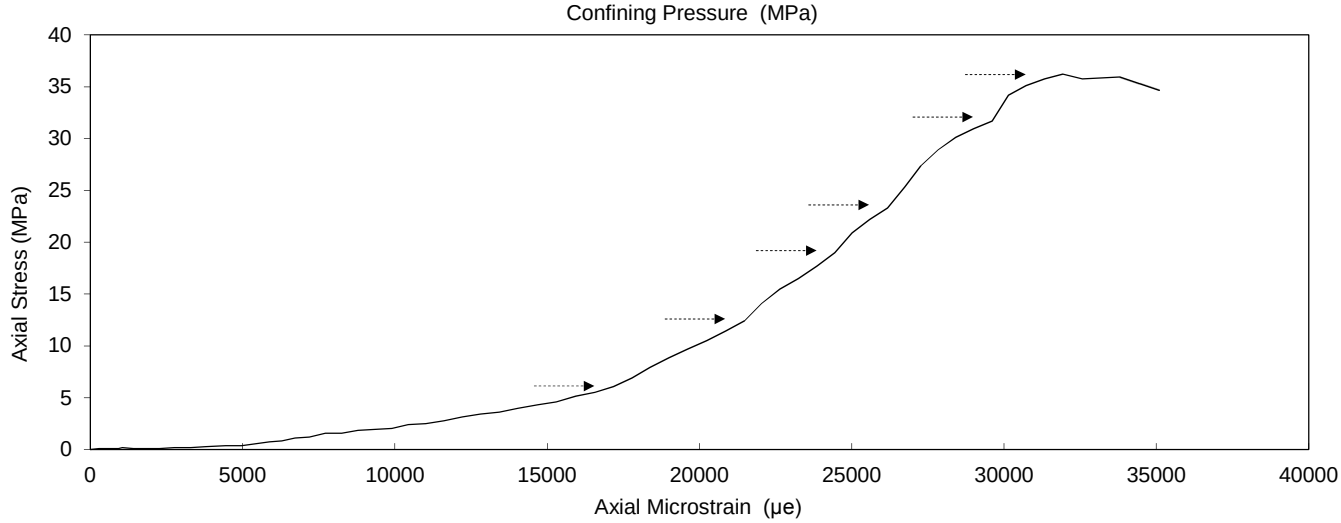
Mode of failure: Diagonal shearing



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

Date tested: 31-01-2019





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Date: 04/02/2019

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ST JOHN'S MASTERPLAN PH2

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BS1377 : Part 7 : 1990 Clause 4

Determination of Shear Strength by Direct Shear

(small shearbox apparatus)

Borehole No:	RBH16
Sample No:	11
Depth (m):	16.55

Description:

Reddish brown slightly micaceous slightly sandy CLAY. Sand is predominantly fine.

Specimen Details

Depth within original sample	*mm*	n/a		
Orientation within original sample		n/a		
Test condition		Submerged		
Preparation		< 2 mm material remoulded at existing moisture content to the approximate in-situ density.		
Particle density	*Mg/m³*	2.70 (assumed)		
Specimen Number		**1**	**2**	**3**
Length	*mm*	59.94	60.79	61.18
Width	*mm*	60.04	60.85	61.07
Height	*mm*	18.65	18.39	18.07
Initial water content	*%*	11.9	11.9	11.9
Initial wet density	*Mg/m³*	2.23	2.21	2.22
Initial dry density	*Mg/m³*	2.00	1.97	1.98
Initial voids ratio		0.35	0.37	0.36

Consolidation Stage

Normal stress	*kPa*	50	100	200
Duration	*day(s)*	1	1	1

Shearing Stage

Normal stress	*kPa*	50	100	200
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.0072	0.0072	0.0072
Maximum shear stress	*kPa*	35.8	56.0	96.7
Horizontal displacement at MSS	*mm*	0.9	4.1	1.7
Residual Conditions:				
Rate of horizontal displacement		n/a	n/a	n/a
Residual shear stress		n/a	n/a	n/a
Final cumulative displacement		n/a	n/a	n/a
Total traverses		n/a	n/a	n/a
Method of reversal		n/a	n/a	n/a
Final water content	*%*	20.4	20.4	18.2
Duration	*day(s)*	1	1	1

Shear Strength Parameters

Maximum Condition:

Apparent Cohesion	*kPa*	**16**
Angle of Shearing Resistance	*degrees*	**22.0**

Notes:

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 27/02/2019

Project Number:

GEO / 28564

Project Name:

St John's Masterplan Ph2

Project Ref: 42269

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BS1377 : Part 7 : 1990 Clause 4

Determination of Shear Strength by Direct Shear

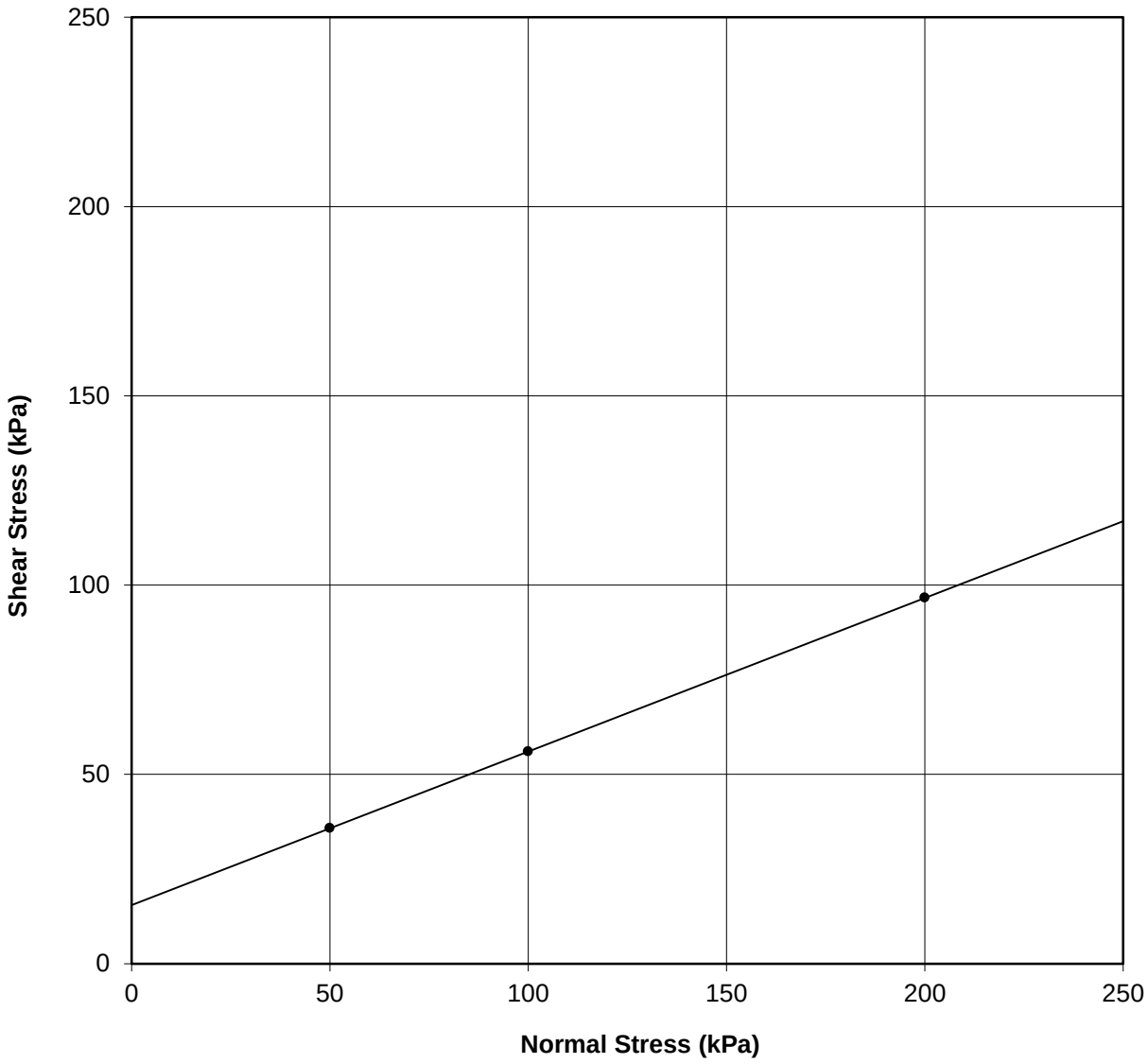
(small shearbox apparatus)

Borehole No:	RBH16
Sample No:	11
Depth (m):	16.55

Description:

Reddish brown slightly micaceous slightly sandy CLAY. Sand is predominantly fine.

Shear Stress v Normal Stress



Peak: c' = 16

Φ' = 22 °

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S R Allen (Senior Tech)

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BS1377 : Part 7 : 1990 Clause 4

Determination of Shear Strength by Direct Shear

(small shearbox apparatus)

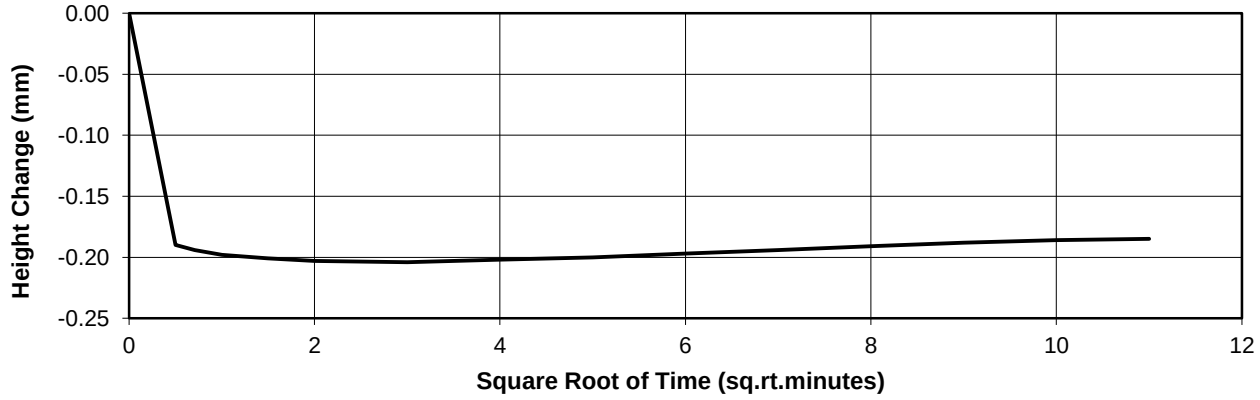
Borehole No:	RBH16
Sample No:	11
Depth (m):	16.55

Description:

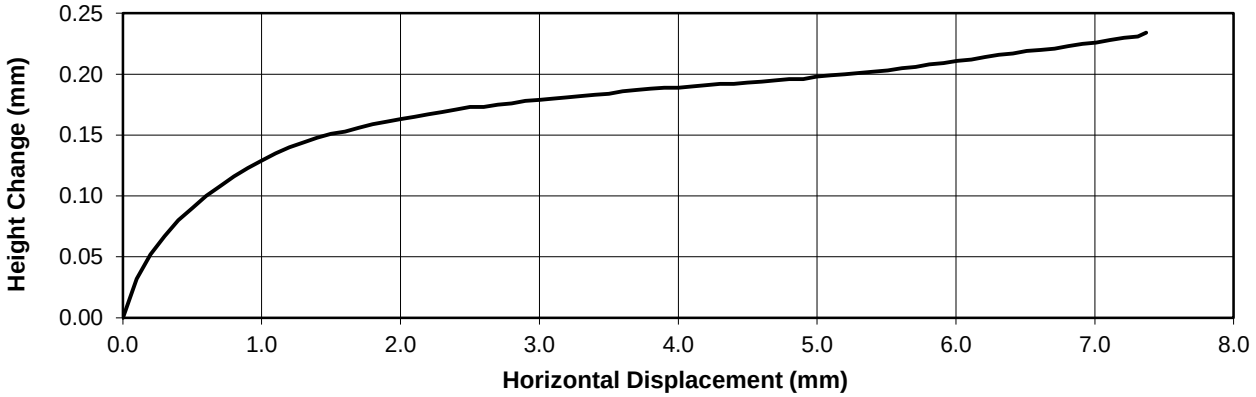
Reddish brown slightly micaceous slightly sandy CLAY. Sand is predominantly fine.

Specimen No 1 **Normal Pressure = 50 kPa**

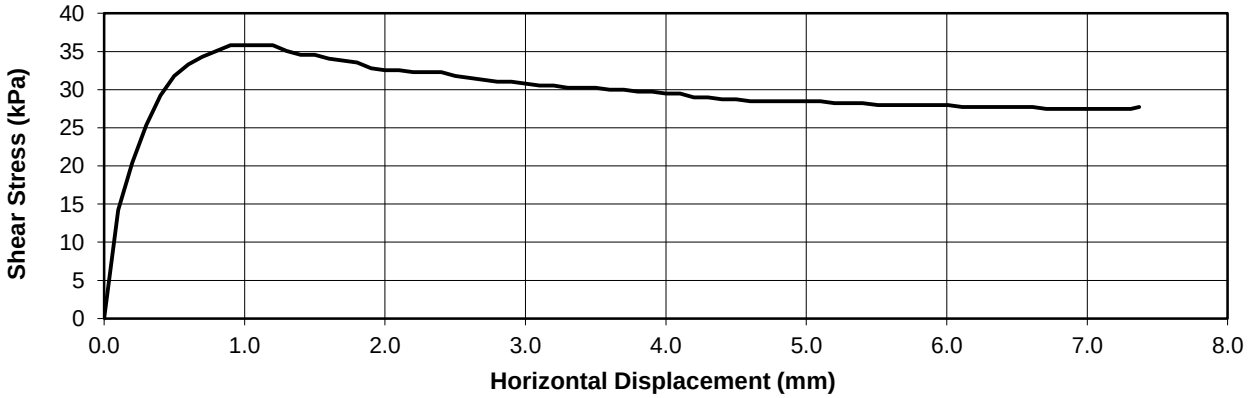
Height Change v Square Root Time



Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



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BS1377 : Part 7 : 1990 Clause 4

Determination of Shear Strength by Direct Shear

(small shearbox apparatus)

Borehole No:	RBH16
Sample No:	11
Depth (m):	16.55

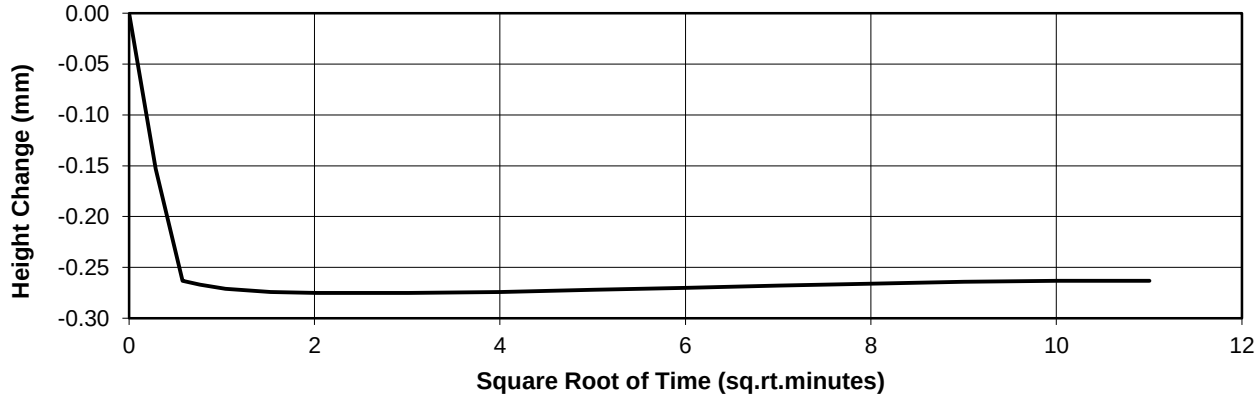
Description:

Reddish brown slightly micaceous slightly sandy CLAY. Sand is predominantly fine.

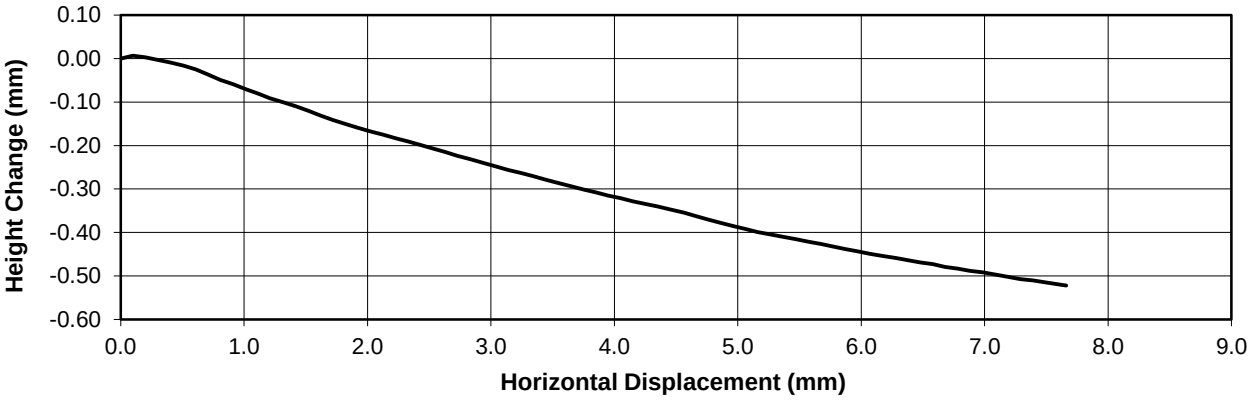
Specimen No 2

Normal Pressure = 100 kPa

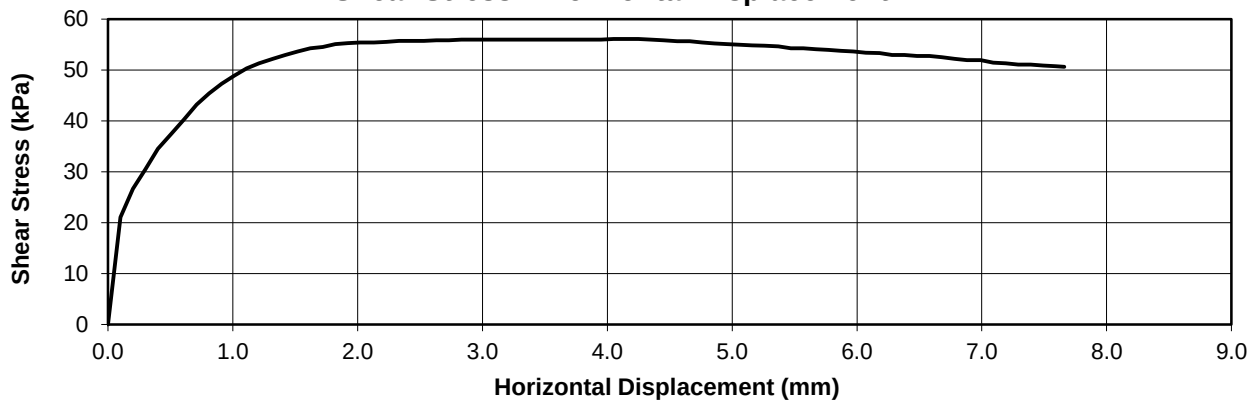
Height Change v Square Root Time



Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



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BS1377 : Part 7 : 1990 Clause 4

Determination of Shear Strength by Direct Shear

(small shearbox apparatus)

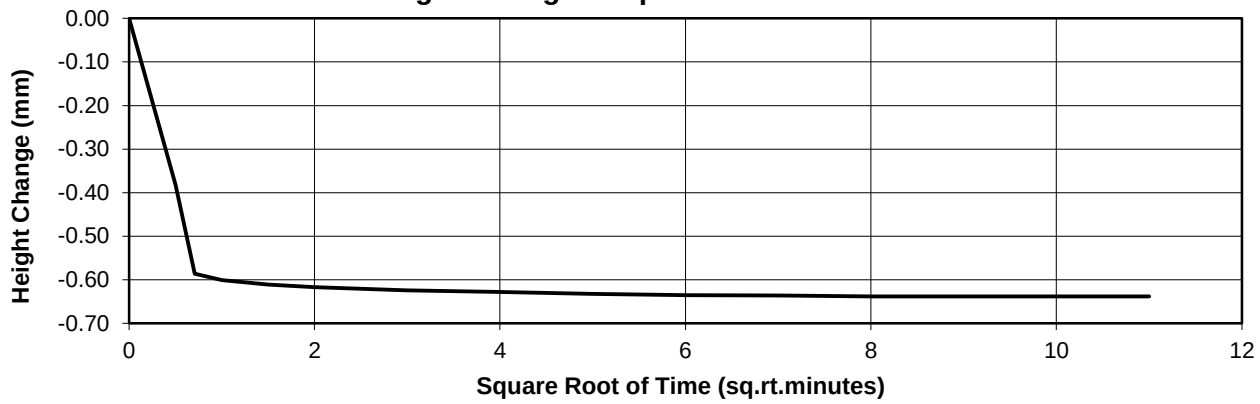
Borehole No:	RBH16
Sample No:	11
Depth (m):	16.55

Description:

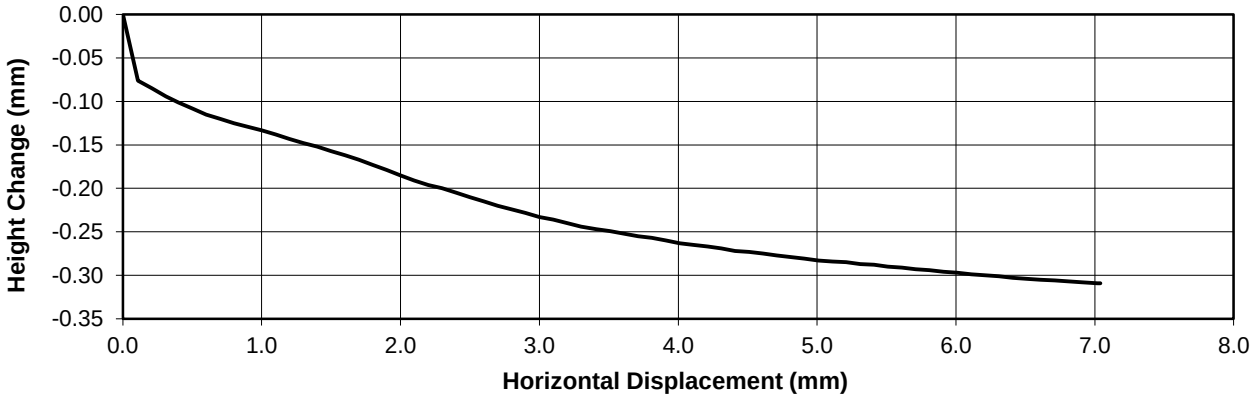
Reddish brown slightly micaceous slightly sandy CLAY. Sand is predominantly fine.

Specimen No 3 **Normal Pressure = 200 kPa**

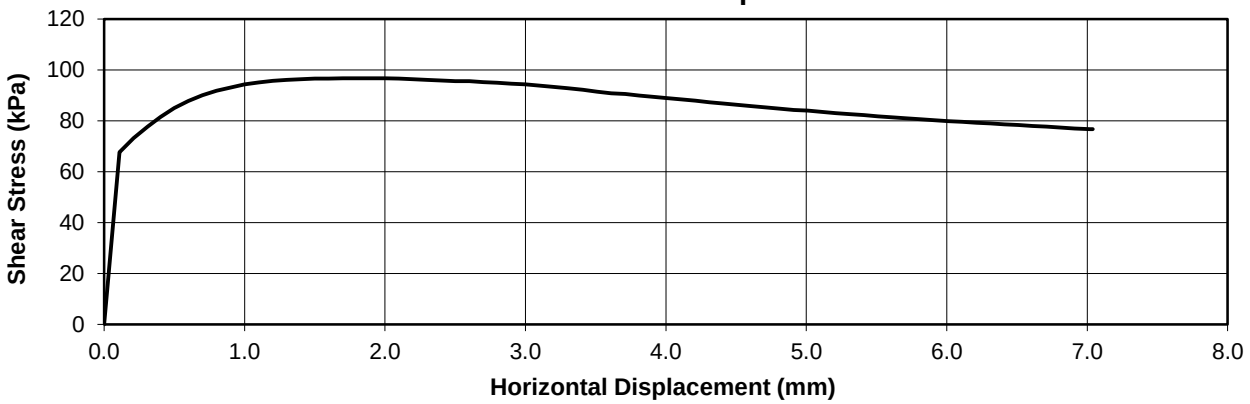
Height Change v Square Root Time



Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH18
Sample No:	14
Depth (m):	13.28

Description:

Weak to very weak orangish brown fine to medium-grained SANDSTONE. Moderately weathered. Intact rock with no pre-existing shear plane. Debris is sand and fine to medium gravel.

Specimen Details

Type of shear plane		Intact rock
Preparation		Rock core encapsulated in concrete avoiding shear plane then positioned in shearbox with shear plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	100.6
Maximum Width	*mm*	100.4
Area	*mm²*	7928.7

Shearing Stage

Normal stress	*kPa*	500	1000	2500
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1		
Maximum shear stress	*kPa*	928.2		
Horizontal displacement at MSS	*mm*	4.1		
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	459.9	741.3	1379.5
Final cumulative displacement	*mm*	15.3		
Duration	*day(s)*	1		

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**n/a**
Angle of Shearing Resistance	*degrees*	**n/a**
Residual Condition:		
Apparent Cohesion	*kPa*	**258**
Angle of Shearing Resistance	*degrees*	**24.5**

Notes:

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SRA

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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

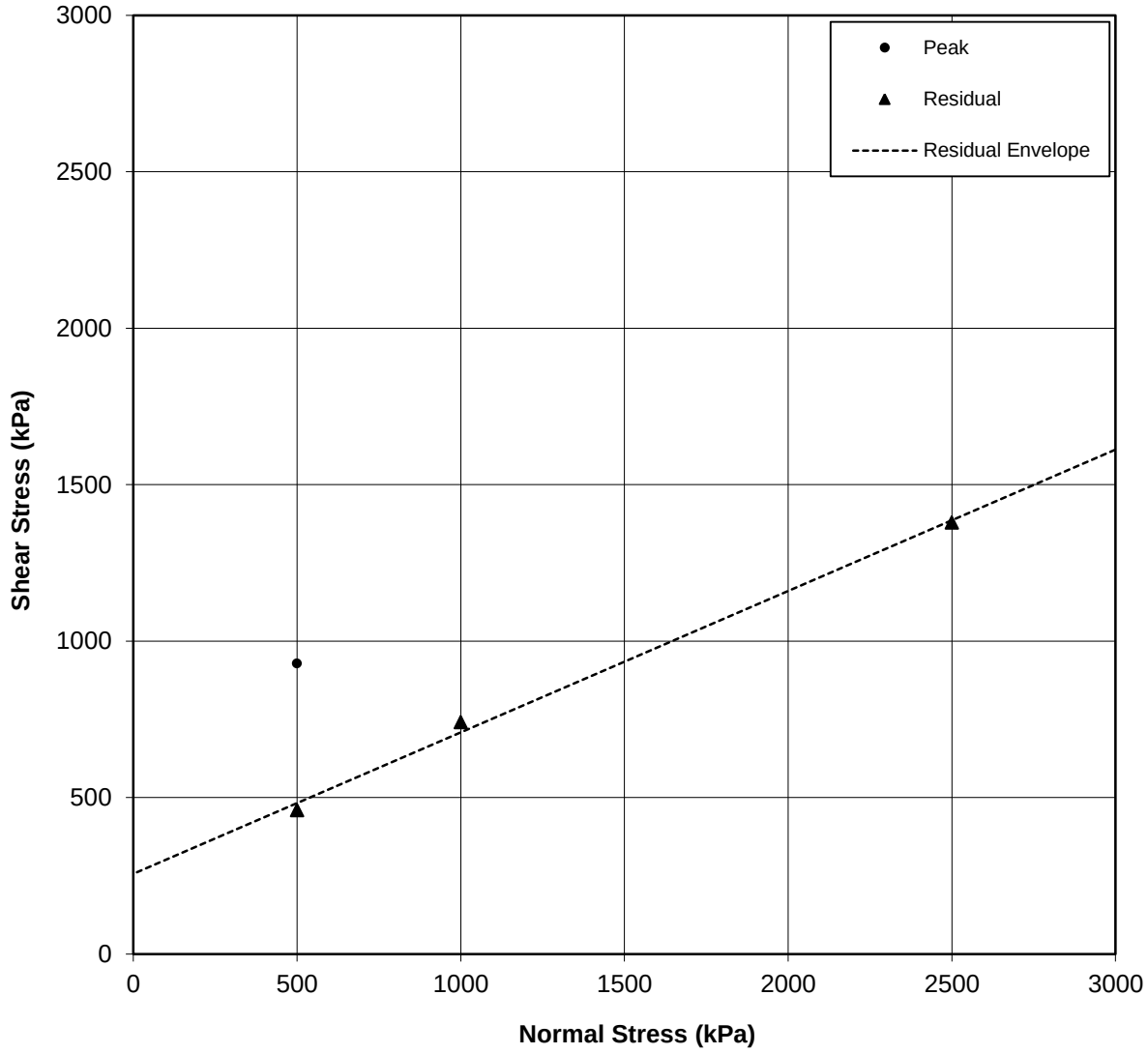
(large shearbox apparatus)

Borehole No:	RBH18
Sample No:	14
Depth (m):	13.28

Description:

Weak to very weak orangish brown fine to medium-grained SANDSTONE. Moderately weathered. Intact rock with no pre-existing shear plane. Debris is sand and fine to medium gravel.

Shear Stress v Normal Stress



Residual: c'r = 258

Φ' r= 24.5 °

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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

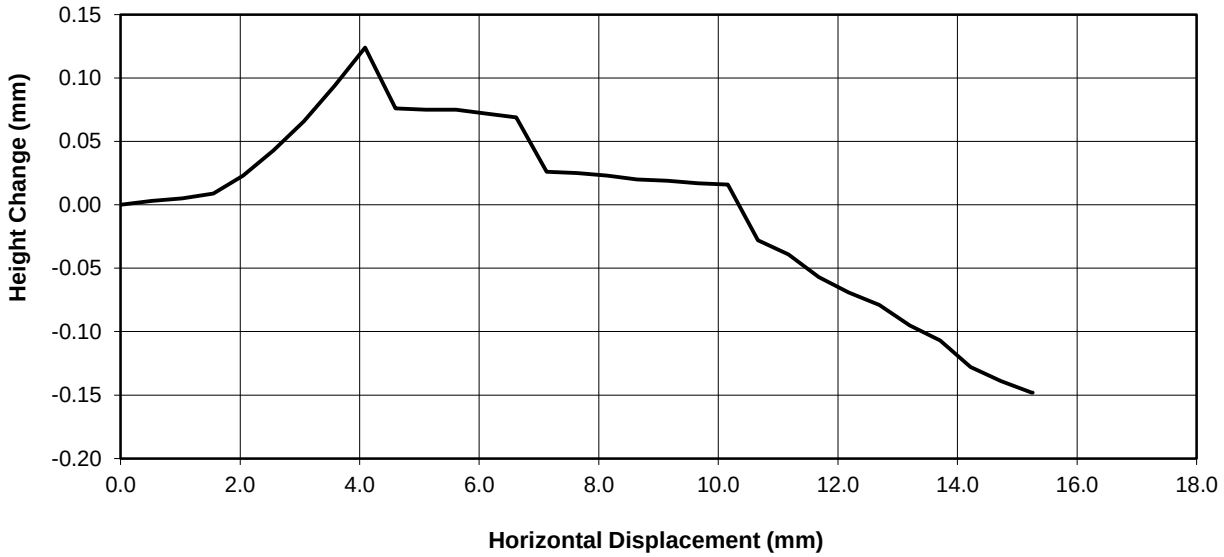
(large shearbox apparatus)

Borehole No:	RBH18
Sample No:	14
Depth (m):	13.28

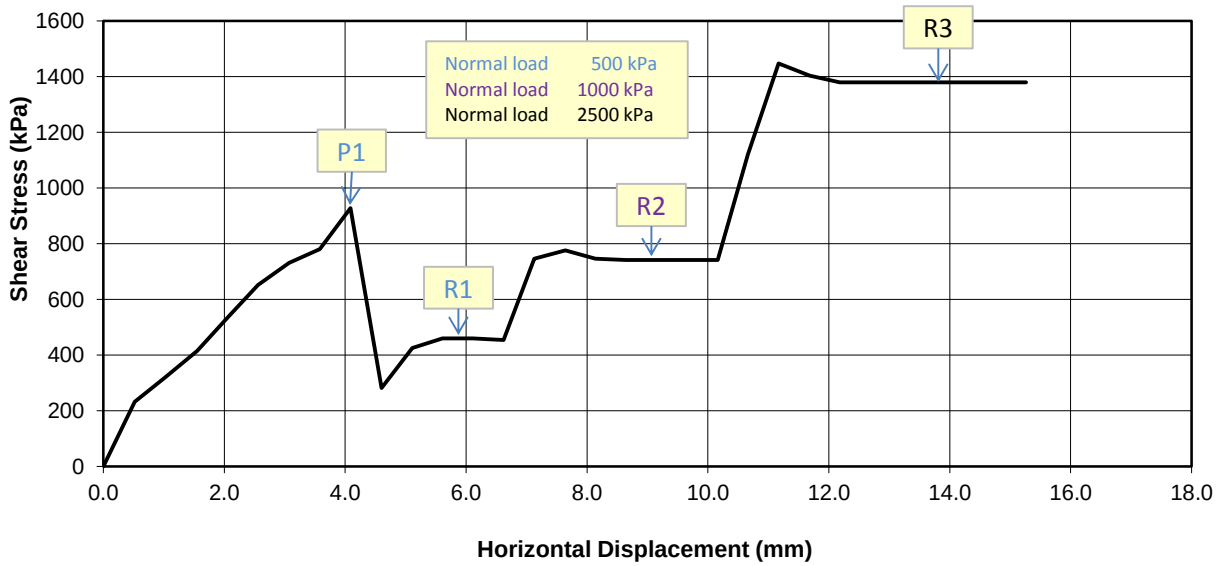
Description:

Weak to very weak orangish brown fine to medium-grained SANDSTONE. Moderately weathered. Intact rock with no pre-existing shear plane. Debris is sand and fine to medium gravel.

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

(large shearbox apparatus)

Borehole No:	RBH21
Sample No:	2
Depth (m):	14.90

Description:

Weak to very weak orangish brown fine to medium-grained SANDSTONE. Moderately weathered. Intact rock with no pre-existing shear plane. Debris is sand and fine to medium gravel.

Specimen Details

Type of shear plane		Intact rock
Preparation		Rock core encapsulated in concrete avoiding shear plane then positioned in shearbox with shear plane parallel to interface of top and bottom halves of shearbox.
Specimen Number		**1**
Maximum Length	*mm*	101.8
Maximum Width	*mm*	100.8
Area	*mm²*	8055.4

Shearing Stage

Normal stress	*kPa*	500	1000	2500
Peak Conditions:				
Rate of horizontal displacement	*mm/min*	0.1		
Maximum shear stress	*kPa*	962.0		
Horizontal displacement at MSS	*mm*	4.1		
Residual Conditions:				
Rate of horizontal displacement	*mm/min*	0.1	0.1	0.1
Residual shear stress	*kPa*	340.7	632.7	1029.7
Final cumulative displacement	*mm*	16.8		
Duration	*day(s)*	1		

Shear Strength Parameters

Maximum Condition:		
Apparent Cohesion	*kPa*	**n/a**
Angle of Shearing Resistance	*degrees*	**n/a**
Residual Condition:		
Apparent Cohesion	*kPa*	**233**
Angle of Shearing Resistance	*degrees*	**18.0**

Notes:

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S R Allen (Senior Tech)

Date: 27/02/2019

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Determination of Shear Strength by Direct Shear on Rock Sample

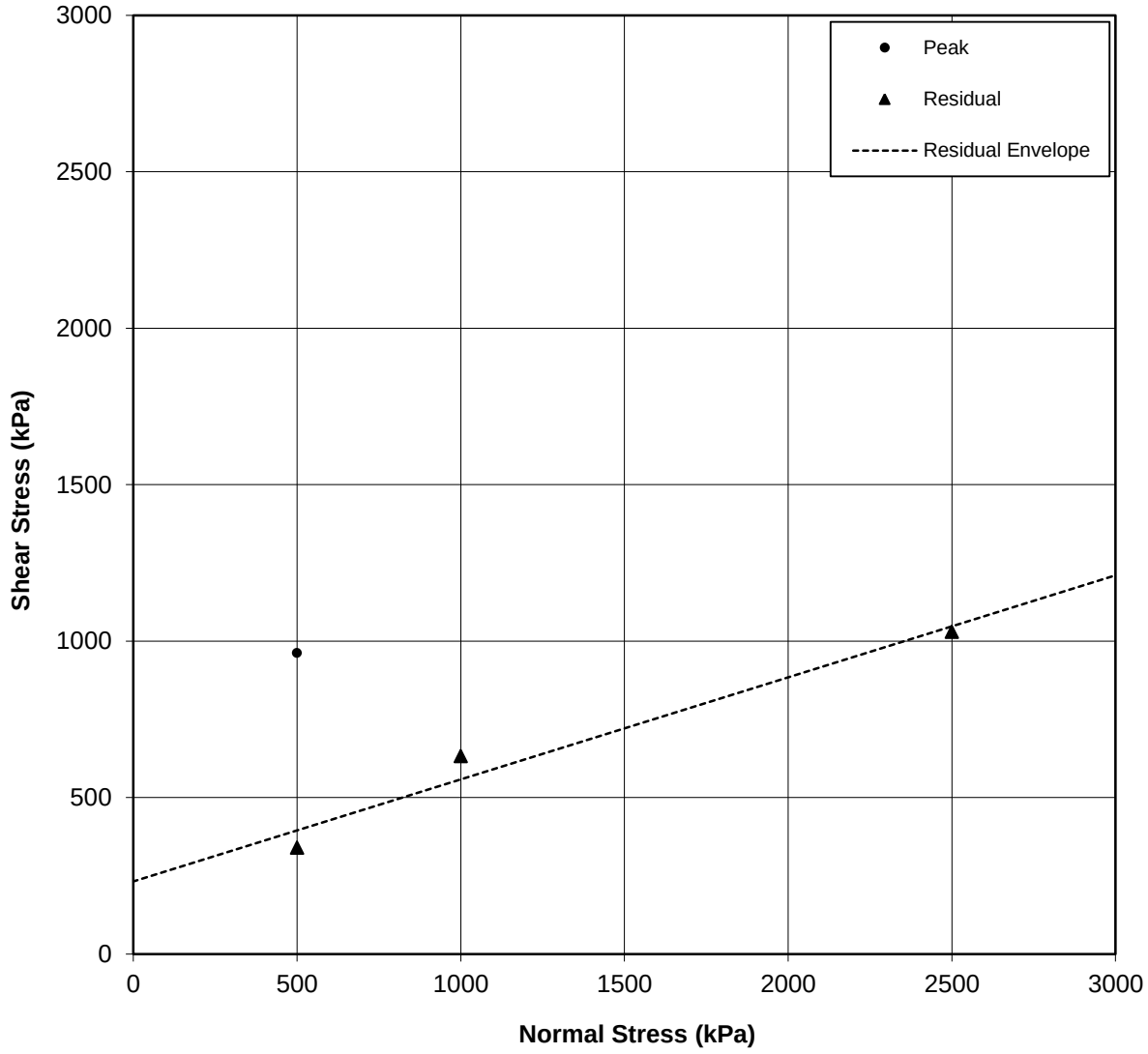
(large shearbox apparatus)

Borehole No:	RBH21
Sample No:	2
Depth (m):	14.90

Description:

Weak to very weak orangish brown fine to medium-grained SANDSTONE. Moderately weathered. Intact rock with no pre-existing shear plane. Debris is sand and fine to medium gravel.

Shear Stress v Normal Stress



Residual: c'r = 233

Φ' r= 18 °

Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 27/02/2019

Project Number:

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Project Name:

St John's Masterplan Ph2

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ISRM Suggested Method

Determination of Shear Strength by Direct Shear on Rock Sample

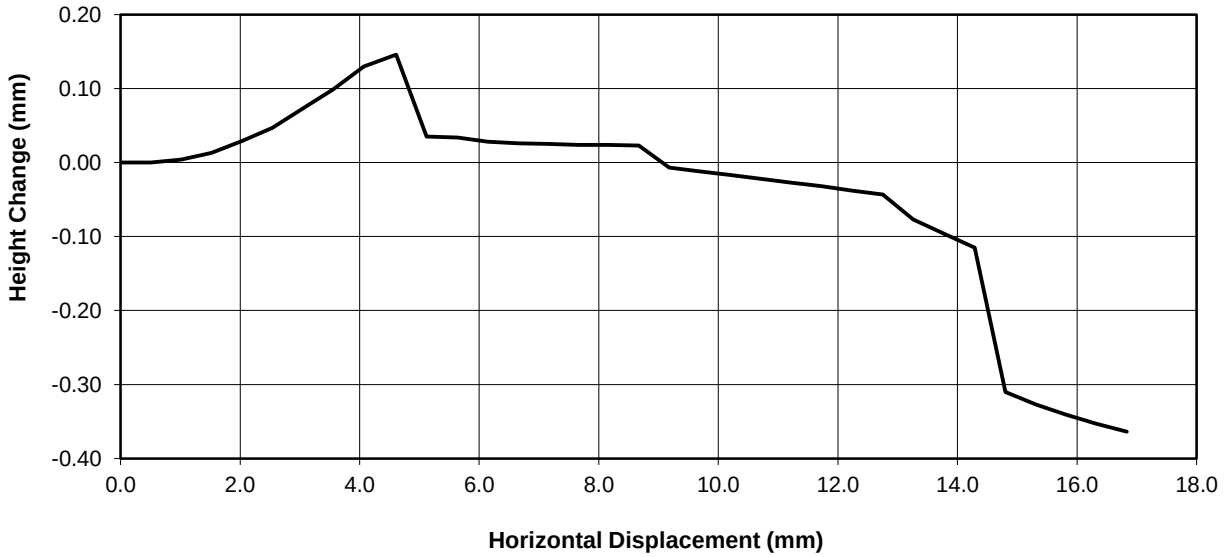
(large shearbox apparatus)

Borehole No:	RBH21
Sample No:	2
Depth (m):	14.90

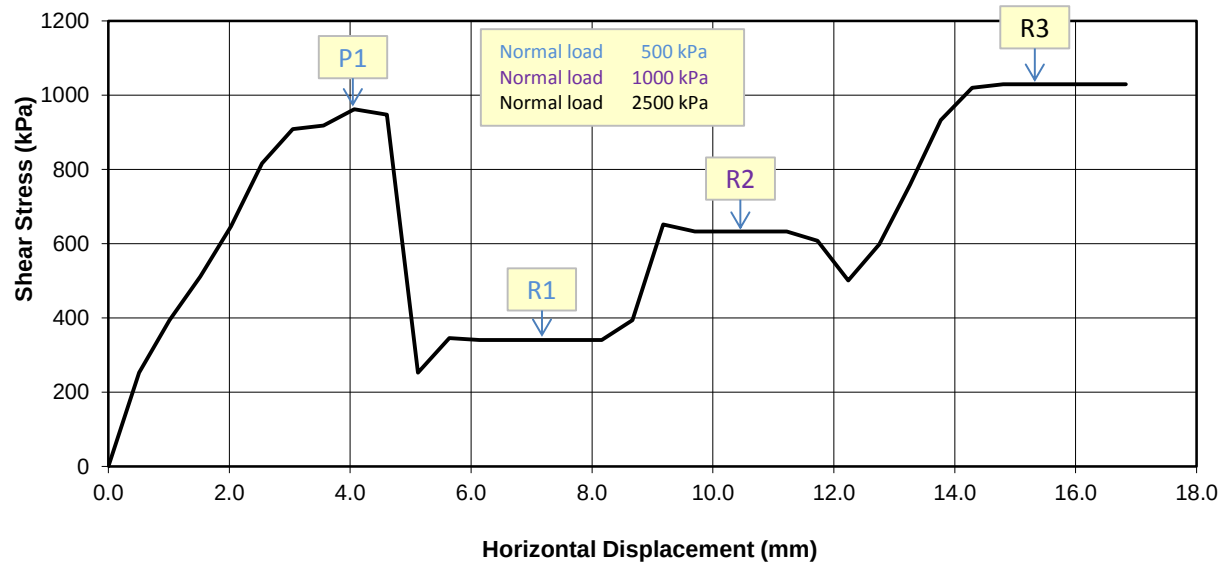
Description:

Weak to very weak orangish brown fine to medium-grained SANDSTONE. Moderately weathered. Intact rock with no pre-existing shear plane. Debris is sand and fine to medium gravel.

Height Change v Horizontal Displacement



Shear Stress v Horizontal Displacement



Checked and Approved by

SRA

S R Allen (Senior Tech)

Date: 27/02/2019

Project Number:

GEO / 28564

Project Name:

St John's Masterplan Ph2

Project Ref: 42269

GEOLABS®

ISRM Suggested Methods – Rock Characterization Testing and Monitoring 1974 - 2006

INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Sample details				Indirect Tensile Strength test (LF0879C (1000kN) compression frame used)											
Borehole Ref.	Sample Ref.	Depth (m)	Description	D. Tested	Sample Diameter (mm)	Sample Width (mm)	Degree of Saturation (%)	Water Content (%)	Specific Gravity* (Mg/m³)	Stress Rate (N/s)	Test Duration (min:sec)	Failure Sketch	Failure Load (kN)	Tensile Strength (MPa)	Remarks
RBH21	-	16.80-17.02	Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered	30/01/19	101.30	51.50	85.8	12.2	2.70 (a)	200	00:11		2.10	0.256	
RBH15	-	17.58-17.80	Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered	30/01/19	100.30	50.60	91.5	10.9	2.70 (a)	200	00:09		1.80	0.226	
RBH16	-	15.22	Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered	30/01/19	101.60	50.60	92.5	11.2	2.70 (a)	200	00:10		1.90	0.235	
RBH18	-	12.85-13.00	Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered	30/01/19	101.40	50.50	86.1	12.6	2.70 (a)	200	00:18		3.50	0.435	

* Specific Gravity: (a) assumed or (m) measured/supplied by client.

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 04/02/2019

Project Number:

GEO / 28564

Project Name:

ST JOHN'S MASTERPLAN PH2

42269

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ISRM Suggested Methods – Rock Characterization Testing and Monitoring 1974 - 2006

INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	RBH21
Sample Ref.:	
Depth (m):	16.80-17.02

Description:
Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered

Sample Details

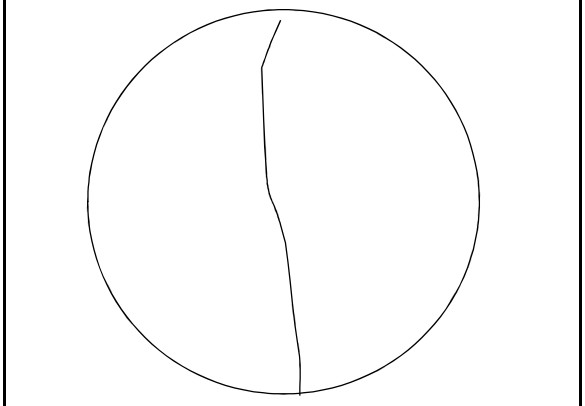
Diameter	101.30 mm
Thickness	51.50 mm
Thickness / Diameter Ratio	0.51
Bulk Density	2.19 Mg/m³
Dry Density	1.95 Mg/m³
Water Content	12.2 %
Specific Gravity (Assumed)	2.70 Mg/m³
Degree of Saturation	85.8 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:11 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Axial Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 30/01/2019

Failure Load
2.10 kN

Tensile Strength
0.256 MPa

Sample type: C

Remarks:

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are all met.

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 04/02/2019

Project Number:

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INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	RBH15
Sample Ref.:	
Depth (m):	17.58-17.80

Description:
Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered

Sample Details

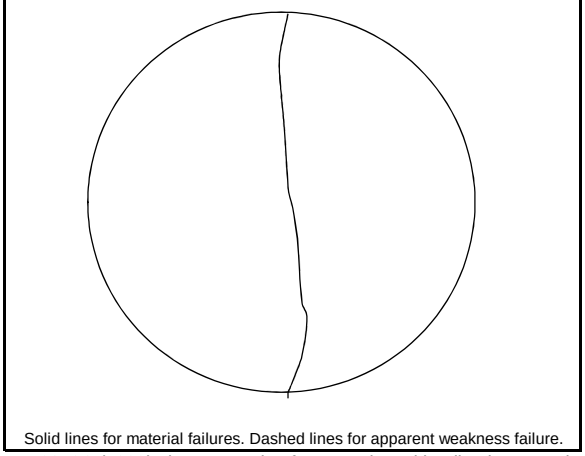
Diameter	100.30 mm
Thickness	50.60 mm
Thickness / Diameter Ratio	0.50
Bulk Density	2.26 Mg/m³
Dry Density	2.04 Mg/m³
Water Content	10.9 %
Specific Gravity (Assumed)	2.70 Mg/m³
Degree of Saturation	91.5 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:09 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Axial Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 30/01/2019

Failure Load
1.80 kN

Tensile Strength
0.226 MPa

Sample type: C

Remarks:

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are all met.

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 04/02/2019

Project Number:

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Project Name:

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INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	RBH16
Sample Ref.:	
Depth (m):	15.22

Description:
Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered

Sample Details

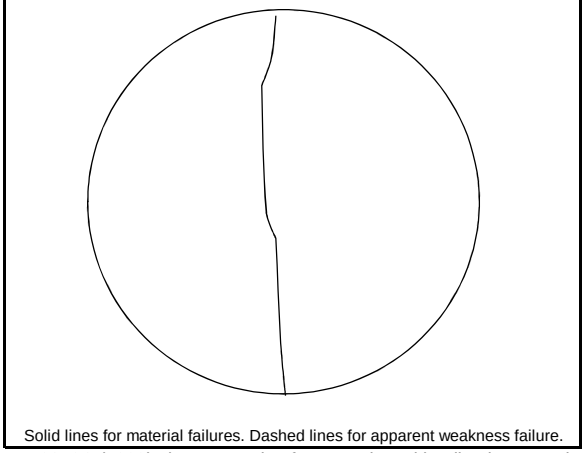
Diameter	101.60 mm
Thickness	50.60 mm
Thickness / Diameter Ratio	0.50
Bulk Density	2.26 Mg/m³
Dry Density	2.03 Mg/m³
Water Content	11.2 %
Specific Gravity (Assumed)	2.70 Mg/m³
Degree of Saturation	92.5 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:10 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Axial Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 30/01/2019

Failure Load
1.90 kN

Tensile Strength
0.235 MPa

Sample type: C

Remarks:

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are all met.

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 04/02/2019

Project Number:

GEO / 28564

Project Name:

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ISRM Suggested Methods – Rock Characterization Testing and Monitoring 1974 - 2006

INDIRECT TENSILE STRENGTH BY THE BRAZIL TEST

Borehole Ref.:	RBH18
Sample Ref.:	
Depth (m):	12.85-13.00

Description:
Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered

Sample Details

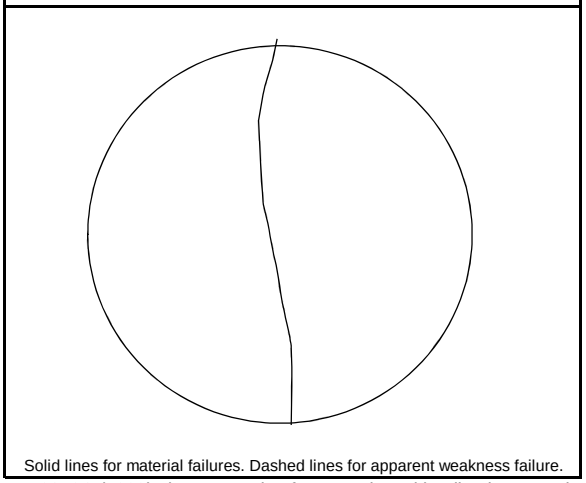
Diameter	101.40 mm
Thickness	50.50 mm
Thickness / Diameter Ratio	0.50
Bulk Density	2.18 Mg/m³
Dry Density	1.94 Mg/m³
Water Content	12.6 %
Specific Gravity (Assumed)	2.70 Mg/m³
Degree of Saturation	86.1 %

Test Results

Stress Rate	0.20 kN/s
Test Duration	00:18 min:sec
Angle of loading with respect to anisotropy	90 º

Failure Sketch

Mode of failure: Axial Split



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

LF0879C (1000kN) compression frame and steel loading jaws used

Date tested: 30/01/2019

Failure Load
3.50 kN

Tensile Strength
0.435 MPa

Sample type: C

Remarks:

Note: The dimensional requirements of Flatness (<0.25 mm), Perpendicularity (to within 0.25º) and irregularities across thickness (< 0.025 mm) are all met.

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 04/02/2019

Project Number:

GEO / 28564

Project Name:

ST JOHN'S MASTERPLAN PH2

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UKAS TESTING 1982

ISRM Suggested Methods – Rock Characterization Testing and Monitoring 1974 - 2006

SOUND VELOCITY TEST

Sample details										Travel Time		Sound velocity	
Borehole Ref.	Sample Ref.	Depth (m)	Description	D. Tested	Sample Diameter (mm)	Sample Length (mm)	Bulk Density (Mg/m³)	Water Content (%)	Compression wave (µs)	Shear wave (µs)	Compression V_p (m/s)	Shear V_s (m/s)
RBH21	-	14.30-14.55	Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered	30/01/19	101.20	77.20	2.23	-	37.5	69.6	2059	1109
RBH15	-	16.60-16.80	Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered	30/01/19	101.50	203.50	2.32	-	94.6	175.4	2151	1160
RBH18	-	16.25-16.50	Weak to very weak, thinly laminated, brown fine to medium grained SANDSTONE. Moderately weathered	30/01/19	102.10	85.40	2.23	-	39.8	70.6	2146	1210

Equipment used: Proceq Pundit Lab+ Ultrasonic Testing Instrument fitted with 150 kHz transducers for the P wave determinations and 250 kHz transducers for the S wave determinations.

Checked and Approved by

CC

C Clergeaud (Snr. Geologist)

Date: 04/02/2019

Project Number:

GEO / 28564

Project Name:

ST JOHN'S MASTERPLAN PH2

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Appendix E – Ground Gas and Groundwater Monitoring Results

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IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Gas and Groundwater Monitoring Results

Contract Number:	*42206*	**Gas Monitor:**	*GA10157*
Contract Name:	*St John's Masterplan*	**Readings Taken By:**	*PN*
Date:	*26th July 2018*	**Checked By:**	*TW*

Background Readings:					
Weather Conditions:	*Sunny, 25°*	O_2% v/v	CO_2% v/v	CH_4% v/v	CO ppm	H_2S ppm
Ground Conditions (dry / wet etc):	*Dry*					
Atmospheric Pressure (Start):	*1011mb*	*20.9*	*0.0*	*0.0*	*0*	*0*
Atmospheric Pressure (Finish):	*1011mb*					
Time (Start): 07:15 Time (Finish):	14:30					

Hole No:	VOC ppm	O_2% v/v	CO_2% v/v	CH_4% v/v		CO ppm	H_2S ppm	Rel Pressure (mb)	Gas flow Rate (l/hr)	Depth to base of well	SWL	LNAPL or DNAPL
	Steady	Steady	Steady	Peak	Steady	Steady	Steady	Steady	Steady	mBGL	mBGL	mBGL
BH02	*0.0*	*19.9*	*0.1*	*0.0*	*0.0*	*0*	*0*	*1.62*	*0.0*	*19.81*	*4.25*	*ND*
BH03	*0.0*	*18.6*	*0.9*	*0.0*	*0.0*	*0*	*0*	*0.97*	*0.0*	*9.48*	*3.92*	*ND*
BH04B	*0.0*	*20.6*	*0.2*	*0.0*	*0.0*	*0*	*0*	*0.67*	*0.0*	*19.66*	*3.12*	*ND*
RBH02	*0.0*	*20.4*	*0.1*	*0.0*	*0.0*	*0*	*0*	*7.63*	*See remarks*	*18.62*	*3.41*	*ND*
RBH04	*0.0*	*18.2*	*1.2*	*0.0*	*0.0*	*0*	*0*	*1.07*	*-0.1*	*6.23*	*4.44*	*ND*
RBH06	*0.0*	*19.7*	*0.2*	*0.0*	*0.0*	*0*	*0*	*0.96*	*0.0*	*10.25*	*3.90*	*ND*
WS04	*0.0*	*12.2*	*4.5*	*0.0*	*0.0*	*0*	*0*	*0.09*	*0.0*	*2.85*	*Dry*	*ND*
WS05	*0.0*	*16.2*	*3.4*	*0.0*	*0.0*	*0*	*0*	*0.06*	*0.0*	*3.03*	*Dry*	*ND*
WS06	*0.0*	*19.7*	*1.6*	*0.0*	*0.0*	*0*	*0*	*0.41*	*0.0*	*3.03*	*Dry*	*ND*
BH03 (Hist)	*0.0*	*18.6*	*1.5*	*0.0*	*0.0*	*0*	*0*	*-0.18*	*0.0*	*21.80*	*3.45*	*ND*
WS10	*Unable to locate*											

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

Remarks:	RBH02 Flow - Initial = -7.0 per hour After 5 minutes flow fluctuating between -1.2 per hour and -2.3 per hour. No access to WS11, WS08 and RBH03 due to on site demolition

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Gas and Groundwater Monitoring Results

Contract Number:	*42206*	**Gas Monitor:**	*GA2000*
Contract Name:	*St John's Masterplan*	**Readings Taken By:**	*PN*
Date:	*9th August 2018*	**Checked By:**	*HH*

Background Readings:			O_2% v/v	CO_2% v/v	CH_4% v/v	CO ppm	H_2S ppm
	Weather Conditions:	*Sunny, 20°*					
	Ground Conditions (dry / wet etc):	*Dry*					
	Atmospheric Pressure (Start):	*1011mb*	*20.8*	*0.0*	*0.0*	*0*	*0*
	Atmospheric Pressure (Finish):	*1010mb*					
	Time (Start): 08:15 Time (Finish):	13:00					

Hole No:	VOC ppm	O_2% v/v	CO_2% v/v	CH_4% v/v		CO ppm	H_2S ppm	Rel Pressure (mb)	Gas flow Rate (l/hr)	Depth to base of well	SWL	LNAPL or DNAPL
	Steady	Steady	Steady	Peak	Steady	Steady	Steady	Steady	Steady	mBGL	mBGL	mBGL
BH02	*0.0*	*14.4*	*1.5*	*0.0*	*0.0*	*0*	*0*	*0.31*	*0.0*	*19.78*	*4.26*	*ND*
BH03	*0.0*	*18.1*	*0.8*	*0.0*	*0.0*	*0*	*0*	*0.41*	*0.0*	*9.47*	*3.93*	*ND*
BH04B	*0.0*	*20.5*	*0.2*	*0.0*	*0.0*	*0*	*0*	*0.18*	*0.0*	*19.64*	*3.14*	*ND*
RBH02	*0.0*	*19.0*	*0.1*	*0.0*	*0.0*	*0*	*0*	*4.17*	*-1.4*	*18.51*	*3.63*	*ND*
RBH04	*0.0*	*17.0*	*1.7*	*0.0*	*0.0*	*0*	*0*	*0.20*	*0.0*	*10.31*	*4.19*	*ND*
RBH06	*Unable to access due to demolition in progress*											
WS04	*0.0*	*12.3*	*4.9*	*0.0*	*0.0*	*0*	*0*	*-0.11*	*0.0*	*2.85*	*Dry*	*NA*
WS05	*0.0*	*16.0*	*3.4*	*0.0*	*0.0*	*0*	*0*	*-0.29*	*0.0*	*3.03*	*Dry*	*NA*
WS06	*0.0*	*19.0*	*1.8*	*0.0*	*0.0*	*0*	*0*	*0.31*	*0.0*	*3.03*	*Dry*	*NA*
WS08	*0.0*	*20.8*	*0.4*	*0.0*	*0.0*	*0*	*0*	*0.22*	*0.0*	*3.05*	*Dry*	*NA*
BH03 (Hist)	*0.0*	*18.5*	*1.4*	*0.0*	*0.0*	*0*	*0*	*0.36*	*0.0*	*21.80*	*3.45*	*ND*

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

Remarks: WS11 & RBH03 within demolition area- no access.

Unable to locate WS10

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Gas and Groundwater Monitoring Results

Contract Number:	*42206*	**Gas Monitor:**	*GA10157*
Contract Name:	*St John's Masterplan*	**Readings Taken By:**	*PN*
Date:	*23rd August 2018*	**Checked By:**	*HH*

Background Readings:		O_2% v/v	CO_2% v/v	CH_4% v/v	CO ppm	H_2S ppm
	Weather Conditions: *Overcast, 16°*					
	Ground Conditions (dry / wet etc): *Wet*					
	Atmospheric Pressure (Start): *1009mb*	*20.8*	*0.0*	*0.0*	*0*	*0*
	Atmospheric Pressure (Finish): *1009mb*					
	Time (Start): 08:10 Time (Finish): 13:00					

Hole No:	VOC ppm	O_2% v/v	CO_2% v/v	CH_4% v/v		CO ppm	H_2S ppm	Rel Pressure (mb)	Gas flow Rate (l/hr)	Depth to base of well	SWL	LNAPL or DNAPL
	Steady	Steady	Steady	Peak	Steady	Steady	Steady	Steady	Steady	mBGL	mBGL	mBGL
BH02	*0.0*	*2.5*	*4.0*	*0.0*	*0.0*	*0*	*0*	*0.27*	*0.0*	*19.76*	*4.26*	*ND*
BH03	*0.0*	*18.7*	*0.9*	*0.0*	*0.0*	*0*	*0*	*0.39*	*0.0*	*9.47*	*1.97*	*ND*
BH04B	*0.0*	*20.6*	*0.2*	*0.0*	*0.0*	*0*	*0*	*0.44*	*0.0*	*19.64*	*3.18*	*ND*
RBH02	*0.0*	*19.8*	*0.2*	*0.0*	*0.0*	*0*	*0*	*0.65*	*1.0*	*18.37*	*3.38*	*ND*
RBH04	*0.0*	*19.5*	*0.6*	*0.0*	*0.0*	*0*	*0*	*1.15*	*-0.1*	*10.31*	*4.06*	*ND*
*RBH05**	*0.0*	*20.9*	*0.3*	*0.0*	*0.0*	*0*	*0*	*-1.15*	*0.3*	*19.75*	*4.18*	*ND*
RBH06	*Unable to access due to demolition in progress*											
WS04	*0.0*	*13.0*	*5.2*	*0.0*	*0.0*	*0*	*0*	*-0.33*	*0.0*	*2.85*	*Dry*	*NA*
WS05	*0.0*	*16.1*	*3.3*	*0.0*	*0.0*	*0*	*0*	*-0.35*	*0.0*	*3.03*	*Dry*	*NA*
WS06	*0.0*	*19.1*	*1.1*	*0.0*	*0.0*	*0*	*0*	*0.22*	*0.0*	*3.03*	*Dry*	*NA*
WS08	*0.0*	*17.0*	*0.2*	*0.0*	*0.0*	*0*	*0*	*0.40*	*0.0*	*3.05*	*Dry*	*NA*
BH03 (Hist)	*0.0*	*19.1*	*1.3*	*0.0*	*0.0*	*0*	*0*	*0.41*	*0.0*	*21.80*	*3.44*	*ND*

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

Remarks: *RBH05 Initial flow = 16.1 1/h Steady after 5 minutes. WS11 & RBH03 within demolition area- no access.
Unable to locate WS10

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Gas and Groundwater Monitoring Results

Contract Number:	*42206*	**Gas Monitor:**	*G5000*
Contract Name:	*St John's Masterplan*	**Readings Taken By:**	*M Lysuawa*
Date:	*13th September2018*	**Checked By:**	

Background Readings:		O_2% v/v	CO_2% v/v	CH_4% v/v	CO ppm	H_2S ppm
Weather Conditions:	*Overcast*					
Ground Conditions (dry / wet etc):	*Dry*					
Atmospheric Pressure (Start):	*1018Mb*	*20.9*	*0.0*	*0.0*	*0*	*0*
Atmospheric Pressure (Finish):	*1019Mb*					
Time (Start): 11:00	Time (Finish): 15:00					

Hole No:	VOC ppm	O_2% v/v	CO_2% v/v	CH_4% v/v		CO ppm	H_2S ppm	Rel Pressure (mb)	Gas flow Rate (l/hr)	Depth to base of well	SWL	LNAPL or DNAPL
	Steady	Steady	Steady	Peak	Steady	Steady	Steady	Steady	Steady	mBGL	mBGL	mBGL
BH02	*0.0*	*3.2*	*3.9*	*0.0*	*0.0*	*0*	*0*	*-0.18*	*0.0*	*19.74*	*4.08*	*0.00*
BH03	*0.0*	*20.1*	*0.4*	*0.0*	*0.0*	*0*	*0*	*0.00*	*0.0*	*9.45*	*2.24*	*0.00*
BH04B	*0.0*	*20.7*	*0.0*	*0.0*	*0.0*	*0*	*0*	*-0.04*	*0.0*	*19.63*	*7.74*	*0.00*
RBH02	*0.0*	*20.2*	*0.2*	*0.0*	*0.0*	*0*	*0*	*0.05*	*0.0*	*17.94*	*3.12*	*0.00*
RBH04	*0.0*	*20.6*	*0.1*	*0.0*	*0.0*	*0*	*0*	*0.08*	*0.0*	*10.50*	*7.28*	*0.00*
RBH05	*0.0*	*19.8*	*0.2*	*0.0*	*0.0*	*0*	*0*	*-0.06*	*0.0*	*19.73*	*4.02*	*0.00*
WS04	*0.0*	*20.5*	*0.2*	*0.0*	*0.0*	*0*	*0*	*0.00*	*0.0*	*2.82*	*Dry*	*0.00*
WS05	*0.0*	*19.4*	*1.3*	*0.0*	*0.0*	*0*	*0*	*0.08*	*0.0*	*2.95*	*Dry*	*0.00*
WS06	*0.0*	*19.9*	*1.0*	*0.0*	*0.0*	*0*	*0*	*0.05*	*0.0*	*3.02*	*Dry*	*0.00*
WS08	*0.0*	*18.9*	*0.2*	*0.0*	*0.0*	*0*	*0*	*0.00*	*0.0*	*3.02*	*Dry*	*0.00*
BH03 (Hist)	*unable to locate*											

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

Remarks: WS10, RBH06, RBH03, WS11 Buried.

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Geotechnical & Environmental Specialists

Gas and Groundwater Monitoring Results

Contract Number:	*42206*	**Gas Monitor:**	*GA10157*
Contract Name:	*St John's Masterplan*	**Readings Taken By:**	*ML*
Date:	*1st Ocotber 2018*	**Checked By:**	*HH*

Background Readings:					
Weather Conditions:	*Sunny*	O_2% v/v	CO_2% v/v	CH_4% v/v	CO ppm	H_2S ppm
Ground Conditions (dry / wet etc):	*Dry*					
Atmospheric Pressure (Start):	*1023mb*	*20.9*	*0.0*	*0.0*	*0*	*0*
Atmospheric Pressure (Finish):	*1026mb*					
Time (Start): 09:00 Time (Finish):	13:00					

Hole No:	VOC ppm	O_2% v/v	CO_2% v/v	CH_4% v/v		CO ppm	H_2S ppm	Rel Pressure (mb)	Gas flow Rate (l/hr)	Depth to base of well	SWL	LNAPL or DNAPL
	Steady	Steady	Steady	Peak	Steady	Steady	Steady	Steady	Steady	mBGL	mBGL	mBGL
BH02	*0.9*	*1.5*	*4.1*	*0.0*	*0.0*	*0*	*0*	*0.00*	*-0.1*	*19.74*	*4.16*	*NR*
BH03	*unable to locate*											
BH04B	*0.0*	*20.7*	*0.0*	*0.0*	*0.0*	*0*	*0*	*0.00*	*0.0*	*18.84*	*3.13*	*NR*
RBH02	*4.2*	*20.5*	*0.3*	*0.0*	*0.0*	*0*	*0*	*-0.40*	*-0.2*	*17.72*	*3.04*	*NR*
RBH04	*0.2*	*15.4*	*2.1*	*0.0*	*0.0*	*0*	*0*	*0.00*	*0.0*	*8.27*	*3.72*	*NR*
RBH06	*unable to locate*											
WS04	*0.1*	*14.2*	*4.9*	*0.0*	*0.0*	*0*	*0*	*-0.11*	*0.0*	*2.78*	*Dry*	*NA*
WS05	*unable to locate*											
WS06	*0.0*	*20.7*	*0.1*	*0.0*	*0.0*	*0*	*0*	*0.00*	*0.1*	*3.04*	*2.92*	*NR*
WS08	*0.0*	*20.5*	*0.3*	*0.0*	*0.0*	*0*	*0*	*0.00*	*-0.1*	*3.04*	*Dry*	NA
WS10	*1.0*	*13.6*	*7.1*	*0.0*	*0.0*	*0*	*0*	*0.10*	*0.0*	*4.40*	*4.26*	*NR*

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

Remarks: BH03, WS05, RBH06, RBH03, WS11 Buried.

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Gas and Groundwater Monitoring Results

Contract Number:	*42206*	**Gas Monitor:**	*GA10157*
Contract Name:	*St John's Masterplan*	**Readings Taken By:**	*ML*
Date:	*16th October 2018*	**Checked By:**	*HH*

Background Readings:			O_2% v/v	CO_2% v/v	CH_4% v/v	CO ppm	H_2S ppm
	Weather Conditions:	*Overcast*					
	Ground Conditions (dry / wet etc):	*Dry*					
	Atmospheric Pressure (Start):	*1010mb*	*20.9*	*0.0*	*0.0*	*0*	*0*
	Atmospheric Pressure (Finish):	*1011mb*					
	Time (Start): 8:00 Time (Finish):	10:00					

Hole No:	VOC ppm	O_2% v/v	CO_2% v/v	CH_4% v/v		CO ppm	H_2S ppm	Rel Pressure (mb)	Gas flow Rate (l/hr)	Depth to base of well	SWL	LNAPL or DNAPL
	Steady	Steady	Steady	Peak	Steady	Steady	Steady	Steady	Steady	mBGL	mBGL	mBGL
BH02	*0.4*	*1.4*	*4.2*	*0.0*	*0.0*	*1*	*0*	*0.08*	*0.0*	*19.74*	*4.14*	*ND*
BH03	*Buried under demolition rubble*											
BH04B	*0.0*	*20.7*	*0.1*	*0.0*	*0.0*	*0*	*0*	*0.08*	*0.0*	*16.40*	*3.14*	*ND*
RBH02	*Buried under demolition rubble*											
RBH04	*0.0*	*20.7*	*0.1*	*0.0*	*0.0*	*0*	*0*	*-0.05*	*0.0*	*3.05*	*Dry*	*NR*
RBH05	*6.0*	*17.2*	*0.7*	*0.0*	*0.0*	*2*	*0*	*0.11*	*0.1*	*19.71*	*3.96*	*ND*
WS04	*0.0*	*14.7*	*5.0*	*0.0*	*0.0*	*0*	*0*	*0.00*	*0.1*	*2.83*	*Dry*	*NR*
WS05	*Buried under demolition rubble*											
WS06	*Buried under demolition rubble*											
WS08	*0.0*	*14.3*	*0.4*	*0.0*	*0.0*	*0*	*0*	*0.00*	*0.0*	*3.07*	*2.91*	*ND*
WS10	*Buried under demolition rubble*											

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

Remarks: RBH03, RBH06 and WS11 Buried.

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Gas and Groundwater Monitoring Results

Contract Number:	*42269*	**Gas Monitor:**	*GA5000*
Contract Name:	*St Johns Phase 2*	**Readings Taken By:**	*IB*
Date:	*14th November 2018*	**Checked By:**	*HH*

Background Readings:					
Weather Conditions:	*Cloudy*	O_2% v/v	CO_2% v/v	CH_4% v/v	CO ppm	H_2S ppm
Ground Conditions (dry / wet etc):	*Damp*					
Atmospheric Pressure (Start):	*1015mb*	*20.9*	*0.1*	*0.0*	*0.0*	
Atmospheric Pressure (Finish):						
Time (Start):12:10 Time (Finish):						

Hole No:	VOC ppm	O_2% v/v	CO_2% v/v	CH_4% v/v		CO ppm	H_2S ppm	Rel Pressure (mb)	Gas flow Rate (l/hr)	Depth to base of well	SWL	LNAPL or DNAPL
	Steady	Steady	Steady	Peak	Steady	Steady	Steady	Steady	Steady	mBGL	mBGL	mBGL
BH06	*0.7*	*20.9*	*0.1*	*0.0*	*0.0*	*0*	*0*	*0.02*	*0.0*	*7.08*	*3.40*	*ND*
RBH09	*Unable to locate RBH09.*											
RBH14	*1.1*	*19.0*	*0.2*	*0.0*	*0.0*	*20*	*0*	*0.00*	*-0.1*	*14.86*	*3.67*	*ND*
RBH18A	*3.4*	*20.8*	*0.1*	*0.0*	*0.0*	*1*	*0*	*0.00*	*0.1*	*12.33*	*3.28*	*ND*
RBH22	*5.1*	*16.4*	*3.2*	*0.0*	*0.0*	*0*	*0*	*0.00*	*0.1*	*7.29*	*3.91*	*ND*

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

Remarks:

IAN FARMER ASSOCIATES
Geotechnical & Environmental Specialists

Gas and Groundwater Monitoring Results

Contract Number:	*42269*	**Gas Monitor:**	*GA5000*
Contract Name:	*St Johns Phase 2*	**Readings Taken By:**	*IB*
Date:	*22nd November 2018*	**Checked By:**	*HH*

Background Readings:		
Weather Conditions:	*Overcast*	
Ground Conditions (dry / wet etc):	*Damp*	
Atmospheric Pressure (Start):	*1015mb*	
Atmospheric Pressure (Finish):	*1015mb*	
Time (Start): 11:10 Time (Finish):	13:00	

O_2% v/v	CO_2% v/v	CH_4% v/v	CO ppm	H_2S ppm
20.9	*0.1*	*0.0*	*0*	*0*

Hole No:	VOC ppm	O_2% v/v	CO_2% v/v	CH_4% v/v		CO ppm	H_2S ppm	Rel Pressure (mb)	Gas flow Rate (l/hr)	Depth to base of well	SWL	LNAPL or DNAPL
	Steady	Steady	Steady	Peak	Steady	Steady	Steady	Steady	Steady	mBGL	mBGL	mBGL
BH06	*5.2*	*16.3*	*1.9*	*0.0*	*0.0*	*0*	*0*	*-0.02*	*0.1*	*6.93*	*3.40*	*ND*
RBH09	*Unable to locate RBH09 - buried*											
RBH14	*0.5*	*20.3*	*0.1*	*0.0*	*0.0*	*3*	*0*	*-0.38*	*-0.7*	*14.87*	*3.66*	*ND*
RBH18A	*Unable to locate RBH18A - buried*											
RBH22	*1.4*	*18.5*	*2.3*	*0.0*	*0.0*	*0*	*0*	*-0.01*	*0.0*	*7.02*	*4.00*	*ND*

>>>> = Flow above detection limit of 30 l/hr, <<< = Negative flow greater than -10 l/hr. >Max = In excess of lower explosive limit.

Remarks:

Appendix F – GAC Screening Thresholds

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Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM

curtins

Contaminants	Residential with home grown produce	Residential without 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 *(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* 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						
Aliphatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_6	*42*	*42*	*730*	*3200*	*570000*	*95000*
$EC_{>6}$ - EC_8	*100*	*100*	*2300*	*7800*	*600000*	*150000*
$EC_{>8}$ - EC_{10}	*27*	*27*	*320*	*2000*	*13000*	*14000*
EC_{10}-EC_{12}	*130*	*130*	*2200*	*9700*	*13000*	*21000*
EC_{12}-EC_{16}	*1100*	*1100*	*11000*	*59000*	*13000*	*25000*
$EC_{>16}$ - EC_{35}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
$EC_{>35}$ - EC_{44}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_7	*70*	*370*	*13*	*26000*	*56000*	*76000*
$EC_{>7}$ - EC_8	*130*	*860*	*22*	*56000*	*56000*	*87000*
$EC_{>8}$ - EC_{10}	*34*	*47*	*8.6*	*3500*	*5000*	*7200*
EC_{10} - EC_{12}	*74*	*250*	*13*	*16000*	*5000*	*9200*
EC_{12} - EC_{16}	*140*	*1800*	*23*	*36000*	*5100*	*10000*
$EC_{>16}$ - EC_{21}	*260*	*1900*	*46*	*28000*	*3800*	*7600*
$EC_{>21}$ - EC_{35}	*1100*	*1900*	*370*	*28000*	*3800*	*7800*
$EC_{>35}$ - 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*
Tetrachlorethene (PCE)	*0.18*	*0.18*	*0.65*	*19*	*1400*	*810*
1,1,1 Trichlorethane	*8.8*	*9*	*48*	*660*	*140000*	*57000*

Notes

1. All values above are in mg/kg
2. **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
3. Soil organic matter (SOM) is assumed to be 1% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. 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
6. 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
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. 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)
15. NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 2.5% SOM

curtins

Contaminants	Residential with home grown produce	Residential without 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 *(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* 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						
Aliphatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - 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*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC>_5$ - 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
Aromatic						
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*)
Polycyclic Aromatic Hydrocarbons (PAH)						
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*
Tetrachlorethene (PCE)	*0.39*	*0.4*	*1.5*	*42*	*1400*	*1100*
1,1,1 Trichlorethane	*18*	*18*	*110*	*1300*	*140000*	*76000*

Notes

1. All values above are in mg/kg
2. **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
3. Soil organic matter (SOM) is assumed to be 2.5% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. 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
6. 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
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. 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)
15. NA: Not applicable

Tier 1 Thresholds

Water Contaminants: Initial Assessment of Risk

Introduction

The Generic Assessment Criteria (GAC) employed as Tier 1 Controlled Water Screening criteria are given in Tables 1 and 2. The more conservative available Drinking Water Standards (DWS) and Environmental Quality Standards (EQS) (Freshwater and Saltwater), applicable in England and Wales have been included in the tables.

The list of determinands is non-industry specific and it should be recognised that additional site specific determinands may need to be taken into account. The applicability of these criteria, with regard to the developed Conceptual Site Model, is discussed within the relevant section of the preceding report. Further details on individual GAC can be obtained in the referenced source legislation.

Generic Assessment Criteria

Table 1 – Inorganic Contaminant Controlled Waters Generic Assessment Criteria

Contaminant	Units	Hardness Banding (mg/l CaCO3)	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
Arsenic	µg/l	-	50	25	10	10
Boron	µg/l	-	2000	7000	1000	0.3
Cadmium	µg/l	<40	0.08	0.2	5	3
		40- <50	0.08			
		50- <100	0.09			
		100- <200	0.15			
		>200	0.25			
Chromium III	µg/l	-	4.7	-	50	50
Chromium VI	µg/l	-	3.4	0.6		
Copper	µg/l	-	1 bioavailable[i]	3.76 Where DOC[ii] ≤ 1mg	2000	2000
				3.76 + (2.677 x ((DOC/2)-0.5)) Where DOC[ii] >1mg/l		
Cyanide (Free)	µg/l	-	1	1		
Cyanide (Total)	µg/l	-	1	1	50	70
Iron	µg/l	-	1000	1000	200	300
Lead	µg/l		1.2	1.3	10	10
Mercury	µg/l	-	0.07[iii]	0.07 [iii]	1	1
Nickel	µg/l	-	4 bioavailable[i]	8.6	20	70

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Contaminant	Units	Hardness Banding (mg/l CaCO3)	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
Selenium	µg/l	-	-	-	10	10
Sulphate	mg/l	-	400	-	250	-
Sulphide	µg/l	-	0.25	-	-	-
Zinc	µg/l	-	10.9 bioavailable[ii] + ABC[v]	6.8 dissolved[iV] + ABC	5000	3000

i - fraction likely to have toxic effect as determined using the UKTAG Metal Bioavailability Assessment Tool
ii - concentration of dissolved organic carbon in mg/l of the receiving water (as identified in the Conceptual Site Model)
iii - in absence on Annual Average the Maximum Allowable Concentration Used
iv - total dissolved as reported
V - Average Background Concentration (ABC) as listed in Part 2 Table 2 in Ref. 1.

Table 2 – Organic Contaminant Controlled Waters Generic Assessment Criteria

Contaminant	Units	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
Organics					
Phenol (total)	µg/l	7.7	7.7	0.5	-
MTBE	µg/l	-	-	-	15
Total Petroleum Hydrocarbons (TPH)					
Aliphatic C5-C6	µg/l	-	-	-	15000
Aliphatic C6-C8	µg/l	-	-	-	15000
Aliphatic C8-C10	µg/l	-	-	-	300
Aliphatic C10-C12	µg/l	-	-	-	300
Aliphatic C12-C16	µg/l	-	-	-	300
Aliphatic C16-C21	µg/l	-	-	-	300
Aliphatic C21-C35	µg/l	-	-	-	300
Aromatic C6-C7 (benzene)	µg/l	10	8	1	10
Aromatic C7-C8 (toluene)	µg/l	74	74	-	700
Aromatic C8-C10 (ethylbenzene)	µg/l	20	20	-	300
Aromatic C10-C12	µg/l	-	-	-	100
Aromatic C12-C16	µg/l	-	-	-	100
Aromatic C16-C21	µg/l	-	-	-	90
Aromatic C21-C35	µg/l	-	-	-	90
Total Hydrocarbons (Dissolved / Emulsion)	µg/l	-	-	10 (revoked)	300

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Contaminant	Units	EQS (Freshwater)	EQS (Saltwater)	EU DWS	WHO
BTEX Compounds					
Benzene	µg/l	10	8	1	10
Toluene	µg/l	74	74	-	700
Ethyl-benzene	µg/l	20	20	-	300
Xylene (o+p+m)	µg/l	30	30	-	-
Polycyclic Aromatic Hydrocarbons (PAH)					
Anthracene	µg/l	0.1	0.1	-	-
Benzo(a)pyrene	µg/l	0.00017	0.00017	0.01	0.01
Napthalene	µg/l	2	2	-	-
PAHs Sum of four- benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, indeno(1,2,3-c,d)pyrene	µg/l	-	-	0.1	-

References

1 The Water Framework Directive, (Standards and Classification) Directions (England and Wales) [2015]
2 Council Directive 76/464/EEC, Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) [1976]
3 Council Directive 98/83/EC on the quality of water intented for human consumption [1998]
4 World Health Organisation (WHO), Guidelines for Drinking Water Quality. Third edition [2004]

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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

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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.

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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 *high probability* that *severe harm* could arise to a designated receptor from an identified hazard at the site without appropriate further action.
High Risk	*Harm* is *likely to arise* to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	*It is possible* that without appropriate further action *harm could arise* to a designated receptor. It is relatively *unlikely* that any such harm would be *severe*, and if any harm were to occur it is *more likely* that such harm would be *relatively mild.*
Low Risk	*It is possible* that *harm could arise* to a designated receptor from an identified hazard. It is *likely* that, at worst, if any harm was realised any effects would be *mild.*
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.

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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
39 Fitzwilliam Square
Dublin 2
Ireland
T. 00353 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
28 Lowther Street
Kendal
Cumbria
LA9 4DH
T. 01539 724 823
kendal@curtins.com

Leeds
Rose Wharf
Ground Floor
Leeds
L29 8EE
T. 0113 274 8509
leeds@curtins.com

Liverpool
Curtin House
Columbus Quay
Riverside Drive
Liverpool
L3 4DB
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

Curtins Consulting Ltd registered in England and Wales No: 2054159
Registered office: 51-55 Tithebarn Street, Liverpool, L2 2SB