

Ground Investigation Report

Manchester College

LTE Group

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Quality information

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The methodology adopted and the sources of information used by AECOM in providing its services are outlined in this Report. The work described in this Report was undertaken between June and September 2019 and is based on the conditions encountered and the information available during the said period of time. The scope of this Report and the services are accordingly factually limited by these circumstances. AECOM disclaim any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to AECOM's attention after the date of the Report.

The exploratory holes carried out during the fieldwork, which investigate only a small volume of the ground in relation to the size of the site, can only provide a general indication of site conditions. The comments made and recommendations given in this Report are based on the ground conditions apparent at the site of the exploratory holes. There may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this Report.

The comments made on groundwater conditions are based on observations made during site work and the limited monitoring programme. It should be noted that groundwater levels might vary owing to seasonal or other effects.

The site reconnaissance consisted of a general external inspection of the site aimed at identifying any obvious signs of geotechnical hazards and potential sources of ground contamination affecting the site. The site visit excluded detailed consideration of the ecological or archaeological aspects of the site, and if such are believed to be of potential significance then it is recommended that specialist advice is sought.

The investigation itself was designed generally to meet the objectives of a main investigation, as defined by BS10175:2011 Investigation of Potentially Contaminated Sites: Code of Practice (BSI). The results may not provide sufficient data to make detailed estimates of the quantities involved in any remediation work, if required.

The opinions expressed in this Report concerning any contamination found and the risks arising there from are based on current good practice simple statistical assessment and comparison with available soil guideline values, AECOM generic assessment criteria and other guidance values.

It should be noted that the effects of ground and water borne contamination on the environment are constantly under review, and authoritative guidance values are potentially subject to change. The conclusions presented herein are based on the guidance values available at the time this Report was prepared, however, no liability by AECOM can be accepted for the retrospective effects of any changes or amendments to these values.

Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

Reference to historical Ordnance Survey (OS) maps and/or data provides invaluable information regarding the land use history of a site. However, it should be noted that historical evidence will be incomplete for the period pre-dating the first edition and between the release of successive maps.

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1. Introduction

1.1 Background

LTE Group (the 'client') commissioned AECOM Ltd to prepare a Ground Investigation Report (GIR) for the Manchester College, former Boddingtons Brewery site (the 'site'). The site became derelict after closure of the brewery in 2005 and the buildings were subsequently demolished, and the site became used as a car park. Manchester College now propose to develop the site as a centre for media and visual arts and LTE group are acting on behalf of Manchester College in managing the project.

Detailed optioneering of ground works to remediate and improve the ground on the site is outside the scope of this report. This document is intended to outline the current ground conditions and provide a basis from which remedial/ reclamation options can be evaluated. As such Sections 11 and 12 it only touches briefly on possible options for groundworks on the site.

1.2 Scope of Work

AECOM was provided with a desk study carried out by Capita for the site in 2018, which included information from a 2015 ground investigation undertaken by Ian Farmer Associates. AECOM undertook a gap analysis to determine what further information would be required to enable a geotechnical and geo-environmental appraisal to be carried out for the proposed development. Following this AECOM were instructed to prepare a data gap assessment (Review of Existing Site Data and Gap Analysis, Feb 2019), a specification for the ground investigation and to supervise the ground investigation. The purpose of this investigation was to provide sufficient information on the ground and groundwater conditions at the site to characterise the potential geo-environmental risks and geotechnical hazards for the proposed development and to provide a ground model and geotechnical parameters for foundation design.

This report presents:

- an assessment of the geology of the site developed from information from the Capita desk study, BGS mapping and borehole records, and the ground investigations of 2015 and 2019;
- an engineering assessment of the ground conditions;
- advice on existing and proposed foundations and retaining walls;
- advice on groundwater, such as potential water ingress and the possible effects on the temporary and permanent works;
- recommendations for chemical aggressivity on buried concrete;
- details of the contamination investigation findings, including soil sampling and gas and groundwater monitoring;
- an assessment of the ground-related human health risk posed from the soil using Stage 2 Generic Assessment Criteria,
- an assessment of the risk to controlled waters using published water target values;
- an assessment of the risk from ground gas to the development;
- a statement of the requirement, or otherwise, for remedial action; and,
- where appropriate recommendations for further investigation to refine uncertainty or inform remedial action.

2. Site Description and Proposed Development

The site location and existing layout is shown in Figures 1 and 2. The site is currently used as a car park. The site comprises alternating ground surfaces of partially paved and partially tarmacked areas, with evidence of brick cover in places (presumably related to historic buildings). There is evidence of standing water within topographical depressions across the site, most notably between area of paved and tarmacked surface.

A retaining wall is present on the southern boundary of the proposed development, extending from approximately 1m to 10m in height across the wider site area towards the east. This is split into two parts by a ramp which gives access to a higher area of the car park outside the current site “red line” boundary. The material behind the retaining wall is unknown and appears artificial, with no visual sign of drainage holes. Evidence of a possible utilities box was notes on top of the retaining wall structure.

A further retaining wall approximately 10m in height is located to the east of the site above which is the higher part of the car park.

The site is bounded by Great Ducie Street (A56) to the west, by New Bridge Street (A6042) to the south, and by a continuation of the car park to the north and east, beyond which are industrial premises and an area of derelict ground immediately to the north with HMP Manchester beyond, and industrial premises to the east. The MEN arena is located immediately south of New Bridge Street. There is a strip of land between the site and a retaining structure to the east known as the ‘green strip’ which is not included in this assessment.

The proposed development will comprise a new building to house the media studies centre at The Manchester College. It is proposed that the northern part of the site will become a green zone with landscaping, and the majority of the site to the south will comprise a multi storey building which will form a square around a central roofed atrium. Along the Trinity Way side of the proposed development a 750mm diameter contiguous pile retaining wall runs parallel to New Bridge Street.

3. Initial Conceptual Site Model (iCSM)

Based on the conclusions of the AECOM Review of Existing Site Data and Gap Analysis prepared for LTE Group, February 2019 (AECOM, 2019), a preliminary risk assessment was developed. The findings of which are presented in the following sections.

3.1 Environmental Risk Assessment Review

The findings of the preliminary risk assessment suggest a low to moderate risk from land contamination to the proposed development or wider environment. However, key risk elements noted in the AECOM data gap analysis were the lack of geo-environmental data within the proposed college boundary and the lengthy time frame (~10 years) since the last intrusive investigation. Table 3.1-1 includes the primary sources, pathways and receptors noted during the previous Capita intrusive investigation 2009¹ along with the data uncertainties noted, and recommendations made, by AECOM in the data gap analysis (AECOM, 2019).

¹ AECOM were not provided with the Capita Intrusive Investigation GI Report 2009.

Table 3.1-1 The sources pathways and receptors noted during the previous Capita intrusive investigation 2009 and the data uncertainties noted, and recommendations made, by AECOM in the data gap analysis (AECOM, 2019).

Sources	Pathways	Receptor	Data Uncertainties	Recommendations
Contaminated Soils (S1)	P1. Particulate inhalation / dermal contact/ ingestion	R1. Site users – Commercial workers, residents and public	DU1. The most recent ground investigation is more than 10 years old and therefore the applicability of the results is questioned.	R1. Additional ground investigation designed following BS ISO 18400 (BSI, 2017), that targets the wider area across the site and is inclusive of the made ground and the deeper and natural soils, is recommended. That will allow a more accurate portrayal of the underlying conditions at the site. R2. To refine the conceptual site model with the obtained soils and leachate data to reduce the level of uncertainty and quantify the associated risks related to the proposed development. R3. The development may require the removal of shallow soils for foundations and therefore waste classification for disposal is recommended.
	P2. Vapour inhalation	R2. Adjoining site users	DU2. The information gathered from the 2009 investigation is biased to a specific section within the site boundary (soil samples were localised to the east of the site). The data gathered omits a large proportion of the site. Therefore, cannot be extrapolated to accurately assess the wider conditions at the site.	
	P4. Leaching and migration of contaminants into the underlying aquifer	R3. Controlled water groundwater	DU3. Chemical analysis undertaken during the previous intrusive investigation did not obtain any environmental samples from below 2m bgl. Therefore, the presence and concentration of CoPC within the deeper soils is unknown.	
	P5. Root uptake	R4. Controlled water surface water courses	DU4. There may be potential for soil contaminants to leach into the unsaturated zone and migrate in deeper groundwater. The depth to groundwater is currently unknown.	
			DU5. The CSM does not differentiate between separate contamination sources, and therefore generalises the proposed risk at the site.	
Contaminated Groundwater (S2)			DU6. The CSM does not refer to a potential pathway for spillage/ surface runoff into receiving water courses. The River Irwell is located approx. 150m south west of the site boundary.	R4. It is recommended that as part of the additional ground investigation (R1) groundwater standpipes are installed following BS ISO 5667-22:1010 (BSI, Water Quality. Sampling. Guidance on the design and installation of groundwater monitoring points. British Standards Institute, 2010). That will allow depth to groundwater beneath the site to be assessed to determine if the groundwater beneath the site is at a sufficient depth as to not impact the River Irwell. If groundwater is encountered, chemical analysis is recommended to assess the concentration of potential contamination beneath the site.
	P2. Vapour inhalation	R1. Site users	See DU5.	
	P6. Migration with groundwater flow/ plausible hydraulic continuity with River Irwell	R3. Controlled water groundwater R4. Controlled water surface water.	DU7. The previous investigation did not encounter groundwater and therefore there is no groundwater environmental chemical assessment data. The depth to groundwater is also unknown. The environmental risks with regards to ground water or surface water cannot be assessed. It is also unclear if groundwater is in hydraulic continuity with the River Irwell. DU8. As depth to groundwater is unknown, the risk of vapour inhalation from contaminated groundwater cannot be accurately assessed.	

Sources	Pathways	Receptor	Data Uncertainties	Recommendations
			DU9. Standing levels of groundwater were encountered at depths from 4.26m to 5.70m bgl within the Made Ground and weathered sandstone respectively, although a continuous groundwater body was not identified. Intrusive investigations at the site suggest a resting groundwater level of >12.50m bgl. DU10. The eastern portion of the site is underlain by cohesive superficial deposits which are likely to inhibit both lateral and vertical migration of groundwater. The pathway remains based on the encountered granular Made Ground and anticipated bedrock as a viable pathway for groundwater migration. The deposits beneath the western portion of the site and how this may influence groundwater movement is unknown. DU11. If the previous network of boreholes has not been decommissioned there may be a possibility that the wells are connecting the underlying strata and allowing contaminant transport from the surface, through superficial deposits to the bedrock geology. DU12. The conceptual site model does not differentiate the superficial and bedrock aquifer properties, categorising them together as controlled groundwater. The superficial deposits identified on the east of the site are termed a secondary (undifferentiated) aquifer and secondary A aquifer to the west of the site, whereas the bedrock sandstone is termed a principal aquifer and should be risked separately.	R5. To refine the conceptual site model with the obtained groundwater data to reduce the level of uncertainty and quantify the associated risks related to the proposed development.
Ground Gas	P7. Migration through structures P5. Structural damage due to explosion of combustible gas.	R1. Site users – commercial workers, residents and public R5. Property (building)	See DU1 DU13. During the 2009 intrusive investigation, ground gas analysis was undertaken on only one occasion and only two boreholes were assessed, both were on the periphery of the site boundary. This cannot be considered an accurate representation of the ground gas regime. Therefore, there is no data to account for the potential for asphyxiation through the collection of ground gas in confined spaces. Nor is there data to assess the risk of structural damage due to explosion of combustible gas.	R6. As part of the recommended ground investigation (R1), it is also recommended that ground gas analysis is undertaken to appropriately interpret the gas regime beneath the site. This is to be observed over a set period of time, and following best practice from BS 8576:2013 (BSI, 2013). R7. To refine the conceptual site model with the obtained gr data to reduce the level of uncertainty and quantify the associated risks related to the proposed development.

3.2 Geotechnical Review and Potential Constraints

A number of Geotechnical risks and uncertainties were identified as part of AECOM's review of the desk study and the data gap analysis as follows:

Existing retaining wall at southern edge of proposed building – this wall supports Trinity Way and the southern raised area of the site. Little was known about the geometry of the wall, its form of construction, its foundations and backfill, all of which are needed to assess future wall stability if any changes are made to ground levels or loading on either side of the wall.

Buried Obstructions – The previous GI encountered a number of obstructions in the ground, believed to be buried structures or large boulders in backfill. These presents a significant risk to the proposed construction. More significantly they have prevented previous ground investigations extending to sufficient depth leaving uncertainty regarding the depth of backfilling.

Insufficient information regarding bedrock levels – It is probable that piling or ground improvement techniques will be required on the site and as such more detailed information on bedrock levels and properties were required for design.

Insufficient information regarding ground water – Previous ground water monitoring did not extend to sufficient depth to encountered ground water except for some shallow perched water. A knowledge of the depth of the water table and the lateral continuity of the perched water is needed for foundation design and temporary works design.

Covered water wells – These are shown on the historic mapping and are associated with the brewery. If present they create a risk for foundation stability and for ground water contamination. Further investigation was needed to see if they were still present at depth.

Geological Fault – A geological fault is shown across the site on the mapping. This could have a significant impact on the ground model and the foundation solutions selected and needed to be investigated further.

3.3 Recommendations

To investigate the conclusions made in the AECOM desk study a ground investigation was proposed comprising the following:

- A geophysical survey to help target the exploratory holes and to assess the extent and nature of buried features beneath the site.
- Combined dynamic sampling and rotary core holes using dual purpose rigs to determine the nature and thickness of made ground and superficial deposits and the engineering properties of the underlying sandstone bedrock, and for installation of ground gas and groundwater monitoring standpipes.
- Trial Pits for the location of services and to provide access for Electricity North West (ENW) to carry out testing to confirm the status of their cables
- Trial pits to investigate the construction of retaining wall bases and for general assessment of the near surface ground conditions
- Trial pits to investigate the ground behind retaining walls
- Trial pits distributed across the site to provide information on the near surface ground conditions across the site and to provide additional sampling points for environmental samples to characterise the made ground.
- Trial Trenches to determine the location of former wells used to supply water to the brewery.
- Cores through the retaining walls to assess their condition and construction and thickness.

A ferroskan survey was required to determine the distribution of reinforcement in the retaining walls.

4. Ground Investigation

4.1 Overview

Based on the findings of the gap analysis, a ground investigation was carried out to confirm the nature (chemical and geotechnical) and thickness of the made ground and natural superficial materials. Geotechnical properties of the underlying sandstone bedrock were assessed. Monitoring was undertaken to determine the groundwater conditions and the ground gas regime. Water abstraction wells were recorded at the site and it was considered necessary to attempt to locate these and to determine the impact of the construction on the wells, and visa versa, and whether the wells could give rise to a pathway for contaminants to the sandstone aquifer underlying the site and surrounding area.

Prior to commencement of the intrusive investigation in May 2019, Brownfield Solutions subcontracted a geophysical investigation to Bentham Geoconsulting comprising an electrical conductivity survey, magnetometer survey, and ground proving radar survey was undertaken to assist in targeting the exploratory holes to be carried out during the main investigation and to determine the extent of features penetrated by the intrusive survey such as buried slabs, boulders in the made ground, faults and wells.

Previous investigations had either failed to penetrate the made ground, including buried concrete slabs beneath the site, or comprised rotary drilling which only provided information on the bedrock. It was therefore decided to use a dual purpose drilling rig that would carry out dynamic sampling and Standard Penetration Testing (SPT), and obtain driven tube samples (U100) in cohesive superficial deposits and would continue through obstructions and bedrock by rotary core drilling.

Trial pits were undertaken to expose cables for North West Electricity to test to determine their status, to inspect retaining wall foundations, to inspect backfill behind foundations, and to obtain samples for characterisation of the made ground.

Trial Trenches were carried out to try to locate two wells recorded as supplying water to the former Boddingtons Brewery.

Cores were obtained from the retaining walls to determine their condition, thickness and construction.

A ferro-scan survey was undertaken of the retaining walls to determine the distribution of reinforced concrete.

The intrusive investigation, together with the cores from the retaining walls and the ferro-scan survey was carried out by Brownfield Solutions Ltd (BSL) between June 4th and June 21st 2019, a draft report was issued on August 4th 2019 (BSL).

Details of exploratory holes (as reported post completion) are summarised in Table 4.1-1.

Table 4.1-1. Summary Details of Exploratory holes

Method and purpose of investigation	Locations	Depth (m)	Number	Dates undertaken
Dynamic sampling and rotary coring for assessment of ground and groundwater conditions	BH101 - BH111 and BH109a	7.20-20.50	12	04/06/2019-18/06/2019
Trial Pits – For services (Hand Dug)	TP101, TP104, TP106-TP109	0.7-1.5	6	06/06/2019 and-10-11/06/2019
Trial Pits – For assessment of fill behind retaining wall	TP102	2.3	1	11/06/2019
Trial Pits – To investigate the retaining wall foundations	TP103, TP105	0.40-1.35	2	10/06/2019-11/06/2019
Trial pits – For assessment of contamination status of the made ground	TP201 - TP213	0.60-1.20	13	19/06/2019-20/06/2019
Trial Trenches - To locate former wells	TT101-TT104	3.60-4.30	4	10-11/06/2019 and 19-20/06/2019

Samples were obtained from the exploratory holes for chemical and geotechnical analysis, and standpipes were installed to allow for future gas and groundwater monitoring. The scope of monitoring and testing is described in Sections 4.2 to 4.5. The investigations locations are presented on Figure 2.

In addition to the exploratory holes above the following additional work was carried out to investigate the retaining walls.

Table 4.1-2 – Investigation of retaining wall superstructure

Method and purpose of investigation	Locations	Height above wall base (m)	Length (m)	Number	Dates
Retaining Wall cores	WC01,WC102 and WC03	0.0,1.0 and 4.5	0.44, 0.27 and 0.23	3	12/06/2019
Ferrosan	Scan 1, Scan 2 and Scan 3	0.00, 1.00 and 4.50	N/A	3	14/06/2019

In addition to the 2019 investigation, an investigation undertaken by Ian farmer Associates in 2015 for a larger area than the current site included, within the site boundary, two cable percussion boreholes to depths of between 6.50m and 6.80m which proved rock head, and ten trial pits to between 0.2m and 4.0m.

4.2 In-Situ Testing

4.2.1 Standard Penetration Test

Standard Penetration Tests (SPTs) were undertaken at regular intervals in the made ground and natural superficial deposits. The tests were carried out in accordance with the proposals recommended by BS 1377, Part 9, 1990. Forty three SPTs were undertaken: seventeen in Made Ground; fourteen in natural clay; five in natural sand, and: seven in weathered sandstone.

The boreholes carried out by Ian Farmer Associates in 2015 also included fourteen SPTs: six in the made ground; four in natural sand; and four in weathered sandstone bedrock.

4.2.2 Photo ionisation detector (PID)

A total of 75 samples were screened with a PID, taken from depths between 0.10m and 3.50m during the 2019 investigation to determine the potential presence of volatile chemicals of concern.

4.3 Laboratory Testing

4.3.1 Environmental Testing

Based on the historical land uses identified in the data gap analysis (AECOM, 2019) selected soil and groundwater samples were analysed by UKAS accredited laboratory i2 Analytical Ltd for the determinants listed in Table 4.3-1.

Table 4.3-1. Chemical Testing suites

Determinand	Total Soils Analytical Suite E	Total Leachate Analytical Suite M	Total Waters Analytical Suite F
Metal suite (arsenic, barium, beryllium, boron, cadmium, chromium (hexavalent and total), copper, lead, mercury, nickel, selenium, vanadium, zinc)	✓	✓	✓
Calcium, magnesium, potassium, sodium			✓
pH	✓	✓	✓
Sulphide	✓	✓	✓
Water Soluble Sulphate (as SO ₄)	✓	✓	✓

Determinand	Total Soils Analytical Suite E	Total Leachate Analytical Suite M	Total Waters Analytical Suite F
Sulphur	✓	✓	✓
PAH USEPA-17	✓		✓
PAH EPA-16		✓	✓
Phenol	✓		✓
Fraction organic carbon	✓		✓
TPH (CWG) speciated	✓	✓	✓
VOCs	✓		
SVOCs	✓		
BTEX and MTBE	✓	✓	✓
Phenols	✓		✓
Cyanide (total)	✓		✓
Cyanide (free)	✓		✓
Asbestos screen and ID	✓		✓
Ammoniacal Nitrogen as N			✓
Electrical Conductivity			✓
Chloride			✓
Nitrate as N			✓
No. Samples	28	9	8

4.4 Gas and Groundwater Monitoring

All gas monitoring was undertaken by BSL using a GA5000/ GFM436 infrared gas meter with integral electronic flow analyser in accordance with BS8576:2013. Measurements of the percentage volume in air (%v/v) of oxygen (O₂), carbon dioxide (CO₂) and methane (CH₄) were recorded in addition to the percentage Lower Explosive Limit (%LEL) of methane and the atmospheric pressure (Note: 100% LEL equates to 5% by volume). Flow measurements on each standpipe (L/h) were also taken.

Two visits were undertaken on 11 July and 23 July 2019.

During the post investigation monitoring, 8 No. groundwater samples were taken from the following locations: BH101, BH102, BH103, BH106, BH107, BH108, BH109A, and BH111 on 23rd July 2019. The analysis undertaken is presented in Brownfield Solutions Factual Report (Brownfield Solutions, 2019).

4.5 Geotechnical Testing

Representative disturbed samples were obtained for all soil types encountered. Selected samples were scheduled for testing at an approved laboratory in accordance with BS1377 and BS EN ISO 17892. The following tests were scheduled:

Table 4.5-1. Summary of Geotechnical Testing

BS 1377 Part Number	Test Type	Quantity
Part 2:	Natural Moisture Content	41
Part 2:	Plasticity Index Analysis	14
Part 2:	Particle Size Analysis	17
Part 3:	Suite C: Full BRE Suite* (soil)	21
Part 3:	Suite C: Full BRE Suite* (Groundwater)	8

BS 1377 Part Number	Test Type	Quantity
Part 5	One Dimensional Consolidation Test	4
Part 7	Unconsolidated Undrained triaxial Compression Test (Single Stage)	5
ISRM 2007 pp125-132	Point Load Strength Index Test (Rock)	20
ISRM 2007 page153 Part 1	Uniaxial Compressive Strength (Rock)	10

*Testing required for the assessment of ground aggressivity to buried concrete covered by Suite C was included within the chemical test suites carried out for contamination assessment under the title "General Inorganics"

No geotechnical test results have been assigned to AECOM from previous investigations.

5. Ground Conditions and Material Properties

5.1 Introduction

The following chapter provides a review of the ground investigation information currently available. This chapter also details the derivation of geotechnical properties from field or laboratory test data, empirical correlations, theoretical conversions, assumptions or references to design codes.

5.2 Stratigraphy

Table 5.2-1 presents a summary of the ground conditions encountered across the exploratory holes.

Table 5.2-1. Ground Conditions Encountered in the Ground Investigation

Geological Unit	Typical Description	Range of depths to top of stratum (mbgl)	Range of thickness (m)
Hardstanding and other road surfacing	Includes reinforced concrete and tarmac, and unbound car park surfacing.	0	0.1 – 0.45
Granular Made Ground	Gravelly sand and sandy gravel with cobbles of brick, concrete, sandstone and limestone with fragments of wood, cloth, plastic, glass and metal, clayey below approximately 2m bgl.	0 – 0.45	0 – 4.8
Buried Concrete 1	Reinforced concrete: probably buried ground floor slab, where present usually separates granular made ground above from clayey granular or cohesive made ground or natural ground below.	0.55 – 1.1	0.- 0.95 (0.2-0.95 Where encountered and full thickness penetrated)
Granular Made Ground (Clayey)	Medium dense dark brown to black clayey sandy gravel with medium angular brick cobble content and low ask, glass and slag content	1.3 – 2.3	0 – 3.3
Cohesive Made ground	Brown sandy gravelly clay (also locally present above buried concrete layer 1)	0 – 2.05	0 – 2.2
Buried concrete 2	Reinforced concrete basement floor slab. Located at base of made ground	2.0 – 3.75	0 - 1.25 (0.95 – 1.25 Where encountered and full thickness penetrated)
Cohesive alluvium	Soft dark brown and brown mottled grey sandy clay, locally slightly gravelly	1.3 – 1.45	0 – 2.55
Granular Alluvium	Loose locally medium dense light brown, brown and reddish brown, typically gravelly, locally silty or clayey fine to coarse sand	0.8 – 4.0	0 – 1.7
Glacial Till	Firm brown mottled grey slightly sandy slightly gravelly clay, gravel is subangular of sandstone and mudstone	1.3 -4.1	0 – 3.8
Glacio-Fluvial - Cohesive	Firm dark brown and grey sandy clay	2.2	0-1.0
Glacio-Fluvial - Granular	Brown slightly gravelly fine to coarse sand	3.7	0-0.2
Weathered Sandstone (Chester	Medium dense red fine to coarse sand, locally sandstone cobbles present	3.8 – 5.2	0.2 – 3.9

Geological Unit	Typical Description	Range of depths to top of stratum (mbgl)	Range of thickness (m)
Formation)			
Sandstone	Weak thinly bedded red coarse grained sandstone	4.25 – 8.0	Not proven (maximum penetrated 15.0)

5.2.1 Surfacing

Surfacing included the following:

- Unbound gravel base, typically 0.45m in thickness, comprising mostly coarse gravel of limestone;
- Asphalt typically 0.05m in thickness overlying granular sub base.
- Concrete slab either 0.4m mas concrete or 0.3m reinforced concrete, comprising former floor slabs.

5.2.2 Granular Made Ground

The granular made ground can be characterised as two slightly different materials, one with a higher fines content than the other as described in the following Sections.

Granular Made Ground

Granular made ground was identified at all exploratory hole locations across the site. The granular made ground was identified underlying the car park surfacing at all locations, (except TP103 which terminated on a concrete slab) to depths of between 0.2m and 1.1m bgl, and thickness ranging from 0.05m to 1.8m. The exploratory hole logs indicate that the Made Ground, in most locations, consisted of reddish brown sandy fine to coarse gravel and gravelly fine to coarse sand with variable cobble content, with cobbles comprising brick, concrete, asphalt, sandstone, limestone and mudstone.

SPTs are plotted against depth and level in Charts 1a and 1b. Two SPTs were carried out with the test zone entirely within the granular made ground, the N values were 23 and >50. As there are obstructions in the made ground, the N value of 23, indicative of medium dense material, is considered to be representative of the granular made ground.

One grading (Chart 6b) was carried out by wet sieving on a sample of granular made ground, the result indicated that the material consisted of silty very sandy fine to coarse gravel.

Clayey Granular Made ground

Clayey granular made ground was identified at six locations across the site; BH104, BH105, BH106A, TT01 and TT03/4. They comprised reddish brown clayey sandy and slightly sandy subangular fine to coarse gavel of brick, sandstone, limestone and mudstone, occasionally with some cobbles. These strata were identified underlying the granular made ground at depths of between 1.3m – 2.3m bgl, with thicknesses ranging from 0.5m to 2.15m. At BH106A a second layer of clayey granular made ground was encountered from 3.10m to 4.80m bgl.

Two SPTs were carried out in clayey granular made ground, the 'N' value was 7 in both cases indicating that the clayey granular made ground was loose.

One grading was carried out on clayey granular made ground, the result indicating that the sample tested consisted of sandy clay. However, the cobble size content of this material, which cannot be including in sieve analyses is so great that if it were taken into account, the material may classify as very clayey cobbles.

One liquid and plastic limit test was carried out on the material less than 425µm and this indicated that the material classified as clay of low plasticity. Again, the cobble content of this material is such that the material could classify as very clayey cobbles.

5.2.3 Cohesive Made Ground

Cohesive made ground was encountered at sixteen locations across the site BH102, BH104, BH107, BH108, BH109, BH111, TP102, TP104, TP108, TP201, TP202, TP204 and TP209-212. They comprised soft, soft to firm and firm reddish brown, brown mottled grey and dark brown typically slightly sandy gravelly clay, locally with medium to high cobble content. These strata were identified underlying granular made ground at depths of between 0.4m and 2.05m bgl, and occasionally from ground level (TP102). Where the full thickness of this stratum was penetrated, (in each of the boreholes) it was found to range between 0.3m and 2.20m. At BH 107 cohesive made ground was found both above and below a thick buried concrete slab with a combined thickness of 2.5m.

Chart 1a and 1b shows that six SPTs were carried out on cohesive made ground, one recorded an 'N' value of >50, indicative of an obstruction, the remaining 'N' values ranged between 5 and 10 with an average of 8, indicative of generally soft and soft to firm material.

Two gradings were carried out by sieve analysis and sedimentation and are presented on Chart 6a. One of these analyses indicated that the material comprised sandy clay or silt and the other indicated slightly sandy gravelly clay or silt.

Two liquid and plastic limit tests were carried out on samples of cohesive made ground, one indicated that the sample was classified as clay of low plasticity, and the other indicated that the sample tested was non plastic.

5.2.4 Concrete slabs

Concrete slabs were recorded at three distinct levels across the site:

Concrete layer 1: Surface slabs, located at former brewery roadways either comprising 0.4m thick mass concrete or 0.3m thick reinforced concrete, encountered at three locations: BH110, TP105 and TT102;

Concrete layer 2: Buried slabs forming former ground floor slabs, now buried under made ground located at depths of between 0.55m and 1.1m below existing ground level, and with thicknesses typically ranging from 0.2m to 0.4m, where fully penetrated. At one location (BH103) the slab attained a thickness of 0.95m. These buried slabs were encountered at six locations: BH102, BH103, BH104, BH108, TP206 and TP 208, reinforced concrete was only recorded at BH104.

Concrete layer 3: Buried slabs forming the floor of basements within the former brewery located at depths of between 2.0m and 4.2m below existing ground level, with thickness, where fully penetrated of between 0.9m and 1.25m, were encountered at six locations: BH104, BH105, BH106A, BH107, TT101 and TT103/04, reinforced concrete was only recorded at BH106A.

5.2.5 Cohesive Alluvium

Cohesive alluvium was encountered at two locations coinciding with where the made ground was relatively thin, BH101 and BH110, at depths of 1.45m and 1.3m respectively, and with recorded thicknesses of 2.55m and 0.5m respectively. The cohesive alluvium was described as soft mottled grey and dark grey, sandy clay, locally slightly gravelly, with the gravel content described as angular, fine to coarse of sandstone and mudstone.

Five SPTs have been carried out on cohesive alluvium. The 'N' values range from 5 to 8, these values are indicative of soft clay.

Five gradings were carried out by wet sieving and sedimentation on five samples of cohesive alluvium and are presented in Chart 6c. The gradings were indicative of sandy clay, three of which were also slightly gravelly, and one of the gradings was indicative of very silty fine and medium sand.

Two liquid and plastic limit tests were carried out on samples of cohesive alluvium. These are plotted in Chart 3. One indicated that the cohesive alluvium was non plastic and the other that it comprised clay of intermediate plasticity and medium shrinkage potential.

One triaxial compression test was carried out on cohesive alluvium BH101 at 2.4m, the results showed that the sample tested had an undrained shear strength of 64kPa this indicated that the material tested was of medium strength.

A single oedometer consolidation test was carried out on a sample of cohesive alluvium. The results gave a coefficient of consolidation (Mv) of 0.36 MN/m² for a pressure range of overburden to overburden plus one increment, indicative of a clay of high compressibility.

5.2.6 Granular Alluvium

Granular alluvium was encountered at five locations across the site BH101, BH103, BH108, BH110 and TP105, either below made ground or cohesive alluvium, at depths of between 0.8m and 4.0m with recorded thicknesses ranging from 0.5m to 1.7m. The granular alluvium comprises predominantly loose brown, light brown and reddish brown gravelly fine to coarse sand, locally clayey or silty and occasionally grading to medium dense sandy fine to coarse gravel of sandstone and mudstone.

Five SPTs were carried out in granular alluvium (see charts 1a and 1b). The SPT 'N' values recorded were between 5 and 16 (average 9) which showed that the granular alluvium was generally loose.

Three gradings were carried out on samples of material described as granular alluvium (See Chart 6d). One was indicative of silty fine and medium sand, but the other two were indicative of fine soils with 46% and 70% passing the 63 micron sieve, although in both cases there was a significant proportion of coarse silt. The appropriate classification from the gradings should be slightly sandy to sandy slightly gravelly silt or clay.

Two liquid and plastic limit tests were carried out on the granular alluvium, one indicated that the material was non plastic, the other (plotted on Chart 3), that the material was clay of low plasticity.

5.2.7 Glacial Till

Glacial till was encountered beneath either made ground or alluvium at five locations across the site BH102, BH109, BH110, BH111 and TT02, at depths of between 1.3m and 3.9m with recorded thicknesses ranging from 0.2m and 3.9m. The glacial till is described as firm, locally soft to firm, brown mottled grey, slightly sandy slightly gravelly and gravelly clay, with the gravel fraction described as subangular fine to coarse gravel of sandstone and mudstone. The glacial till contains localised layers of glacio-fluvial deposits.

Nine SPTs were carried out in the glacial till and are plotted on Charts 1a and 1b. With the exception of three outlying 'N' values of 35 to >50, the values ranged between 9 and 19, indicative of clay of medium to high strength.

Moisture content and liquid and plastic limit determinations were carried out on glacial till, the results are plotted on Charts 2 and 3 summarised in Table 5.2-2

Table 5.2-2. Classification Properties for Cohesive Glacial Till

Soil Parameter	No. of Tests	Average value	Range
Moisture Content	6	17 (19)	7.7-25 (13-25)
Liquid Limit (%)	4	37	31-40
Plastic Limit (%)	4	18	13-21
Plasticity Index (%)	4	19	18-20

*In addition, one sample of glacial till was proved to be non-plastic. Figures in brackets exclude the non-plastic sample.

The results plotted on Chart 3 indicate that the glacial till typically comprised clay of low to intermediate plasticity and was of low to medium shrinkage potential. The moisture content was typically at or close to the plastic limit.

Three single stage unconsolidated undrained triaxial compression tests were carried out on samples of glacial till these gave values of undrained cohesion of 49kPa, 189kPa and 200kPa, indicative of a range from medium strength to very high strength.

Two one dimensional oedometer consolidation tests were carried out on samples of glacial till. These gave values of coefficient of compressibility (Mv) of 0.27 and 0.41 m²/MN for an applied pressure range from overburden to overburden plus one increment, indicative of clay of medium to high compressibility.

5.2.8 Cohesive Glacio-Fluvial Deposits

A thick bed of cohesive glacio-fluvial material was encountered at BH109 from 2.2m to 3.2m depth, within glacial till. It is described as firm brown mottled dark grey sandy clay.

One SPT was carried out in this material, the 'N' value was 8, indicative of clay of low to medium strength.

One set of liquid and plastic limit tests were carried out on the cohesive glacio-fluvial deposits. These gave values of liquid limit of 41, plastic limit of 20 and plasticity index of 21, indicative of clay of intermediate plasticity and medium shrinkage potential.

One single stage unconsolidated undrained triaxial compression test was carried out on a sample of cohesive glacio-fluvial material, the recorded value of undrained shear strength was 178kpa, indicative of clay of very high strength.

A single one dimensional oedometer consolidation test was carried out on a sample of cohesive glacio-fluvial deposits. The recorded coefficient of compressibility was $0.31 \text{ m}^2/\text{MN}$, for an applied pressure range from overburden to overburden plus one increment, indicative of clay of high compressibility.

5.2.9 Granular Glacio-Fluvial Deposits

A bed of granular glacio-fluvial material was encountered at BH110 from 3.7m to 3.9m depth, within glacial till. It is described as brown slightly gravelly sand. No testing was carried out on this stratum.

5.2.10 Weathered Sandstone (Chester Formation)

Weathered sandstone was encountered underlying made ground, concrete basement floor slabs, alluvium and glacial till and immediately overlying intact sandstone bedrock at all borehole locations (BH101 to BH111 including BH106A and BH109A). It was encountered at depths of between 3.8m and 5.2m, with a recorded thickness typically ranging from 0.2m to 1.7m, but locally at BH109/ BH109A the thickness was recorded as 4.2m. The weathered sandstone was typically described as red coarse sand. The logger has recorded this stratum as medium dense, but there is no evidence to substantiate this.

At BH109/ 109A cobbly gravel of mixed lithologies was recorded. There are three possible reasons for this. One is that a pebble bed was encountered in the Chester Formation, giving rise to difficulty in advancing BH109, and the need to drill BH109A adjacent to it. Another is that a fluvio-glacial channel was encountered and that the material is not due to weathering of the sandstone. And a third possibility is that an unrecorded pit was dug, and that the gravel and cobbles were used to backfill this feature. Consideration has also been given to this being on the fault shown as crossing the site. If this were the case however, broken sandstone would be expected to be present, and not gravel of mixed lithologies.

Two SPTs were carried out in the weathered sandstone, both refusing ('N' > 50)

5.2.11 Sandstone (Chester Formation)

Sandstone of the Chester Formation was encountered in each of the boreholes at depths of between 3.8m and 8.0m. The sandstone was described as weak red coarse grained sandstone with sub horizontal medium spaced tight planar bedding joints.

Full recovery of solid core was normally obtained and the RQD ranged between 20% and 85%, except for localised more broken rock just below rock head where the RQD was occasionally 0%.

Uniaxial compression tests were carried out on ten samples of rock core from the sandstone of the Chester Formation where the separation between core breaks exceeded 2 x core diameter at depths of between 6.5m and 18.2m bgl. These are plotted in Chart 4. The uniaxial compressive strength ranged from 5.08 MN/m^2 to 18.7 MN/m^2 , with an average of 10.87 MN/m^2 . There was no significant change of strength with depth, the lowest and highest values both in the range 6.5m to 8.0m depth. If three outlying values of strength of between 15 MN/m^2 and 18.7 MN/m^2 are removed, the remaining seven values range from 5.08 MN/m^2 to 11 MN/m^2 with an average of 8.37 MN/m^2 .

Point load strength index tests were carried out on twenty specimens of sandstone of the Chester Formation, all were axial, normal to the bedding. The results, expressed as i_{s50} in Chart 5, ranged from 0.07 MN/m^2 to

0.40MN/m² with an average of 0.24MN/m². There was a scatter of results which did not specifically relate to depth or location.

A comparison between the point load index test results and the uniaxial compressive strength indicates a correlation factor of approximately 35 from i_{s50} to uniaxial compressive strength. This indicates a scatter of equivalent uniaxial compressive strength from 2.4MN/m² to 14MN/m².

5.3 Groundwater

Groundwater strikes were encountered in all the boreholes within the Chester Formation sandstone at depths of between 8m and 11m, except in BH106 which was terminated at the base of the inspection pit. One groundwater strike was encountered in glacial till at a depth of 3m bgl in BH107. It is very likely that this was a pocket of perched groundwater trapped within generally impermeable glacial till. Groundwater strikes/seepages recorded during the ground investigation are presented on the borehole logs in the Factual Report (Brownfield Solutions Limited, 2019).

Standpipe monitoring well installations were installed in boreholes BH101-BH103, BH106A, BH10, BH108 BH109A, BH110 and BH111 to monitor groundwater conditions. The groundwater monitoring standpipes were installed with response zones extending from approximately 1m below to 1m above the level of water strikes in the Chester Formation Sandstone. Two groundwater monitoring visits have been carried out on the 11th July 2019 and 23rd July 2019. The minimum and maximum recorded groundwater levels within the boreholes from the two monitoring visits are presented in Table 5.3-1. Groundwater was measured between 4.32m bgl and 6.21m bgl on the level part of the car park and between 9.32m bgl and 9.5m bgl at BH111 on the ramp in the south of the site, at elevations between 23.96m AOD and 25.19m AOD. Groundwater was encountered at one location within glacial till at a depth of 3m bgl at BH111.

The groundwater levels measured at the site indicate there is an aquifer in the sandstone across the site with a standing water level roughly corresponding to or just below the base of the weathered sandstone.

In order to understand if the ground water identified at the site is likely to be in connectivity with the River Irwell. Groundwater level contour analysis was carried out (BH104 and BH105 did not have standpipes installed) (Figure 5.3-1). It can be seen that the ground water level falls towards the south west of the site, in the direction of the River Irwell. The ground water levels, on site, were compared with approximate ground water levels of the River Irwell. Information taken from an on-line elevation finder tool (@freemaptools, 2019), indicates that the surface water may be at an elevation from 24 mAOD, just south of New Bridge Street (A6042) approx. 500m from the site boundary. Based on these findings it is plausible that there is connectivity between the ground water on site and the River Irwell.

Figure 3 Ground water level (mAOD) measured within boreholes at the site (23rd July 2019).

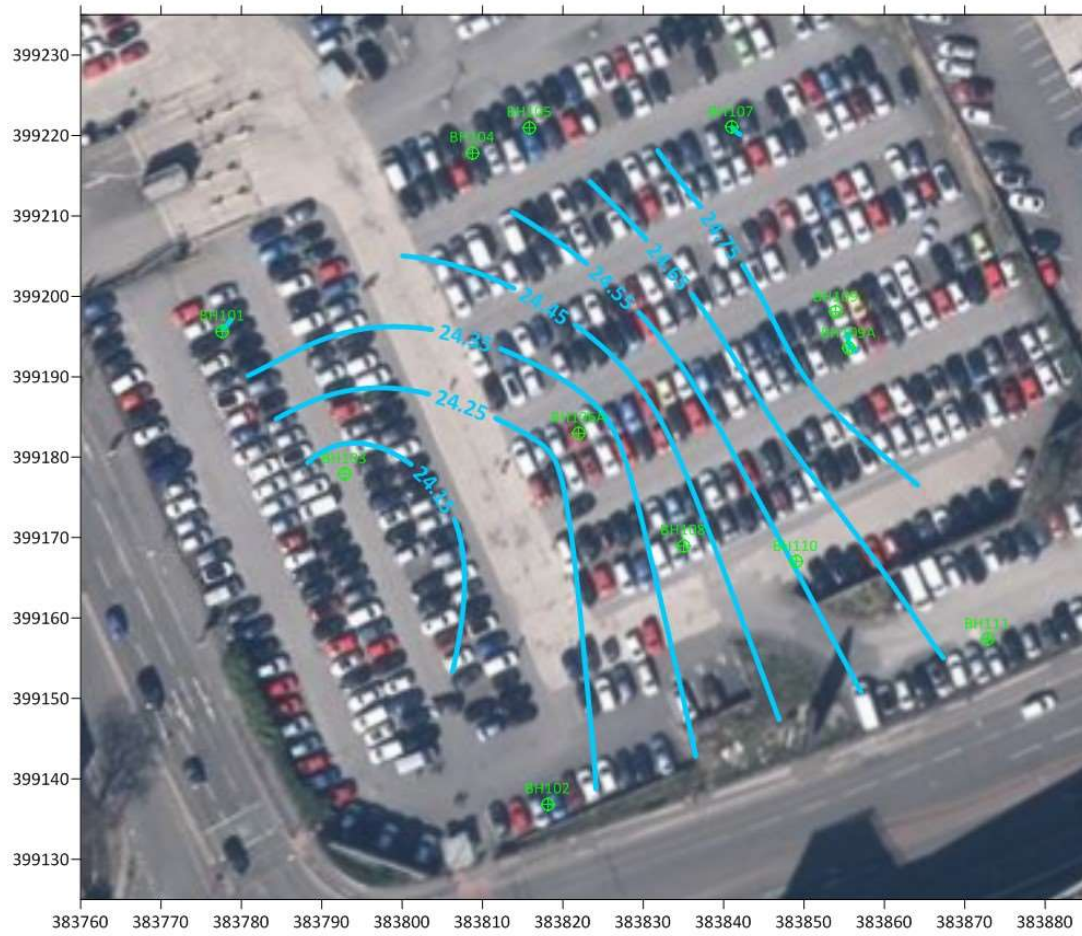


Table 5.3-1. Groundwater Level Monitoring Results

Exploratory Hole	Ground Level (mAOD)	Response Zone Stratum	Installation Details	Units	Groundwater Depth and Level	
					02/05/2018	15/05/2018
BH101	29.47	Chester Formation (sandstone)	8.50-10.50m slotted standpipe	m bgl	5.39	5.51
				mAOD	24.08	23.96
BH102	30.16	Chester Formation (sandstone)	10.00-12.00m slotted standpipe	m bgl	5.92	5.95
				mAOD	24.24	24.21
BH103	29.40	Chester Formation (sandstone)	7.50-9.50m slotted standpipe	m bgl	5.26	5.31
				mAOD	24.14	24.09
BH106A	29.40	Chester Formation (sandstone)	8.50 – 10.50m slotted standpipe	m bgl	-	5.12
				mAOD	-	24.28
BH107	30.17	Chester Formation (sandstone)	9.50 – 11.50m slotted standpipe	m bgl	6.21	5.32
				mAOD	23.96	24.85
BH108	29.51	Chester Formation (sandstone)	9.00 – 11.00m slotted standpipe	m bgl	4.32	4.51
				mAOD	25.19	25.00
BH109A	30.41	Chester Formation (sandstone)	10.00– 11.00m slotted standpipe	m bgl	24.98	5.43
				mAOD	24.85	5.56
BH111	34.25	Chester Formation (sandstone)	15.00 – 17.00m slotted standpipe	m bgl	9.32	9.55
				mAOD	24.93	24.70

5.4 Soil Aggressivity to Concrete

Tests for pH and sulphate (2:1 water: soil extract) were carried out on soil samples of different strata recovered from the boreholes. A summary of the results is presented in Table 5.4-1:

Table 5.4-1. Summary of the ACEC classifications for different strata

Stratum	Count	Characteristic Value				ACEC & (DS) Classification worst case*
		pH	Water Soluble SO ₄ (mg/l)	Total Sulphur (mg/kg)	Total Potential SO ₄ (%)	
Made Ground (All)	21	7.85	1950	8475	2.54*	AC 5 (DS5)
Made ground without anomalous value	20	7.85	1198	1800	0.54*	AC 2 (DS2)
Alluvium	5	6.9	910	1500	0.45*	AC 2 (DS2)
Groundwater	8	7.45	231*	-	-	AC 1 (DS1)

The results indicate that, in accordance with BRE Special Digest 1 (2005), the Aggressive Chemical Environment Concrete (ACEC) Classification of the site as a whole is AC-5 with a Design Sulphate Class of DS-5, inclusive of one anomalous concentration of Sulphur of 28000mg/kg. If it is possible to isolate the vicinity of the anomaly to the made ground adjacent to the western site boundary (TP107), the overall site classification could be reduced to Class AC-2 with a Sulphate Design Class of DS2. This assessment is based on a brownfield site with the possible presence of pyrite and with mobile groundwater conditions. The classification of the groundwater present at depth within the Cheshire Formation sandstone is ACEC Class AC 1 and Design Sulphate Class DS1.

5.5 Characteristic Engineering Parameters

A summary table of the parameters derived for each soil type is presented in Table 5.5-1 and footnotes are given explaining the derivations. The designer should review these in light of the ground investigation data local to the structure in question and the particular geotechnical analysis that they are undertaking to derive appropriate characteristic values.

When considering the derived values summarised in Table 5.5-1 with a view to selecting characteristic parameters, the designer should bear the following in mind:

- Moderately conservative (approximating to lower quartile values) have been selected with the following exceptions:
 - Made Ground - The made ground would be expected to be highly variable in composition laterally and with depth and as such more conservative parameters have been derived from the available data.
 - Small data sets – More conservative parameters have been selected where available data sets are small.
- The provided stiffness parameters (E_u and E') are moderately conservative values for moderate to high strain levels. Stiffnesses should be selected which are appropriate to the strain level in the ground, the load direction and the level of conservatism appropriate to the analysis. Consideration should be given to sensitivity studies where appropriate.
- The drained friction angles given are peak values. Critical state or remoulded values may be more appropriate for certain analyses.
- When assessing negative skin friction, higher strength parameters should be adopted to derive moderately conservative (high) downdrag actions.
- No parameters have been provided for the Clayey gravelly Made ground. It is suggested that the same parameters be adopted as for the cohesive Made ground where this stratum is encountered.

Laboratory strength and stiffness testing in the cohesive soils has been undertaken on U100 samples rather than UT100 samples. As such they would be expected to exhibit some disturbance and do not fully comply with Eurocode 7 standards

Table 5.5-1. Summary of Derived Parameters

Geological Unit	γ_b^1 kN/m ³	ϕ'_7 Deg	C_u (kPa)	UCS (MPa)	E' (MPa)	E_u (MPa)	E_m (MPa)
Made Ground (Granular) ⁴	18	34 ²	--		23 ³	--	
Made Ground (Cohesive) ⁴	17	28	33 ⁶		3 ⁵	6 ⁵	
Alluvium	17	28	25 ⁹		2.8 ⁸	5 ⁵	
Glacial Till	18	30	60 ⁶		11 ¹²	17 ¹³	
Cohesive Glacio-Fluvial Deposits ⁴	18	28	40 ⁹		3.2 ⁸	8 ⁵	
Weathered Sandstone ⁴	18	40	--		50	--	
Sandstone	23			5 ¹⁰			300 ¹¹

- 1 BS8002 Typical Unit weights for soils of similar description
- 2 Stroud (1989) correlation with N , for $N=23$
- 3 Stroud (1989) Fig 12 $E'=1N$, where $N=23$
- 4 Cautious assessment based on small data set or anticipated high material variability
- 5 CIRIA 143 (1995) $E'=0.6N$ and $E_u=1N$
- 6 Stroud (1989) $C_u=5.5N$
- 7 $c'=0\text{kPa}$
- 8 Based on $E'=1/M_v$ from oedometer test
- 9 Stroud (1989) $C_u=5N$

- 10 Based on Lower quartile of the point load test results and the lowest UCS.
- 11 Tomlinson (2001) - Deformation modulus calculated using $j=0.2$ and $M_r=300$
- 12 Average of $E'=0.6N$ (CIRIA 143) and $E'=270Cu$ (Stroud, 1989)
- 13 Average of $E_u=1N$ (CIRIA 143) and $E_u=400Cu$ (Jamiolkowski, 1979)

5.6 Visual and Olfactory Evidence of Contamination

Concrete was identified down to 0.44m (unproven) at three locations, WC101, WC102 and WC103 in the south east corner of the site.

Made ground was identified at all other locations with inclusions of concrete, brick, metal glass, ceramic, plastic, rebar, timber, cloth, clinker, ash, metal cables, rubber, tarmacadam, breeze blocks.

Borehole logs record a 'very mild hydrocarbon odour from 3.4 – 3.55m' in made ground at BH105. Gravel was of brick, sandstone limestone. No other olfactory evidence was recorded.

A total of 15 samples were screened with a photoionisation detector (PID) and recorded on the borehole logs. All PID readings were <0 ppm.

6. Human Health Risk Assessment

6.1 Introduction to Generic Risk Assessment Methodology

AECOM has adopted a prescribed methodology for assessing risks to human health at a generic level (termed 'generic quantitative risk assessment' (GQRA) or 'Stage 2' in accordance with CLR11 guidance.

For sites where the initial conceptual site model (iCSM) has identified one or more complete contaminant linkage to human health, it is often necessary to clarify the risks posed by that contaminant linkage by comparison of reported soil and groundwater contaminant concentrations with guideline values that represent acceptable concentrations.

The procedures outlined in EA Science Reports SC050021/SR2, SR3, SR4 and SR7 have been adopted in conjunction with the amendments to generic land-use exposure models published in DEFRA research report SP1010 detailing the derivation of Category 4 Screening Levels (C4SL) to select and develop generic assessment criteria (GAC) for soil. This approach has also been adapted to develop assessment criteria for groundwater and soil vapour.

6.2 Selection and Derivation of Stage 2 GAC

6.2.1 Hierarchy of Published Sources

AECOM utilises a hierarchy of published sources for Stage 2 generic assessment criteria for soil.

The hierarchy of published sources are:

- Defra Category 4 Screening Levels (C4SL)
- Land Quality Management (LQM) / Chartered Institute of Environmental Health (CIEH) Suitable for Use Levels (S4UL) for Sandy loam soil
- Environmental Industries Commission (EIC) GAC
- AECOM GAC
- Dutch Intervention Values (IV) and Serious Risk Concentrations (SRC)
- United States Environmental Protection Agency (USEPA) Regional Screening Levels (RSL)

No LQM or EIC values are available for lead, and therefore the published C4SLs for lead are the default soil GAC. Further consideration of Defra SP1010 C4SLs for other substances is made where appropriate, subject to the current limited availability to six substances.

There are no published sources of relevant GAC for non-potable groundwater and soil vapour.

6.2.2 Application of GAC to Site Data

A typical first step is to compare individual soil, groundwater, and/or soil vapour concentrations to the GAC in order to establish whether further more detailed assessment and/or potentially remediation is required. This comparison can be expressed numerically as a Hazard Quotient (HQ):

$$HQ = \frac{\text{Sample Concentration}}{GAC}$$

Dependent on the assessment assumptions and uncertainties, a $HQ < 1$ indicates an acceptable level of risk from the substance being evaluated. The assessment of cumulative risk from multiple substances is not required at a GQRA level with the exception of TPH. In accordance with EA science report P5-080/TR3, a hazard index (HI) is calculated for each individual sample based on the summation of the HQ for each TPH fraction.

Statistical analysis may be warranted, if justified by the available data, to support initial GAC comparisons to individual reported concentrations. For ground investigations of contaminated land sites where judgemental sampling is often employed and representative datasets are small statistical analysis is not typically viable.

In accordance with EA guidance co-authored by AECOM, GAC can be used as a starting point for evaluating long-term risks to human health from substances in soil. They address one specific consideration – long-term adverse effects on human health – and are designed to indicate where long-term (chronic) human health soil exposure risks are considered to be tolerable or minimal. They do not represent the “trigger” for an unacceptable risk under Part 2A of EPA 1990, and they do not address risk related to construction workers, acute exposure, ecology, controlled waters or building materials, they do not inform on the geotechnical suitability of the soil, and they do not inform on the aesthetic quality of the soil – both visual and olfactory. Therefore, the GAC have not been explicitly derived to define remediation standards and are just one component in the assessment of whether soil is suitable for use.

It is good practice to use multiple lines of evidence to support GQRA conclusions.

6.3 Proposed Land Use Scenario

The proposed redevelopment scenario selected for the site is “Commercial land use” (EA, Updated technical background to the CLEA model SR SC050021/SR3, 2009). This generic scenario assumes a typical commercial or light industrial property, multi storey building (three storeys) where employees spend most time indoors involved in office based or relatively light physical work. The critical receptor is a working female adult aged 16 – 65 years old. Exposure duration 49 years (EA, Updated technical background to the CLEA model SR SC050021/SR3, 2009). It is considered that this model appropriately reflects the future use of the Manchester College.

6.4 Exposure Scenario Modelling Parameters

The exposure pathways modelled in CLEA for derivation of the assessment criteria are listed in Table 6.4-1. These are the default exposure pathways for the scenario “Commercial land use” modelled to derive GAC against which to screen site data for this land use.

Table 6.4- 1 Exposure Pathways

Exposure Pathway	Commercial Industrial
Soil and indoor dust ingestion	✓
Dermal contact with dust (indoors)	✓
Dermal contact with soil (outdoors)	✓
Inhalation of dust (indoors)	✓
Inhalation of soil derived dust (outdoors)	✓
Inhalation of soil vapour (indoor and outdoor)	✓
Groundwater vapour inhalation (indoor and outdoor)	✓

In order to provide the most conservative assessment the lowest TOC ≥ 0.58 to $< 1.45\%$ was used. With a soil type ‘Sand’ to calculate the GAC.

It should be noted that Stage 2 assessments tend to be relatively conservative and therefore suitable for screening the potential chronic long term risks to human health at a site.

6.5 Soils Analytical Data

Soil results and environmental laboratory certificates are provided in the Factual Report (Brownfield Solutions Ltd, 2019).

Comparison of the results to appropriate screening criteria can be found in Appendix A.

Of the 28 soil samples taken only one sample at location TP103, was found to contain CoPC (namely polycyclic aromatic hydrocarbons (PAHs)) that exceeded the GAC for human health (See Table 6.5-1). The sample was taken at 0.2m in a sandy gravelly sub base (made ground), 0.1m below a tarmacadam layer. TP103 was excavated with the purpose of exposing the existing foundation of the retaining wall. It is located external to, and east of, the site boundary. As these chemicals are not volatile and the materials are located outside of the proposed development footprint there is not considered to be an unacceptable risk to site users.

Table 6.5- 1 Summary of exceedances at location TP103

CoPC	Concentration mg/kg	GAC mg/kg	HQ (conc/GAC)
benzo(a)pyrene	160	35	4.57
dibenz(a,h)anthracene	22	3.5	6.29
benzo(b)fluoranthene	170	45	3.78
Coal Tar BaP Surrogate	160	15	10.67

6.6 Asbestos in Soils

Asbestos (chrysotile) was detected in seven of the twenty eight soil samples. Of the seven samples in which asbestos was detected, three contained total % asbestos greater than the method limit of detection (see table 6.6-1).

Table 6.6- 1 Asbestos qualitative and quantitative analysis

Location	Depth (m)	Soil description	Location within site	Asbestos containing material type 'detected' (ACM)	Total % asbestos in sample
TP102	1.0	MG: Clayey slightly sandy gravel with high cobble content. Cobbles are partial brick and sandstone with breeze blocks, plastic and rubber.	South of the site.	Loose fibres.	<0.001 – Below method detection limit.
TP109	1.2	MG: slightly sandy gravelly clay. Gravel is fine to coarse of brick, sandstone, quartzite and limestone.	East of and external to the site boundary.	Loose fibres.	<0.001 – Below method detection limit.
TP201	0.5	MG: slightly sandy gravel, medium cobble content. Inclusions of glass, cloth and plastic	North west of the site.	Loose fibres.	<0.001 – Below method detection limit.
TP203	0.9	MG: slightly sandy gravel, medium cobble content. Inclusions of glass, cloth and plastic	North of the site.	Loose fibres.	<0.001 – Below method detection limit.
TP206	0.7	MG: limestone gravel over slightly sandy gravel, medium cobble content. Inclusions of glass, cloth and plastic	Central to the site.	Hard/ cement type material.	0.002
BH105	1.0	MG: limestone gravel over slightly sandy gravel with medium cobble content, cobbles are of brick, with inclusions of timber, rebar, glass, cloth and plastic.	North of the site.	Loose fibres and bitumen.	0.008
BH106	1.0	MG: Limestone gravel over slightly sandy gravel with medium cobble content. Cobbles are whole and partial brick with timber, rebar, glass, cloth and plastic.	Central to the site.	Bitumen	0.002

The soil results for asbestos are shown in the environmental laboratory certificates provided in the Factual Report (Brownfield Solutions Ltd, 2019).

6.7 Groundwater Analytical Results

Groundwater results were compared to appropriate human health screening criteria to assess the effects of ground water vapours on human health (commercial land use). All volatile CoPCs assessed within this screening criteria were below the method detection limit, therefore no unacceptable risks were identified.

6.8 Discussion of Results

Only one soil sample (TP103) contained PAHs, benzo(a)pyrene, benzo(b)fluoranthene and dibenz(a,h)anthracene above the human health, commercial land use, screening criteria. The exceedances were at depth 0.2m within a made ground, sandy gravel sub base, beneath a layer of tarmacadam. Currently, as the exceedances were identified in a sample below the tarmacadam layer it is unlikely that the CoPCs will be inhaled, ingested or come into dermal contact and therefore the risk is low in the current or any future land use exposure scenario. Although the tarmacadam layer is likely to be the source of PAH's to the layer below. As TP103 is external to the site boundary there are no plans to excavate at this location. Therefore, this location will remain as it currently stands and is not considered to present an unacceptable risk to future site users.

Asbestos fibres were detected in soil samples at seven locations (Table 6.6-1) but only quantifiable in three of those locations. These locations were spread throughout the site, within the made ground. With regards the future landuse setting it is unlikely that site users would come into contact with soils containing asbestos.

All groundwater chemical samples were below the human health commercial/ industrial land use screening criteria indicating there is not an unacceptable risk to human health from vapours.

6.9 Identification and Management of Acute Risks

The chronic Human Health Risk Assessment presented within this report does not provide a risk assessment with regards to acute risks to construction and maintenance workers.

Asbestos risks to human health will need to be managed by reference to the Control of Asbestos Regulations (CAR and specifically the CARSOIL Guidance) and suitable risk assessments for earthworks undertaken.

It is recommended that prior to any earthworks commencing, an appropriate health and safety risk assessment, in accordance with Construction Design Management 2015, should be carried out with regards to acute risk, by the Principal Contractor, in accordance with current health and safety regulations. This assessment should cover potential risks to both construction staff and the local population. Based on the findings of this risk assessment, appropriate mitigation measures should be implemented during the construction period (e.g. in general accordance with CIRIA C552).

7. Controlled Waters Risk Assessment

7.1 Groundwater and Surface Water Generic risk assessment methodology

AECOM has a prescribed methodology for assessing risks to controlled waters at a generic level, termed 'generic quantitative risk assessment' (GQRA) or 'Stage 2' in CLR11 (EA, 2004).

For sites in England and Wales where the conceptual site model has identified a potentially complete contaminant linkage to controlled waters, the first step is to define a suitable water target value (WTV) for the identified point of compliance upon which the risk assessment can be based. For groundwater compliance points the drinking water standard (DWS) is used in England and Wales while for surface water compliance points an environmental quality standard (EQS) is adopted.

For England and Wales, Stage 2 WTV have been selected following the Level 1 assessment methodology detailed in the EA's Remedial Target Methodology (RTM).

7.1.1 Selection of Stage 2 WTV

Selection of DWS Criteria for England and Wales

- United Kingdom drinking water standards.
- European Union (EU) drinking water standards.
- World Health Organisation (WHO) drinking water standards.

In addition, for some compounds other criteria have been considered, although these are also not published standards, such as:

- Published taste or odour data which are relevant for aquifers used for potable supply have been selected for oxygenates such as MTBE which are known to have taste and odour thresholds which are significantly lower than toxicity based criteria.
- WHO (2008) proposals for drinking water guidelines which are based on the TPHCWG approach for TPH fractions.

Selection of EQS Criteria for England, Scotland and Wales.

The selection process used to determine the freshwater and coastal EQS is presented below in order of preference:

- United Kingdom environmental quality standards including SEPA WAT-SG-53.
- PNEC derived for EU REACH registration dossiers/chemical safety reports (via the Fuel Ether REACH Consortium FERC).

When an EQS or PNEC is not available, a GAC will not be set. However, for a number of sites where groundwater has the potential to provide base-flow to surface water, the groundwater may also have resource potential and therefore also be screened against DWS based standards.

7.1.2 Stage 2 Assessment for Groundwater Data

The Stage 2 assessment involves the comparison of measured groundwater concentrations against the WTV. If the concentrations are below the water target concentrations, then the risks are considered insignificant. If the concentrations in the source are above the WTV, there is a potentially unacceptable risk to groundwater or surface water which requires further qualitative or quantitative assessment.

Whilst the hierarchies detailed above are appropriate for most sites there may be site specific conditions which require review of alternative criteria to be adopted, i.e. where an aquifer is located in an area of low environmental sensitivity and/or is considered unlikely to be utilised for potable supply or to provide base-flow to surface water. Where alternative criteria have been considered this will be highlighted.

7.2 Selection of Appropriate Controlled Waters Criteria Values

The underlying shallow superficial deposits are a mix of Secondary (undifferentiated) aquifer to the east of the site and Secondary A aquifer to the west (DEFRA). The secondary A aquifer is described by the Environment Agency as “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”. It may be, therefore, that the shallow groundwater is in connectivity with the surface water of the River Irwell, as the river is located approx. 150m south west of the site boundary.

The underlying sandstone bedrock is a Principal Aquifer. Although, the site is not within a SPZ (DEFRA). The number and type of groundwater abstractions locally are unknown. As this aquifer “may support water supply and/ or river base flow on a strategic scale”, to allow for a conservative screening assessment, the soil leachate and groundwater data has been screened against DWS and EQS values.

The results are interpreted to assess potential risks to controlled waters. It should be noted that for a risk to be present then a relevant contaminant linkage must be present.

7.3 Soil Leachate Analytical Results

Nine soil samples were submitted for leachate analysis and compared to appropriate DWS and EQS screening criteria. The environmental laboratory certificates showing soil leachate results are provided in the Factual Report, (Brownfield Solutions Ltd, 2019). The screening tables are in Appendix A.

The majority of compounds analysed for were not identified at concentrations above the laboratory method limit of detection. All exceedances of DWS and EQS WTV were for metals.

Arsenic (As) was found to exceed DWS at two locations BH101, 0.6m, within made ground (sandy, gravelly clay) to the east of the site and BH105, 3.5m, within made ground (sandy, clayey gravel) to the north of the site. Three of the nine samples analysed for As were over the MDL. The average of the three As detections was 15.8 µg/l, just above the DWS for As 10 µg/l (Table 7.3-1).

Table 7.3- 1 Summary of arsenic data where exceedances of DWS were detected for leachate samples from made ground.

Determinand	All Data Summary				DWS µg/l	n > DWS	HQ Range (of 3 samples)
	n	Min µg/l	Mean (of 3 detects) µg/l	Max µg/l			
As	9	<1.1	15.8	33	10	2	0.35 – 3.3

Five metals copper (Cu), lead (Pb), nickel (Ni), vanadium (V), zinc (Zn) exceeded EQS screening levels, at nine locations (BH101 0.6m, BH102 0.5m, BH103 2.5m, BH105 3.5m, BH106 3.5m, BH108 1.2m, BH111 1.0m, TP105 0.6m, TP108 0.5m) throughout the site. All exceedances were within made ground.

As leachates showed low levels of metal contamination in made ground throughout the site, in order to establish whether land is suitable for use under the land use planning system statistical analysis was undertaken following Chartered Institute of Environmental Health guidance on comparing soil contamination data with a critical concentration (CIEH, 2008).

Of the five metals that underwent statistical analysis three metals (Pb, Ni and V) contained concentrations that were below the method MDL. Since a ‘less than’ value cannot be used to compute the key statistics, a value of 50% of the MDL was used i.e. for a MDL of 1 µg/l the value was set at 0.5 µg/l. In line with (CIEH, 2008) because >15% of each data set (2 of the 9 samples) represented non-detects the sensitivity of changing the MDL value was tested. This was carried out by assessing the % change in mean value of the concentration data with (i) non detects set at 50% of the MDL and (i) non detects set at zero. For all three metals the % difference in the mean was <2%. Therefore, setting the non-detects at 50% of the MDL was deemed not to critically alter the outcome of the statistical results (CIEH, 2008).

Outlier values were identified during the statistical analysis for Cu, Pb, Zn and V. However, it could not be demonstrated that the outliers were due to an error in sample strategy or lab analysis and therefore the 'outliers' were included in the data set (CIEH, 2008). The only exception is for V where an outlier (100 µg/l) an order of magnitude higher than the other concentration values was detected at BH105, 3.5m. This concentration was excluded from the data set. It is possible that this location represents a 'hot spot' of contamination with regards to V. Other metal exceedances within this sample were high (but not deemed to be outliers because there were similar concentrations of these metals at other locations). Furthermore, one of the two As, DWL exceedances noted above was detected at this location and the borehole logs indicate that there was a mild hydrocarbon odour at 3.5m.

In order to assess the suitability of land under a planning scenario, the statistical test carried out determines if there is a 95% probability that the true population mean falls below the critical concentration (the critical concentration is the EQS). The test involves comparing the 95th upper confidence limit (UCL95) of the true population mean with the critical concentration and deciding if the difference is due simply to chance or is statistically different (CIEH, 2008).

The question relating to this analysis is: Is there sufficient evidence that the true mean concentration of the contaminant metals is less than the critical concentration (EQS)?

- Null hypothesis (H_0) = the true mean is equal to or greater than the critical concentration.
- Alternative hypothesis (H_1): the true mean is less than the critical concentration.

The results of the statistical analysis shown that for Cu and Pb the population mean is higher than the critical concentration (in this case the EQS). As the UCL95 is higher than the population mean, the UCL95 will therefore be higher than the critical concentration. There is no need to continue with further statistical analysis. It can therefore be concluded that it is not possible to reject the H_0 .

For Ni (90% confidence) and Zn (80% confidence) the UCL95 is higher than the critical concentration (EQS). Therefore, the H_0 cannot be rejected. The confidences are lower than 95% and therefore, these results may be less reliable than at a 95% confidence level.

For V, (96% confidence) the UCL95 is less than the critical concentration. The H_0 can be rejected for the H_1 .

The results of the statistical analysis for Cu, Pb, Ni and Zn indicate that the true mean concentration of the metals may be equal to or greater than the EQS. For V, the true mean is less than the critical concentration, with the exception of location BH105 at 3.5m.

The results indicate therefore that in its current state the land on site may not be suitable for use under the land use planning system (CIEH, 2008) due to potential risks to controlled waters. This is discussed further in the discussion section below.

Note: Mercury (Hg) and hexavalent chromium (CrVI) were below MDL, with the exception of one sample for CrVI (33 µg/l) an order of magnitude over the EQS of 3.4 µg/l at location BH103, 2.5m. The MDL for these metals is higher than the EQS and therefore, it cannot be determined if these metals truly exceed EQS.

7.4 Groundwater Analytical Results

Eight water samples were taken from boreholes across the site where standpipes were installed (BH101, BH102, BH103, BH106A, BH107, BH108, BH109A and BH111). Samples were submitted for groundwater analysis and compared to appropriate DWS and EQS WTV screening criteria. The laboratory analytical results are presented in the Factual Report, (Brownfield Solutions Ltd, 2019). The screened data is in Appendix A.

The majority of compounds were not detected above MDL.

There were no exceedances of DWS identified in groundwater samples.

There were six exceedances of EQS for Cu in groundwater samples identified at locations BH101, BH102, BH103, BH107, BH108, BH109A which supports the findings of the leachate data where Cu was considered to be a potential risk to controlled waters. No other EQS exceedances were identified.

A summary is presented in Table 7.4-1.

Table 7.4- 1Summary of Cu data where exceedances of EQS were detected for groundwater samples

Determinand Metals (µg/L) and Inorganics (mg/L)	All Data Summary				EQS (fresh) µg/l	n > EQS	HQ Range (of 7 detects)
	n	Min µg/l	Mean (of 7 detects) µg/l	Max µg/l			
Copper (filtered)	8	<0.5	1.97	3	1	6	0.8 - 3

7.5 Discussion of Results

Soil leachate analysis was carried out on nine soil samples from nine locations across the site. Five metals copper (Cu), lead (Pb), nickel (Ni), vanadium (V), zinc (Zn) exceeded EQS screening levels. All soil samples contained metal exceedances. All exceedances were within made ground.

In order to establish whether land is suitable for use under the land use planning system, statistical analysis was undertaken following Chartered Institute of Environmental Health guidance on comparing soil contamination data with a critical concentration (CIEH, 2008). The results indicate that concentrations of a small number of metals were greater than the EQS in soil leachates and therefore in its current state the land may not be suitable for use under the land use planning system (CIEH, 2008).

Ground water analysis was carried out on eight ground water samples taken from boreholes located across the site. Six exceedances of EQS for Cu in groundwater samples were identified at locations BH101, BH102, BH103, BH107, BH108, BH109A.

Groundwater contour analysis was carried out and a contour plot is provided in section 5. The results indicated that it is plausible that there is connectivity between the groundwater on site and the River Irwell.

The ground water level is below the depths of the soil leachate exceedances identified (maximum depth 3.5m). However, as ground water EQS exceedances were identified for Cu the results indicate that there is currently a pathway for Cu to leach from the soils into ground water. No other metals were found to exceed EQS or DWS within groundwater.

As the groundwater is located in the bedrock strata, designated as a principal aquifer it is possible that the groundwater may be providing other sources of water regionally. Therefore there are implications with regards to the environmental risk the site may currently pose if future abstraction was considered.

It is understood that as part of the planned works, the preferred reclamation strategy is for the made ground may be excavated and returned to site to create a development platform. If the material is to be returned to the site it is possible, based on statistical analysis, that metals such as Cu, Pb, Ni, V and Zn identified in the soil leachate may pose an environmental risk. Currently, with the site in its current state, the results indicate that there may be a pathway for Cu to be leached from soils to deep groundwater. However, the proposed reclamation strategy for the site will require the the existing made ground to be excavated removing obstructions and replaced to create the development platform and therefore any gross contamination will be managed through an inspection/ discovery strategy. Furthermore, the college development will comprise hardstanding which will limit the potential for chemicals to leached from the unsaturated zone where it will be placed to the ground water aquifer unit.

Given the mitigation which will be embedded in the proposed development plan it is not considered that further investigation or remediation is required for this pollutant linkage.

8. Ground Gas Risk Assessment

8.1 Approach to Assessment

The generation or migration of ground gases from man-made or natural sources can pose a major hazard to buildings or other structures if the gases are able to accumulate within confined spaces. In terms of the proposed development, the main risks are that ground gases may accumulate in confined spaces in future site infrastructure.

It is understood that the proposed college will comprise of a multi-story building and an atrium centrally placed. There are plans for a soft landscaped area to the north of the site. Most of the site will be covered in hard standing. However, there may be potential for the build-up of ground gas in any enclosed spaces. In order to determine whether gas generation is occurring at a significant rate within the site, a ground gas monitoring programme was implemented based upon the British Standard code of practice BS8485:2015 (BSI, 2015) including assessment based upon the CIRIA Report C665, 2007.

In accordance with BS8485:2007 the timing of these visits was designed to provide gas monitoring results across a range of atmospheric pressures and conditions including low and falling pressures. Borehole gas screening values (calculated from the borehole flow rate multiplied by the concentration of the particular gas being considered, as defined by Wilson and Card, 1999) were then compared to BS8485:2015 (BSI, 2015).

The calculations of gas screening values should be carried out for both methane and carbon dioxide and the worst-case adopted in order to establish the appropriate protection measures. Any further considerations will typically take into account factors such as the value of the gas concentrations and/or the flow rate, the robustness of the data, the source characteristics and the specifics of the development. The BS8485 guidance suggests that monitoring should be undertaken at low (less than 1000mb) or falling atmospheric pressures in order to obtain worse case gas concentrations and flow rates.

8.2 Data Collection

Two rounds of ground gas monitoring have been undertaken on eight wells. Seven wells on 11th July 2019 (BH106 had access blocked) and eight wells on 23rd July 2019. Gas monitoring response zones varied from a minimum depth of 0.5 m (BH101 and BH103) to a maximum depth of 4 m (BH107). The response zones for five locations were in MG to a maximum depth of 4 m (BH107). Three boreholes had response zones that included natural strata described as sandy / gravelly CLAY (BH101, BH109 and BH111) to a maximum depth of 2.5m (BH111).

8.3 Ground Characteristics Influencing Gas Regime Classification

A proposed pragmatic approach to ground gas assessment that can be used in conjunction with gas monitoring to reduce the period of monitoring required is addressed in CL:AIRE research bulletin, a pragmatic approach to ground gas risk assessment (CL:AIRE, A Pragmatic Approach to Ground Gas Risk Assessment, 2012). This involves measuring the total organic carbon content, thickness and nature of made ground. The approach is advised for 'low risk' sites.

The TOC content of made ground from 15 locations across the site (BH101, BH102, BH103, BH105, BH106, BH108, BH110, BH111, TP102, TP106, TP107, TP108, TP201, TP203, TP206) was assessed.

Table 8.5- 12 TOC % content of MG samples taken from across the site

MG general description	Min TOC	Average TOC	Max TOC	Depth (m)	Locations	Number of samples
Sandy gravelly CLAY	0.42	0.69	1	0.6 – 2.5	BH101, BH102, BH103, BH108 and BH111	5
Sandy GRAVEL	0.75	1.28	1.8	0.5 – 3.5	BH106, TP107, BH102, TP201, TP203, TP102, BH105, BH106	8

*gravel is generally described as brick, sandstone and limestone

In addition to Table 8.5-2, two samples were described as gravelly SAND (TP108 and TP106 both 0.5m depth) one contained a TOC content of 0.88% (BH108) and the other a TOC content of 3% (BH106). At the latter location cobbles were described to have inclusions of tarmacadam.

Furthermore, two samples TP206 and BH110 were described as 'limestone Gravel', 0.5 – 0.7m depth. TOCs contents 1.2% (BH110) and 1.7% (TP206). The limestone may have contributed to the TOC content. However, limestone was described as a top layer over reddish sandy Gravel within made ground. Therefore, limestone Gravel is not considered representative of the total TOC within the MG on site and has not been included in the calculations in Table 8.5-2.

The characteristic situation of the site based on TOC content in made ground was assessed taking into consideration Table 1 in report RB17 (CL:AIRE, A Pragmatic Approach to Ground Gas Risk Assessment, 2012). For the assessment the made ground must have a maximum thickness of 5 m and average <3 m. The thickness of the made ground at the site fit with this. The proven thickness of made ground assessed in the boreholes ranged from 1.3 – 5 m (average 2.9 m).

The TOC value chosen for the assessment is 0.99% this is the average of the two described strata in Table 8.5-3, sandy gravelly CLAY and sandy GRAVEL within the made ground. The strata descriptions are considered representative of made ground throughout the site. Therefore the average TOC % is considered representative of levels across the site.

As the old Boddingtons Brewery building was demolished <20 years ago the TOC content at the site was compared to the TOC content in RB17 Table 1, for made ground <20 years old.

Based on the above, the results indicate that the characteristic situation at the site is CS1.

Table 8.5- 23 – Summary of characteristic situations based on gas monitoring and TOC%

Nature of gas source	Gas concentration and flow rates used to calculate GSV	GSV / Characteristic situation	TOC content/ Characteristic Situation from Table 1 RB17	Comments
MG – Average depth 2.9 m	0% methane 1.5% carbon dioxide (max) 0.5 l/h (max)	0.000 methane 0.015 carbon dioxide / CS1	0.99% / CS1	Made Ground placed <20 years ago

Based on this assessment CS1 protection measures in accordance with BS8485 are recommended. During site reclamation, if made ground is to be removed and replaced an inspection/ discovery strategy should be employed to observed materials with the potential for gas generation e.g. putrescible materials and these should be managed appropriately.

8.4 Ground Gas Monitoring Results and Discussion

The gas monitoring results are presented in Appendix A at the rear of the report and a summary of the monitoring round is presented below in Table 8.3-1. To confirm the CS1 assessment recommended from the review of TOC and made ground properties two additional rounds of ground gas monitoring were undertaken.

Table 8.3- 1 Ground Gas Monitoring data per monitoring round.

Round No.	Date	Steady State (Maximum) Methane %v/v	Steady State (Maximum) Carbon Dioxide %v/v	Steady State (Minimum) Oxygen %v/v	Maximum Flow Rate (L/h)
Round 1	11/07/2019	0.0	0.8	2.4	1
Round 2	23/07/2019	0.0	1.5	4.1	0.3

The maximum flow rate detected at all locations over the two monitoring rounds was 0.5 l/h at BH101, depth 0.5-1.5m in made ground, plus 0.05m of natural sandy clay. The maximum flow rate had declined to 0.3 l/h for round 2 (BH101). Methane was not detected during either round. The maximum carbon dioxide detected for round 1 was 0.8% at BH101 and 1.5% at BH103. Oxygen was between 18.1% and 20.6% at all locations with the exception of BH101, that had a depleted oxygen level of 2.4% (round 1) rising to 4.1% (round 2) (depths and strata as previously described for BH101). The potential for depleted oxygen to be present in excavation should be considered for construction workers.

Concentrations of hydrogen sulphide and carbon monoxide were not encountered at detectable levels at any location during both rounds.

The classification of the gas regime is based upon a location specific gas screening value (GSV). The GSV for each location is calculated as the gas flow rate in l/h multiplied by the gas readings as a fraction of the volume. The GSVs for carbon dioxide and methane for each round of monitoring at the site are calculated below in Table 8.5-1.

Using the GSV, characteristic situations (CS) between 1 (very low risk) and 6 (very high risk) for either carbon dioxide or methane are derived using Table 2 from BS8485 (BSI, 2015). The CS values have been calculated based on a 'worst case basis' for each round, and for both rounds combined (BSI, 2015). The worst case check involves multiplying the maximum flow in any standpipe with the maximum gas concentration in any standpipe (but discounting any peak instantaneous flow). The results are present in Table 8.5-1.

Table 8.5-34 Gas Screening Values & Characteristic Situation for each phase for methane and carbon dioxide

Phase No.	Max Carbon Dioxide (%)	Max Methane(%)	Methane GSV	Carbon Dioxide GSV	Characteristic situation
Round1 – 17/07/2019	0.8	0	0	0.004	1
Round2 – 23/07/2019	1.5	0	0	0.005	1
Round 1 and 2	1.5	0	0	0.008	1

The characteristic situation for the site within strata assessed is confirmed to be CS1. This indicates ground gas as the site poses a very low hazard potential (BSI, 2015).

Two borehole monitoring rounds were undertaken for the ground gas assessment and it is possible that the frequency of monitoring may not have been sufficient to characterise the consistency or inconsistency of the gas regime over the monitoring period.

9. Hazardous Waste Assessment

Classification report was run on 28 soil samples (HazWasteOnline, 2019).

The results show that five soil samples (TP109 1.2m, BH105 1m, TP106 0.5m, TP206 0.7m, TP103 0.2m) were classified as hazardous due to their carcinogenic (HP7) and mutagenic (HP11) properties resulting from high concentrations of TPH (C6 – C40) petroleum group (1160 – 7600 mg/kg).

Additionally, one of the five soil samples (TP103, 0.2m) was classified as hazardous due to their carcinogenic (HP7) and mutagenic (HP11) properties resulting from high concentrations of total PAHs (1400 mg/kg). This location is off site and there are no plans to excavate at this location.

The results are in the Factual Report (Brownfield Solutions Ltd, 2019).

10. Revised Conceptual Site Model and Risk Assessment

10.1 Introduction

This revised CSM has been updated based on the findings of the intrusive investigation and is summarised below.

10.2 Sources: Chemicals of Potential Concern (CoPC)

Human health

S1. Soils - benzo(a)pyrene, dibenz(a,h)anthracene, and benzo(b)fluoranthene, asbestos (one location)

Controlled Waters - Groundwater

S2. Soil leachate

- DWS – Arsenic (two locations)
- EQS – Copper, lead, nickel, vanadium and zinc (nine locations)

Groundwater

- EQS - Copper (eight locations)

Ground Gas associated with anthropogenic ground

S3. Ground gas associated with anthropogenic ground

10.3 Potential pathways

P1. Dermal contact / ingestion

P2. Particulate ingestion

P3. Vertical migration of CoPC to deep groundwater – sandstone Principal Aquifer

P4. Vertical/ lateral migration of groundwater/ hydraulic continuity with River Irwell

P5. Vapour inhalation due to Gas migration into enclosed spaces

10.4 Receptors

R1. Site users – Site workers (chronic), visitors and general public (acute) - current

R2. Site users – Site workers/ students (chronic) and future site visitors (acute) - future

R3. Controlled water – Ground Water Bedrock: Sandstone Principal Aquifer – current

R4. Controlled water – Ground Water Bedrock: Sandstone Principal Aquifer - future

R5. Controlled water – Surface water – River Irwell – current

R6. Controlled water – Surface water – River Irwell – future

10.5 Contaminant Linkages and Risk Evaluation

Current best practice recommends that the determination of hazards due to contaminated land is based on the principle of risk assessment, as outlined in the Environment Agency guidance on Model Procedures for the Management of Land Contamination (CLR11).

For a risk to be present, there must be a viable contaminant linkage; i.e. a mechanism whereby a source impacts on a sensitive receptor via a pathway.

Assessments of risks associated with each of these contaminant linkages are discussed in the following sections.

Using criteria broadly based on those presented in the Construction Industry Research and Information Association publication C552 (CIRIA 2001) and R&D 66 (NHBC/EA/CIEH, 2008), the magnitude of the risk associated with potential contamination at the site has been assessed. To do this an estimate is made of:

- The magnitude of the potential consequence (i.e. severity);
- The magnitude of probability (i.e. likelihood).

The severity of the risk is classified according to the criteria in Table 10.5-1 below;

Table 10.5- 1Risk Severity

Severe	Acute risks to human health likely to result in “significant harm” (e.g. very high concentrations of contaminants/ground gases) Catastrophic damage to buildings/property (e.g. by explosion, sites with high gassing potential, extensive VOC contamination) Major pollution of controlled waters (e.g. surface watercourses or major aquifers/source protection zones) Short term risk to a particular ecosystem
Medium	Chronic (long-term) risk to human health likely to result in “significant harm” (e.g. elevated concentration of contaminants/ground gases) Pollution of sensitive controlled waters (e.g. surface watercourses or major/minor aquifers) Significant effects on sensitive ecosystems or species
Mild	Pollution of non-sensitive waters (e.g. smaller surface watercourses or non-aquifers) Significant damage to crops, buildings, structures or services (e.g. by explosion, sites with medium gassing potential, elevated concentrations of contaminants)
Minor	Non-permanent human health effects (requirement for protective equipment during site works to mitigate health effects) Damage to non-sensitive ecosystems or species Minor (easily repairable) damage to buildings, structures or services (e.g. by explosion, sites with low gassing potential)

The probability of the risk occurring is classified according to the criteria shown in Table 10.5-2.

Table 10.5- 2 Risk Probability

High Likelihood	Contaminant linkage may be present that appears very likely in the short-term and risk is almost certain to occur in the long term, or there is evidence of harm to the receptor
Likely	Contaminant linkage may be present, and it is probable that the risk will occur over the long term
Low Likelihood	Contaminant linkage may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
Unlikely	Contaminant linkage may be present but the circumstances under which harm would occur even in the long-term are improbable.

An overall evaluation of the level of risk is gained from a comparison of the severity and probability, as shown in Table 10.5-3.

Table 10.5-3 Risk Evaluation

		Severity			
Likelihood		HIGH	MEDIUM	MILD	MINOR
	HIGH	Very High	High	Moderate	Moderate/Low
	LIKELY	High	Moderate	Moderate/Low	Low
	LOW	Moderate	Moderate/Low	Low	Very Low
	UNLIKELY	Moderate/Low	Low	Very Low	Very Low

The contaminant linkages which have been identified on the site are presented in Table 10.5-4 along with an evaluation of the potentially associated risks. The level of risk is determined based on the current condition of the site not including the effects of any mitigation measures.

Table 10.5- 4 Potential contaminant linkages

Source	Pathway	Receptor	Potential Severity	Likelihood of Occurrence	Level of Risk	Discussion
S1. CoPC within the Anthropogenic ground and from historical land uses	P1. Dermal contact and ingestion	R1. On-site Receptors – Current: Human health: Site workers (chronic) visitors and general public (acute).	Mild	Unlikely	Very Low	1. The Site is currently a car park. The only CoPCs (PAHs) were identified beneath a tarmac layer at one location (TP103) that is east of and external to the site boundary.
		R2. On-site Receptors – Future: Human health: Future site visitors (acute). Human health: Future site workers/students (chronic).	Mild	Unlikely	Very Low	2. As the location will not be excavated it will remain as it is, post construction, and the risk remains the same, 'very low'.
	P2. Inhalation of particulates	R1. On-site Receptors – Current: Human health: Site workers (chronic) visitors and general public (acute).	Medium	Unlikely	Low	3. See discussion 1. Asbestos containing material was identified in seven of the twenty eight soil samples. Although it was only quantified at three locations. A risk assessment in accordance with the CAR 2015 should be undertaken.
		R2. On-site Receptors – Future: Human health: Future site visitors (acute). Human health: Future site workers/students (chronic).	Medium	Unlikely	Low	4. Post construction the site will be covered in hard standing and the likelihood of inhalation of particulates is unlikely, although the severity is medium. Therefore, the risk is low.
S2. CoPC in leachate generated from Anthropogenic ground and historic land use	P3. Vertical migration of CoPC to deep groundwater – sandstone Principal Aquifer	R3. Current: Ground Water Bedrock: Sandstone Principal Aquifer	Medium	Likely	Moderate	5. Soil leachate analysis showed two exceedances of DWS for arsenic and low level EQS exceedances of five metals (Pb, Cu, Zn, Ni, V). Of these only Cu was found to exceed EQS in drinking water. Results indicate that there is currently a pathway for Cu to leach from the soils into ground water. The groundwater aquifer is a Principal aquifer and therefore may provide a regional source of water. The area is not within a source protection zone. However, numbers and use of abstraction wells within 1km are unknown. The severity therefore is considered medium and the occurrence likely therefore the risk is moderate.

Source	Pathway	Receptor	Potential Severity	Likelihood of Occurrence	Level of Risk	Discussion
		R4. Future: Ground Water Bedrock: Sandstone Principal Aquifer	Medium	Unlikely	Low	6. See discussion 5. To facilitate construction there are plans to excavate and replace the made ground to site above the water table. The site will be covered in hard standing and therefore less likely that there will be vertical migration of CoPC to deep ground water. However, if the CoPCs identified in the leachate are still present there may still be a risk. Likelihood is considered unlikely, severity medium and therefore the risk is considered low.
	P4. Vertical/ lateral migration of groundwater / hydraulic continuity with River Irwell	R5. Current: Surface water - River Irwell	Medium	Likely	Moderate	7. See discussion 5 Ground water contours indicate that there may be connectivity between ground water and the River Irwell. There may be subsequent impacts to the Irwell, therefore the severity is considered medium and the occurrence likely therefore the risk is moderate.
		R6. Future: Surface water - River Irwell	Medium	Unlikely	Low	8. See discussion 6.
S3. Ground gases associated with the Anthropogenic ground	P5. Vapour inhalation due to Gas migration into enclosed spaces	R1. On-site Receptors – Current: Human health: Site workers (chronic) visitors and general public (acute).	Minor	Unlikely	Very Low	9. Based upon the GSVs calculated for the site from the gas monitoring program the site has been classified as CS1 very low hazard potential with no gas protection measures are required.
		R2. On-site Receptors – Future: Human health: Future site visitors (acute). Human health: Future site workers/students (chronic).	Mild	Low	Low	10. See discussion 9, there is no reason based on the ground investigation information obtained to reason that the ground gas characteristic situation would change from CS1. If circumstances are found to be different to those identified then the ground gas characterisation should be reviewed.

10.6 Discussion of Risks to Construction Workers & Off-site Receptors during construction works.

AECOM understands that the proposed development works will be undertaken in compliance with Construction Design and Management (CDM) 2015 regulations.

Prior to work commencing, a health and safety risk assessment should be carried out by the appointed Principal Contractor / developed in accordance with current health and safety regulations. This assessment should cover potential risks to construction staff, permanent site staff and the local population. Based on the findings of this risk assessment, appropriate mitigation measures should be implemented during the construction period.

The greatest potential for generation of dust will be during the site works and therefore dust generation should be kept to a minimum in accordance with general best practice, as outlined in, for example, 'Environmental Good Practice on Site', CIRIA Publication C692 to reduce this risk. The risk to construction workers during the excavation and construction phases in terms of potential exposure to high concentrations of contaminants is considered to be low given the historic and current land uses identified at the site.

Asbestos containing material was identified in seven soil samples. During the construction phase anthropogenic ground across the site will be exposed. Anthropogenic ground found to be contaminated with asbestos should be reviewed during the construction phase and suitable mitigation measures be put in place such as removal / capping prior to any potential development.

11. Engineering Assessment of Ground Conditions

11.1 Proposed Development

The proposed development will comprise a new building to house the media studies centre at The Manchester College. It is proposed that the northern part of the site will become a green zone with landscaping, and the majority of the site to the south will comprise a multi storey building which will form a square around a central roofed atrium.

11.2 Ground Model

The ground model can be divided into two distinct characteristic ground profiles:

The western part of the site (occupying a strip approximately 20m wide adjacent to the western site boundary), southern and south eastern parts of the site. These areas are underlain by a relatively thin layer of made ground, between 0.85m thick (TP105) and 2.95m thick (BH103). These areas were formerly occupied by terraced housing, and along the western side, more recently by the Brewers Arms and other small buildings associated with the former Boddingtons Brewery. Concrete slabs are located at the surface, and buried concrete slabs are also present at shallow depth, typically approximately 1m. The made ground is underlain by superficial deposits which rest on the underlying sandstone of the Chester formation.

The central and northern part of the site. This area was the site of the main brewery buildings, many of which had basements with concrete floor slabs. These areas are underlain by a much thicker layer of made ground which has a thick concrete slab at its base in some locations, where the floor slabs of the basement of the former brewery have been left intact. The depth to the base of the made ground, including concrete floor slabs ranges between 4.40m (BH104) and 5.00m (BH105). Concrete slabs may also be found at surface or at shallow depth. Made ground or concrete slabs generally overlie sandstone of the Chester Formation.

11.3 Geotechnical Constraints

The principal geotechnical constraint is that the made ground is of highly variable consistency, and contains many buried obstructions including both intact floor slabs and large fragments of demolition rubble, and objects buried during the levelling of the site. As a result, it is unsuitable as a founding material in its present condition, and because of the obstructions it is not practicable to improve, or to pile through the made ground in its present condition.

In those areas of the site at which the made ground is thin, the natural superficial deposits are variable in nature, and the upper part comprises mostly soft alluvial clay. Although glacial till which forms the lower part of the superficial deposits is stiffer, it includes cohesive and granular glacio-fluvial deposits that are soft or loose and is unlikely to provide a suitable founding stratum for the large multi-storey building proposed. Unlike the made ground it is likely to be feasible to carry out ground improvement, or to pile through the natural superficial deposits.

There is a localised thick layer of gravel recorded below the made ground at BH109/ BH109A. This is below rock head level across the remainder of the site. The extent is not known, and this could impact on the design of piles and selection of pile type where present beneath the site. It is therefore recommended that this feature is investigated thoroughly at the detailed design stage.

A further constraint to the development is the existing retaining wall along the southern boundary. This will require removal and replacement with a new retaining structure closer to the southern site boundary.

11.4 Groundwater

Groundwater monitoring instruments have been installed within the sandstone of the Chester Formation encountered beneath the site. These indicate that the groundwater level is generally just below the base of the made ground in the area of the main building of the former brewery, and just below the top of the sandstone of

the Chester Formation. This is unlikely to present a constraint on the development at the construction stage. However, the general increase of groundwater levels over the long term, must be considered for detailed design.

One groundwater strike was encountered in glacial till within the site, this is an isolated occurrence and is likely to be due to a small body of perched water trapped within impermeable glacial till.

11.5 Foundations Assessment

11.5.1 Foundation Options

The variability and obstructions within the made ground and nature of the superficial deposits precludes the use of shallow spread footings for supporting the projected loads.

This will therefore require a deep foundation solution.

Options available for remediating and improving the ground on the site in combination with deep founding solutions are:

- No Ground improvement. Piling from existing ground level;
- Excavation of the existing made ground, processing and reusing the made ground by placing the processed material without full compaction to a specification. Then improving the replaced ground and superficial deposits remaining above rock head by installing stone columns, or other ground improvement measures, to produce suitable material for supporting a piling platform and ground bearing floor slabs, and piles to support building columns.
- Excavation of the made ground and processing and compacting the material into place in thin layers in accordance with the Highways Specification 600 series – Table 6.4. to produce a surface suitable to support a piling platform and ground bearing floor slabs, and piles to support building columns.
- Excavating the made ground and superficial deposits to rock head and incorporating a basement into the building and constructing foundations at basement floor level. Consideration could be given to adopting raft foundations bearing onto the sandstone bedrock, or alternatively, short piled foundations socketed into bedrock

These options are described and discussed in more detail in Section 12.

11.6 Retaining Walls

Two retaining walls are located on the site. These were probably once a single retaining wall that has subsequently been split by the construction of a ramp used for vehicular access to an upper level to the east of the site. A small retaining wall starts from almost zero height close to the southwest corner of the site and increases to approximately 3m where it turns north to form the western wingwall of the ramp. A second higher eastern retaining wall forms the eastern wingwall of the ramp and then turns east to separate the ramp from the car park, increasing in height to the west. These are to be demolished and replaced by single wall closer to the southern site boundary.

BH102 was placed to target the western section of the retaining wall and BH111 to target the eastern section. Trial Pit TP102 was placed to investigate the existing fill immediately above the central part of the proposed retaining wall and immediately behind the western wingwall of the ramp.

At the western end of the wall made ground was encountered to 2.2m bgl, with glacial till described as soft to 4.8m bgl below which there was weathered sandstone to 5.1m underlain by sandstone bedrock. At BH111 the made ground is recorded to 1.3m bgl, which is approximately 3m above the level of the main part of the site. This is underlain by glacial till to 5.1m bgl which rests on weathered sandstone to 5.1m bgl with sandstone bedrock at 5.5m bgl, which is approximately 1m below the general level of the car park. It is unlikely to be practicable to drive sheet piles or take bored piles through the made ground. It is therefore considered that the made ground should be excavated to the base of bedrock in the western part of the site. Further east the base of made ground rises above the floor level for the proposed building. It is envisaged that a piled retaining wall will be required, but that this should be a contiguous bored pile wall to penetrate the underlying sandstone, as it is unlikely that sheet piles could be driven into the sandstone, and there is not enough glacial till above rock head to provide lateral support for a piled retaining wall.

11.7 Geotechnical Risk Register

A geotechnical risk register describing risks affecting the both the safety of the project and its commercial success is given in Table 11.7-1.

Table 11.7-1 Geotechnical Risk Register

HAZARD RISK	CAUSE	BEFORE CONTROL			CONSEQUENCE	AFFECTED	MITIGATION MEASURES
		P	C	R			
Buried utilities	Disruption	3	3	9	Unexpected utilities exposed during foundation construction	Proposed foundations	Confirm status of all utilities – undertake utilities search Utility diversions
Concrete attack	High soluble sulphate concentrations in founding soils	2	2	4	Reduction in concrete strength / structural damage.	Proposed foundations	Ground investigation undertaken and chemical classification undertaken to BRE SD1. Use appropriate concrete class required.
Buried obstructions	Numerous obstructions including boulder size fragments of demolition rubble and intact mass concrete and reinforced concrete slabs	4	4	16	Unexpected concrete structure exposed during foundation construction	Proposed foundations	Confirm status and details of culvert. Undertake detail survey
Unstable Excavations	Loose or soft soil	4	4	16	Collapse	Proposed works	Temporary shoring or stabilisation measures likely to be required for excavations
Settlement	Soft / loose ground deposits present	2	3	6	Excessive settlement of structures. Excessive differential settlement.	Proposed works	Allowance for risk item in construction and design life /maintenance costs. Any presence of soft/loose material identified during construction consider removal if encountered. Adequate design.

Geotechnical Risk Evaluation Matrix

PROBABILITY (P)			IMPACT (I)				=	Probability	Impact					
Very High	Very likely >75%	5	Very High	5	TIME	COST			5	4	3	2	1	
					>50%	>20%								
High	Probable 40-75%	4	High	4	25-50%	10-20%	4	20	16	12	8	4		
Medium	Possible 10-40%	3	Medium	3	10-25%	5-10%	3	15	12	9	6	3		
Low	Unlikely 2-10%	2	Low	2	2-10%	1-5%	2	10	8	6	4	2		
Very Low	Negligible <2%	1	Very Low	1	<2%	<1%	1	5	4	3	2	1		

12. Groundwork Options

12.1 Review of Options

Due to the nature of the made ground which contains many obstructions, and the need to found the building on the underlying sandstone, several options have been considered to prepare the site for the proposed development. These options, together with the appropriate foundation solutions are described in the following paragraphs and summarised in table 12.1.

Option 1 – Piling from Existing surface

Piling from existing ground level through the made ground in its existing condition is not considered to be a suitable option because there is no way of knowing where all the obstructions are. The most suitable option for getting through the concrete slabs, some of which are reinforced, may be to use cased bored piles with diamond tipped shoes they would be extremely expensive and are quite likely to be damaged in ground with multiple small obstructions. It would not be possible to use driven or CFA piles.

Option 2 – Excavation, Processing, Re-use of Made Ground followed by Ground Improvement

This option entails excavating the existing made ground and reprocessing it, by crushing material larger than 125mm, and removing unsuitable material such as wood, plastic and metal, including rebar in reinforced concrete. The material would be replacement in the excavation by tracking it in thick layers without specified compaction.

This may be the most suitable option given the time constraints of the anticipated construction programme which will require material placement in the winter or early spring when the weather is at its wettest and when there is little opportunity to dry stockpiled material to a specified moisture content as required within a specification for compaction. However, material placed without compaction to a specification is unlikely to be strong enough or uniform enough to support piling rigs, shallow foundations and ground bearing floor slabs. It will therefore be necessary to carry out ground improvement by installation of vibro-stone columns, or a suitable alternative method, capable of improving the ground to a depth of up to 5m. The ground improvement would also be required through the natural superficial deposits overlying the sandstone bedrock. Care must be taken to ensure that the crushing plant is capable of handling very large material or that breaking by drop weights or similar is undertaken prior to loading into the crusher. Following completion of ground improvement suitable testing should be carried out to verify that the ground has achieved the minimum required strength across the area.

Option 3 – Excavation, Processing and Re-use of Made ground including Full Compaction

This option, which includes excavation of the made ground and processing and compacting the material into place in thin layers in accordance with the Highways Specification 600 series – Table 6.4. to produce a surface suitable to support a piling platform and ground bearing floor slabs, and piles to support building columns, initially appears to be better than option 2. However due to the likelihood that the construction programme requiring placement of the fill in the winter period, this will make it difficult to achieve the moisture content within the required tolerance. Failure to achieve the required moisture content would result in the fill not achieving the required strength. Waiting for suitable conditions would impact on the construction programme. Another issue with this option is that the natural superficial deposits above rock head would also require removal, or ground improvement. This material is unlikely to be suitable for re-use and would therefore require disposal off site and replacement with suitable fill, at additional expense to the contract. Ground improvement would be an additional process within this option and would further impact on the programme.

Option 4 – Construction of a basement

Under this option the made ground and superficial deposits would be excavated to rock head and a multistorey basement would be incorporated into the building which would now be founded at basement floor level. Consideration could be given to adopting raft foundations bearing onto the sandstone bedrock, or alternatively, short piled foundations socketed into bedrock.

This option would resolve any issues with achieving a good construction platform for foundation construction, and would provide additional space either for parking, or additional internal accommodation. There would be

increased building construction costs and a large volume of material would require off site disposal, but the cost of placement of fill and compaction and/ or ground improvement would be removed.

If this option is taken forward there are a number of important aspects which need to be considered in more detail including:

- Temporary and permanent basement wall types
- Construction sequencing
- Ground water exclusion
- Founding level

The potential impact of rising groundwater in the long term would have to be considered in the design. It is not likely that groundwater would be a significant issue within the construction period.

The deep weathered sandstone located at BH109/ BH109A would impact more on a raft than on piles, but this option would expose the ground to rock head over a larger area than other options and would make defining the extent of this feature easier to investigate.

12.2 Recommendation of Preferred Option

The clients programme requires that the site reclamation occurs during the Winter/ Spring and has a tight programme for completion of the development, therefore, Option 2 is considered to be the preferred geotechnical reclamation strategy. Based on the information reviewed in this ground investigation there is not considered to be a land contamination requirement of the reclamation strategy beyond the need for the site personnel to inspect the materials encountered and to segregate based on visual and olfactory observations.

Table 12-1 Summary of options for groundworks

Option	Pros	Cons	Recommendation
Option 1: Rotary pile through obstructions and improve shallow (<1m) made ground only through excavation and removal of obstructions and replacement as engineered fill for ground bearing slab construction.	No need to excavate all site soils	- Potential uncertain duration due to uncertainty of nature of obstructions; - Potential costs due to damaging rigs and augers due to the potential presence of rebar; - Potential for differential settlements and need to increase specification of floor slab - Does not remove potentially unforeseen ground contamination or geotechnical issues not encountered from recent surveys	Do not progress
Option 2: excavate all MG to remove obstructions average depth 3m and track back (not engineered), following by piling for the structure and VSC for the ground bearing slab	- No obstructions to piling. - Removes all in ground obstructions. - Removes geotechnical and geo-environmental risks associated with the made ground. - Tracking back and use of VSC means that it is not largely weather dependent. - Will likely allow better adherence to required programme.	- Does not create an engineered development platform. - Potentially more costly than other solutions.	PREFERRED - Progress as meets objectives regarding programme and developability.

Option	Pros	Cons	Recommendation
Option 3: excavate all MG to remove obstructions average depth 3m and replace as engineered fill to a method compaction providing a development platform for the ground bearing slab, followed by piling for the structures.	- No obstructions to piling. - Removes all in ground obstructions. - Removes geotechnical and geo-environmental risks associated with the made ground. - Creates an engineered development platform suitable for the ground bearing slab.	- Weather conditions may hinder ability to gain a validated development platform meeting the required specifications. - Programme delays due to inclement weather. - Cost over-runs due to inclement weather. - Best undertaken in dry weather conditions after spring.	Consider further only if programme allows - summer. If works to be undertaken over winter, early spring or late autumn, do not progress.
Option 4: Consider excavation and disposal of MG with founding slab placed at depth which would mean an additional below grade storey, car park etc in the design.	- Removes risk associated with the made ground through removal from site including obstructions and contamination or geotechnical issues. - Potentially, subject to other design constraints, could allow an undercroft carpark. - Potentially removes the need for piling of the structure which could have cost implications.	Temporary works to manage water ingress and stability given the site location could be an issue in the winter months.	Could be feasible in cost comparison with other options presented but subject to a design review and cost benefit analysis. Additional wider feasibility study possibly should be considered before progressing.

13. Conclusions and Recommendations

	Conclusions	Recommendations
Foundations & Floor Slabs	The made ground and superficial deposits overlying the sandstone are unsuitable for bearing the anticipated structural loads for the college building. The underlying sandstone bedrock which provides a strong founding material is present at approximately 5m below existing ground level. The made ground contains many obstructions including existing floor concrete slabs which would make piling difficult.	It is recommended that the existing made ground is removed prior to construction and adopting one of the following options chosen for site redevelopment: Processing the made ground by breaking down the concrete slabs and very coarse material within the made ground and re-using it by placing it into the excavated area, and then improving the placed made ground and superficial deposits by installation of vibro-stone columns. This to provide a suitable platform for supporting pile caps and ground bearing floor slabs; Removal of the made ground, and other superficial materials off site for disposal, and creating a basement level and founding directly onto the sandstone, using short piles or, if the loadings permit, large pad foundations.
Excavations	Large excavations are likely to be required during ground preparation. Large obstructions and concrete slabs will require breaking out prior to excavation The made ground and superficial deposits will require extensive support.	It is recommended that breakers are supplied with all excavators due to the extent of concrete slabs and made ground with large obstruction., It is recommended that the sides of the excavations are supported with vertical support to minimise the space required. It is recommended that contiguous bored piles are adopted, to achieve the necessary penetration to provide adequate lateral support.
Retaining wall	A retaining wall is to be constructed adjacent to the southern site boundary. The made ground and natural superficial strata above rock head are unsuitable for bearing substantial lateral loads.	It is recommended that a contiguous bored pile wall is adopted., because sheet piles will not penetrate the sandstone bedrock, and substantial penetration into the sandstone will be required to achieve the necessary lateral resistance.
Soil aggressivity to buried concrete	High sulphate concentrations have been identified, resulting in ground which is aggressive to buried concrete.	It is recommended that the locality of one exceptionally high recorded sulphate concentration is investigated and isolated if possible. If it is not possible to locate a specific source resulting in this high sulphate concentration a Design Sulphate Class of DS-5 and AEC Classification of AC-5 are recommended for buried concrete design in the made ground. However, if it can be shown that the sulphate concentration is localised, and the source removed, lower classifications of Design Sulphate Class of DS-2 and AEC Classification of AC-2 are recommended.

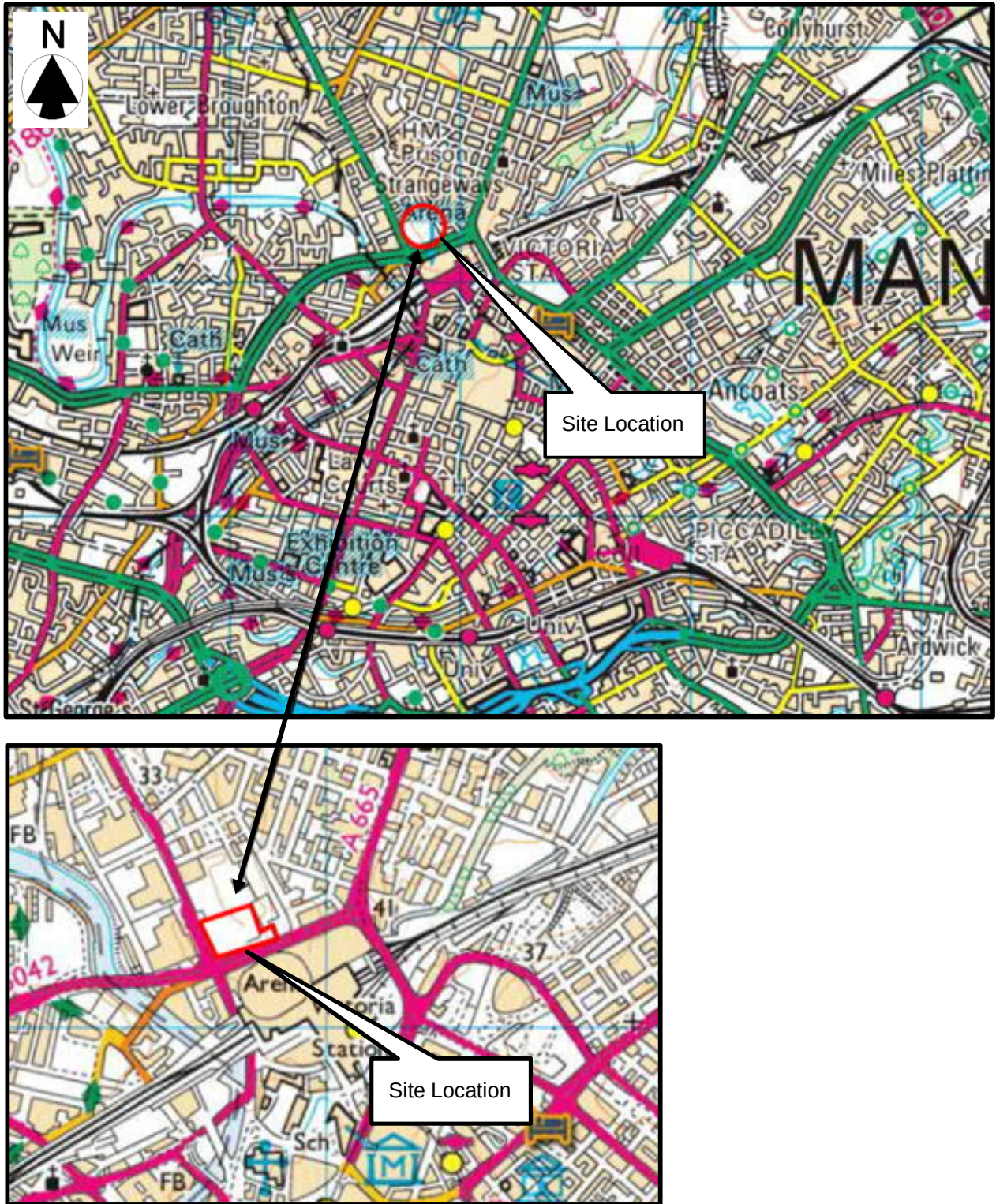
	Conclusions	Recommendations
Groundwater	The standing groundwater level is at or just below rock head across the site, this is below the deepest likely level of excavation. In the long term, the groundwater level is likely to rise gradually	It is recommended that the long term rise in groundwater level is considered in the design of foundations and any below ground structures.
Human Health	The Site is currently a car park and proposed for a college covered with a structure and hardstanding. The only CoPCs (PAHs) were identified beneath a tarmacadam layer at one location (TP103) that is east of and external to the site boundary. As the PAHs were below this layer it is very unlikely there is particulate inhalation, ingestion or dermal contact to the future development. Therefore, the risk is considered very low to the future development. Asbestos containing material was identified in seven of the twenty eight soil samples. Although it was only quantified at three locations. For the future development the site will be covered in hard standing or a gravel layer. The likelihood of inhalation of particulates is unlikely, although the severity is medium. Therefore the risk is low.	The risk of asbestos inhalation is considered low. Currently the site is covered with hard standing and post construction the site will be covered in hard standing. During the construction phase made ground across the site will be exposed. Made ground found to be contaminated with asbestos should be reviewed during the construction phase and suitable mitigation measures be put in place such as removal / capping prior to any potential development. A CAR 2015 risk assessment is required to confirm any measures during the earthworks.
Controlled Waters	It is understood that as part of the planned works, the made ground may be excavated and returned to site to create a development platform. If the material is to be returned to the site it is possible, based on statistical analysis, that metals such as Cu, Pb, Ni, V and Zn identified in the soil leachate may pose an environmental risk. Currently the results indicate that there may be a pathway for Cu to be leached from soils to deep groundwater. The college development will comprise hardstanding, however, which will limit the potential for chemicals to leached from the unsaturated zone where it will be placed to the ground water aquifer unit.	Given the mitigation which will be embedded in the proposed development plan it is not considered that further investigation or remediation is required for this pollutant linkage.
Ground Gas	Based upon the GSVs calculated for the site from the gas monitoring program the site has been classified as a CS1 site with a very low hazard potential. Further analysis taking into	Characteristic Situation (CS) 1 ground gas protection measures are recommended on the basis of the information obtained in the phase of ground investigation presented in this report.

	Conclusions	Recommendations
Waste Issues, Disposal of Material (Duty of Care, sustainability, WAC)	consideration TOC content within made ground indicates that, in line with the gas monitoring, the site is CS1, low hazard potential. A classification of CS1, requires no further measures to be put in place (BSI, 2015).	
	In the event that made ground is to be excavated and disposed of off site an on-line hazardous waste classification report was run on 28 soil samples (HazWasteOnline, 2019). The results show that five soil samples (TP109 1.2m, BH105 1m, TP106 0.5m, TP206 0.7m, TP103 0.2m) were classified as hazardous due to their carcinogenic (HP7) and mutagenic (HP11) properties resulting from high concentrations of TPH (C6 – C40) petroleum group (1160 – 7600 mg/kg). Additionally, one of the five soil samples (TP103, 0.2m) was classified as hazardous due to their carcinogenic (HP7) and mutagenic (HP11) properties resulting from high concentrations of total PAHs (1400 mg/kg).	Any cut and fill works required at the site are likely to be considered to fall under the Environmental Permitting Regulations 2010 by the Environment Agency and may require an Environmental Permit. However, it may be possible to apply for a waste exemption under the Environmental Permitting Regulations. Alternatively, it may be possible to re-use material on site under the CL:AIRE Code of Practice 'The Definition of Waste: Development Industry Code of Practice (CL:AIRE 2011)', if agreed with the Environment Agency. Material encountered during construction works that is considered to be potentially contaminated through visual or olfactory evidence will require chemical testing to confirm the waste classification. If excavated, hazardous material should either be treated on site for re-use or should be removed from site and taken to a suitable licensed receiving facility. All waste classifications should be confirmed by the receiving facility.

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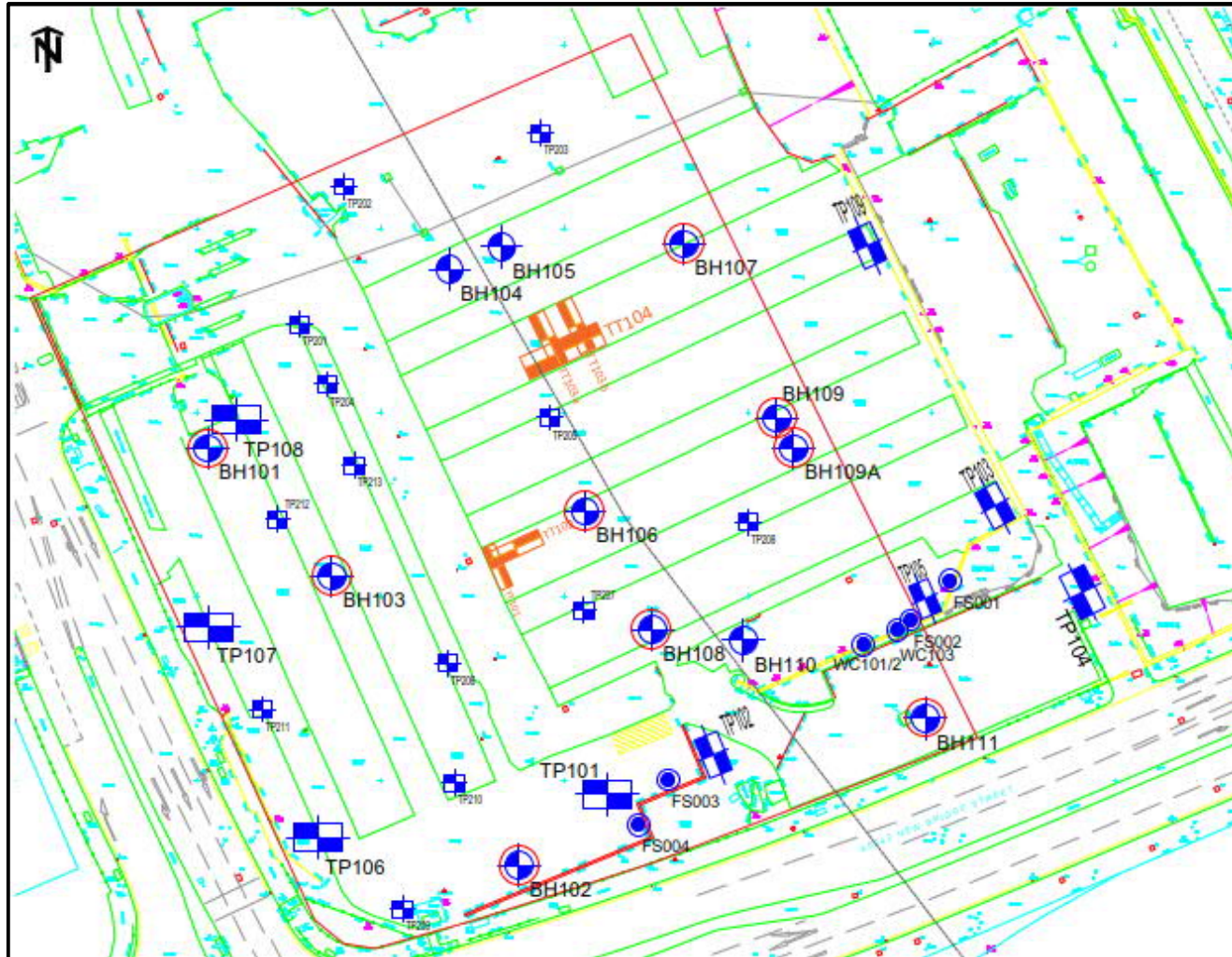
FIGURES



Manchester College – Boddingtons Brewery Site
 Project Number: 385460
 Author: JM
 04/09/2019

Figure 1
 Site Location

AECOM

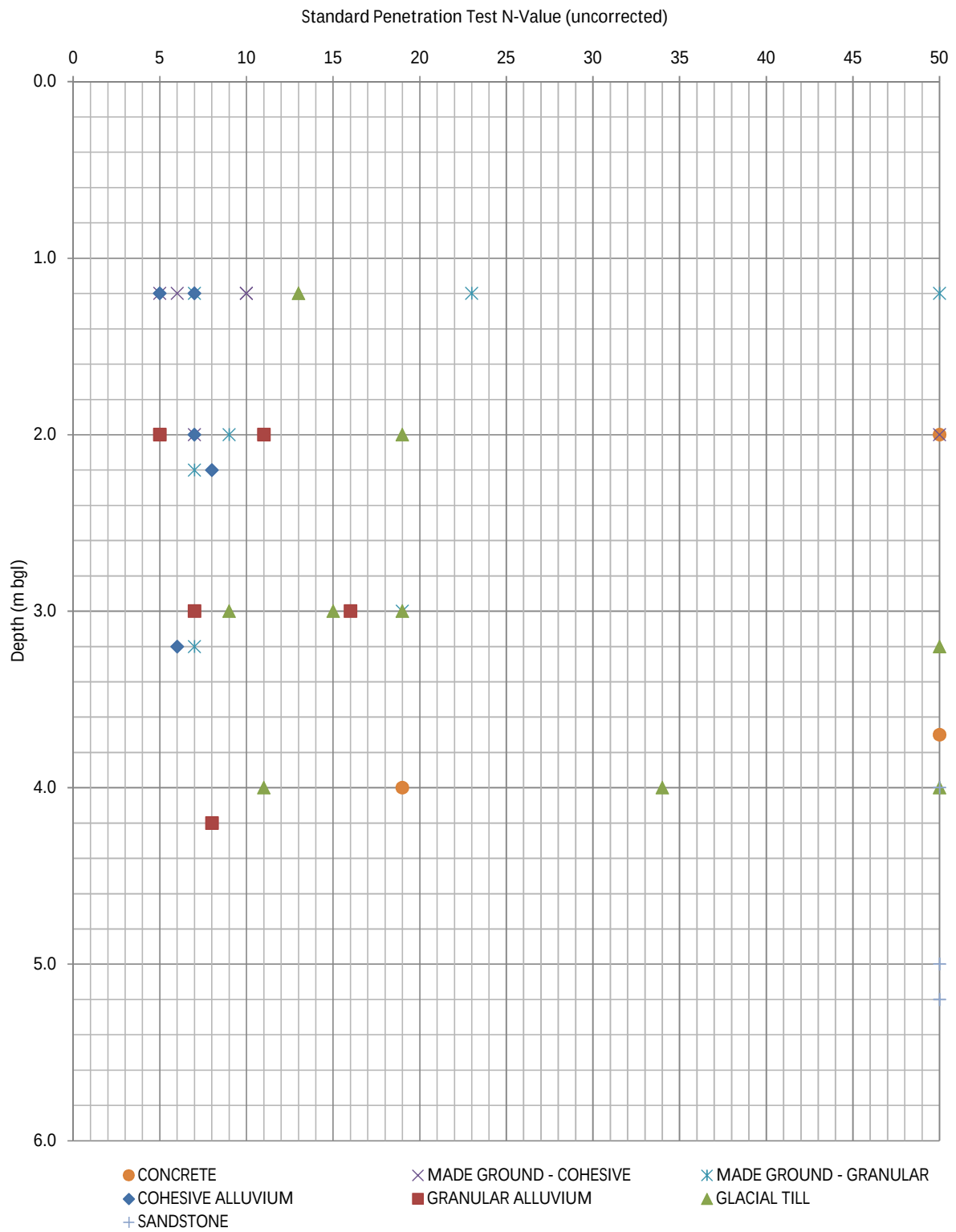


Manchester College – Boddingtons Brewery Site
 Project Number: 385460
 Author: JM
 04/09/2019

Figure 2
 Exploratory Hole
 Location Plan

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CHARTS



Title: SPT v Depth (m bgl) Plot

Project: Manchester College - Boddingtons Brewery Site

Number: 385460

Chart No. 1a

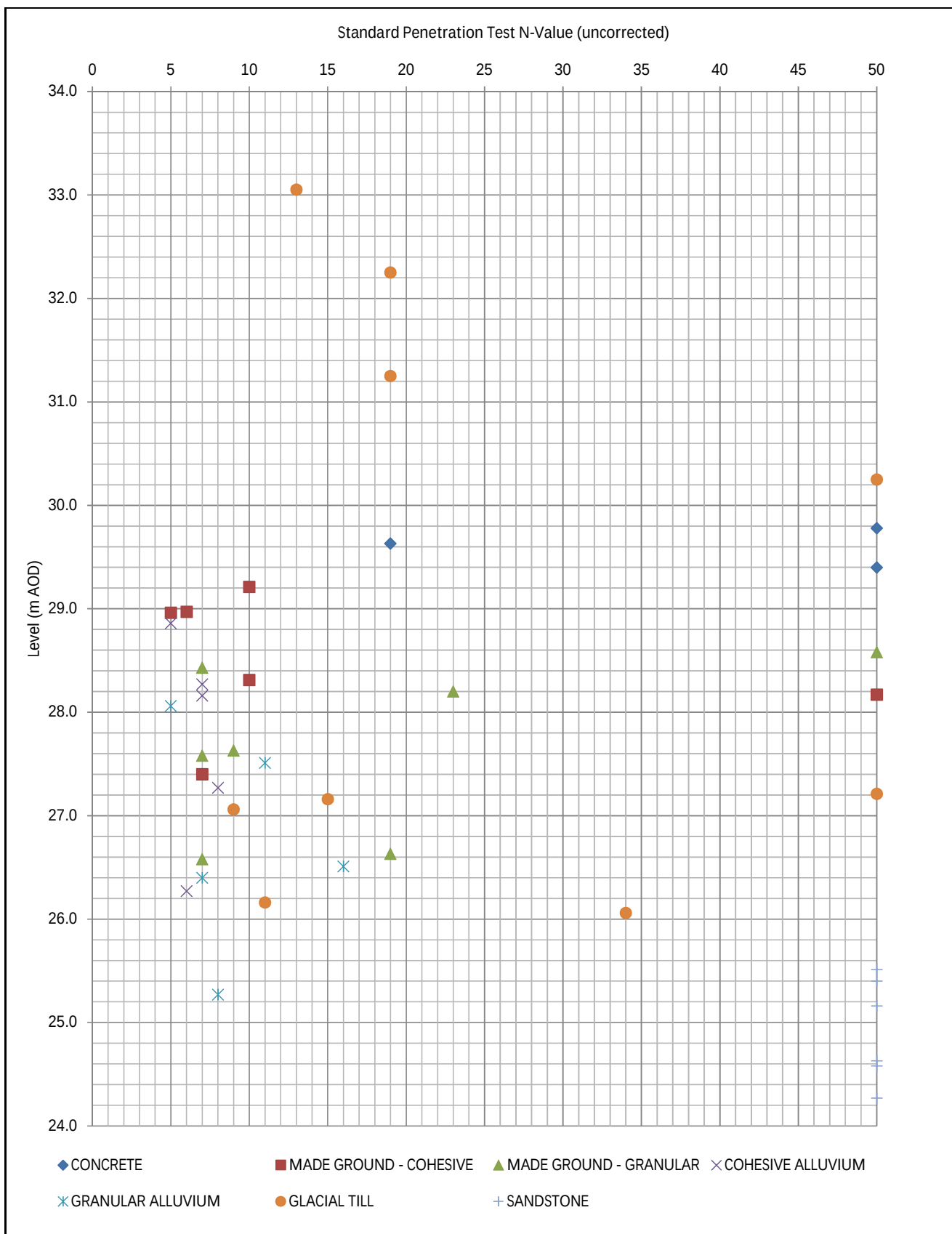


Checked: CM

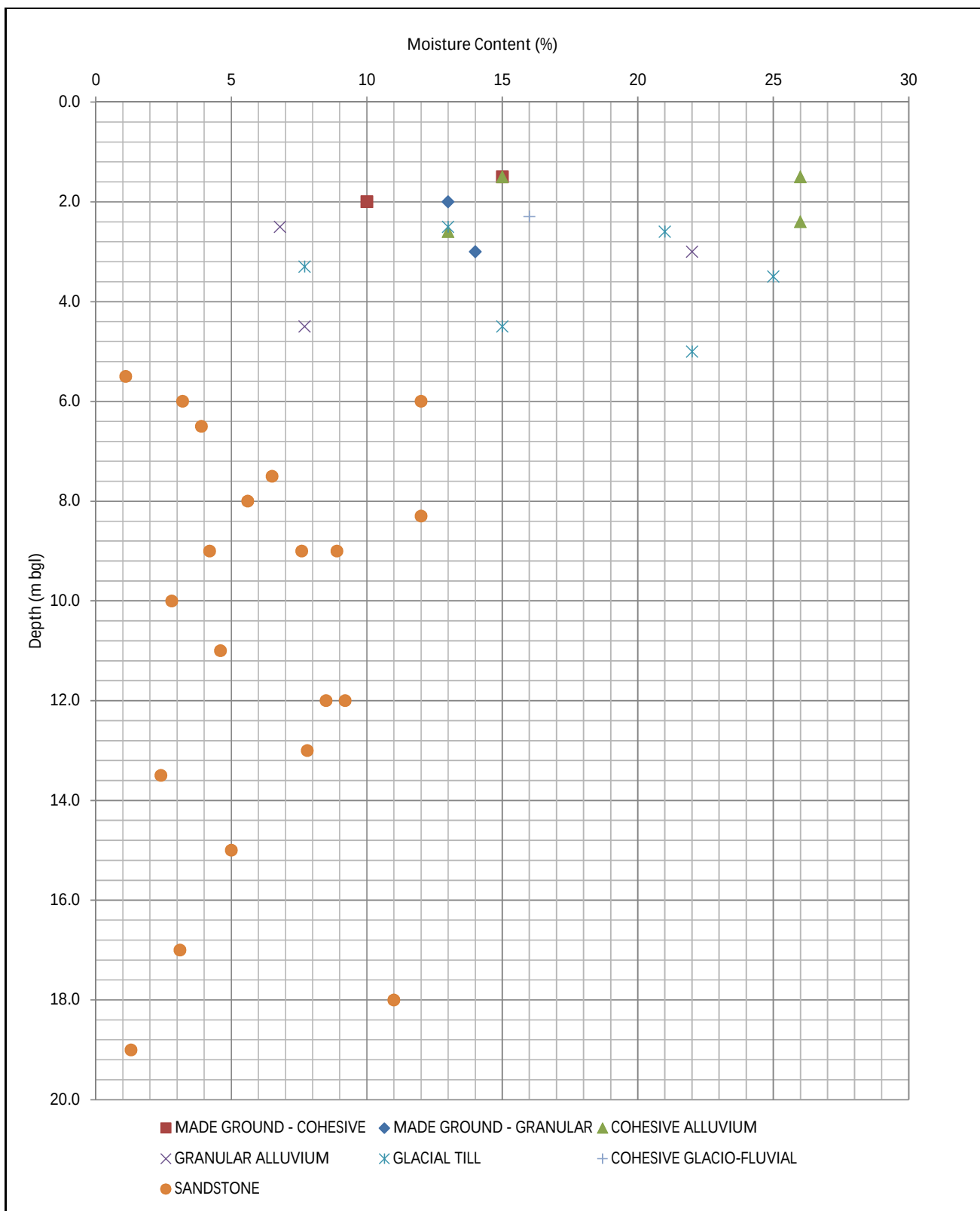
Designed: JM

Date: 28/08/2019

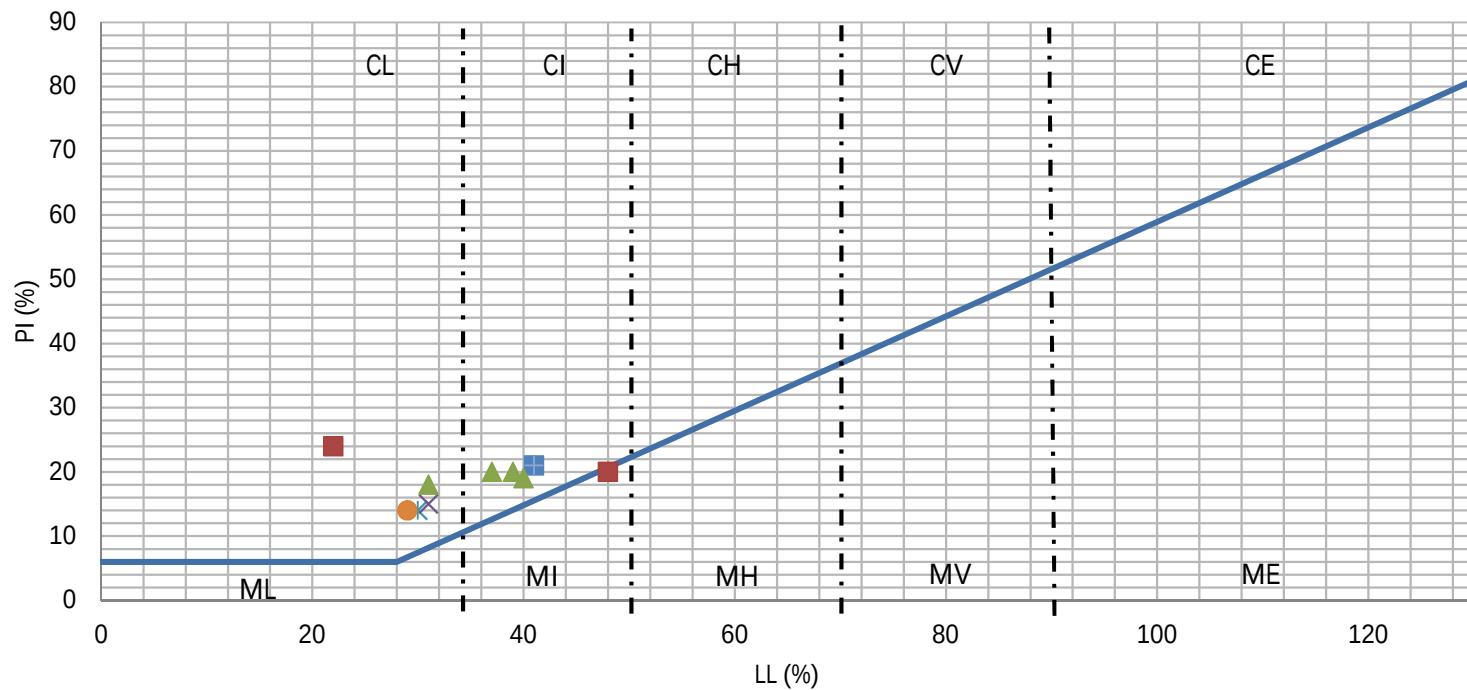
Date: 28/08/2019



Title: SPT v Level (m AOD) Plot			
Project: Manchester College - Boddingtons Brewery Site			
Number: 385460	Chart No. 1b	Checked: CM	Designed: JM
		Date: 28/08/2019	Date: 28/08/2019



Title: Moisture Content v Depth (m bgl) Plot			
Project: Manchester College - Boddingtons Brewery Site			
Number: 385460	Chart No. 2a	Checked: CM	Designed: JM
		Date: 28/08/2019	Date: 28/08/2019



Title: Plasticity Index v Liquid Limit

Project: Manchester College - Boddingtons Brewery Site



Number: 385460

Chart No. 3

Checked:

CM

Designed:

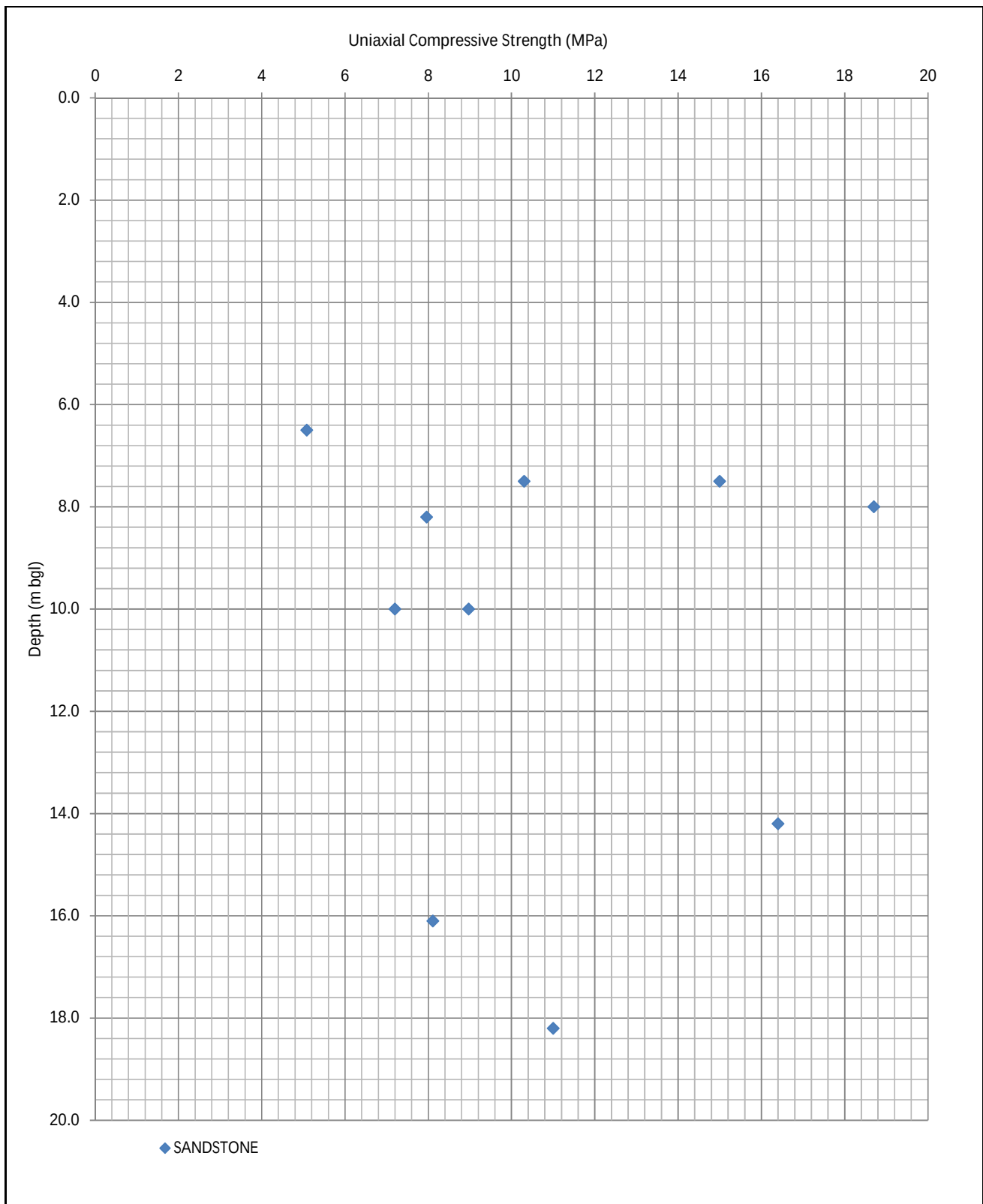
JM

Date:

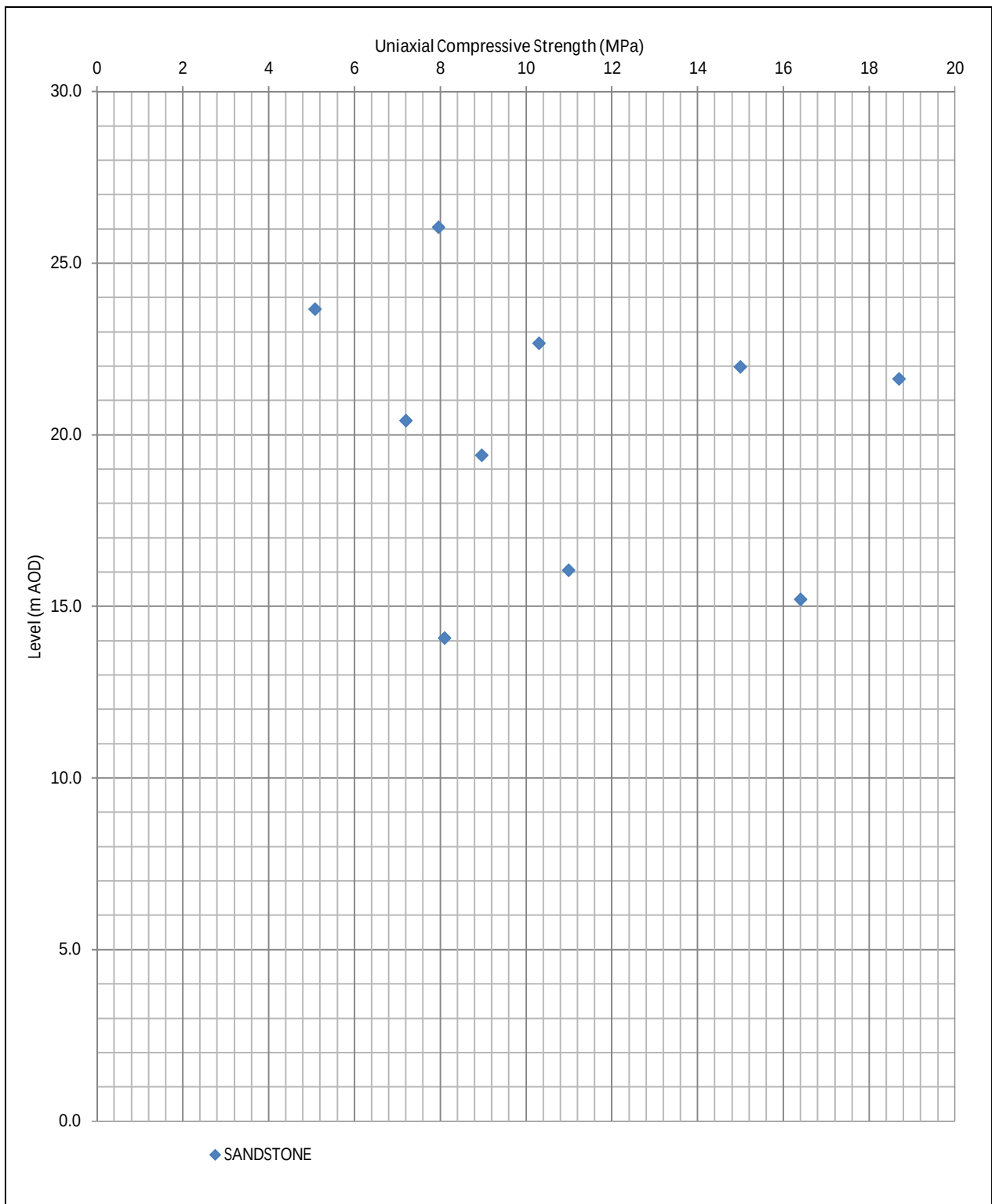
28/08/2019

Date:

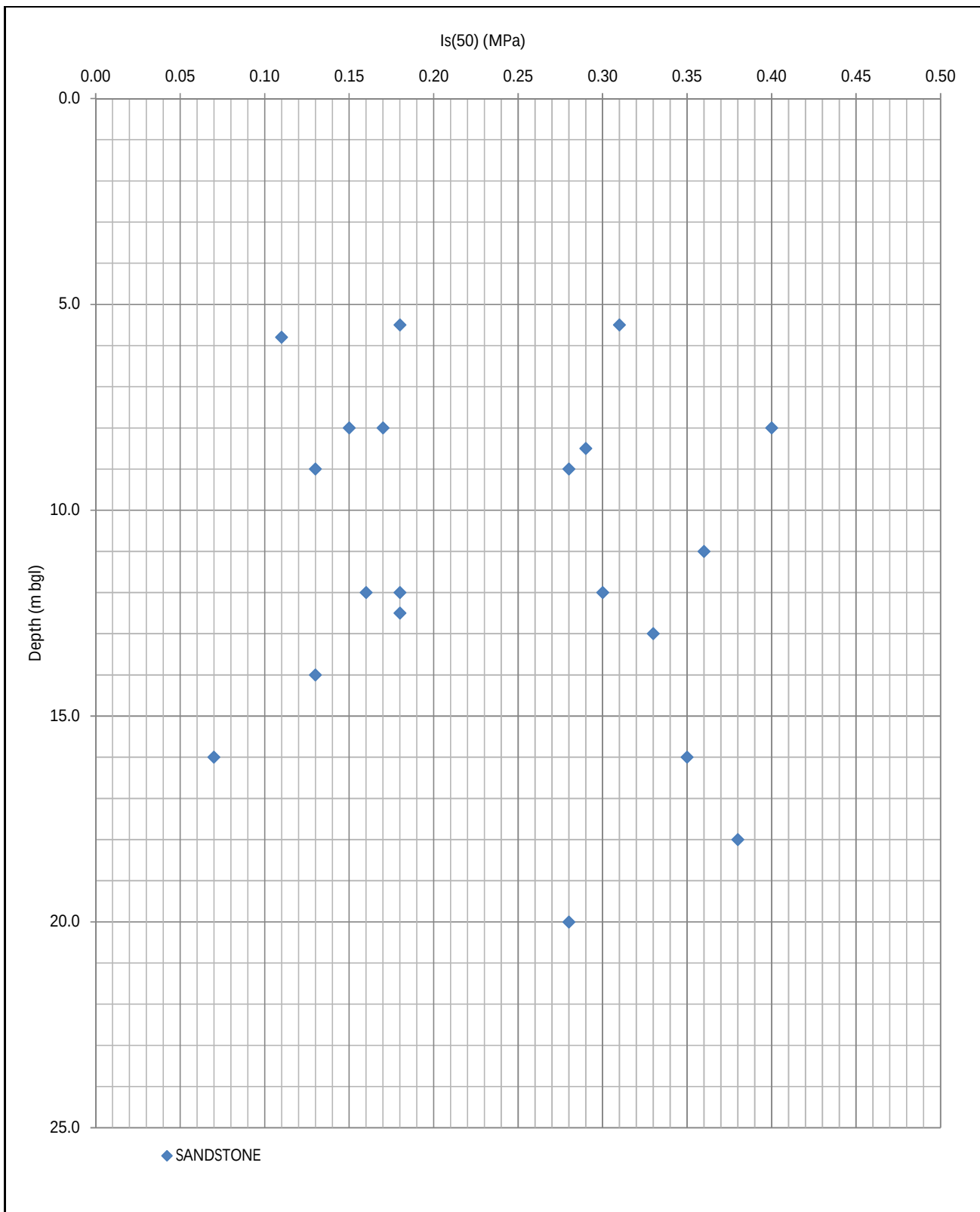
28/08/2019



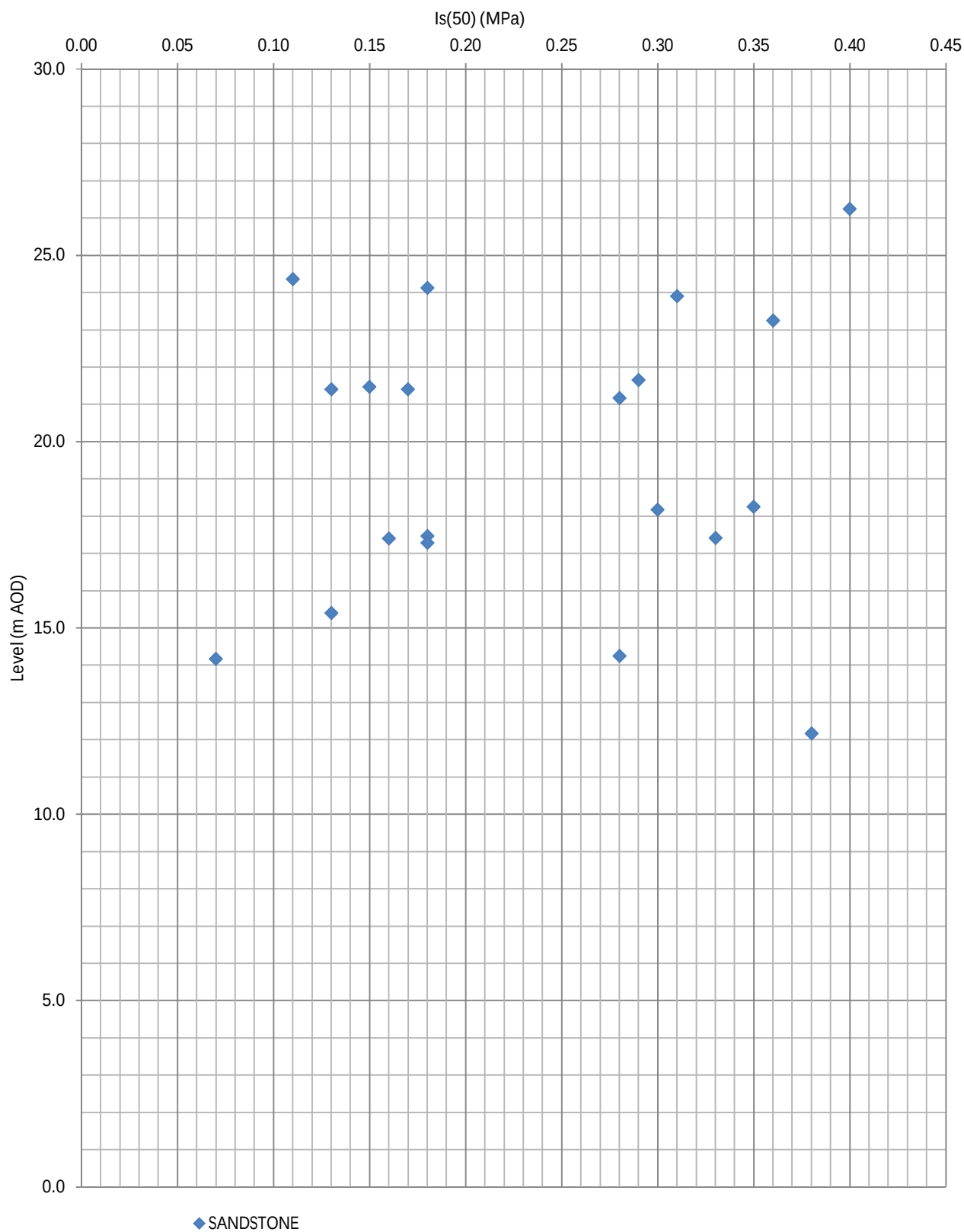
Title: Uniaxial Compressive Strength v Depth (m bgl) Plot			
Project: Manchester College - Boddingtons Brewery Site			
Number: 385460	Chart No. 4a	Checked: CM	Designed: JM
		Date: 28/08/2019	Date: 28/08/2019



Title: Uniaxial Compressive Strength v Level (m AOD) Plot			
Project: Manchester College - Boddingtons Brewery Site			
Number: 385460	Chart No. 4b	Checked: CM	Designed: JM
		Date: 28/08/2019	Date: 28/08/2019



Title: Is(50) v Depth (m bgl) Plot			
Project: Manchester College - Boddingtons Brewery Site			
Number: 385460	Chart No. 5a	Checked: CM	Designed: JM
		Date: 28/08/2019	Date: 28/08/2019



Title: Is(50) v Level (m AOD) Plot

Project: Manchester College - Boddingtons Brewery Site

Number: 385460

Chart No. 5b

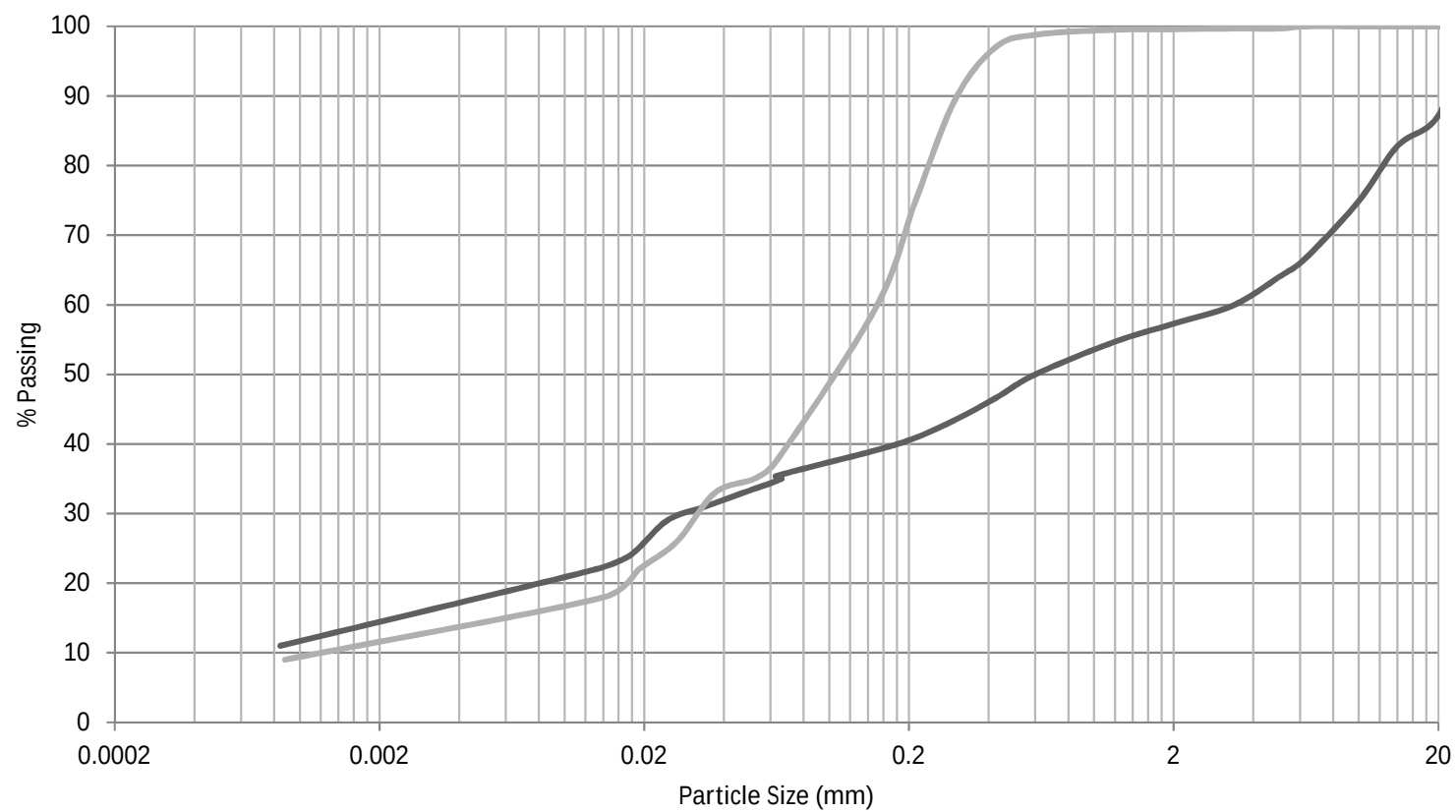
Checked: CM

Date: 28/08/2019

Designed: JM

Date: 28/08/2019





Title: Particle Size Distribution Plot - Made Ground Cohesive

Project: Manchester College - Boddingtons Brewery Site



Number: 385460

Chart No. 6a

Checked:

CM

Designed:

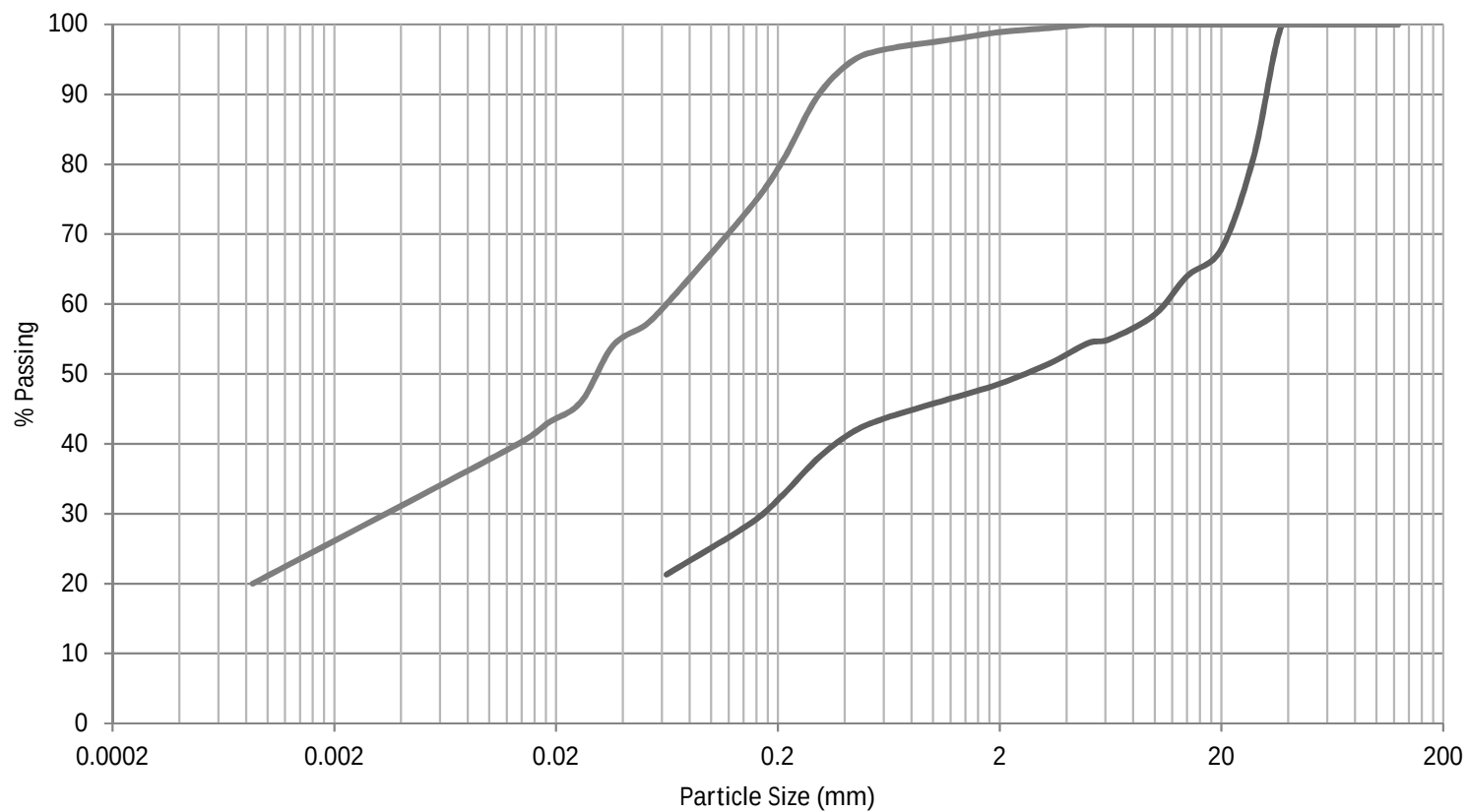
JM

Date:

03/09/2019

Date:

03/09/2019



Title: Particle Size Distribution Plot - Made Ground Granular

Project: Manchester College - Boddingtons Brewery Site



Number: 385460

Chart No. 6b

Checked:

CM

Designed:

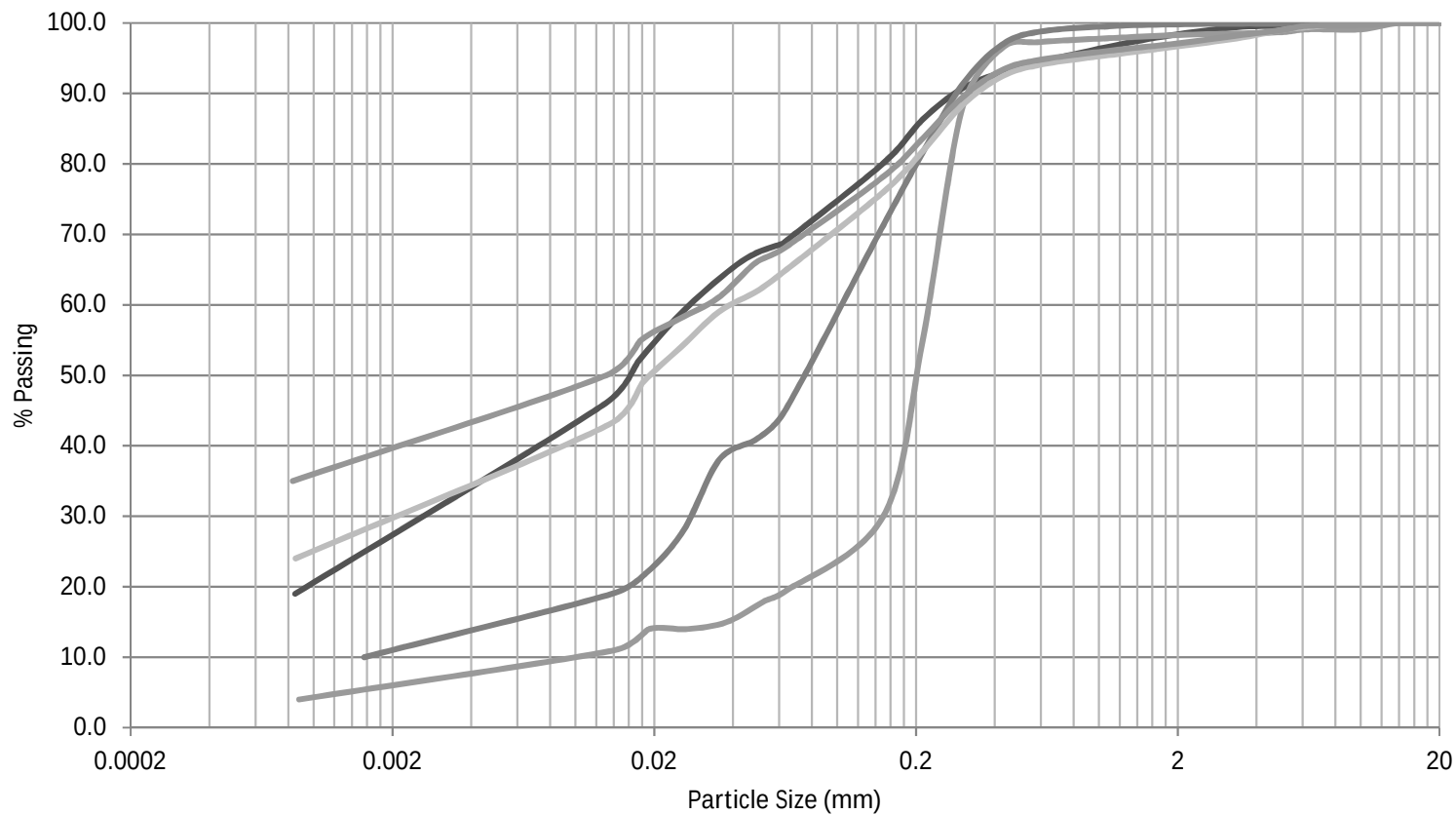
JM

Date:

03/09/2019

Date:

03/09/2019



Title: Particle Size Distribution Plot - Cohesive Alluvium

Project: Manchester College - Boddingtons Brewery Site



Number: 385460

Chart No. 6c

Checked:

CM

Designed:

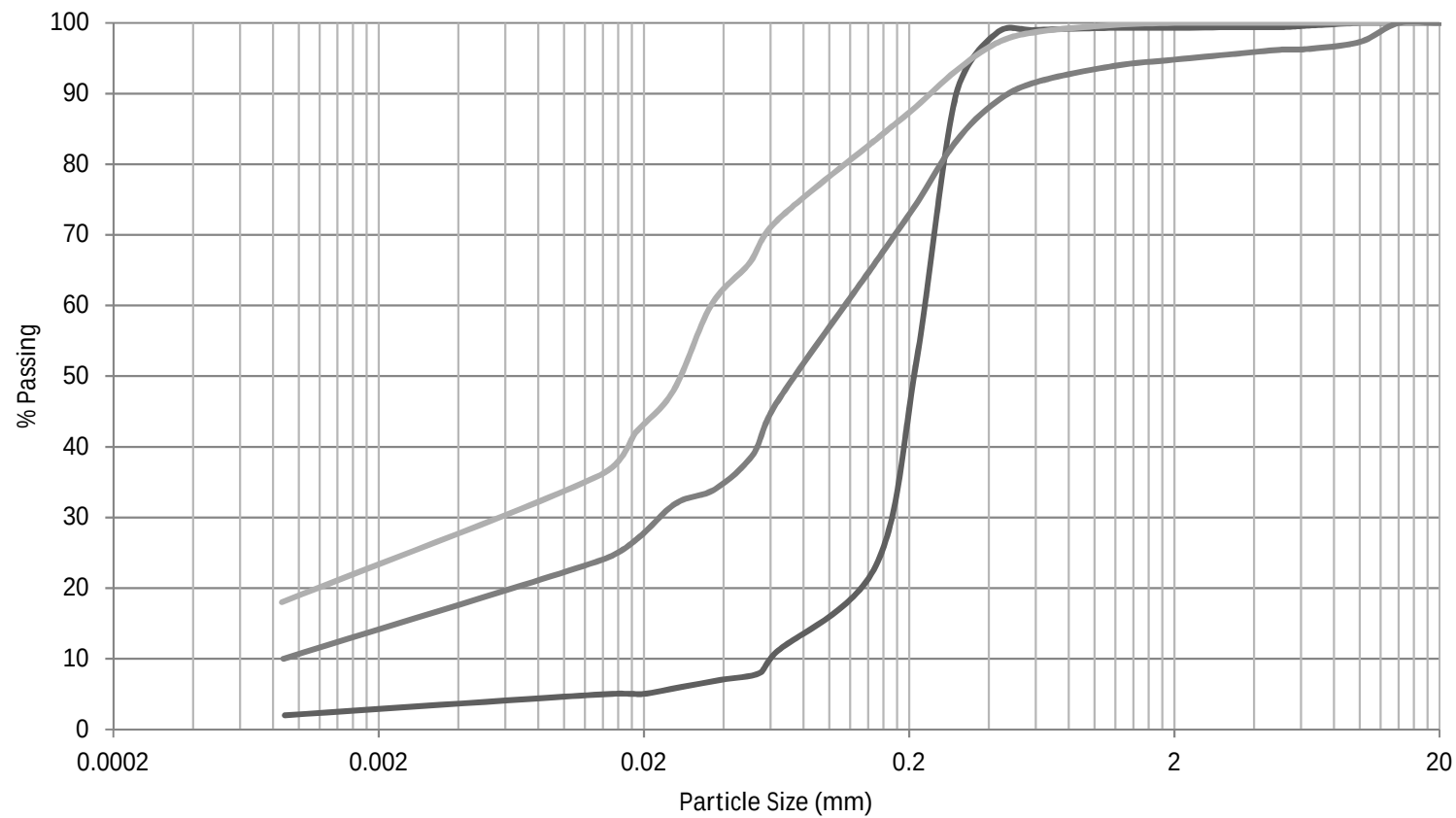
JM

Date:

03/09/2019

Date:

03/09/2019



Title: Particle Size Distribution Plot - Granular Alluvium

Project: Manchester College - Boddingtons Brewery Site



Number: 385460

Chart No. 6d

Checked:

CM

Designed:

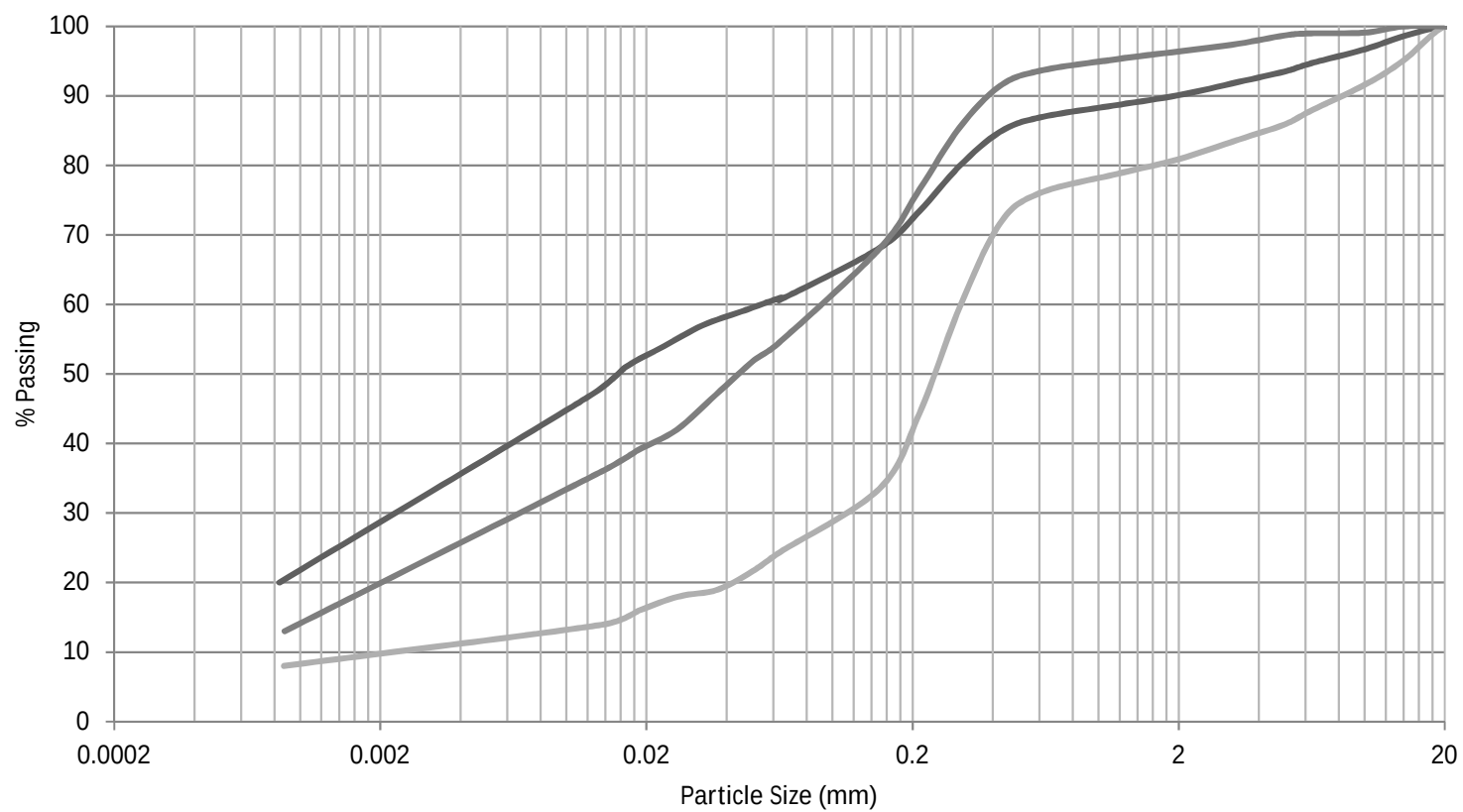
JM

Date:

03/09/2019

Date:

03/09/2019



Title: Particle Size Distribution Plot - Glacial Till

Project: Manchester College - Boddingtons Brewery Site



Number: 385460

Chart No. 6e

Checked:

CM

Designed:

JM

Date:

03/09/2019

Date:

03/09/2019

APPENDIX A -CHEMICAL ANALYSIS SHEETS

Solid
Analytical Results
ManchesterCollege
The LTE Group

Location Code	BH101	BH101	BH102	BH102	BH103	BH103	BH105	BH105	BH106	BH106	BH108	BH108	BH110	BH111
Sample Depth Range	0.6	1.5	0.5	1.5	2.5	3.2	1	3.5	1	3.5	1.2	2.2	0.5	1
Sampled Date Time	06/06/2019	06/06/2019	13/06/2019	13/06/2019	12/06/2019	12/06/2019	04/06/2019	04/06/2019	10/06/2019	10/06/2019	14/06/2019	14/06/2019	13/06/2019	17/06/2019

Chem_Group	ChemName	output unit	EQL	GAC_HH_COM/IND_SAND_0.58-1.45%TOC													
TPH	>C5-C6 Aliphatics	mg/kg	0.001	2000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>C6-C8 Aliphatics	mg/kg	0.001	4300	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>C8-C10 Aliphatics	mg/kg	0.001	1000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>C10-C12 Aliphatics	mg/kg	1	5000	<1	<1	<1	<1	<1	<1	<1	1.6	2.2	<1	<1	<1	<1
	>C12-C16 Aliphatics	mg/kg	2	37000	<2	<2	4	<2	<2	<2	2.8	<2	9.1	7.8	<2	8.5	4.6
	>C16-C21 Aliphatics	mg/kg	8		<8	<8	28	<8	<8	<8	28	11	37	23	<8	<8	33
	>C21-C35 Aliphatics	mg/kg	8		120	<8	220	<8	21	<8	690	62	210	140	<8	16	140
	>C5-C35 Aliphatics	mg/kg	10		130	<10	250	<10	25	<10	720	74	260	180	<10	16	180
	>EC5-EC7 Aromatics	mg/kg	0.001	12000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>EC7-EC8 Aromatics	mg/kg	0.001	28000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>EC8-EC10 Aromatics	mg/kg	0.001	1800	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>EC10-EC12 Aromatics	mg/kg	1	9100	<1	<1	<1	<1	<1	<1	2.6	<1	<1	<1	<1	<1	<1
	>EC12-EC16 Aromatics	mg/kg	2	34000	2	<2	7.8	15	5.5	<2	14	3.6	8.2	3.1	10	4.1	15
	>EC16-EC21 Aromatics	mg/kg	10	28000	16	<10	49	<10	53	<10	84	40	66	39	<10	<10	47
	>EC21-EC35 Aromatics	mg/kg	10	28000	190	<10	350	<10	130	85	340	110	330	210	<10	<10	170
	>EC5-EC35 Aromatics	mg/kg	10		210	<10	410	24	180	93	440	160	410	250	14	<10	230
BTEx	Benzene	mg/kg	0.001	12	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Toluene	mg/kg	0.001	28000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Ethylbenzene	mg/kg	0.001	2700	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Xylene (m & p)	mg/kg	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Xylene (o)	mg/kg	0.001	3100	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Oxygenates	MTBE	mg/kg	0.001	3340	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chlorinated Hydrocarbons	Chloromethane	mg/kg	0.001	0.48	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Vinyl chloride	mg/kg	0.001	0.031	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Chloroethane	mg/kg	0.001	463	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1-dichloroethene	mg/kg	0.001	12.6	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	trans-1,2-dichloroethene	mg/kg	0.001	10.1	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1-dichloroethane	mg/kg	0.001	122	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	cis-1,2-dichloroethene	mg/kg	0.001	6.37	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Chloroform	mg/kg	0.001	44	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1,1-trichloroethane	mg/kg	0.001	310	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Carbon tetrachloride	mg/kg	0.001	1.4	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Trichloroethene	mg/kg	0.001	0.57	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1,2-trichloroethane	mg/kg	0.001	42.5	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Tetrachloroethene	mg/kg	0.001	8.6	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
VOC	2,2-dichloropropane	mg/kg	0.001		-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1-dichloropropene	mg/kg	0.001		-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,2-dichloroethane	mg/kg	0.001	0.28	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,2-dichloropropane	mg/kg	0.001	1.43	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Dibromomethane	mg/kg	0.001	99	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Bromodichloromethane	mg/kg	0.001	1.3	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	cis-1,3-dichloropropene	mg/kg	0.001		-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	trans-1,3-dichloropropene	mg/kg	0.001		-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,3-dichloropropane	mg/kg	0.001	23000	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Chlorodibromomethane	mg/kg	0.001	39	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1,1,2-tetrachloroethane	mg/kg	0.001	49	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Styrene	mg/kg	0.001	1660	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Bromoform	mg/kg	0.001	347	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Isopropylbenzene	mg/kg	0.001	632	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1,2,2-tetrachloroethane	mg/kg	0.001	120	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	n-propylbenzene	mg/kg	0.001	1880	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,3,5-trimethylbenzene	mg/kg	0.001	1500	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	tert-butylbenzene	mg/kg	0.001	120000	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,2,4-trimethylbenzene	mg/kg	0.001	19.2	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	sec-butylbenzene	mg/kg	0.001	120000	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	p-isopropyltoluene	mg/kg	0.001		-	-	-	-	-	-	-	<0.001	-	-	-	-	-
PAH	n-butylbenzene	mg/kg	0.001	58000	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,2-dibromo-3-chloropropane	mg/kg	0.001	0.064	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Hexachlorobutadiene	mg/kg	0.001	14	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Ethane, 1,1,1-trichloro-2,2,2-trifluoro-	mg/kg	0.001		-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Naphthalene	mg/kg	0.00005	90	<0.05	<0.05	0.27	<0.05	<0.05	<0.05	0.61	<0.0001	0.33	<0.05	<0.05	<0.05	<0.05
	Acenaphthylene	mg/kg	0.05	72000	<0.05	<0.05	0.27	<0.05	<0.05	<0.05	0.26	<0.05	<0.05	<0.05	<0.05	0.52	<0.05
	Acenaphthene	mg/kg	0.05	71000	<0.05	<0.05	0.23	<0.05	<0.05	<0.05	0.97	0.75	0.87	<0.05	<0.05	<0.05	<0.05
	Fluorene	mg/kg	0.05	59000	<0.05	<0.05	0.25	<0.05	<0.05	<0.05	0.92	0.71	0.6	<0.05	<0.05	<0.05	<0.05
	Phenanthrene	mg/kg	0.05	22000	0.29	<0.05	2	<0.05	1.3	<0.05	4.6	4.5	4	1.3	<0.05	<0.05	4.9
	Anthracene	mg/kg	0.05	520000	<0.05	<0.05	0.94	<0.05	0.34	<0.05	1.3	1.4	1.9	0.47	<0.05	<0.05	2.2
	Fluoranthene	mg/kg	0.05	23000	0.74	<0.05	6.5	<0.05	1.8	<0.05	7.8	7.4	7.8	2.8	<0.05	<0.05	14
	Pyrene	mg/kg	0.05	54000	0.72	<0.05	6.6	<0.05	1.8	<0.05	7.5	7.2	7.6	2.8	<0.05	<0.05	15
	Benz(a)anthracene	mg/kg	0.05	170	0.38	<0.05	3.4	<0.05	0.8	<0.05	3.5	3.2	3.3	1.4	<0.05	<0.05	7.2
	Chrysene	mg/kg	0.05	350	0.36	<0.05	3.5	<0.05	0.6	<0.05	3.4	3	3.2	1.1	<0.05	<0.05	5.5
	Benzo(a) pyrene	mg/kg	0.05	35	0.35	<0.05	4.2	<0.05	0.6	<0.05	3.5	3	3.4	1.5	<0.05	<0.05	8.2
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.05	510	0.22	<0.05	2.3	<0.05	0.25	<0.05	1.9	1.6	2.2	0.87	<0.05	<0.05	4.2
	Dibenz(a,h)anthracene	mg/kg	0.05	3.5	<0.05	<0.05	0.58	<0.05	<0.05	<0.05	0.52	0.48	0.72	<0.05	<0.05	<0.05	1.4
	Benzo(g,h,i)perylene	mg/kg	0.05	3900	0.29	<0.05	3	<0.05	0.35	<0.05	2.2	2	2.7	1.1	<0.05	<0.05	5.5
	Benzo(b)fluoranthene	mg/kg	0.05	45	0.38	<0.05	3.7	<0.05	0.53	<0.05	3.3	3.1	3.8	1.4	<0.05	<0.05	7.4
	Benzo(k)fluoranthene	mg/kg	0.05	1200	0.28	<0.05	3.4	<0.05	0.34	<0.05	2.3	1.8	1.8	1	<0.05	<0.05	6
	PAH 17 Total	mg/kg	0.85		4	<0.9	41	<0.9	8.7	<0.9	45	41	44	16	<0.9	<0.9	83

Solid
Analytical Results
ManchesterCollege
The LTE Group

				Location Code	BH101	BH101	BH102	BH102	BH103	BH103	BH105	BH105	BH106	BH106	BH108	BH108	BH110	BH111
				Sample Depth Range	0.6	1.5	0.5	1.5	2.5	3.2	1	3.5	1	3.5	1.2	2.2	0.5	1
				Sampled Date Time	06/06/2019	06/06/2019	13/06/2019	13/06/2019	12/06/2019	12/06/2019	04/06/2019	04/06/2019	10/06/2019	10/06/2019	14/06/2019	14/06/2019	13/06/2019	17/06/2019
Chem_Group	ChemName	output unit	EQL	GAC_HH_COM/IND_SAND_0.58-1.45%TOC														
SVOC	Coronene	mg/kg	0.05		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	2-methylnaphthalene	mg/kg	0.1	3000	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-
	4-bromophenyl phenyl ether	mg/kg	0.2		-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-
	4-chlorophenyl phenyl ether	mg/kg	0.3		-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
	Azobenzene	mg/kg	0.3	26	-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
	Bis(2-chloroethoxy) methane	mg/kg	0.3	2500	-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
	Bis(2-chloroethyl)ether	mg/kg	0.2	1	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-
	Carbazole	mg/kg	0.3		-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
	Dibenzofuran	mg/kg	0.2	1000	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-
	Hexachloroethane	mg/kg	0.05	9.99	-	-	-	-	-	-	-	<0.05	-	-	-	-	-	-
	Bis(2-chloroisopropyl) ether	mg/kg	0.1	47000	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-
	9,10-Anthracenedione	mg/kg	0.3	57	-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
Phenolics	2-methylphenol	mg/kg	0.3	41000	-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
	2-nitrophenol	mg/kg	0.3		-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
	2,4-dimethylphenol	mg/kg	0.3	12300	-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
	4-chloro-3-methylphenol	mg/kg	0.1	82000	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-
	4-methylphenol	mg/kg	0.2	82000	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-
	Phenol	mg/kg	0.2	370	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-
	2-chloronaphthalene	mg/kg	0.1	187	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-
	Total Monohydric Phenols (S) Corrected	mg/kg	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Anilines	Aniline	mg/kg	0.1	400	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-
	4-chloroaniline	mg/kg	0.1	11	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-
	4-nitroaniline	mg/kg	0.2	110	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-
Explosives	2,4-Dinitrotoluene	mg/kg	0.2	3740	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-
	2,6-dinitrotoluene	mg/kg	0.1	1850	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-
	Nitrobenzene	mg/kg	0.3	22	-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
Halogenated Benzenes	Chlorobenzene	mg/kg	0.001	26	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
	2-chlorotoluene	mg/kg	0.001	23000	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
	4-chlorotoluene	mg/kg	0.001	23000	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
	1,3-dichlorobenzene	mg/kg	0.001	14	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
	1,4-dichlorobenzene	mg/kg	0.001	2000	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
	1,2-dichlorobenzene	mg/kg	0.001	930	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
	1,2,4-trichlorobenzene	mg/kg	0.001	98	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
	1,2,3-trichlorobenzene	mg/kg	0.001	46	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
	Hexachlorobenzene	mg/kg	0.3	86	-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
	Hexabromobenzene	mg/kg	0.001	2300	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
					-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
Halogenated Hydrocarbons	Bromomethane	mg/kg	0.001	30	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
	Trichlorofluoromethane	mg/kg	0.001	350000	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
	1,2-dibromoethane	mg/kg	0.001	0.16	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	-
Halogenated Phenols	2-chlorophenol	mg/kg	0.1	5800	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-
	2,4-dichlorophenol	mg/kg	0.3	2500	-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
	2,4,5-trichlorophenol	mg/kg	0.2	82000	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-
	2,4,6-trichlorophenol	mg/kg	0.1	210	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-
Phthalates	Butyl benzyl phthalate	mg/kg	0.3	941000	-	-	-	-	-	-	-	<0.3	-	-	-	-	-	-
	Di-n-butyl phthalate	mg/kg	0.2	15400	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-
	Diethylphthalate	mg/kg	0.2	113000	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-
	Dimethyl phthalate	mg/kg	0.1		-	-	-	-	-	-	-	<0.1	-	-	-	-	-	-
Solvents	Isophorone	mg/kg	0.2	2400	-	-	-	-	-	-	-	<0.2	-	-	-	-	-	-
Metals	Arsenic	mg/kg	1	640	12	2.7	7.8	9.4	5	<1	11	8.9	11	4.8	8.8	6.7	7.8	7.4
	Barium	mg/kg	1	22100	120	37	210	94	91	61	180	210	240	150	77	38	200	90
	Beryllium	mg/kg	0.06	12	0.84	0.49	0.79	0.94	0.4	0.54	0.76	1	1.2	0.82	0.82	0.53	0.75	0.72
	Boron	mg/kg	0.2	240000	2	0.8	3.6	1.4	1.7	0.7	4.2	1.4	3.3	2.7	1.9	0.8	2.2	0.5
	Cadmium	mg/kg	0.2	190	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	0.3	0.3	<0.2	<0.2	<0.2	<0.2	<0.2
	Chromium (III+VI)	mg/kg	1	8,600	26	15	27	23	16	25	23	34	28	30	14	13	29	15
	Copper	mg/kg	1	68000	39	16	45	33	19	19	35	58	49	39	54	17	37	25
	Lead	mg/kg	1	2300	86	10	92	45	19	8	270	150	81	80	72	12	62	27
	Mercury	mg/kg	0.3	1100	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	Nickel	mg/kg	1	980	18	14	23	21	12	17	17	28	24	23	17	13	23	24
	Selenium	mg/kg	1	12000	<1	<1	<1	<1	<1	1.4	<1	1.9	<1	<1	<1	<1	<1	<1
	Vanadium	mg/kg	1	9000	24	15	29	28	20	18	27	30	27	30	20	15	30	21
	Zinc	mg/kg	1	730000	52	34	120	43	45	46	87	97	91	72	45	33	83	36
	Chromium (hexavalent)	mg/kg	1.2	33	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Inorganics	Cyanide (Free)	mg/kg	1	150	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Cyanide Total	mg/kg	1	1200	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Sulphide	mg/kg	1		1.9	3.4	50	<1	1.8	<1	51	20	88	5.3	3.4	<1	30	<1
	% Moisture	%	0		9.2	9	11	17	12	11	12	17	14	16	17	<13	11	19
	pH (Lab)	pH Units	0		9.8	6.9	7.6 - 9.1	8.6	7.8 - 8.4	7.9	9.8	9.3	9	7.5 - 7.6	7.6 - 8.3	8.2	8.5	7.9 - 8.4

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				Location Code	BH111	TP102	TP103	TP104	TP105	TP105	TP106	TP107	TP108	TP109	TP201	TP203	TP206	TP103/4
				Sample Depth Range	1.5	1	0.2	0.6	0.6	1.2	0.5	0.3	0.5	1.2	0.5	0.9	0.7	2
				Sampled Date Time	17/06/2019	10/06/2019	11/06/2019	10/06/2019	10/06/2019	10/06/2019	05/06/2019	05/06/2019	11/06/2019	10/06/2019	02/07/2019	02/07/2019	02/07/2019	10/06/2019
Chem_Group	ChemName	output unit	EQL	GAC_HH_COM/IND_SAND_0.58-1.45%TOC														
TPH	>C5-C6 Aliphatics	mg/kg	0.001	2000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>C6-C8 Aliphatics	mg/kg	0.001	4300	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>C8-C10 Aliphatics	mg/kg	0.001	1000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>C10-C12 Aliphatics	mg/kg	1	5000	<1	<1	<1	3.6	<1	<1	<1	<1	<1	<1	<1	5.7	5	<1
	>C12-C16 Aliphatics	mg/kg	2	37000	9.8	<2	27	52	<2	<2	5.5	8.7	<2	2.5	<2	11	13	<2
	>C16-C21 Aliphatics	mg/kg	8		16	<8	150	64	<8	<8	26	49	<8	25	13	18	38	<8
	>C21-C35 Aliphatics	mg/kg	8		<8	31	1600	28	<8	<8	240	350	<8	440	140	100	460	54
	>C5-C35 Aliphatics	mg/kg	10		29	31	1700	150	<10	<10	270	410	<10	470	150	130	510	62
	>EC5-EC7 Aromatics	mg/kg	0.001	12000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>EC7-EC8 Aromatics	mg/kg	0.001	28000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>EC8-EC10 Aromatics	mg/kg	0.001	1800	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	>EC10-EC12 Aromatics	mg/kg	1	9100	<1	<1	<1	2.2	<1	<1	4.9	<1	<1	<1	2.9	4.1	1.7	<1
	>EC12-EC16 Aromatics	mg/kg	2	34000	36	2.3	61	100	<2	9.7	31	20	4.6	<2	6.3	12	7.2	4.7
	>EC16-EC21 Aromatics	mg/kg	10	28000	18	15	710	160	<10	<10	160	100	<10	23	48	70	63	14
	>EC21-EC35 Aromatics	mg/kg	10	28000	<10	83	5100	120	<10	<10	800	450	<10	670	310	160	800	93
	>EC35-EC35 Aromatics	mg/kg	10		54	100	5900	390	<10	18	1000	580	<10	690	370	250	880	110
BTEx	Benzene	mg/kg	0.001	12	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Toluene	mg/kg	0.001	28000	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Ethylbenzene	mg/kg	0.001	2700	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Xylene (m & p)	mg/kg	0.001		<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
	Xylene (o)	mg/kg	0.001	3100	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Oxygenates	MTBE	mg/kg	0.001	3340	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chlorinated Hydrocarbons	Chloromethane	mg/kg	0.001	0.48	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Vinyl chloride	mg/kg	0.001	0.031	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Chloroethane	mg/kg	0.001	463	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1-dichloroethene	mg/kg	0.001	12.6	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	trans-1,2-dichloroethene	mg/kg	0.001	10.1	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1-dichloroethane	mg/kg	0.001	122	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	cis-1,2-dichloroethene	mg/kg	0.001	6.37	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Chloroform	mg/kg	0.001	44	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1,1-trichloroethane	mg/kg	0.001	310	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Carbon tetrachloride	mg/kg	0.001	1.4	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Trichloroethene	mg/kg	0.001	0.57	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
1,1,2-trichloroethane	mg/kg	0.001	42.5	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	
Tetrachloroethene	mg/kg	0.001	8.6	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	
VOC	2,2-dichloropropane	mg/kg	0.001		-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1-dichloropropene	mg/kg	0.001		-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,2-dichloroethane	mg/kg	0.001	0.28	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,2-dichloropropane	mg/kg	0.001	1.43	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Dibromomethane	mg/kg	0.001	99	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Bromodichloromethane	mg/kg	0.001	1.3	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	cis-1,3-dichloropropene	mg/kg	0.001		-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	trans-1,3-dichloropropene	mg/kg	0.001		-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,3-dichloropropane	mg/kg	0.001	23000	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Chlorodibromomethane	mg/kg	0.001	39	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1,1,2-tetrachloroethane	mg/kg	0.001	49	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Styrene	mg/kg	0.001	1660	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Bromoform	mg/kg	0.001	347	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Isopropylbenzene	mg/kg	0.001	632	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,1,2,2-tetrachloroethane	mg/kg	0.001	120	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	n-propylbenzene	mg/kg	0.001	1880	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,3,5-trimethylbenzene	mg/kg	0.001	1500	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	tert-butylbenzene	mg/kg	0.001	120000	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,2,4-trimethylbenzene	mg/kg	0.001	19.2	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	sec-butylbenzene	mg/kg	0.001	120000	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
p-isopropyltoluene	mg/kg	0.001		-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	
n-butylbenzene	mg/kg	0.001	58000	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	
1,2-dibromo-3-chloropropane	mg/kg	0.001	0.064	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	
Hexachlorobutadiene	mg/kg	0.001	14	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-	
Ethane, 1,1,1-trichloro-2,2,2-trifluoro-	mg/kg	0.001		-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-	
PAH	Naphthalene	mg/kg	0.00005	90	<0.05	<0.05	3.1	<0.05	<0.05	<0.05	3.6	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Acenaphthylene	mg/kg	0.05	72000	<0.05	<0.05	4.3	<0.05	<0.05	<0.05	1.5	0.35	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Acenaphthene	mg/kg	0.05	71000	<0.05	0.32	17	0.63	<0.05	<0.05	3.5	1.9	<0.05	0.22	<0.05	1.5	0.45	

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		Location Code																
		Sample Depth Range																
		Sampled Date Time																
Chem_Group	ChemName	output unit	EQL	GAC_HH_COM/IND_SAND_0.58-1.45%TOC	BH111	TP102	TP103	TP104	TP105	TP105	TP106	TP107	TP108	TP109	TP201	TP203	TP206	TT103/4
					1.5	1	0.2	0.6	0.6	1.2	0.5	0.3	0.5	1.2	0.5	0.9	0.7	2
					17/06/2019	10/06/2019	11/06/2019	10/06/2019	10/06/2019	10/06/2019	05/06/2019	05/06/2019	11/06/2019	10/06/2019	02/07/2019	02/07/2019	02/07/2019	10/06/2019
SVOC	Coronene	mg/kg	0.05		<0.05	<0.05	17	<0.05	<0.05	<0.05	<0.05	1.4	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	2-methylnaphthalene	mg/kg	0.1	3000	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
	4-bromophenyl phenyl ether	mg/kg	0.2		-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
	4-chlorophenyl phenyl ether	mg/kg	0.3		-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
	Azobenzene	mg/kg	0.3	26	-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
	Bis(2-chloroethoxy) methane	mg/kg	0.3	2500	-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
	Bis(2-chloroethyl)ether	mg/kg	0.2	1	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
	Carbazole	mg/kg	0.3		-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
	Dibenzofuran	mg/kg	0.2	1000	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
	Hexachloroethane	mg/kg	0.05	9.99	-	-	-	-	-	-	-	-	<0.05	-	-	-	-	-
	Bis(2-chloroisopropyl) ether	mg/kg	0.1	47000	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
	9,10-Anthracenedione	mg/kg	0.3	57	-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
Phenolics	2-methylphenol	mg/kg	0.3	41000	-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
	2-nitrophenol	mg/kg	0.3		-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
	2,4-dimethylphenol	mg/kg	0.3	12300	-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
	4-chloro-3-methylphenol	mg/kg	0.1	82000	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
	4-methylphenol	mg/kg	0.2	82000	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
	Phenol	mg/kg	0.2	370	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
	2-chloronaphthalene	mg/kg	0.1	187	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
	Total Monohydric Phenols (S) Corrected	mg/kg	1		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Anilines	Aniline	mg/kg	0.1	400	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
	4-chloroaniline	mg/kg	0.1	11	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
	4-nitroaniline	mg/kg	0.2	110	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
Explosives	2,4-Dinitrotoluene	mg/kg	0.2	3740	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
	2,6-dinitrotoluene	mg/kg	0.1	1850	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
	Nitrobenzene	mg/kg	0.3	22	-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
Halogenated Benzenes	Chlorobenzene	mg/kg	0.001	26	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	2-chlorotoluene	mg/kg	0.001	23000	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	4-chlorotoluene	mg/kg	0.001	23000	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,3-dichlorobenzene	mg/kg	0.001	14	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
	1,4-dichlorobenzene	mg/kg	0.001	2000	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
	1,2-dichlorobenzene	mg/kg	0.001	930	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
	1,2,4-trichlorobenzene	mg/kg	0.001	98	-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
	1,2,3-trichlorobenzene	mg/kg	0.001	46	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Hexachlorobenzene	mg/kg	0.3	86	-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
	Hexabromobenzene	mg/kg	0.001	2300	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
Halogenated Hydrocarbons	Bromomethane	mg/kg	0.001	30	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	Trichlorofluoromethane	mg/kg	0.001	350000	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
	1,2-dibromoethane	mg/kg	0.001	0.16	-	-	-	-	-	-	-	-	<0.001	-	-	-	-	-
Halogenated Phenols	2-chlorophenol	mg/kg	0.1	5800	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
	2,4-dichlorophenol	mg/kg	0.3	2500	-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
	2,4,5-trichlorophenol	mg/kg	0.2	82000	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
	2,4,6-trichlorophenol	mg/kg	0.1	210	-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
Phthalates	Butyl benzyl phthalate	mg/kg	0.3	941000	-	-	-	-	-	-	-	-	<0.3	-	-	-	-	-
	Di-n-butyl phthalate	mg/kg	0.2	15400	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
	Diethylphthalate	mg/kg	0.2	113000	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
	Dimethyl phthalate	mg/kg	0.1		-	-	-	-	-	-	-	-	<0.1	-	-	-	-	-
Solvents	Isophorone	mg/kg	0.2	2400	-	-	-	-	-	-	-	-	<0.2	-	-	-	-	-
Metals	Arsenic	mg/kg	1	640	6.3	3.4	6.3	8.3	<1	5.2	15	2.9	8.9	11	9.3	10	6.5	9.2
	Barium	mg/kg	1	22100	150	620	130	110	74	69	140	110	93	350	180	160	180	170
	Beryllium	mg/kg	0.06	12	0.62	0.29	0.73	1.3	0.58	0.45	1.3	0.38	0.78	0.47	0.7	0.91	0.56	0.93
	Boron	mg/kg	0.2	240000	0.4	0.8	0.7	1.2	0.4	0.4	0.9	0.4	0.7	1.3	3.2	3.4	2.3	2.2
	Cadmium	mg/kg	0.2	190	<0.2	1.8	8.4	<0.2	1.9	<0.2	0.4	0.2	<0.2	0.9	0.2	0.4	0.6	<0.2
	Chromium (III+VI)	mg/kg	1	8,600	16	15	37	34	11	8.8	20	22	18	22	28	23	21	26
	Copper	mg/kg	1	68000	17	31	39	43	13	12	92	24	40	31	35	53	47	38
	Lead	mg/kg	1	2300	7.7	79	42	44	18	8.4	140	25	64	65	95	110	83	41
	Mercury	mg/kg	0.3	1100	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3	<0.3
	Nickel	mg/kg	1	980	20	10	31	34	13	10	22	13	14	15	19	24	20	25
	Selenium	mg/kg	1	12000	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Vanadium	mg/kg	1	9000	21	11	64	31	8.2	14	32	15	26	26	26	23	28	
	Zinc	mg/kg	1	730000	40	92	76	59	86	30	120	180	49	130	88	110	98	70
	Chromium (hexavalent)	mg/kg	1.2	33	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2	<1.2
Inorganics	Cyanide (Free)	mg/kg	1	150	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Cyanide Total	mg/kg	1	1200	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Sulphide	mg/kg	1		<1	6.8	120	20	16	6.9	8.8	33	<1	20	25	24	12	9.4
	% Moisture	%	0		12	7.7	6.6	21	3.3	7.3	8.3	15	17	13	10	18	5.2	14
	pH (Lab)	pH Units	0		8.4	9.1	8	7.8	8 - 10.8	8.8	8.7	8.6	7.2 - 8.1	11.3	9.2	8.6	9.4	9.6

Solid
Analytical Results
ManchesterCollege
The LTE Group

Location Code															
Sample Depth Range															
Sampled Date Time															
Statistical Summary															
Chem_Group	ChemName	output unit	EQL	GAC_HH_COMIND_SAND_0.58-1.45%TOC	Number of Results	Number of Detects	Minimum Concentration	Minimum Detect	Maximum Concentration	Maximum Detect	Average Concentration	Median Concentration	Standard Deviation	Number of Guideline Exceedances	Number of Guideline Exceedances (Detects Only)
TPH	>C5-C6 Aliphatics	mg/kg	0.001	2000	28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
	>C6-C8 Aliphatics	mg/kg	0.001	4300	28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
	>C8-C10 Aliphatics	mg/kg	0.001	1000	28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
	>C10-C12 Aliphatics	mg/kg	1	5000	28	5	<1	1.6	5.7	5.7	1.1	0.5	1.4	0	0
	>C12-C16 Aliphatics	mg/kg	2	37000	28	14	<2	2.5	52	52	6.4	1.75	11	0	0
	>C16-C21 Aliphatics	mg/kg	8		28	16	<8	11	150	150	22	12.5	30	0	0
	>C21-C35 Aliphatics	mg/kg	8		28	20	<8	16	1600	1600	183	58	326	0	0
	>C5-C35 Aliphatics	mg/kg	10		28	21	<10	16	1700	1700	208	102	344	0	0
	>EC5-EC7 Aromatics	mg/kg	0.001	12000	28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
	>EC7-EC8 Aromatics	mg/kg	0.001	28000	28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
	>EC8-EC10 Aromatics	mg/kg	0.001	1800	28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
	>EC10-EC12 Aromatics	mg/kg	1	9100	28	6	<1	1.7	4.9	4.9	1.1	0.5	1.2	0	0
	>EC12-EC16 Aromatics	mg/kg	2	34000	28	24	<2	2	100	100	14	7.5	21	0	0
	>EC16-EC21 Aromatics	mg/kg	10	28000	28	20	<10	12	710	710	65	31	133	0	0
	>EC21-EC35 Aromatics	mg/kg	10	28000	28	19	<10	83	5100	5100	377	125	955	0	0
	>EC5-EC35 Aromatics	mg/kg	10		28	24	<10	14	5900	5900	457	195	1100	0	0
BTEX	Benzene	mg/kg	0.001	12	28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
	Toluene	mg/kg	0.001	28000	28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
	Ethylbenzene	mg/kg	0.001	2700	28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
	Xylene (m & p)	mg/kg	0.001		28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
	Xylene (o)	mg/kg	0.001	3100	28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
Oxygenates	MTBE	mg/kg	0.001	3340	28	0	<0.001	ND	<0.001	ND	0.0005	0.0005	0	0	0
Chlorinated Hydrocarbons	Chloromethane	mg/kg	0.001	0.48	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Vinyl chloride	mg/kg	0.001	0.031	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Chloroethane	mg/kg	0.001	463	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,1-dichloroethene	mg/kg	0.001	12.6	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	trans-1,2-dichloroethene	mg/kg	0.001	10.1	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,1-dichloroethane	mg/kg	0.001	122	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	cis-1,2-dichloroethene	mg/kg	0.001	6.37	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Chloroform	mg/kg	0.001	44	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,1,1-trichloroethane	mg/kg	0.001	310	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Carbon tetrachloride	mg/kg	0.001	1.4	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Trichloroethene	mg/kg	0.001	0.57	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,1,2-trichloroethane	mg/kg	0.001	42.5	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Tetrachloroethene	mg/kg	0.001	8.6	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
VOC	2,2-dichloropropane	mg/kg	0.001		2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,1-dichloropropene	mg/kg	0.001		2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,2-dichloroethane	mg/kg	0.001	0.28	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,2-dichloropropane	mg/kg	0.001	1.43	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Dibromomethane	mg/kg	0.001	99	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Bromodichloromethane	mg/kg	0.001	1.3	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	cis-1,3-dichloropropene	mg/kg	0.001		2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	trans-1,3-dichloropropene	mg/kg	0.001		2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,3-dichloropropane	mg/kg	0.001	23000	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Chlorodibromomethane	mg/kg	0.001	39	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,1,1,2-tetrachloroethane	mg/kg	0.001	49	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Styrene	mg/kg	0.001	1660	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Bromoform	mg/kg	0.001	347	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Isopropylbenzene	mg/kg	0.001	632	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,1,2,2-tetrachloroethane	mg/kg	0.001	120	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	n-propylbenzene	mg/kg	0.001	1880	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,3,5-trimethylbenzene	mg/kg	0.001	1500	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	tert-butylbenzene	mg/kg	0.001	120000	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,2,4-trimethylbenzene	mg/kg	0.001	19.2	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	sec-butylbenzene	mg/kg	0.001	120000	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	p-isopropyltoluene	mg/kg	0.001		2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	n-butylbenzene	mg/kg	0.001	58000	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,2-dibromo-3-chloropropane	mg/kg	0.001	0.064	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Hexachlorobutadiene	mg/kg	0.001	14	2	0	<0.001	ND	<0.1	ND		0.02525		0	0
	Ethane, 1,1,1-trichloro-2,2,2-trifluoro-	mg/kg	0.001		2	0	<0.001	ND	<0.001	ND		0.0005		0	0
PAH	Naphthalene	mg/kg	0.00005	90	28	5	<0.0001	0.27	3.6	3.6	0.3	0.025	0.87	0	0
	Acenaphthylene	mg/kg	0.05	72000	28	6	<0.05	0.26	4.3	4.3	0.28	0.025	0.84	0	0
	Acenaphthene	mg/kg	0.05	71000	28	13	<0.05	0.22	17	17	1	0.025	3.2	0	0
	Fluorene	mg/kg	0.05	59000	28	12	<0.05	0.23	11	11	0.82	0.025	2.1	0	0
	Phenanthrene	mg/kg	0.05	22000	28	19	<0.05	0.29	81	81	5.7	1.3	15	0	0
	Anthracene	mg/kg	0.05	520000	28	17	<0.05	0.18	32	32	2	0.405	6	0	0
	Fluoranthene	mg/kg	0.05	23000	28	19	<0.05	0.26	200	200	12	2.3	37	0	0
	Pyrene	mg/kg	0.05	54000	28	19	<0.05	0.24	190	190	12	2.3	36	0	0
	Benz(a)anthracene	mg/kg	0.05	170	28	18	<0.05	0.38	140	140	7.4	1.05	26	0	0
	Chrysene	mg/kg	0.05	350	28	18	<0.05	0.34	91	91	5.3	0.935	17	0	0
	Benzo(a) pyrene	mg/kg	0.05	35	28	18	<0.05	0.35	160	160	8.1	1.055	30	1	1
	Indeno(1,2,3-c,d)pyrene	mg/kg	0.05	510	28	18	<0.05	0.22	85	85	4.3	0.655	16	0	0
	Dibenz(a,h)anthracene	mg/kg	0.05	3.5	28	11	<0.05	0.48	22	22	1.1	0.025	4.1	1	1
	Benzo(g,h,i)perylene	mg/kg	0.05	3900	28	18	<0.05	0.29	97	97	5	0.8	18	0	0
	Benzo(b)fluoranthene	mg/kg	0.05	45	28	18	<0.05	0.38	170	170	8.5	1.025	32	1	1
	Benzo(k)fluoranthene	mg/kg	0.05	1200	28	18	<0.05	0.28	63	63	3.6	0.745	12	0	0
	PAH 17 Total	mg/kg	0.85		28	18	<0.9	4	1400	1400	78	12.35	262	0	0

Solid
Analytical Results
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The LTE Group

Location Code															
Sample Depth Range															
Sampled Date Time															
Statistical Summary															
Chem_Group	ChemName	output unit	EQL	GAC_HH_COM/IND_SAND_0.58-1.45%TOC	Number of Results	Number of Detects	Minimum Concentration	Minimum Detect	Maximum Concentration	Maximum Detect	Average Concentration	Median Concentration	Standard Deviation	Number of Guideline Exceedances	Number of Guideline Exceedances (Detects Only)
SVOC	Coronene	mg/kg	0.05		28	2	<0.05	1.4	17	17	0.68	0.025	3.2	0	0
	2-methylnaphthalene	mg/kg	0.1	3000	2	0	<0.1	ND	<0.1	ND		0.05		0	0
	4-bromophenyl phenyl ether	mg/kg	0.2		2	0	<0.2	ND	<0.2	ND		0.1		0	0
	4-chlorophenyl phenyl ether	mg/kg	0.3		2	0	<0.3	ND	<0.3	ND		0.15		0	0
	Azobenzene	mg/kg	0.3	26	2	0	<0.3	ND	<0.3	ND		0.15		0	0
	Bis(2-chloroethoxy) methane	mg/kg	0.3	2500	2	0	<0.3	ND	<0.3	ND		0.15		0	0
	Bis(2-chloroethyl)ether	mg/kg	0.2	1	2	0	<0.2	ND	<0.2	ND		0.1		0	0
	Carbazole	mg/kg	0.3		2	0	<0.3	ND	<0.3	ND		0.15		0	0
	Dibenzofuran	mg/kg	0.2	1000	2	0	<0.2	ND	<0.2	ND		0.1		0	0
	Hexachloroethane	mg/kg	0.05	9.99	2	0	<0.05	ND	<0.05	ND		0.025		0	0
	Bis(2-chloroisopropyl) ether	mg/kg	0.1	47000	2	0	<0.1	ND	<0.1	ND		0.05		0	0
	9,10-Anthracenedione	mg/kg	0.3	57	2	0	<0.3	ND	<0.3	ND		0.15		0	0
Phenolics	2-methylphenol	mg/kg	0.3	41000	2	0	<0.3	ND	<0.3	ND		0.15		0	0
	2-nitrophenol	mg/kg	0.3		2	0	<0.3	ND	<0.3	ND		0.15		0	0
	2,4-dimethylphenol	mg/kg	0.3	12300	2	0	<0.3	ND	<0.3	ND		0.15		0	0
	4-chloro-3-methylphenol	mg/kg	0.1	82000	2	0	<0.1	ND	<0.1	ND		0.05		0	0
	4-methylphenol	mg/kg	0.2	82000	2	0	<0.2	ND	<0.2	ND		0.1		0	0
	Phenol	mg/kg	0.2	370	2	0	<0.2	ND	<0.2	ND		0.1		0	0
	2-chloronaphthalene	mg/kg	0.1	187	2	0	<0.1	ND	<0.1	ND		0.05		0	0
	Total Monohydric Phenols (S) Corrected	mg/kg	1		28	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Aniline	mg/kg	0.1	400	2	0	<0.1	ND	<0.1	ND		0.05		0	0
Anilines	4-chloroaniline	mg/kg	0.1	11	2	0	<0.1	ND	<0.1	ND		0.05		0	0
	4-nitroaniline	mg/kg	0.2	110	2	0	<0.2	ND	<0.2	ND		0.1		0	0
Explosives	2,4-Dinitrotoluene	mg/kg	0.2	3740	2	0	<0.2	ND	<0.2	ND		0.1		0	0
	2,6-dinitrotoluene	mg/kg	0.1	1850	2	0	<0.1	ND	<0.1	ND		0.05		0	0
	Nitrobenzene	mg/kg	0.3	22	2	0	<0.3	ND	<0.3	ND		0.15		0	0
Halogenated Benzenes	Chlorobenzene	mg/kg	0.001	26	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	2-chlorotoluene	mg/kg	0.001	23000	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	4-chlorotoluene	mg/kg	0.001	23000	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,3-dichlorobenzene	mg/kg	0.001	14	2	0	<0.001	ND	<0.2	ND		0.05025		0	0
	1,4-dichlorobenzene	mg/kg	0.001	2000	2	0	<0.001	ND	<0.2	ND		0.05025		0	0
	1,2-dichlorobenzene	mg/kg	0.001	930	2	0	<0.001	ND	<0.1	ND		0.02525		0	0
	1,2,4-trichlorobenzene	mg/kg	0.001	98	2	0	<0.001	ND	<0.3	ND		0.07525		0	0
	1,2,3-trichlorobenzene	mg/kg	0.001	46	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Hexachlorobenzene	mg/kg	0.3	86	2	0	<0.3	ND	<0.3	ND		0.15		0	0
	Hexabromobenzene	mg/kg	0.001	2300	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
Halogenated Hydrocarbons	Bromomethane	mg/kg	0.001	30	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	Trichlorofluoromethane	mg/kg	0.001	350000	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
	1,2-dibromoethane	mg/kg	0.001	0.16	2	0	<0.001	ND	<0.001	ND		0.0005		0	0
Halogenated Phenols	2-chlorophenol	mg/kg	0.1	5800	2	0	<0.1	ND	<0.1	ND		0.05		0	0
	2,4-dichlorophenol	mg/kg	0.3	2500	2	0	<0.3	ND	<0.3	ND		0.15		0	0
	2,4,5-trichlorophenol	mg/kg	0.2	82000	2	0	<0.2	ND	<0.2	ND		0.1		0	0
	2,4,6-trichlorophenol	mg/kg	0.1	210	2	0	<0.1	ND	<0.1	ND		0.05		0	0
Phthalates	Butyl benzyl phthalate	mg/kg	0.3	941000	2	0	<0.3	ND	<0.3	ND		0.15		0	0
	Di-n-butyl phthalate	mg/kg	0.2	15400	2	0	<0.2	ND	<0.2	ND		0.1		0	0
	Diethylphthalate	mg/kg	0.2	113000	2	0	<0.2	ND	<0.2	ND		0.1		0	0
	Dimethyl phthalate	mg/kg	0.1		2	0	<0.1	ND	<0.1	ND		0.05		0	0
Solvents	Isophorone	mg/kg	0.2	2400	2	0	<0.2	ND	<0.2	ND		0.1		0	0
Metals	Arsenic	mg/kg	1	640	28	26	<1	2.7	15	15	7.4	7.8	3.4	0	0
	Barium	mg/kg	1	22100	28	28	37	37	620	620	155	135	114	0	0
	Beryllium	mg/kg	0.06	12	28	28	0.29	0.29	1.3	1.3	0.74	0.74	0.26	0	0
	Boron	mg/kg	0.2	240000	28	28	0.4	0.4	4.2	4.2	1.6	1.35	1.1	0	0
	Cadmium	mg/kg	0.2	190	28	11	<0.2	0.2	8.4	8.4	0.61	0.1	1.6	0	0
	Chromium (III+VI)	mg/kg	1	8,600	28	28	8.8	8.8	37	37	22	22.5	7.3	0	0
	Copper	mg/kg	1	68000	28	28	12	12	92	92	36	36	17	0	0
	Lead	mg/kg	1	2300	28	28	7.7	7.7	270	270	66	63	56	0	0
	Mercury	mg/kg	0.3	1100	28	0	<0.3	ND	<0.3	ND	0.15	0.15	0	0	0
	Nickel	mg/kg	1	980	28	28	10	10	34	34	19	19.5	6.1	0	0
	Selenium	mg/kg	1	12000	28	2	<1	1.4	1.9	1.9	0.58	0.5	0.31	0	0
	Vanadium	mg/kg	1	9000	28	28	8.2	8.2	64	64	24	26	10	0	0
	Zinc	mg/kg	1	730000	28	28	30	30	180	180	75	74	36	0	0
	Chromium (hexavalent)	mg/kg	1.2	33	28	0	<1.2	ND	<1.2	ND	0.6	0.6	0	0	0
Inorganics	Cyanide (Free)	mg/kg	1	150	28	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Cyanide Total	mg/kg	1	1200	28	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Sulphide	mg/kg	1		28	22	<1	1.8	120	120	20	9.1	28	0	0
	% Moisture	%	0		28	28	3.3	3.3	21	21	12	12	4.4	0	0
	pH (Lab)	pH Units	0		28	28	6.9	6.9	11.3	11.3	8.7	8.6	0.89	0	0

**Leachate
Analytical Results
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The LTE Group**

[illegible]

Chem_Group	ChemName	output unit	EQL	GAC_WTV_EN/WA_DWS	GAC_WTV_EN/WA_EQS-Fresh														
TPH	>C10-C35 Aliphatics	µg/L	10			<10	-	<10	-	<10	-	-	<10	-	<10	<10	-	-	
	>EC10-EC35 Aromatics	µg/L	10			<10	-	<10	-	<10	-	-	<10	-	<10	<10	-	-	
	>C5-C6 Aliphatics	µg/L	1	15,000 ¹²		<1	-	<1	-	<1	-	-	<1	-	<1	<1	-	-	
	>C6-C8 Aliphatics	µg/L	1	15,000 ¹²		<1	-	<1	-	<1	-	-	<1	-	<1	<1	-	-	
	>C8-C10 Aliphatics	µg/L	1	300 ¹²		<1	-	<1	-	<1	-	-	<1	-	<1	<1	-	-	
	>C10-C12 Aliphatics	µg/L	10	300 ¹²		<10	-	<10	-	<10	-	-	<10	-	<10	<10	-	-	
	>C12-C16 Aliphatics	µg/L	10	300 ¹²		<10	-	<10	-	<10	-	-	<10	-	<10	<10	-	-	
	>C16-C21 Aliphatics	µg/L	10	300 ¹²		<10	-	<10	-	<10	-	-	<10	-	<10	<10	-	-	
	>C21-C35 Aliphatics	µg/L	10	300 ¹²		<10	-	<10	-	<10	-	-	<10	-	<10	<10	-	-	
	>EC5-EC7 Aromatics	µg/L	1		10 ¹⁰	<1	-	<1	-	<1	-	-	<1	-	<1	<1	-	-	
	>EC7-EC8 Aromatics	µg/L	1	700 ¹²	74 ¹⁷	<1	-	<1	-	<1	-	-	<1	-	<1	<1	-	-	
	>EC8-EC10 Aromatics	µg/L	1	300 ¹²		<1	-	<1	-	<1	-	-	<1	-	<1	<1	-	-	
	>EC10-EC12 Aromatics	µg/L	10	90 ¹²		<10	-	<10	-	<10	-	-	<10	-	<10	<10	-	-	
	>EC12-EC16 Aromatics	µg/L	10	90 ¹²		<10	-	<10	-	<10	-	-	<10	-	<10	<10	-	-	
	>EC16-EC21 Aromatics	µg/L	10	90 ¹²		<10	-	<10	-	<10	-	-	<10	-	<10	<10	-	-	
>EC21-EC35 Aromatics	µg/L	10	90 ¹²		<10	-	<10	-	<10	-	-	<10	-	<10	<10	-	-		
BTX	Benzene	µg/L	1	1 ¹¹	10 ¹⁰	<1	-	<1	-	<1	-	-	<1	-	<1	<1	-	-	
	Toluene	µg/L	1	700 ¹³	74 ¹⁷	<1	-	<1	-	<1	-	-	<1	-	<1	<1	-	-	
	Ethylbenzene	µg/L	1	300 ¹³	20 ¹¹²	<1	-	<1	-	<1	-	-	<1	-	<1	<1	-	-	
	Xylene (m & p)	µg/L	1			<1	-	<1	-	<1	-	-	<1	-	<1	<1	-	-	
	Xylene (o)	µg/L	1	190 ¹¹⁰		<1	-	<1	-	<1	-	-	<1	-	<1	<1	-	-	
	MTBE	µg/L	10	1,800 ¹¹⁵	5,100 ¹¹³	<10	-	<10	-	<10	-	-	<10	-	<10	<10	-	-	
PAH	Naphthalene	µg/L	0.01	6 ¹¹⁵	2 ¹⁰	<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Acenaphthylene	µg/L	0.01	18 ¹¹⁵		<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Acenaphthene	µg/L	0.01	18 ¹¹⁵		<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Fluorene	µg/L	0.01	12 ¹¹⁵		<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Phenanthrene	µg/L	0.01	4 ¹¹⁵		<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Anthracene	µg/L	0.01	90 ¹¹⁵	0.1 ¹⁰	<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Fluoranthene	µg/L	0.01	4 ¹¹⁵	0.0063 ¹⁰	<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Pyrene	µg/L	0.01	9 ¹¹⁵		<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Benz(a)anthracene	µg/L	0.01	3,5 ¹¹⁵		<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Chrysene	µg/L	0.01	7 ¹¹⁵		<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Benzo(a) pyrene	µg/L	0.01	0.01 ¹¹	0.00017 ¹⁰	<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Indeno(1,2,3-c,d)pyrene	µg/L	0.01	Use PAHs (sum of 4) ¹¹	see BaP and notes ¹⁰	<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Dibenz(a,h)anthracene	µg/L	0.01	0.07 ¹¹⁵		<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Benzo(g,h,i)perylene	µg/L	0.01	Use PAHs (sum of 4) ¹¹	0.0082 ¹⁰	<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
	Benzo(b)fluoranthene	µg/L	0.01	Use PAHs (sum of 4) ¹¹	0.017 ¹⁰	<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-	
Benzo(k)fluoranthene	µg/L	0.01	Use PAHs (sum of 4) ¹¹	0.017 ¹⁰	<0.01	-	<0.01	-	<0.01	-	-	<0.01	-	<0.01	<0.01	-	-		
PAH 16 Total	µg/L	0.2			<0.2	-	<0.2	-	<0.2	-	-	<0.2	-	<0.2	<0.2	-	-		
Metals	Arsenic	µg/L	1.1	10 ¹¹	50 ¹⁷	11	-	<1.1	-	<1.1	-	-	33	-	<1.1	<1.1	-	-	
	Barium	µg/L	0.05	1,300 ¹³		12	-	31	-	14	-	-	40	-	34	18	-	-	
	Beryllium	µg/L	0.2	12 ¹³		<0.2	-	<0.2	-	<0.2	-	-	<0.2	-	<0.2	<0.2	-	-	
	Boron	µg/L	10	1,000 ¹¹	2,000 ¹¹²	110	-	160	-	32	-	-	71	-	160	47	-	-	
	Chromium (III+VI)	µg/L	0.4	50 ¹¹		4.8	-	2.1	-	31	-	-	3.3	-	2.3	2.1	-	-	
	Copper	µg/L	0.7	2,000 ¹¹	1 ¹⁷	11	-	7.8	-	12	-	-	46	-	9.4	5.5	-	-	
	Lead	µg/L	1	10 ¹¹	1.2 ¹⁰	3.1	-	<1	-	<1	-	-	25	-	1.4	3.8	-	-	
	Mercury	µg/L	0.5	1 ¹¹	0.07 ¹⁰	<0.5	-	<0.5	-	<0.5	-	-	<0.5	-	<0.5	<0.5	-	-	
	Nickel	µg/L	0.3	20 ¹¹	4 ¹⁰	1.4	-	<0.3	-	<0.3	-	-	7.7	-	2	2	-	-	
	Selenium	µg/L	4	10 ¹¹		<4	-	<4	-	<4	-	-	7.1	-	<4	<4	-	-	
	Vanadium	µg/L	1.7	86 ¹¹⁰	20 ¹¹²	24	-	3.3	-	<1.7	-	-	100	-	4.6	4.3	-	-	
	Zinc	µg/L	0.4	6000 ¹¹⁰	10.9 ¹⁷	11	-	7.4	-	6.5	-	-	9.8	-	9	6.1	-	-	
	Chromium (hexavalent)	µg/L	5	Use Chromium (total) ¹¹	3.4 ¹⁷	<5	-	<5	-	33	-	-	<5	-	<5	<5	-	-	
	Inorganics	Water Soluble Sulphate	g/L	0.0013			0.35	0.15	0.62	0.089	0.3	0.079	0.78	0.16	0.41	0.31	0.027	0.023	0.36
		pH (Lab)	pH Units	0			10	-	-	-	-	-	-	9.4	-	-	-	-	-

Leachate
Analytical Results
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Field ID	BH111	BH111	TP102	TP103	TP103/4	TP104	TP105	TP105	TP106	TP107	TP108	TP109	TP201	TP203	TP206
Location Code	BH111	BH111	TP102	TP103	TP103/4	TP104	TP105	TP105	TP106	TP107	TP108	TP109	TP201	TP203	TP206
Sample Depth Range	1.000-	1.500-	1.000-	0.200-	2.000-	0.600-	0.600-	1.200-	0.500-	0.300-	0.500-	1.200-	0.500-	0.900-	0.700-
Sampled Date Time	17/06/2019	17/06/2019	10/06/2019	11/06/2019	10/06/2019	10/06/2019	10/06/2019	10/06/2019	05/06/2019	05/06/2019	11/06/2019	10/06/2019	02/07/2019	02/07/2019	02/07/2019
Matrix Description															

Chem_Group	ChemName	output unit	EQL	GAC_WTV_EN/WA_DWS	GAC_WTV_EN/WA_EQS-Fresh															
TPH	>C10-C35 Aliphatics	µg/L	10			<10	-	-	-	-	-	<10	-	-	-	<10	-	-	-	-
	>EC10-EC35 Aromatics	µg/L	10			<10	-	-	-	-	-	<10	-	-	-	<10	-	-	-	-
	>C5-C6 Aliphatics	µg/L	1	15,000 ²²		<1	-	-	-	-	-	<1	-	-	-	<1	-	-	-	-
	>C6-C8 Aliphatics	µg/L	1	15,000 ²²		<1	-	-	-	-	-	<1	-	-	-	<1	-	-	-	-
	>C8-C10 Aliphatics	µg/L	1	300 ²²		<1	-	-	-	-	-	<1	-	-	-	<1	-	-	-	-
	>C10-C12 Aliphatics	µg/L	10	300 ²²		<10	-	-	-	-	-	<10	-	-	-	<10	-	-	-	-
	>C12-C16 Aliphatics	µg/L	10	300 ²²		<10	-	-	-	-	-	<10	-	-	-	<10	-	-	-	-
	>C16-C21 Aliphatics	µg/L	10	300 ²²		<10	-	-	-	-	-	<10	-	-	-	<10	-	-	-	-
	>C21-C35 Aliphatics	µg/L	10	300 ²²		<10	-	-	-	-	-	<10	-	-	-	<10	-	-	-	-
	>EC5-EC7 Aromatics	µg/L	1	1 ⁴³	10 ²⁸	<1	-	-	-	-	-	<1	-	-	-	<1	-	-	-	-
	>EC7-EC8 Aromatics	µg/L	1	700 ²²	74 ²⁷	<1	-	-	-	-	-	<1	-	-	-	<1	-	-	-	-
	>EC8-EC10 Aromatics	µg/L	1	300 ²²		<1	-	-	-	-	-	<1	-	-	-	<1	-	-	-	-
	>EC10-EC12 Aromatics	µg/L	10	90 ²²		<10	-	-	-	-	-	<10	-	-	-	<10	-	-	-	-
	>EC12-EC16 Aromatics	µg/L	10	90 ²²		<10	-	-	-	-	-	<10	-	-	-	<10	-	-	-	-
	>EC16-EC21 Aromatics	µg/L	10	90 ²²		<10	-	-	-	-	-	<10	-	-	-	<10	-	-	-	-
	>EC21-EC35 Aromatics	µg/L	10	90 ²²		<10	-	-	-	-	-	<10	-	-	-	<10	-	-	-	-
BTEX	Benzene	µg/L	1	1 ⁴³	10 ²⁸	<1	-	-	-	-	-	<1	-	-	-	<1	-	-	-	-
	Toluene	µg/L	1	700 ²³	74 ²⁷	<1	-	-	-	-	-	<1	-	-	-	<1	-	-	-	-
	Ethylbenzene	µg/L	1	300 ²³	20 ²¹²	<1	-	-	-	-	-	<1	-	-	-	<1	-	-	-	-
	Xylene (m & p)	µg/L	1			<1	-	-	-	-	-	<1	-	-	-	<1	-	-	-	-
	Xylene (o)	µg/L	1	190 ²¹⁰		<1	-	-	-	-	-	<1	-	-	-	<1	-	-	-	-
Oxygenates	MTBE	µg/L	10	1,800 ²¹⁵	5,100 ²¹³	<10	-	-	-	-	-	<10	-	-	-	<10	-	-	-	-
PAH	Naphthalene	µg/L	0.01	6 ²¹⁵	2 ²⁸	<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Acenaphthylene	µg/L	0.01	18 ²¹⁵		<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Acenaphthene	µg/L	0.01	18 ²¹⁵		<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Fluorene	µg/L	0.01	12 ²¹⁵		<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Phenanthrene	µg/L	0.01	4 ²¹⁵		<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Anthracene	µg/L	0.01	90 ²¹⁵	0.1 ²⁸	<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Fluoranthene	µg/L	0.01	4 ²¹⁵	0.0063 ²⁸	<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Pyrene	µg/L	0.01	9 ²¹⁵		<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Benzo(a)anthracene	µg/L	0.01	3,5 ²¹⁵		<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Chrysene	µg/L	0.01	2 ²¹⁵		<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Benzo(a) pyrene	µg/L	0.01	0.01 ²¹	0.00017 ²⁸	<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Indeno(1,2,3-c,d)pyrene	µg/L	0.01	Use PAHs (sum of 4) ²¹	see BaP and notes ²⁹	<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Dibenz(a,h)anthracene	µg/L	0.01	0.07 ²¹⁵		<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Benzo(g,h,i)perylene	µg/L	0.01	Use PAHs (sum of 4) ²¹	0.0082 ²⁵	<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Benzo(b)fluoranthene	µg/L	0.01	Use PAHs (sum of 4) ²¹	0.017 ²⁸	<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	Benzo(k)fluoranthene	µg/L	0.01	Use PAHs (sum of 4) ²¹	0.017 ²⁸	<0.01	-	-	-	-	-	<0.01	-	-	-	<0.01	-	-	-	-
	PAH 16 Total	µg/L	0.2			<0.2	-	-	-	-	-	<0.2	-	-	-	<0.2	-	-	-	-
Metals	Arsenic	µg/L	1.1	10 ²¹	50 ²⁷	<1.1	-	-	-	-	-	<1.1	-	-	-	3.5	-	-	-	-
	Barium	µg/L	0.05	1,300 ²³		31	-	-	-	-	-	60	-	-	-	21	-	-	-	-
	Beryllium	µg/L	0.2	12 ²⁵		<0.2	-	-	-	-	-	<0.2	-	-	-	<0.2	-	-	-	-
	Boron	µg/L	10	1,000 ²¹	2,000 ²¹²	<10	-	-	-	-	-	65	-	-	-	<10	-	-	-	-
	Chromium (III+VI)	µg/L	0.4	50 ²¹		0.5	-	-	-	-	-	2.4	-	-	-	5	-	-	-	-
	Copper	µg/L	0.7	2,000 ²¹		1 ²⁷	-	-	-	-	-	47	-	-	-	22	-	-	-	-
	Lead	µg/L	1	10 ²¹	1.2 ²⁸	1.1	-	-	-	-	-	4.9	-	-	-	19	-	-	-	-
	Mercury	µg/L	0.5	1 ²¹	0.07 ²⁶	<0.5	-	-	-	-	-	<0.5	-	-	-	<0.5	-	-	-	-
	Nickel	µg/L	0.3	20 ²¹	4 ²⁸	1.1	-	-	-	-	-	6.7	-	-	-	3.9	-	-	-	-
	Selenium	µg/L	4	10 ²¹		<4	-	-	-	-	-	<4	-	-	-	<4	-	-	-	-
	Vanadium	µg/L	1.7	86 ²¹⁰	20 ²¹²	<1.7	-	-	-	-	-	9.8	-	-	-	9.1	-	-	-	-
	Zinc	µg/L	0.4	6000 ²¹⁰	10.9 ²⁷	5.1	-	-	-	-	-	19	-	-	-	12	-	-	-	-
	Chromium (hexavalent)	µg/L	5	Use Chromium (total) ²¹	3.4 ²⁷	<5	-	-	-	-	-	<5	-	-	-	<5	-	-	-	-
Inorganics	Water Soluble Sulphate	g/L	0.0013			0.034	0.047	0.088	0.1	0.4	0.12	0.068	0.031	0.12	2	0.02	0.11	0.53	0.34	0.41
	pH (Lab)	pH Units	0			-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Leachate
Analytical Results
ManchesterCollege
The LTE Group

Field ID
Location Code
Sample Depth Range
Sampled Date Time
Matrix Description

Statistical Summary

Chem_Group	ChemName	output unit	EQL	GAC_WTV_EN/WA_DWS	GAC_WTV_EN/WA_EQS-Fresh	Number of Results	Number of Detects	Minimum Concentration	Minimum Detect	Maximum Concentration	Maximum Detect	Average Concentration	Median Concentration	Standard Deviation	Number of Guideline Exceedances	Number of Guideline Exceedances (Detects Only)
TPH	>C10-C35 Aliphatics	ug/L	10			9	0	<10	ND	<10	ND	5	5	0	0	0
	>EC10-EC35 Aromatics	ug/L	10			9	0	<10	ND	<10	ND	5	5	0	0	0
	>C5-C6 Aliphatics	ug/L	1	15,000 ⁷²		9	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>C6-C8 Aliphatics	ug/L	1	15,000 ⁷²		9	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>C8-C10 Aliphatics	ug/L	1	300 ⁸²		9	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>C10-C12 Aliphatics	ug/L	10	300 ⁸²		9	0	<10	ND	<10	ND	5	5	0	0	0
	>C12-C16 Aliphatics	ug/L	10	300 ⁸²		9	0	<10	ND	<10	ND	5	5	0	0	0
	>C16-C21 Aliphatics	ug/L	10	300 ⁸²		9	0	<10	ND	<10	ND	5	5	0	0	0
	>C21-C35 Aliphatics	ug/L	10	300 ⁸²		9	0	<10	ND	<10	ND	5	5	0	0	0
	>EC5-EC7 Aromatics	ug/L	1	1 ⁷¹	10 ¹⁸	9	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>EC7-EC8 Aromatics	ug/L	1	700 ⁸²	74 ⁴⁷	9	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>EC8-EC10 Aromatics	ug/L	1	300 ⁸²		9	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>EC10-EC12 Aromatics	ug/L	10	90 ⁸²		9	0	<10	ND	<10	ND	5	5	0	0	0
	>EC12-EC16 Aromatics	ug/L	10	90 ⁸²		9	0	<10	ND	<10	ND	5	5	0	0	0
	>EC16-EC21 Aromatics	ug/L	10	90 ⁸²		9	0	<10	ND	<10	ND	5	5	0	0	0
	>EC21-EC35 Aromatics	ug/L	10	90 ⁸²		9	0	<10	ND	<10	ND	5	5	0	0	0
BTEx	Benzene	ug/L	1	1 ⁷¹	10 ¹⁸	9	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Toluene	ug/L	1	700 ⁸³	74 ⁴⁷	9	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Ethylbenzene	ug/L	1	300 ⁸³	20 ¹¹²	9	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Xylene (m & p)	ug/L	1			9	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Xylene (o)	ug/L	1	190 ¹¹⁰		9	0	<1	ND	<1	ND	0.5	0.5	0	0	0
Oxygenates	MTBE	ug/L	10	1,800 ¹¹⁵	5,100 ¹¹³	9	0	<10	ND	<10	ND	5	5	0	0	0
PAH	Naphthalene	ug/L	0.01	6 ¹¹⁵	2 ¹⁸	9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Acenaphthylene	ug/L	0.01	18 ¹¹⁵		9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Acenaphthene	ug/L	0.01	18 ¹¹⁵		9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Fluorene	ug/L	0.01	12 ¹¹⁵		9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Phenanthrene	ug/L	0.01	4 ¹¹⁵		9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Anthracene	ug/L	0.01	90 ¹¹⁵	0.1 ¹⁸	9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Fluoranthene	ug/L	0.01	4 ¹¹⁵	0.0063 ¹⁸	9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	9	0
	Pyrene	ug/L	0.01	9 ¹¹⁵		9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Benz(a)anthracene	ug/L	0.01	3,5 ¹¹⁵		9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Chrysene	ug/L	0.01	7 ¹¹⁵		9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Benzo(a) pyrene	ug/L	0.01	0.01 ¹¹⁵	0.00017 ¹⁸	9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	9	0
	Indeno(1,2,3-c,d)pyrene	ug/L	0.01	Use PAHs (sum of 4) ¹¹⁵	see BaP and notes ¹⁸	9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Dibenz(a,h)anthracene	ug/L	0.01	0.07 ¹¹⁵		9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Benzo(g,h,i)perylene	ug/L	0.01	Use PAHs (sum of 4) ¹¹⁵	0.0082 ¹⁸	9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	9	0
	Benzo(b)fluoranthene	ug/L	0.01	Use PAHs (sum of 4) ¹¹⁵	0.017 ¹⁸	9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	Benzo(k)fluoranthene	ug/L	0.01	Use PAHs (sum of 4) ¹¹⁵	0.017 ¹⁸	9	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
	PAH 16 Total	ug/L	0.2			9	0	<0.2	ND	<0.2	ND	0.1	0.1	0	0	0
Metals	Arsenic	ug/L	1.1	10 ¹¹	50 ¹⁷	9	3	<1.1	3.5	33	33	5.6	0.55	11	2	2
	Barium	ug/L	0.05	1,300 ¹¹³		9	9	12	12	60	60	29	31	15	0	0
	Beryllium	ug/L	0.2	12 ¹¹⁵		9	0	<0.2	ND	<0.2	ND	0.1	0.1	0	0	0
	Boron	ug/L	10	1,000 ¹¹¹	2,000 ¹¹²	9	7	<10	32	160	160	73	65	59	0	0
	Chromium (III+VI)	ug/L	0.4	50 ¹¹¹		9	9	0.5	0.5	31	31	5.9	2.4	9.5	0	0
	Copper	ug/L	0.7	2,000 ¹¹¹	1 ¹⁷	9	9	2.7	2.7	47	47	18	11	17	9	9
	Lead	ug/L	1	10 ¹¹	1,2 ¹⁸	9	7	<1	1.1	25	25	6.5	3.1	8.8	6	6
	Mercury	ug/L	0.5	1 ¹¹	0.07 ¹⁸	9	0	<0.5	ND	<0.5	ND	0.25	0.25	0	9	0
	Nickel	ug/L	0.3	20 ¹¹	4 ¹⁸	9	7	<0.3	1.1	7.7	7.7	2.8	2	2.8	2	2
	Selenium	ug/L	4	85 ¹¹⁰		9	1	<4	7.1	7.1	7.1	2.6	2	1.7	0	0
	Vanadium	ug/L	1.7	85 ¹¹⁰	20 ¹¹²	9	7	<1.7	3.3	100	100	17	4.6	32	2	2
	Zinc	ug/L	0.4	6000 ¹¹⁰	10,9 ¹⁷	9	9	5.1	5.1	19	19	9.5	9	4.2	3	3
	Chromium (hexavalent)	ug/L	5	Use Chromium (total) ¹¹¹	3,4 ¹⁷	9	1	<5	33	33	33	5.9	2.5	10	9	1
	Water Soluble Sulphate	g/L	0.0013			28	28	0.02	0.02	2	2	0.29	0.135	0.39	0	0
Inorganics	pH (Lab)	pH Units	0			2	2	9.4	9.4	10	10		9.7		0	0

**Leachate
Analytical Results
ManchesterCollege
The LTE Group**

[illegible]

Chem_Group	ChemName	output unit	EQL	GAC_WTV_EN/WA_DWS	GAC_WTV_EN/WA_EQS-Fresh	
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Comments

- #1 WS Regs 2016 (Eng/Wal)
 - #2 WHO Petroleum DWG 2008
 - #3 WHO DWG 2017
 - #4 WHO 2017 - Taste
 - #5 WHO 2017 - Odour
 - #6 WFD England/Wales. 2015 - MAC-EQS Inland
 - #7 WFD England/Wales. 2015 - Freshwater Standards
 - #8 WFD England/Wales. 2015 - AA-EQS Inland
 - #9 Water Env't Regs (Scotland) 2015. AA-EQS Inland
 - #10 USEPA RSL (tapwater) [May 2019]
 - #11 SEPA WAT-SG-53 Fresh EQS - MAC - 2015
 - #12 SEPA WAT-SG-53 Fresh EQS - AA - 2015
 - #13 PNEC (EU REACH) - Freshwater
 - #14 California Draft health protective concentration
 - #15 AECOM DWG (WHO method)
- GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed

Key

XXX	Exceedance of CW/WE Water. DWS - England/Wales
XXX	Exceedance of CW/WE Water. Aquatic Toxicity - England/Wales - Freshwater

Water (HH)
Analytical Results
ManchesterCollege
The LTE Group

Location Code	BH101	BH102	BH103	BH106	BH107	BH108	BH109	BH111
Sampled Date Time	23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019

Chem_Group	ChemName	output unit	EQL	GAC_HH_COM/IND_SAND									
TPH	>C5-C6 Aliphatics	µg/L	1	Insufficiently volatile ^{9.9900000000000000084E11}	<1	<1	<1	<1	<1	<1	<1	<1	<1
	>C6-C8 Aliphatics	µg/L	1	Insufficiently volatile ^{9.9900000000000000084E11}	<1	<1	<1	<1	<1	<1	<1	<1	<1
	>C8-C10 Aliphatics	µg/L	1	Insufficiently volatile ^{9.9900000000000000084E11}	<1	<1	<1	<1	<1	<1	<1	<1	<1
	>C10-C12 Aliphatics	µg/L	10	Insufficiently volatile ^{9.9900000000000000084E11}	<10	<10	<10	<10	<10	<10	<10	<10	<10
	>C12-C16 Aliphatics	µg/L	10	Insufficiently volatile ^{9.9900000000000000084E11}	<10	<10	<10	<10	<10	<10	<10	<10	<10
	>C16-C21 Aliphatics	µg/L	10	Insufficiently volatile ^{9.9900000000000000084E11}	<10	<10	<10	<10	<10	<10	<10	<10	<10
	>C16-C35 Aliphatics	µg/L		Insufficiently volatile ^{9.9900000000000000084E11}	<20	<20	<20	<20	<20	<20	<20	<20	<20
	>C21-C35 Aliphatics	µg/L	10	Insufficiently volatile ^{9.9900000000000000084E11}	<10	<10	<10	<10	<10	<10	<10	<10	<10
	>C5-C35 Aliphatics	µg/L	10	Insufficiently volatile ^{9.9900000000000000084E11}	<10	<10	<10	<10	<10	<10	<10	<10	<10
	>EC5-EC7 Aromatics	µg/L	1	Insufficiently volatile ^{9.9900000000000000084E11}	<1	<1	<1	<1	<1	<1	<1	<1	<1
	>EC7-EC8 Aromatics	µg/L	1	Insufficiently volatile ^{9.9900000000000000084E11}	<1	<1	<1	<1	<1	<1	<1	<1	<1
	>EC8-EC10 Aromatics	µg/L	1	Insufficiently volatile ^{9.9900000000000000084E11}	<1	<1	<1	<1	<1	<1	<1	<1	<1
	>EC10-EC12 Aromatics	µg/L	10	Insufficiently volatile ^{9.9900000000000000084E11}	<10	<10	<10	<10	<10	<10	<10	<10	<10
	>EC12-EC16 Aromatics	µg/L	10	Insufficiently volatile ^{9.9900000000000000084E11}	<10	<10	<10	<10	<10	<10	<10	<10	<10
	>EC16-EC21 Aromatics	µg/L	10	Insufficiently volatile ^{9.9900000000000000084E11}	<10	<10	<10	<10	<10	<10	<10	<10	<10
	>EC21-EC35 Aromatics	µg/L	10	Insufficiently volatile ^{9.9900000000000000084E11}	<10	<10	<10	<10	<10	<10	<10	<10	<10
	>EC5-EC35 Aromatics	µg/L	10	Insufficiently volatile ^{9.9900000000000000084E11}	<10	<10	<10	<10	<10	<10	<10	<10	<10
BTEX	Benzene	µg/L	1	20000	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Toluene	µg/L	1	Insufficiently volatile ^{9.9900000000000000084E11}	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Ethylbenzene	µg/L	1	Insufficiently volatile ^{9.9900000000000000084E11}	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Xylene (m & p)	µg/L	1	Insufficiently volatile ^{9.9900000000000000084E11}	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Xylene Total	µg/L		Insufficiently volatile ^{9.9900000000000000084E11}	<2	<2	<2	<2	<2	<2	<2	<2	<2
	Xylene (o)	µg/L	1	Insufficiently volatile ^{9.9900000000000000084E11}	<1	<1	<1	<1	<1	<1	<1	<1	<1
	Total BTEX	µg/L		Insufficiently volatile ^{9.9900000000000000084E11}	<5	<5	<5	<5	<5	<5	<5	<5	<5
Oxygenates	MTBE	µg/L	1	7.8E6	<1	<1	<1	<1	<1	<1	<1	<1	<1
Phenolics	Total Monohydric Phenols (S) Corrected	µg/L	10		<10	<10	<10	<10	<10	<10	<10	<10	<10
Metals	Arsenic	µg/L	0.15	No path ^{9.9900000000000000012E11}	<0.15	<0.15	0.25	0.22	0.32	<0.15	<0.15	0.22	
	Beryllium	µg/L	0.1	No path ^{9.9900000000000000012E11}	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Boron	µg/L	10	No path ^{9.9900000000000000012E11}	12	110	<10	11	12	96	100	10	
	Cadmium	µg/L	0.02	No path ^{9.9900000000000000012E11}	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Calcium	mg/L	0.01	No path ^{9.9900000000000000012E8}	160	83	180	160	190	62	80	190	
	Chromium (III+VI)	µg/L	0.2	No path ^{9.9900000000000000012E11}	<0.2	1.1	<0.2	<0.2	<0.2	1.1	1.7	<0.2	
	Copper	µg/L	0.5	No path ^{9.9900000000000000012E11}	1.3	2	3	<0.5	2.7	2.2	1.8	0.8	
	Lead	µg/L	0.2	No path ^{9.9900000000000000012E11}	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Magnesium	mg/L	0.01	No path ^{9.9900000000000000012E8}	70	22	76	73	82	18	20	81	
	Mercury	µg/L	0.05	No path ^{9.9900000000000000012E11}	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Nickel	µg/L	0.5	No path ^{9.9900000000000000012E11}	0.9	1.3	1.8	1.1	1.3	2	1	0.8	
	Selenium	µg/L	0.6	No path ^{9.9900000000000000012E11}	6.6	5.7	6	5.5	5.7	4.9	4.4	5.4	
	Vanadium	µg/L	0.2	No path ^{9.9900000000000000012E11}	0.3	<0.2	0.2	0.2	<0.2	<0.2	<0.2	0.3	
	Zinc	µg/L	0.5	No path ^{9.9900000000000000012E11}	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Inorganics	Potassium	mg/L	0.03		7.5	9.8	6.8	6.7	7.7	9	9.5	6.6	
	Chromium (hexavalent)	µg/L	5	No path ^{9.9900000000000000012E11}	<5	<5	<5	<5	<5	<5	<5	<5	<5
	Sodium	mg/L	0.01	No path ^{9.9900000000000000012E8}	24	71	23	22	24	62	67	21	
	Cyanide Total	mg/L	0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Chloride	mg/L	0.15	No path ^{9.9900000000000000012E8}	100	22	100	100	100	21	17	100	
	Sulphide	mg/L	0.01		<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Nitrate (as N)	mg/L	0.01		1.74	2.84	1.62	1.56	1.64	2.79	2.59	1.85	
	Ammoniacal Nitrogen as N	mg/L	0.02		0.16	0.04	0.015	0.024	0.18	0.023	<0.015	<0.015	
	pH (Lab)	pH Units	0		7.5	8.4	7.5	7.4	7.7	8.4	8.4	7.5	

Comments
GAC: Generic Assessment Criteria
(blank): No assessment criteria available

Key
XXX Exceedance of HH GW. Commercial/Industrial. Sand

Water (HH)
Analytical Results
ManchesterCollege
The LTE Group

Location_Code
Sampled Date Time

				Statistical Summary											
Chem_Group	ChemName	output unit	EQL	GAC_HH_COM/IND_SAND	Number of Results	Number of Detects	Minimum Concentration	Minimum Detect	Maximum Concentration	Maximum Detect	Average Concentration	Median Concentration	Standard Deviation	Number of Guideline Exceedances	Number of Guideline Exceedances (Detects Only)
TPH	>C5-C6 Aliphatics	µg/L	1	Insufficiently volatile	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>C6-C8 Aliphatics	µg/L	1	Insufficiently volatile	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>C8-C10 Aliphatics	µg/L	1	Insufficiently volatile	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>C10-C12 Aliphatics	µg/L	10	Insufficiently volatile	8	0	<10	ND	<10	ND	5	5	0	8	0
	>C12-C16 Aliphatics	µg/L	10	Insufficiently volatile	8	0	<10	ND	<10	ND	5	5	0	8	0
	>C16-C21 Aliphatics	µg/L	10		8	0	<10	ND	<10	ND	5	5	0	0	0
	>C16-C35 Aliphatics	µg/L		Insufficiently volatile	8	0	<20	ND	<20	ND	10	10	0	8	0
	>C21-C35 Aliphatics	µg/L	10		8	0	<10	ND	<10	ND	5	5	0	0	0
	>C5-C35 Aliphatics	µg/L	10		8	0	<10	ND	<10	ND	5	5	0	0	0
	>EC5-EC7 Aromatics	µg/L	1	Insufficiently volatile	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>EC7-EC8 Aromatics	µg/L	1	Insufficiently volatile	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>EC8-EC10 Aromatics	µg/L	1	Insufficiently volatile	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>EC10-EC12 Aromatics	µg/L	10	Insufficiently volatile	8	0	<10	ND	<10	ND	5	5	0	8	0
	>EC12-EC16 Aromatics	µg/L	10	Insufficiently volatile	8	0	<10	ND	<10	ND	5	5	0	8	0
	>EC16-EC21 Aromatics	µg/L	10	Insufficiently volatile	8	0	<10	ND	<10	ND	5	5	0	8	0
>EC21-EC35 Aromatics	µg/L	10	Insufficiently volatile	8	0	<10	ND	<10	ND	5	5	0	8	0	
>EC5-EC35 Aromatics	µg/L	10		8	0	<10	ND	<10	ND	5	5	0	0	0	
BTEX	Benzene	µg/L	1	20000	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Toluene	µg/L	1	Insufficiently volatile	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Ethylbenzene	µg/L	1	Insufficiently volatile	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Xylene (m & p)	µg/L	1		8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Xylene Total	µg/L		Insufficiently volatile	8	0	<2	ND	<2	ND	1	1	0	0	0
	Xylene (o)	µg/L	1	Insufficiently volatile	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Total BTEX	µg/L			8	0	<5	ND	<5	ND	2.5	2.5	0	0	0
Oxygenates	MTBE	µg/L	1	7.8E6	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
Phenolics	Total Monohydric Phenols (S) Corrected	µg/L	10		8	0	<10	ND	<10	ND	5	5	0	0	0
Metals	Arsenic	µg/L	0.15	No path	8	4	<0.15	0.22	0.32	0.32	0.16	0.1475	0.1	0	0
	Beryllium	µg/L	0.1	No path	8	0	<0.1	ND	<0.1	ND	0.05	0.05	0	0	0
	Boron	µg/L	10	No path	8	7	<10	10	110	110	45	12	48	8	7
	Cadmium	µg/L	0.02	No path	8	0	<0.02	ND	<0.02	ND	0.01	0.01	0	0	0
	Calcium	mg/L	0.01	No path	8	8	62	62	190	190	138	160	54	8	8
	Chromium (III+VI)	µg/L	0.2	No path	8	3	<0.2	1.1	1.7	1.7	0.55	0.1	0.65	0	0
	Copper	µg/L	0.5	No path	8	7	<0.5	0.8	3	3	1.8	1.9	0.93	0	0
	Lead	µg/L	0.2	No path	8	0	<0.2	ND	<0.2	ND	0.1	0.1	0	0	0
	Magnesium	mg/L	0.01	No path	8	8	18	18	82	82	55	71.5	29	8	8
	Mercury	µg/L	0.05	No path	8	0	<0.05	ND	<0.05	ND	0.025	0.025	0	0	0
	Nickel	µg/L	0.5	No path	8	8	0.8	0.8	2	2	1.3	1.2	0.43	0	0
	Selenium	µg/L	0.6	No path	8	8	4.4	4.4	6.6	6.6	5.5	5.6	0.67	0	0
	Vanadium	µg/L	0.2	No path	8	5	<0.2	0.2	0.3	0.3	0.19	0.2	0.083	0	0
	Zinc	µg/L	0.5	No path	8	0	<0.5	ND	<0.5	ND	0.25	0.25	0	0	0
	Potassium	mg/L	0.03		8	8	6.6	6.6	9.8	9.8	8	7.6	1.3	0	0
	Chromium (hexavalent)	µg/L	5	No path	8	0	<5	ND	<5	ND	2.5	2.5	0	0	0
	Inorganics	Sodium	mg/L	0.01	No path	8	8	21	21	71	71	39	24	23	8
Cyanide Total		mg/L	0.01	0.05	8	0	<0.01	ND	<0.01	ND	0.005	0.005	0	0	0
Chloride		mg/L	0.15	No path	8	8	17	17	100	100	70	100	41	8	8
Sulphide		mg/L	0.01		8	0	<0.005	ND	<0.005	ND	0.0025	0.0025	0	0	0
Nitrate (as N)		mg/L	0.01		8	8	1.56	1.56	2.84	2.84	2.1	1.795	0.56	0	0
Ammoniacal Nitrogen as N		mg/L	0.02		8	6	<0.015	0.015	0.18	0.18	0.057	0.0235	0.071	0	0
pH (Lab)		pH Units	0		8	8	7.4	7.4	8.4	8.4	7.9	7.6	0.46	0	0

Comments

GAC: Generic Assessment Criteria
(blank): No assessment criteria available

Key

XXX	Exceedance of HH GW. Commercial/Industrial. Sand
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Water (DWS/EQS)
Analytical Results
ManchesterCollege
The LTE Group

Location_Code	BH101	BH102	BH103	BH106	BH107	BH108	BH109	BH111
Sampled_Date_Time	23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019	23/07/2019

Chem_Group	ChemName	output unit	EQL	GAC_WTV_EN/WA_DWS	GAC_WTV_EN/WA_EQS-Fresh								
TPH	>C5-C6 Aliphatics	µg/L	1	15000		<1	<1	<1	<1	<1	<1	<1	<1
	>C6-C8 Aliphatics	µg/L	1	15000		<1	<1	<1	<1	<1	<1	<1	<1
	>C8-C10 Aliphatics	µg/L	1	300		<1	<1	<1	<1	<1	<1	<1	<1
	>C10-C12 Aliphatics	µg/L	10	300		<10	<10	<10	<10	<10	<10	<10	<10
	>C12-C16 Aliphatics	µg/L	10	300		<10	<10	<10	<10	<10	<10	<10	<10
	>C16-C21 Aliphatics	µg/L	10	300		<10	<10	<10	<10	<10	<10	<10	<10
	>C16-C35 Aliphatics	µg/L				<20	<20	<20	<20	<20	<20	<20	<20
	>C21-C35 Aliphatics	µg/L	10	300		<10	<10	<10	<10	<10	<10	<10	<10
	>C5-C35 Aliphatics	µg/L	10			<10	<10	<10	<10	<10	<10	<10	<10
	>EC5-EC7 Aromatics	µg/L	1	1	10	<1	<1	<1	<1	<1	<1	<1	<1
	>EC7-EC8 Aromatics	µg/L	1	700	74	<1	<1	<1	<1	<1	<1	<1	<1
	>EC8-EC10 Aromatics	µg/L	1	300		<1	<1	<1	<1	<1	<1	<1	<1
	>EC10-EC12 Aromatics	µg/L	10	90		<10	<10	<10	<10	<10	<10	<10	<10
	>EC12-EC16 Aromatics	µg/L	10	90		<10	<10	<10	<10	<10	<10	<10	<10
	>EC16-EC21 Aromatics	µg/L	10	90		<10	<10	<10	<10	<10	<10	<10	<10
	>EC21-EC35 Aromatics	µg/L	10	90		<10	<10	<10	<10	<10	<10	<10	<10
	>EC5-EC35 Aromatics	µg/L	10			<10	<10	<10	<10	<10	<10	<10	<10
BTEX	Benzene	µg/L	1	1	10	<1	<1	<1	<1	<1	<1	<1	<1
	Toluene	µg/L	1	700	74	<1	<1	<1	<1	<1	<1	<1	<1
	Ethylbenzene	µg/L	1	300	20	<1	<1	<1	<1	<1	<1	<1	<1
	Xylene (m & p)	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
	Xylene Total	µg/L		500	30	<2	<2	<2	<2	<2	<2	<2	<2
	Xylene (o)	µg/L	1	190		<1	<1	<1	<1	<1	<1	<1	<1
	Total BTEX	µg/L				<5	<5	<5	<5	<5	<5	<5	<5
Oxygenates	MTBE	µg/L	1	1800	5100	<1	<1	<1	<1	<1	<1	<1	<1
Phenolics	Total Monohydric Phenols (S) Corrected	µg/L	10			<10	<10	<10	<10	<10	<10	<10	<10
Metals	Arsenic	µg/L	0.15	10	50	<0.15	<0.15	0.25	0.22	0.32	<0.15	<0.15	0.22
	Beryllium	µg/L	0.1	12		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
	Boron	µg/L	10	1000	2000	12	110	<10	11	12	96	100	10
	Cadmium	µg/L	0.02	5	0.08	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
	Calcium	mg/L	0.01			160	83	180	160	190	62	80	190
	Chromium (III+VI)	µg/L	0.2	50		<0.2	1.1	<0.2	<0.2	<0.2	1.1	1.7	<0.2
	Copper	µg/L	0.5	2000	1	1.3	2	3	<0.5	2.7	2.2	1.8	0.8
	Lead	µg/L	0.2	10	1.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
	Magnesium	mg/L	0.01			70	22	76	73	82	18	20	81
	Mercury	µg/L	0.05	1	0.07	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
	Nickel	µg/L	0.5	20	4	0.9	1.3	1.8	1.1	1.3	2	1	0.8
	Selenium	µg/L	0.6	10		6.6	5.7	6	5.5	5.7	4.9	4.4	5.4
	Vanadium	µg/L	0.2	86	20	0.3	<0.2	0.2	0.2	<0.2	<0.2	<0.2	0.3
	Zinc	µg/L	0.5	6000	10.9	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
	Potassium	mg/L	0.03			7.5	9.8	6.8	6.7	7.7	9	9.5	6.6
	Chromium (hexavalent)	µg/L	5	9.99000000000069E11	3.4	<5	<5	<5	<5	<5	<5	<5	<5
Inorganics	Sodium	mg/L	0.01	200		24	71	23	22	24	62	67	21
	Cyanide Total	mg/L	0.01	0.05	0.001	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
	Chloride	mg/L	0.15	250	250	100	22	100	100	100	21	17	100
	Sulphide	mg/L	0.01			<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005
	Nitrate (as N)	mg/L	0.01			1.74	2.84	1.62	1.56	1.64	2.79	2.59	1.85
	Ammoniacal Nitrogen as N	mg/L	0.02		9.99000000000059E8	0.16	0.04	0.015	0.024	0.18	0.023	<0.015	<0.015
	pH (Lab)	pH Units	0			7.5	8.4	7.5	7.4	7.7	8.4	8.4	7.5

Location_Code
Sampled_Date_Time

Statistical Summary																
Chem_Group	ChemName	output unit	EQL	GAC_WTV_EN/WA_DWS	GAC_WTV_EN/WA_EQS-Fresh	Number of Results	Number of Detects	Minimum Concentration	Minimum Detect	Maximum Concentration	Maximum Detect	Average Concentration	Median Concentration	Standard Deviation	Number of Guideline Exceedances	Number of Guideline Exceedances (Detects)
TPH	>C5-C6 Aliphatics	µg/L	1	15000		8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>C6-C8 Aliphatics	µg/L	1	15000		8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>C8-C10 Aliphatics	µg/L	1	300		8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>C10-C12 Aliphatics	µg/L	10	300		8	0	<10	ND	<10	ND	5	5	0	0	0
	>C12-C16 Aliphatics	µg/L	10	300		8	0	<10	ND	<10	ND	5	5	0	0	0
	>C16-C21 Aliphatics	µg/L	10	300		8	0	<10	ND	<10	ND	5	5	0	0	0
	>C16-C35 Aliphatics	µg/L				8	0	<20	ND	<20	ND	10	10	0	0	0
	>C21-C35 Aliphatics	µg/L	10	300		8	0	<10	ND	<10	ND	5	5	0	0	0
	>C5-C35 Aliphatics	µg/L	10			8	0	<10	ND	<10	ND	5	5	0	0	0
	>EC5-EC7 Aromatics	µg/L	1	1	10	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>EC7-EC8 Aromatics	µg/L	1	700	74	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>EC8-EC10 Aromatics	µg/L	1	300		8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	>EC10-EC12 Aromatics	µg/L	10	90		8	0	<10	ND	<10	ND	5	5	0	0	0
	>EC12-EC16 Aromatics	µg/L	10	90		8	0	<10	ND	<10	ND	5	5	0	0	0
	>EC16-EC21 Aromatics	µg/L	10	90		8	0	<10	ND	<10	ND	5	5	0	0	0
	>EC21-EC35 Aromatics	µg/L	10	90		8	0	<10	ND	<10	ND	5	5	0	0	0
	>EC5-EC35 Aromatics	µg/L	10			8	0	<10	ND	<10	ND	5	5	0	0	0
BTEx	Benzene	µg/L	1	1	10	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Toluene	µg/L	1	700	74	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Ethylbenzene	µg/L	1	300	20	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Xylene (m & p)	µg/L	1			8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Xylene Total	µg/L		500	30	8	0	<2	ND	<2	ND	1	1	0	0	0
	Xylene (o)	µg/L	1	190		8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
	Total BTEx	µg/L				8	0	<5	ND	<5	ND	2.5	2.5	0	0	0
Oxygenates	MTBE	µg/L	1	1800	5100	8	0	<1	ND	<1	ND	0.5	0.5	0	0	0
Phenolics	Total Monohydric Phenols (S) Corrected	µg/L	10			8	0	<10	ND	<10	ND	5	5	0	0	0
Metals	Arsenic	µg/L	0.15	10	50	8	4	<0.15	0.22	0.32	0.32	0.16	0.1475	0.1	0	0
	Beryllium	µg/L	0.1	12		8	0	<0.1	ND	<0.1	ND	0.05	0.05	0	0	0
	Boron	µg/L	10	1000	2000	8	7	<10	10	110	110	45	12	48	0	0
	Cadmium	µg/L	0.02	5	0.08	8	0	<0.02	ND	<0.02	ND	0.01	0.01	0	0	0
	Calcium	mg/L	0.01			8	8	62	62	190	190	138	160	54	0	0
	Chromium (III+VI)	µg/L	0.2	50		8	3	<0.2	1.1	1.7	1.7	0.55	0.1	0.65	0	0
	Copper	µg/L	0.5	2000	1	8	7	<0.5	0.8	3	3	1.8	1.9	0.93	6	6
	Lead	µg/L	0.2	10	1.2	8	0	<0.2	ND	<0.2	ND	0.1	0.1	0	0	0
	Magnesium	mg/L	0.01			8	8	18	18	82	82	55	71.5	29	0	0
	Mercury	µg/L	0.05	1	0.07	8	0	<0.05	ND	<0.05	ND	0.025	0.025	0	0	0
	Nickel	µg/L	0.5	20	4	8	8	0.8	0.8	2	2	1.3	1.2	0.43	0	0
	Selenium	µg/L	0.6	10		8	8	4.4	4.4	6.6	6.6	5.5	5.6	0.67	0	0
	Vanadium	µg/L	0.2	86	20	8	5	<0.2	0.2	0.3	0.3	0.19	0.2	0.083	0	0
	Zinc	µg/L	0.5	6000	10.9	8	0	<0.5	ND	<0.5	ND	0.25	0.25	0	0	0
	Potassium	mg/L	0.03			8	8	6.6	6.6	9.8	9.8	8	7.6	1.3	0	0
	Chromium (hexavalent)	µg/L	5	9.99000000000069E11	3.4	8	0	<5	ND	<5	ND	2.5	2.5	0	8	0
Inorganics	Sodium	mg/L	0.01	200		8	8	21	21	71	71	39	24	23	0	0
	Cyanide Total	mg/L	0.01	0.05	0.001	8	0	<0.01	ND	<0.01	ND	0.005	0.005	0	8	0
	Chloride	mg/L	0.15	250	250	8	8	17	17	100	100	70	100	41	0	0
	Sulphide	mg/L	0.01			8	0	<0.005	ND	<0.005	ND	0.0025	0.0025	0	0	0
	Nitrate (as N)	mg/L	0.01			8	8	1.56	1.56	2.84	2.84	2.1	1.795	0.56	0	0
	Ammoniacal Nitrogen as N	mg/L	0.02		9.990000000000059E8	8	6	<0.015	0.015	0.18	0.18	0.057	0.0235	0.071	0	0
	pH (Lab)	pH Units	0			8	8	7.4	7.4	8.4	8.4	7.9	7.6	0.46	0	0

