



Transport for Greater Manchester

STOCKPORT INTERCHANGE, BUS INTERCHANGE

Phase II Geo-Environmental Site Investigation
Report





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CONFIDENTIAL

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Phase II Geo-Environmental Site Investigation Report

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EXECUTIVE SUMMARY

Transport for Greater Manchester (TfGM) instructed WSP UK Ltd (WSP) to undertake a Phase II Geo-Environmental Investigation at Stockport Interchange to assess potential geo-environmental constraints in areas not previously investigated and gather data to inform the proposed development. Stockport Interchange is located at Swaine Street, Stockport, SK3 0EH.

This report presents the assessment with respect to potential ground contamination. An Interpretive Geotechnical Report (IGR) with respect to geotechnical design of the development has been issued separately by WSP (ref: 14113-WSP-SKZ-XX-RP-Y-0003).

The aim of the investigation was to assess soil and groundwater conditions in the proposed landscaping area in the north of the site to gain an understanding of the potential environmental constraints relating to ground contamination that may impact on the proposed development. In addition, an initial assessment of the soils in the eastern part of the site has been undertaken to assess the suitability for re-use during the A6 Wellington Bridge development works.

Site history from the mid-1800s shows development in the proposed landscaped area included part of a print works and chemical works until 1910 before a larger singular building is shown from the 1960s. The A6 Wellington Road was present from 1850 and has remained until present day.

The intrusive ground investigation was undertaken by Geotechnics in November 2019 under part time supervision by WSP. The ground investigation recorded variable ground conditions across the site. Within the proposed landscaped area in the north, Made Ground (generally granular) was encountered to a maximum unproved depth of 4.07m bgl. Obstructions were encountered in the majority of locations between 0.45 and 4.07m bgl which prevented advancement of the exploratory holes. Within the northeast, River Terrace deposits were encountered from 4.50m bgl beneath Made Ground. Within the A6 Wellington Bridge development area, granular Made Ground was encountered beneath a 0.1m thick layer of tarmac to a maximum unproved depth of 1.2mbgl (the target depth of the excavation). No groundwater was encountered.

Potential risks to human health were assessed via generic quantitative risk assessment (GQRA) based on a public open space land use. Elevated concentrations of benzo(a)pyrene were recorded in two locations. No asbestos or asbestos containing material (ACM) was identified however the presence of asbestos in Made Ground across the site cannot be discounted based on investigations in other parts of the site. On this basis, WSP recommends the following.

- Appropriate protective measures are put in place during ground disturbance works (i.e. dust suppression, personal protective equipment) to protect the health of construction and maintenance works in relation to inhalation of dust and direct contact exposures.
- Suitable barriers to direct exposure are put in place in areas of soft landscaping to protect the health of future site users.

Based on the ground conditions encountered in the A6 Wellington Bridge (namely granular Made Ground with ash and slag) and historical chemical analysis undertaken, excavated material as part of the works are considered likely to be chemically suitable for re-use within the development as

construction fill material (i.e. covered by buildings / hardstanding). Additional validation sampling will be required to confirm suitability.

Whilst no groundwater has been detected during this investigation, given the former industrial land use the presence of residual mobile or leachable contamination cannot be discounted. It is noted elevated dissolved concentrations of TPH have historically been detected in the Principal Aquifer in the wider Stockport Development area (AECOM, 2016). Given the site is not located within a Source Protection Zone or within the vicinity of a potable groundwater extraction well, the risks to controlled waters is considered to be low.

The ground gas risk assessment classifies the site as Characteristic Situation 1 – very low risk.

The following actions are recommended to mitigate the identified risks.

- It is recommended that in landscaped areas on Made Ground, a 300mm cover layer of clean soils over a geotextile should be installed to prevent direct contact exposures to contaminated soils.
- During redevelopment, precautions should be taken to reduce the risk of exposure to the identified contamination through appropriate health and safety mitigation measures, such as adequate personal protective equipment, dampening down for dust suppression and other standard safe practices for construction and maintenance workers.
- Measures should be employed to limit surface water runoff such as minimising soil exposure and covering soil stockpiles.
- In the event any previously unidentified contamination is encountered during earthworks, advice from a qualified geo-environmental consultant should be sought.
- In the event ACM are encountered during enabling works for the proposed development professional advice from an appropriately qualified asbestos consultant should be sought; an Asbestos Management Plan may be required to assist in ensuring the protection of the health of ground workers.
- The re-use of materials within the proposed development (e.g. excavated soils, crushed demolition materials etc.) requires demonstration of suitability for use and certainty of use, preferably through a Materials Management Plan (MMP) compliant with the CL:AIRE Definition of Waste Code of Practice;
- Excess soils generated by the redevelopment and intended for off-site disposal require an appropriate waste classification.
- Should more sensitive end-uses be considered for the site in the future a re-assessment of the site conditions would be required.

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1 INTRODUCTION

1.1 TERMS OF REFERENCE

Transport for Greater Manchester (TfGM) instructed WSP UK Ltd (WSP) to undertake a Phase II Geo-Environmental Investigation for two parcels of land within the Stockport Interchange site located at Swaine Street, Stockport, SK3 0EH, (hereafter referred to as 'the site'). The site location is presented in Figure 1 in Appendix A.

This Phase II Geo-Environmental Site Investigation report presents the findings of the investigation related to the assessment of potential contaminated land. An Interpretive Geotechnical Report (IGR) with respect to geotechnical design of the development has been issued separately by WSP (ref: 14113-WSP-SKZ-XX-RP-Y-0003).

1.2 BACKGROUND

WSP is currently providing multidisciplinary design services for the re-development of Stockport Bus Interchange. Previous ground investigation works have been completed at the Stockport Interchange site by AECOM between 2015 and 2016 and reported in the following documents:

- AECOM 'Phase 1 Geotechnical and Geo-environmental Desk Study Report, Stockport Bus Station' (ref: 60340298/GEO/02) dated May 2015; and
- Stockport Interchange – Ground Investigation Report' (ref: 603420298/GEO/02) dated April 2016.

A Preliminary Contaminated Land Report was issued by WSP in December 2017 (WSP, 2017) which summarised potential site constraints associated with contaminated land based on the review of the third party ground investigation works (AECOM 2015 and 2016). The review identified a number of data gaps and additional ground investigation works were required to support changes to the bus station redevelopment, which included:

- Proposed landscaped areas in the north – This area was identified as a former chemical works and additional geo-environmental investigation was required to support the provision of landscaping.

In addition to the above, it was identified additional deeper geotechnical information was required in an area in the south proposed for a residential tower. This has been reported in the IGR issued separately by WSP (ref: 14113-WSP-SKZ-XX-RP-Y-0003).

Further changes to the scheme have occurred since our Preliminary Contaminated Land Report (WSP, 2017) which has led to the requirement for investigation in the following:

- A6 Wellington Bridge - the road under the bridge is to be lowered which will create excess materials that require management; a preliminary assessment of the likely suitability of the excavated soils for re-use during redevelopment is required.

1.3 CLIENT AIMS

WSP understands that TfGM wishes to assess soil and groundwater conditions in the proposed landscaping area in the north of Stockport Interchange and in the A6 Wellington Bridge to gain an understanding of the potential environmental constraints relating to contamination that may impact on the proposed development.

1.4 DEVELOPMENT PLANS

The site forms part of the wider Stockport Interchange Development area which includes the following:

- Construction of a bus interchange and operator accommodation (i.e. retail and food and beverage facilities) at interchange level;
- Construction of a multi-storey residential building over-site development;
- Construction of external green and hard landscaped public realm in and around the site (i.e. over-site level and at the banks of the River Mersey); and
- Construction of a pedestrian link bridge from the interchange site to the rail station.

Proposed development plans are shown in a BDP (the scheme architect) drawings, which are presented in Appendix B.

1.5 PROJECT SCOPE

The following scope of works was undertaken as part of the Phase II investigation.

- Site investigation carried out between 11 November and 21 November 2019;
- Laboratory analysis of recovered soil samples;
- Refinement of the preliminary conceptual site model (CSM);
- Generic quantitative risk assessment (GQRA) with respect to ground contamination;
- Preliminary assessment of soils for storage and re-use during the A6 redevelopment works; and
- Provision of recommendations with respect to the management and mitigation of any potential ground contamination constraints or liabilities.

1.6 LEGISLATIVE CONTEXT AND GUIDANCE

The assessment was undertaken in the legislative context of:

- Part 2A of The Environmental Protection Act (1990); and
- The National Planning Policy Framework (2012).

The investigation and assessment of potential contamination has been undertaken in general accordance with the following good practice and guidance:

- Environment Agency 'Model Procedures for the Management of Land Contamination', CLR11 (2004);
- British Standard 'Investigation of Potentially Contaminated Sites – Code of Practice', BS EN 10175:2017;
- Defra 'Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance', PB13735 (2012); and
- British Standard 'Code of Practice for Ground Investigations', BS 5930:2015.

1.7 SOURCES OF INFORMATION

The following relevant sources of information were reviewed for the production of this report.



Table 1-1 - Sources of Information

Source	Report
WSP Reports	<ul style="list-style-type: none">▪ Interpretive Geotechnical Report (ref: ref: 14113-WSP-SKZ-XX-RP-Y-0003) dated March 2020.▪ 'Contaminated Land Report (ref:14113-WSP-SKZ-XX-RP-Y-0002) dated October 2018.▪ 'Stage 2 Advanced Works, Stockport Interchange – Ground Gas Risk Assessment (ref:70031899-11057) dated October 2018.▪ Advanced works to Stage 2, Preliminary Contaminated Land Report, Stockport Interchange (ref: 70031899-10952) dated 20 December 2017.
Third Party Reports	<ul style="list-style-type: none">▪ Geotechnics 'Stockport Interchange Factual Report' (ref: PN194052) dated February 2020.▪ AECOM, 'Stockport Interchange – Ground Investigation Report' (ref: 603420298/GEO/02) dated April 2016.▪ AECOM 'Phase 1 Geotechnical and Geo-environmental Desk Study Report, Stockport Bus Station' (ref: 60340298/GEO/02) dated May 2015.
Public Information	<ul style="list-style-type: none">▪ British Geological Society (BGS) 1:63360 Series Geological Map Sheet 98 'Stockport' (Solid & Drift edition).▪ Weather Online website accessed 21 February 2020.
Notes:	The report contains British Geological Survey materials ©NERC 2017 and database right.

1.8 CONFIDENTIALITY STATEMENT & LIMITATIONS

This report is addressed to and may be relied upon the following:

Transport for Greater Manchester


This assessment has been prepared for the above named party. This report shall not be relied up on or transferred to any other parties without the express written authorisation of WSP. No responsibility will be accepted where this report is used in its entirety or in part by any other party. General limitations are presented in Appendix F.

2 SITE SETTING

2.1 SITE DESCRIPTION AND CURRENT USE

A summary of pertinent site details is presented in Table 2-1 below which were obtained during a site walkover on 23 March 2018 and over the course of the project. The current layout plan is presented as Figure 2 in Appendix A.

Table 2-1 – Summary of Site Details

Detail	Comment
Name and Address	Land off Swaine Street, Stockport, SK3 0EH (closest postcode).
Site Description and Current Use	<p>The Stockport Interchange site comprises a bus terminal, two surface car parks and associated infrastructure, including the Stockport Viaduct located adjacent to the west. The proposed landscaped area is an undeveloped parcel of land located within the north of the wider Interchange site, as indicated by the yellow dashed polygon in the extract below. The A6 Wellington Bridge is present in the east which trends in a north – south trajectory over the bus terminal. The current layout is shown in Figure 2, an extract of which is presented below.</p> <p>Extract 1 – Layout</p> 
Site Setting and Surrounding Area	<p>The Stockport Interchange development site is located within a mixed commercial, industrial and residential setting and is generally surrounded by the following land uses:</p> <ul style="list-style-type: none"> ▪ North – The River Mersey flowing in a westerly direction with commercial properties beyond. ▪ East – Mersey way shopping centre and commercial buildings.

Detail	Comment
	<ul style="list-style-type: none"> South – Bus terminals and bus lanes associated with the wider Stockport Interchange with commercial properties beyond. West – Stockport railway viaduct.
Visual Observations of Contamination	No visual or olfactory evidence of contamination was observed during the site walkover or intrusive investigation. Localised littering was noted.

2.2 DEVELOPMENT HISTORY

The site history is summarised from a review of the historical maps contained within the AECOM Phase I (2015) which have been reviewed for evidence of potential historical sources of contamination and / or changes in land form.

In summary, earliest available mapping from the mid-1800s indicates the proposed landscaped area formed part of a print works with a number of associated buildings present at this time. Wellington Road was present which remains until present day. By 1895 the area has undergone reconfiguration and is labelled as a chemical works, which remained until 1910. Structures generally remained until the mid- 1960s before a larger singular building is shown occupying the majority of the area until at least 1995.

Historical land use within the surrounding area comprised mixed industrial, commercial and residential use with a cotton mill, reservoir and timber yard present within 100m of the proposed landscaped area during the 1800s. From the mid- 1930s, surrounding land use changed to a predominantly commercial end use and by 1985 the bus station is shown.

2.3 ENVIRONMENTAL SETTING

The environmental setting is summarised in Table 2-2 below.

Table 2-2 – Environmental Setting

Detail	Comment
Geology	<p>Published geological mapping indicates that the geology comprises the following:</p> <ul style="list-style-type: none"> River Terrace Gravels (sand and gravel) beneath the proposed landscaped area whilst Till (Diamiction) is present beneath the A6 Wellington bridge area. The drift deposits are underlain by Chester Formation sandstone bedrock. <p>There are several faults in the surrounding area, the closest of which is located approximately 60m to the west of the proposed landscaped area and trends northwest to southeast.</p>
Hydrogeology	The River Terrace Gravel deposits are classified as a Secondary A aquifer whilst the Till is classified as Unproductive. The Chester Sandstone Formation is classified as a Principal Aquifer.
Hydrology	The nearest indicated surface water feature is the westerly flowing River Mersey located adjacent in the north

2.4 POTENTIAL SOURCES OF CONTAMINATION

A review of the available data indicates a number of areas of potential concern (APCs) in relation to potential for ground contamination. Table 2-3 below provides a summary of the APCs and the potential contamination sources in each APC. The areas of potential concern are indicated on Figure 3 in Appendix A.

Table 2-3 - Areas of Potential Concern and Potential Contamination Sources

APC No.	APC Type	Potential Source / Contaminant of Concern
APC1	Former land use as a print works	Total petroleum hydrocarbons (TPH), polyaromatic hydrocarbons (PAH), metals, phenols, volatile organic compounds (VOCs), asbestos and ground gas.
APC2	Former land use as a chemical works	TPH, PAH, VOCs, metals, phenols, asbestos and ground gas.
APC3	Former surrounding industry including cotton mill, reservoir and timber yard within 100m to the south.	TPH, PAH, VOCs, pesticides and herbicides, metals, asbestos and ground gas.
APC4	Operatorial bus station	TPH, PAH.

3 RATIONALE FOR INVESTIGATION

3.1 PRELIMINARY CONCEPTUAL SITE MODEL

The rationale for the site investigation was scoped to refine the preliminary CSM that was derived in the WSP Contaminated Land Report (WSP, 2018). The preliminary CSM identified the following plausible contaminant linkages that required further assessment.

- Direct contact, ingestion and inhalation of soil-bound contamination by users of the proposed landscaped area, maintenance and construction workers.
- Inhalation of asbestos fibres by users of the proposed landscaped area, maintenance and construction workers and neighbouring site users.
- Inhalation of vapours associated with volatile ground contamination users of the proposed landscaped area, and construction and maintenance workers.
- Accumulation of ground gases in above and below ground structures.
- Migration of mobile contamination to the Secondary A Aquifer, Principal Aquifer and migration towards the River Mersey.

3.2 RATIONALE

The intrusive investigation was designed to assess potential impacts to land quality associated with historical land uses not previously targeted and to obtain sufficient geotechnical information to allow an appropriate assessment of ground conditions. Geotechnical reporting has been issued by WSP under a separate cover (ref: 14113-WSP-SKZ-XX-RP-Y-0003).

The locations of the investigation are presented in Figure 4 in Appendix A. Table 3-1 presents the rationale for each location.

Table 3-1 – Summary of Site Investigation Rationale

Area of Potential Concern / Area	APC	Exploratory Hole Location	Rationale
Former industrial use (including print works and chemical works)	APC1, APC2	WS301 - WS304	To assess potential impacts to soil and groundwater conditions in area formerly used for industry.
Former surrounding industrial use	APC3	WS303	To identify potential contamination migrating from historical offsite sources.
Current operational bus terminal	APC4	-	No additional exploratory hole location was deemed necessary given potential impacts associated with this APC have been addressed in the previous site investigation (AECOM, 2016).
A6 Wellington Bridge	-	TP301 – TP304	To assess likely suitability of the excavated soils for storage and re-use and obtain sufficient geotechnical site data to assess geotechnical risk of the development.
Proposed residential area in the south	-	BH301 – BH302	To obtain deep geotechnical information to support pile design.
General	-	WS305	To obtain geotechnical information for general site coverage.

The scope of works, field methodologies, analytical suite and field measurements are discussed within Section 4 whilst the findings are discussed in Sections 5 to 6.2.

4 GROUND INVESTIGATION

4.1 FIELD WORKS

The ground investigation was carried out between 11 and 21 November 2019 by Geotechnics under the part time supervision WSP. The Geotechnics Factual Report containing the logs and site investigation data is presented in Appendix C. A summary of the fieldworks undertaken is presented in Table 4-1 below and an exploratory hole plan is presented as Figure 4 in Appendix A.

Table 4-1 – Summary of Fieldworks

Investigation Method	No.	Exploratory Hole Reference	Range of Depths (m bgl)*
Dynamic Sampling with Rotary Follow On	3	BH301, BH302A, BH302B	6.90 – 25.10
Trial Pit	4	TP301 -TP304	1.20
Window Sample Holes	7	WS301 -WS305, WS301A, WS302A	0.45 – 5.22

*m bgl (meters below ground level)

Locations suffixed with an A or B indicate positions where additional attempts were required to get the exploratory location to the target depth. BH302, WS301 and WS302 were terminated within the hand pit between 0.45 and 0.60m bgl due to the presence of concrete obstructions.

4.2 MONITORING WELL INSTALLATION

Groundwater monitoring wells were installed in boreholes as summarised in Table 4-2 below and were constructed from 50mm perforated plastic pipe with a pea gravel surround and fitted with air tight gas valves. As a minimum requirement, each monitoring well comprised plain pipe from ground level to 1m with a bentonite pellet surround. Monitoring installations were finished at ground level with a flush fitted lockable cover.

Details of each installation are shown on borehole records contained within the Geotechnics Factual Report presented in Appendix C.

Table 4-2 – Borehole Installation Details

Exploratory Hole Location	Ground Level (m AOD)	Standpipe Diameter (mm)	Screen Top and Base Depth (m bgl)	Screen Top and Base (m AOD)	Strata Targeted
WS301A	42.91	50	1.00 – 2.50	41.91 – 40.41	Made Ground
WS302A	42.96	50	1.00 – 3.00	41.96 – 39.96	Made Ground
WS303	43.00	50	1.00 – 3.00	42.00 – 40.00	Made Ground
WS304	42.67	50	1.00 – 3.00	41.67 – 39.67	Made Ground

Exploratory Hole Location	Ground Level (m AOD)	Standpipe Diameter (mm)	Screen Top and Base Depth (m bgl)	Screen Top and Base (m AOD)	Strata Targeted
WS305	43.79	50	1.00 – 4.00	42.79 – 39.79	Made Ground

4.3 SAMPLING AND LABORATORY TESTING

Soil samples were collected from the exploratory hole locations at different depths and strata. All five groundwater monitoring wells were recorded to be dry during the five groundwater monitoring visits undertaken between 08 January and 12 February 2020 by contractor Geotechnics, and therefore no groundwater samples were obtained.

Soil environmental analysis was undertaken at DETS laboratory in general accordance with accredited methods. The soil samples collected as part of this investigation were submitted for laboratory analysis of the chemicals presented in Table 4-3. The environmental laboratory reports are presented within Appendix C.

Table 4-3 – Summary of Laboratory Chemical Analysis

Chemical Analysis – Soil
<ul style="list-style-type: none"> ▪ Asbestos soil screen ▪ CLEA metals suite (arsenic, barium, beryllium, cadmium, chromium, lead, mercury, copper, nickel, selenium, vanadium and zinc) ▪ Hexavalent Chromium ▪ Polyaromatic Hydrocarbons (PAH) (Total of 16) ▪ Total Petroleum Hydrocarbon by Criteria Working Group (TPH-CWG) ▪ pH ▪ Total Organic Carbon (TOC) ▪ Cyanide (Total and Free) ▪ Sulphate ▪ Phenols ▪ Volatile Organic Compounds (VOCs)

4.4 GROUND GAS MONITORING

Five gas monitoring visits have been undertaken between 08 January and 12 February 2020 by contractor Geotechnics in general accordance with CIRIA C665 –for a low sensitivity, low gas generation potential site.

Groundwater depths were gauged and ground gas concentrations and flow rates were measured using an infra-red gas analyser (GFM435). Peak and steady concentrations of methane (CH₄) carbon dioxide (CO₂) and oxygen (O₂) and trace gases (including carbon monoxide, hydrogen sulphide) were recorded along with peak and steady gas flow rates. Atmospheric pressure was also noted.

The complete monitoring records are presented within the Geotechnics Factual Report in Appendix C. A hazardous ground gas risk assessment is presented in Section 7.4.

5 GROUND AND GROUNDWATER SUMMARY

5.1 GROUND CONDITIONS

The November 2019 ground investigation recorded variable ground conditions across the site. Within the proposed landscaped area in the north, ground conditions comprised Made Ground which was generally granular in nature to a maximum unproved depth of 4.07m bgl. Obstructions were encountered in the majority of locations between 0.45 and 4.07m bgl which prevented advancement of the exploratory holes. Within WS305 located in the northeast, River Terrace deposits were encountered from 4.50m bgl beneath Made Ground. Within the A6 Wellington Bridge development area, granular Made Ground was encountered beneath a 0.1m thick layer of tarmacadam to a maximum unproved depth of 1.2mbgl (the target depth of the excavation).

In the south, ground conditions comprised Made Ground to a maximum depth of 2.0m bgl overlying Till which comprised a variable mixture of clay and sand recorded to depths between 3.80m and 4.00m bgl. Sandstone was encountered beneath the drift deposits to a maximum depth of 25.10m bgl.

A summary of the encountered ground conditions is presented in Table 5-1 below.

Table 5-1 – Summary of Recorded Strata

Stratum		Depth to Base (m bgl)	Thickness (m)	Typical Description	Notes
Made Ground	Hardstanding	0.30	0.30	Concrete / paving / tarmacadam	Found in all locations excluding the proposed landscaped area in the north.
	Granular Made Ground	(0.45) – 4.50	(0.45) – 4.45	Dark greyish brown gravelly sand. Gravel of sandstone, limestone, concrete and brick, locally containing ash.	Present across the majority of the site beneath surface hardstanding / Made Ground.
	Cohesive Made Ground	2.00 – 3.80	0.30 – 1.30	Firm dark brown slightly sandy gravelly clay with coal, slag, concrete and brick	Only recorded in BH302B, WS303.
Glacial Sand and Gravel		(5.22)	(0.72)	Dense fine to coarse Sand	Recorded in WS305 only.
Glacial Till		3.80 – 4.00	1.90 – 2.00	Firm to stiff sandy clay / fine and medium sand	Only recorded in the south (BH301, BH302A and BH302B).
Weathered Sandstone		4.00 – 4.25	0.20 – 0.45	Extremely weak reddish brown fine to coarse grained sandstone. Recovered as sand and gravel	Only recorded in the boreholes in the south.

Stratum	Depth to Base (m bgl)	Thickness (m)	Typical Description	Notes
Chester Formation Sandstone	Not proven (25.10)	Not proven (21.10)	Extremely weak to weak reddish brown fine to coarse grained sandstone	

**Brackets indicate maximum unproven depth and thickness*

5.2 OBSTRUCTIONS

A summary of encountered obstructions is presented in Table 5-2 below.

Table 5-2 – Summary of In-ground Obstructions

Exploratory Hole	Range of Depths (m bgl)	Notes
BH302	0.60	Concrete obstruction
WS301	0.45	Grey concrete
WS301A	3.44	Possible cobble
WS302	0.50	Concrete obstruction
WS302A	3.00	Probable cobble
WS303	4.07	Probable cobble

**Brackets indicate maximum proven depths and thicknesses*

5.3 GROUNDWATER CONDITIONS

Water strikes were not recorded within any of the boreholes or trial pits during the ground investigation. Five monitoring visits were undertaken between 08 January and 12 February 2020. During all monitoring visits, all five monitoring wells (WS301 to WS305), which were all installed within the Made Ground, were recorded to be dry.

The data indicates the absence of perched water / groundwater within the Made Ground. It is anticipated that the main groundwater table rests within the underlying sandstone bedrock which may be in hydraulic continuity with the River Mersey.

5.4 GROUND GAS CONDITIONS

Five ground gas monitoring rounds were completed between 08 January and 12 February 2020. Atmospheric pressure during the monitoring varied between 987 (Round 4) and 1016 (Round 1). Regional barometric pressure was falling during Round 3 and Round 4 and rising during Round 1, Round 2 and Round 5. Given two rounds were undertaken during falling pressure events, the data are considered to be appropriate for ground gas risk assessment on site. The results for the gas monitoring to data are presented in the Geotechnics report presented in Appendix C and summarised in Table 5-3.



Table 5-3 - Summary of Ground Gas Monitoring Results

Monitoring well	Response Zone (RZ) Strata and Depth (m bgl)	Maximum CH ₄ (% v/v)		Maximum CO ₂ (% v/v)		Flow Rate (l/hr)	Frequency of RZ flooding
		Peak	Steady	Peak	Steady	Steady	
WS301A	MG (1.00 -2.50)	0.20	0.20	0.30	0.30	0.00	0 of 5
WS302A	MG (1.00 – 3.00)	0.20	0.20	0.20	0.20	0.00	0 of 5
WS303	MG (1.00 – 3.00)	0.20	0.20	1.00	1.00	0.00	0 of 5
WS304	MG (1.00 – 3.00)	0.20	0.20	0.70	0.70	0.00	0 of 5
WS305	MG (1.00 – 4.00)	0.20	0.20	0.80	0.80	0.30	0 of 5

The data indicates the following.

- The maximum methane concentration was 0.2%v/v which was recorded in all wells on at least one occasion as a steady concentration.
- No carbon dioxide concentrations above 5%v/v were detected. The highest recorded carbon dioxide concentration was 1%v/v recorded in WS303 as a steady concentration during Round 4.
- Steady flow rates were generally below the limit of detection with the exception of WS305, where a maximum flow rate of 0.3l/hr was recorded during Round 5.
- None of the monitoring wells were recorded to have flooded response zones during the monitoring.

A ground gas risk assessment is presented in Section 7-4.

6 CONTAMINATION ASSESSMENT

6.1 DISCUSSION OF SOIL RESULTS

Borehole logs in addition to soil laboratory reports are included within the Geotechnics Factual report in Appendix C. A compiled spreadsheet of chemical soils data is presented in Appendix D. A summary of the laboratory reports in terms of contamination impact is presented below. An assessment of whether the encountered concentrations represents a potential risk to human health and controlled waters is provided in Section 6.2.

Aside from localised inclusions of ash and slag, no obvious visual or olfactory signs of hydrocarbon contamination were noted in soils during the investigation. No suspected asbestos containing materials (ACM) was observed.

The soil analytical results reported the following.

- TPH analysis reported concentrations up to 360mg/kg in the Made Ground (predominantly heavy end TPH), with the highest concentration in WS304 at 0.50m bgl. Samples collected at depths greater than 1m bgl were below the limit of detection (LOD). Concentrations of total TPH within the remaining samples were at relatively low concentrations or below the LOD. On this basis, the identified TPH impacts are considered to be isolated.
- PAHs were detected at relatively high concentrations in two Made Ground samples, where high concentrations of benzo(a)pyrene (71mg/kg in WS302A at 1m bgl and 42mg/kg in WS305 at 3m bgl) were detected. Concentrations of PAHs in the remaining samples were at generally low concentrations or below the LOD.
- Reported concentrations of BTEX were at trace levels in WS303 at 0.20m bgl and below the LOD in the remaining samples.
- Trace concentrations of phenols were detected with the highest concentration reported in WS302A at 1m bgl and WS305 at 3m bgl (1.60mg/kg of p-cresol).
- Trace concentrations of total cyanide were encountered across the site with concentrations ranging between 0.10mg/kg and 0.70mg/kg. It is noted no free cyanide was detected above the LOD.
- Metals were detected generally at relatively low concentrations across the site, and generally consistent in all samples (Made Ground). The highest lead concentration (300mg/kg) was recorded in a sample of ashy Made Ground from WS302A (1m bgl).
- Concentrations of VOCs were below the limited of detection in all samples.
- Asbestos was not identified in the five samples analysed.

6.2 A6 WELLINGTON BRIDGE

The intrusive investigation in the A6 Wellington Bridge area comprised four trial pits (TP301 – TP304) to a maximum depth of 1.50m bgl. Previous ground investigations in the area (AECOM, 2016) comprised two hand pits (HP01 and HP02) to 1.20m bgl and one window sample hole (WS210) to a maximum depth of 5.09m bgl.

During both phases of investigation ground conditions generally comprised tarmacadam over a limestone subbase over granular Made Ground with inclusions of ash, brick, concrete and slag to maximum proved depth of 2.60m bgl. Beneath the Made Ground in WS210 (AECOM, 2016) a



gravelly sand was encountered to 5.09m bgl. No visual or olfactory evidence of hydrocarbon contamination was noted. In addition, no ACM was identified.

Previous chemical testing of soils in the area from WS210, HP01 and HP02 (AECOM, 2016) comprised five samples of Made Ground submitted for asbestos, metals PAH, TPH, phenols, cyanide, VOCs, SVOCs hexavalent chromium and TOC. Within WS210 (0.2m bgl) a number of polyaromatic hydrocarbons including benzo(a)pyrene were found to be in exceedance of the AECOM adopted GAC for commercial end use. A deeper sample of the same strata (1.0mbgl) did not report any exceedances of the adopted GAC suggesting the impact was localised. Asbestos was not identified in any of the samples submitted for screening.

Based on the ground conditions encountered and third party chemical analysis undertaken, it is considered the excavated material as part of the A6 Wellington Bridge works would likely be suitable for re-use within the development as construction fill material (i.e. covered by buildings / hardstanding / capping system). Based on the Made Ground characteristics and chemical concentrations in that portion of the site, the soils are not considered suitable for re-use at surface. Additional validation sampling will be required to confirm suitability for the intended reuse. Reuse of site won materials should be undertaken in accordance with a Materials Management Plan (MMP), prepared in accordance with CL:AIRE the Definition of Waste: The Development Industry Code of Practice.

7 QUANTITATIVE RISK ASSESSMENT

7.1 INTRODUCTION

Legislation and guidance on the assessment of potentially contaminated sites acknowledges the need for a tiered risk-based approach. This assessment represents a generic quantitative risk assessment (GQRA). It incorporates a comparison of site contaminant levels against generic assessment criteria (GAC), including a qualitative assessment of risk using the source-pathway-receptor model.

7.2 HUMAN HEALTH RISK ASSESSMENT

7.2.1 METHODOLOGY

In order to provide a consistent methodology for the assessment of contaminants, a series of soil and groundwater GAC screening values have been calculated by WSP. Further details on the risk assessment approach and methodology for the derivation of GAC are provided in Appendix E.

Based on the CSM, the reported soil concentrations were compared against the GAC for public open space - public park (POS Park). A soil organic matter (SOM) content of 6% was adopted for screening purposes, based on soil specific data.

The laboratory certificates and chemical data are presented within the Geotechnical Factual report in Appendix C. The compiled chemical data table with a comparison against the GAC is presented within Appendix D.

7.2.2 HUMAN HEALTH RISK ASSESSMENT – SOILS

The screening assessment identified benzo(a)pyrene in concentrations above the GAC in two samples of Made Ground, as summarised in Table 7-1 below.

Table 7-1 – GAC Exceedances in Soils

Parameter	GAC for POS Park land use (6% SOM)	GAC Exceedances	
		WS302A 1m bgl	WS305 3.0m bgl
Benzo(a)pyrene	11mg/kg	71mg/kg	42mg/kg

GACs are based on a minimal level of risk. In March 2014, the Department for Environment, Food and Rural Affairs (DEFRA) published derived Category 4 Screening Levels (C4SL) defined as a concentration below which the risk of harm is low. The reported concentrations also exceed the C4SL for benzo(a)pyrene for public open space (park) land use (21 mg/kg).

It is noted WS305 is not located in the area proposed for landscaping and given the depth of impact (3m bgl) the reported concentration at this location is not considered of concern based on the current site layout. In the event materials are to be excavated and re-used further assessment is required.



The benzo(a)pyrene concentration detected in the Made Ground within the proposed landscape area (WS302 at 1m bgl) is considered to potentially present a risk to future site users if the Made Ground is brought to surface during development works.

No other exceedances of contaminants of concern were identified in the samples submitted for analysis as part of this investigation.

7.2.3 ASBESTOS

A total of five Made Ground samples were screened for the presence of asbestos. No asbestos or asbestos containing material was identified in the samples submitted for screening.

Although no asbestos was identified as part of this investigation, given the type of material that is to be disturbed during works (i.e. Made Ground), the age of the former structures and the detection of asbestos during previous site investigations, the presence of asbestos within Made Ground across the site cannot be discounted. On this basis, WSP recommends implementing mitigation measures to minimise dust generation during the ground disturbance works. If suspected ACM is encountered during the ground works, professional advice from a qualified asbestos consultant should be sought.

7.3 CONTROLLED WATERS RISK ASSESSMENT

Based on the preliminary CSM (refer to Section 3.1) the controlled waters receptors include shallow perched water within the Made Ground / drift deposits, the underlying principal aquifer and the River Mersey.

All the five monitoring wells installed as part of this investigation were dry during the monitoring rounds undertaken in January and February 2020.

The reported soil concentrations were generally low and no gross contamination was identified in the Made Ground within the area assessed as part of this investigation. On this basis, potential infiltration of contaminants of concern from the area of investigation to the underlying Principal Aquifer is considered to be minimal. However, given the former industrial use of the site, the presence of residual mobile or leachable contamination on site cannot be discounted. It is noted dissolved concentrations of TPH have previously been detected in the Principal Aquifer in the wider Stockport Development area (AECOM, 2016).

Based on the above and given the site is not located within a Source Protection Zone or within the vicinity of a potable groundwater extraction well, the risk to controlled waters is considered to be low.

7.4 GROUND GAS ASSESSMENT

Monitoring well response zones were installed within the Made Ground in five locations (WS301A, WS302A, WS303, WS304 and WS305). Monitoring wells were monitored on five occasions between 08 January and 12 February 2020.

Table 7-2 below presents the gas screening values (GSV) in general accordance with C665. The GSV is the maximum volume of methane or carbon dioxide gas that could be produced each hour and is calculated as follows:

- $GSV = \frac{\text{maximum steady carbon dioxide concentrations or methane concentrations (\%)}}{100} \times \text{maximum steady flow rate (l/hr)}$.

The GSV has been calculated based on maximum carbon dioxide concentrations recorded at the site.

Table 7-2 – Summary of Ground Gas Monitoring Results

Strata	Max Steady Flow Rate (l/hr)	Max Steady Carbon Dioxide (%v/v)	GSV	Characteristic Situation
Made Ground	0.3	1	0.003	CS1 (very low risk)

Based on the above, the site is classified as Characteristic Situation 1, very low risk. As such no ground gas protection measures are required.

8 REFINED CONCEPTUAL SITE MODEL

The following section provides a refined conceptual model for the site following the GQRA undertaken above. Table 8-1 presents a summary of the potential pollutant linkages.

Table 8-1 – Summary of Potential Pollutant Linkages

Source	Pathway	Receptor	Comments
Human Health			
Shallow impacted soil (non-volatile contamination)	Direct contact, ingestion, or inhalation of soil-bound contaminants	Onsite future users	<p>Low Risk</p> <p>Elevated concentrations of benzo(a)pyrene have been detected in Made Ground at two locations. It is recommended that in landscaped areas on Made Ground, a 300mm cover layer over a geotextile layer should be installed to break any contaminant linkages.</p> <p>During redevelopment, precautions should be taken to reduce the risk of exposure through appropriate health and safety mitigation measures, such as adequate personal protective equipment and other standard safe practices for construction and maintenance workers.</p>
		Construction workers	
		Future maintenance workers	
Free asbestos in soil	Inhalation of asbestos fibres	Onsite future users	<p>Low Risk</p> <p>Whilst no asbestos has been identified given the type of material that is to be disturbed during works (i.e. Made Ground) and the age of the former structures on site, the presence of asbestos within Made Ground across the site cannot be discounted. Mitigation measures should be implemented to minimise dust generation during the ground disturbance works. If suspected ACM is encountered during the ground works, professional advice should be sought.</p>
		Construction workers	
		Future maintenance workers	
Shallow impacted soil (volatile contamination)	Vapour inhalation	Onsite future users	<p>Very Low Risk</p> <p>Trace concentrations of VOCs identified in soils. Based on the proposed development, outdoor vapour inhalation exposure is considered to be negligible.</p>
		Construction workers	
		Future maintenance workers	

Source	Pathway	Receptor	Comments
Human Health			
Hazardous ground gases	Accumulation of gases and explosive/asphyxiating atmospheres	Onsite future users	Very Low Risk Data indicates the site is CS1 (very low risk).
		Construction workers	
		Future maintenance workers	
Controlled Waters			
Impacted groundwater	Migration to the wider environment	Secondary A Aquifer	Low Risk Shallow groundwater was not encountered. Given the former industrial land use the presence of residual mobile or leachable contamination cannot be discounted. TPH have historically been detected in the Principal Aquifer in the wider Stockport Development area previously (AECOM, 2016). Based on the above and given the site is not located within a Source Protection Zone or within the vicinity of a potable groundwater extraction well, the risk to controlled waters is considered to be low.
		Principal Aquifer	
		The River Mersey	

8.1 RISK EVALUATION

The identified risks to receptors are summarised below.

- **Risks to Future Site Users:** Suitable barriers to direct exposure are required to be put in place in areas of soft landscaping.
- **Risks during Construction / Maintenance Workers:** In order to support the redevelopment and maintenance of the site, excavation and movement of Made Ground and fill materials which contain polyaromatic hydrocarbons will be required. Protection of construction workers and maintenance workers will require consideration particularly from risks associated with inhalation of asbestos fibres and direct contact.
- **Risks to Controlled Waters:** Whilst no shallow groundwater has been detected, given the former industrial land use the presence of residual mobile or leachable contamination cannot be discounted. It is noted dissolved concentrations of TPH have historically been detected in the Principal Aquifer in the wider Stockport Development area previously (AECOM, 2016). Based on the reported soil concentrations in the area of investigation, the dissolved concentrations in the wider development area and the site setting (i.e. not located within a Source Protection Zone or within the vicinity of a potable groundwater extraction well), the risk to controlled waters is considered to be low.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 CONCLUSIONS

Based on the findings of the investigation reported herein, WSP concluded the following.

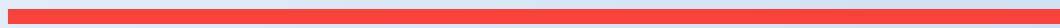
- The proposed landscaped area comprised Made Ground (dark greyish brown gravelly sand, gravel of sandstone, limestone, concrete and brick, locally containing ash) to a maximum unproved depth of 4.07m bgl.
- Elevated concentrations of benzo(a)pyrene were recorded in two locations in exceedance of the adopted GAC protective of human health for a public open space (park) land use scenario.
- No asbestos or asbestos containing material was identified during the current phase, however the presence of asbestos in Made Ground across the site cannot be discounted based on investigations in other parts of the site.
- Whilst no groundwater has been detected, based on previous investigations, the reported soil data and the site setting, the risk to controlled waters is considered to be low.
- The ground gas risk assessment classifies the site as Characteristic Situation 1 – very low risk.
- Excavated material as part of the A6 Wellington Bridge works would likely be suitable for re-use within the development as construction fill material (i.e. covered by buildings / hardstanding). Additional validation sampling will be required to confirm suitability.

9.2 RECOMMENDATIONS

The following actions are recommended in order to mitigate the identified risks.

- It is recommended that in landscaped areas on Made Ground, a 300mm cover layer of clean soils over a geotextile should be installed to protect the health of future users.
- During redevelopment, precautions should be taken to reduce the risk of exposure to the identified contamination through appropriate health and safety mitigation measures, such as adequate personal protective equipment, dampening down for dust suppression and other standard safe practices for construction and maintenance workers.
- Measures should be employed to limit surface water runoff such as minimising soil exposure and covering soil stockpiles.
- In the event any previously unidentified contamination is encountered during earthworks, advice from a qualified geo-environmental consultant should be sought;
- In the event ACM are encountered during enabling works for the proposed development professional advice should be sought from a qualified asbestos consultant; an Asbestos Management Plan may be required to assist in ensuring the protection of the health of ground workers.
- The re-use of materials within the proposed development (e.g. excavated soils, crushed demolition materials etc.) will require demonstration of suitability for use and certainty of use, preferably through a Materials Management Plan (MMP) compliant with the CL:AIRE Definition of Waste Code of Practice.
- Excess soils generated by the redevelopment and intended for off-site disposal will require an appropriate waste classification.
- Should more sensitive end-uses be considered for the site in the future a re-assessment of the site conditions would be required.


Appendix A



FIGURES



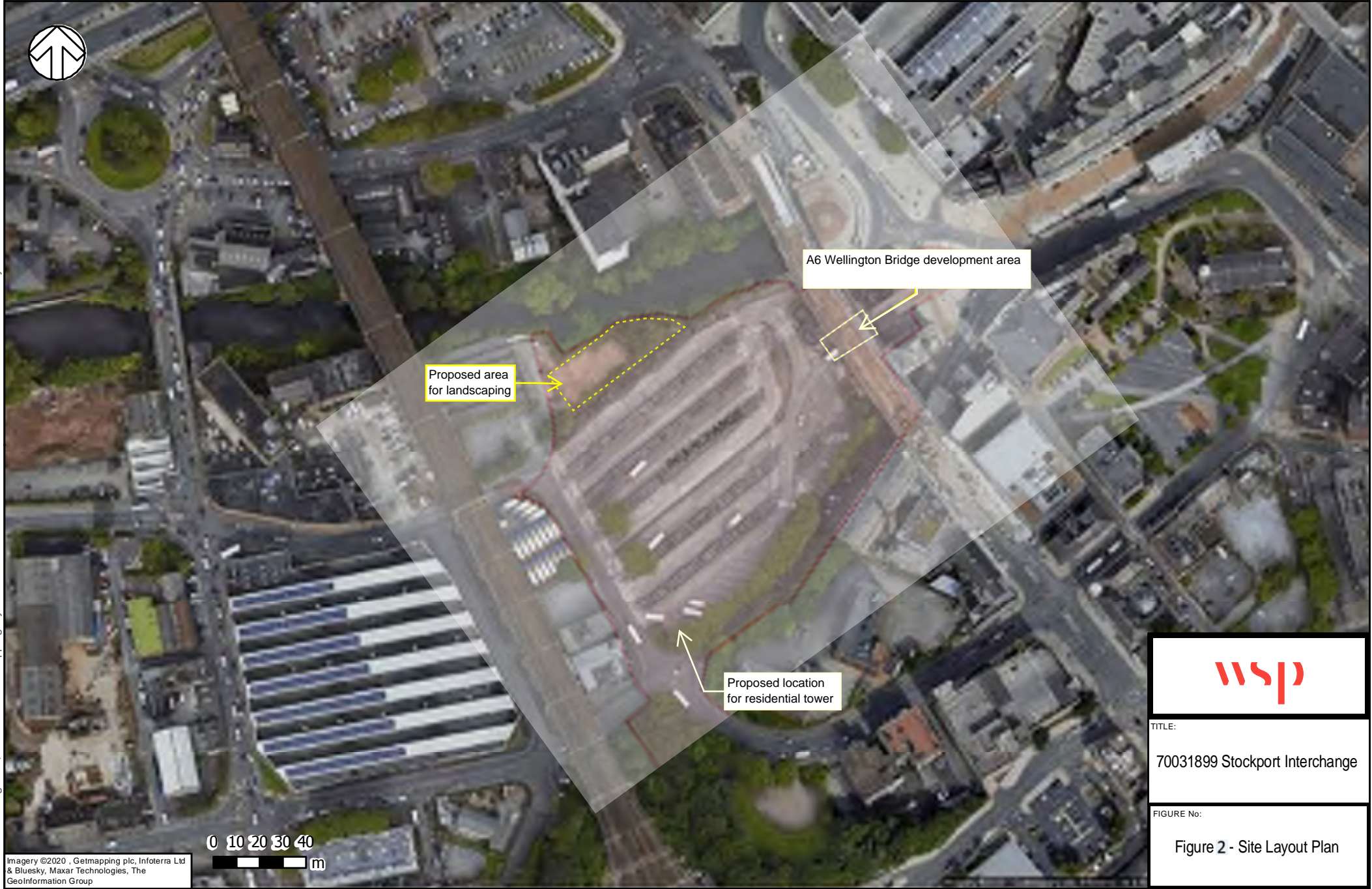
Key

 Approximate Current Bus Interchange Site Boundary



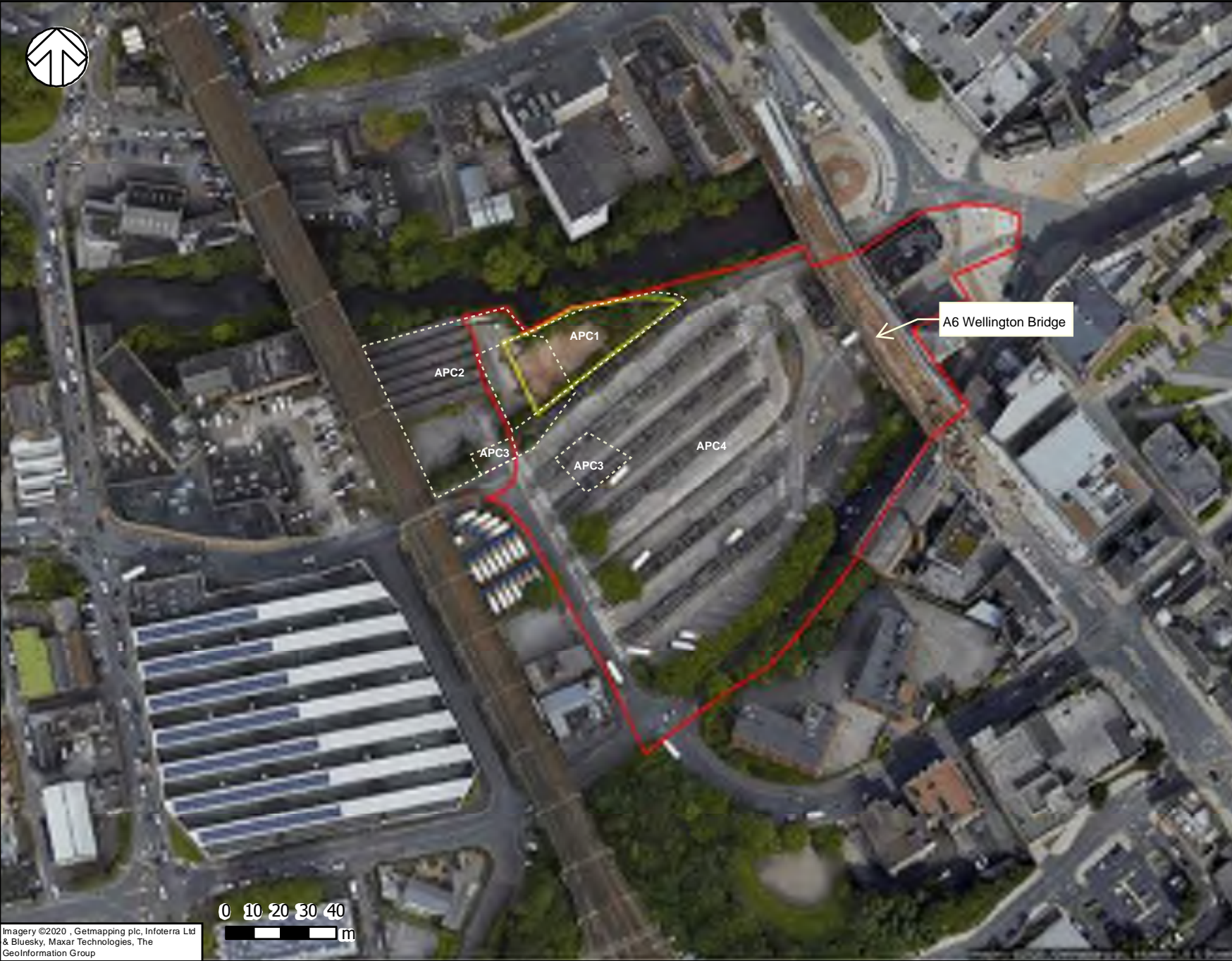
TITLE:
Stockport Bus Interchange,

FIGURE No:
Figure 1 - Site Location Plan



TITLE:
70031899 Stockport Interchange

FIGURE No:
Figure 2 - Site Layout Plan



Key

- Approximate Stockport Interchange Site Boundary
- Proposed Landscaped Area

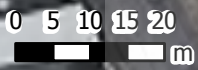
Existing and historical development (indicative locations only)

- APC1 - Former print works
- APC2 - Former chemical works
- APC3 - Off site former industry
- APC4 - Operational bus station



TITLE:
70031899 Stockport Interchange

FIGURE No:
Figure 3 - Areas of Potential Concern



TITLE:
70031899 Stockport Interchange

FIGURE No:
Figure 4 - Borehole Location Plan

Appendix B

DEVELOPMENT PLANS





- KEY**
- Resin Bound Aggregate
 - Natural Stone Paving
 - Granite Aggregate Concrete Paving 1
 - Granite Aggregate Concrete Paving 2
 - Granite Aggregate Concrete Paving 3
 - Surface Graphics
 - Textured Natural Stone Edge
 - Reinforced Grass System
 - Grass
 - Ornamental Planting
 - Proposed Tree
 - Granite Seat Wall / Bench
 - Granite Seat Cube
 - Feature Step / Terrace
 - External Dining Furniture
 - Feature Screen Element
 - Granite Play Platforms
 - Swale Water Feature

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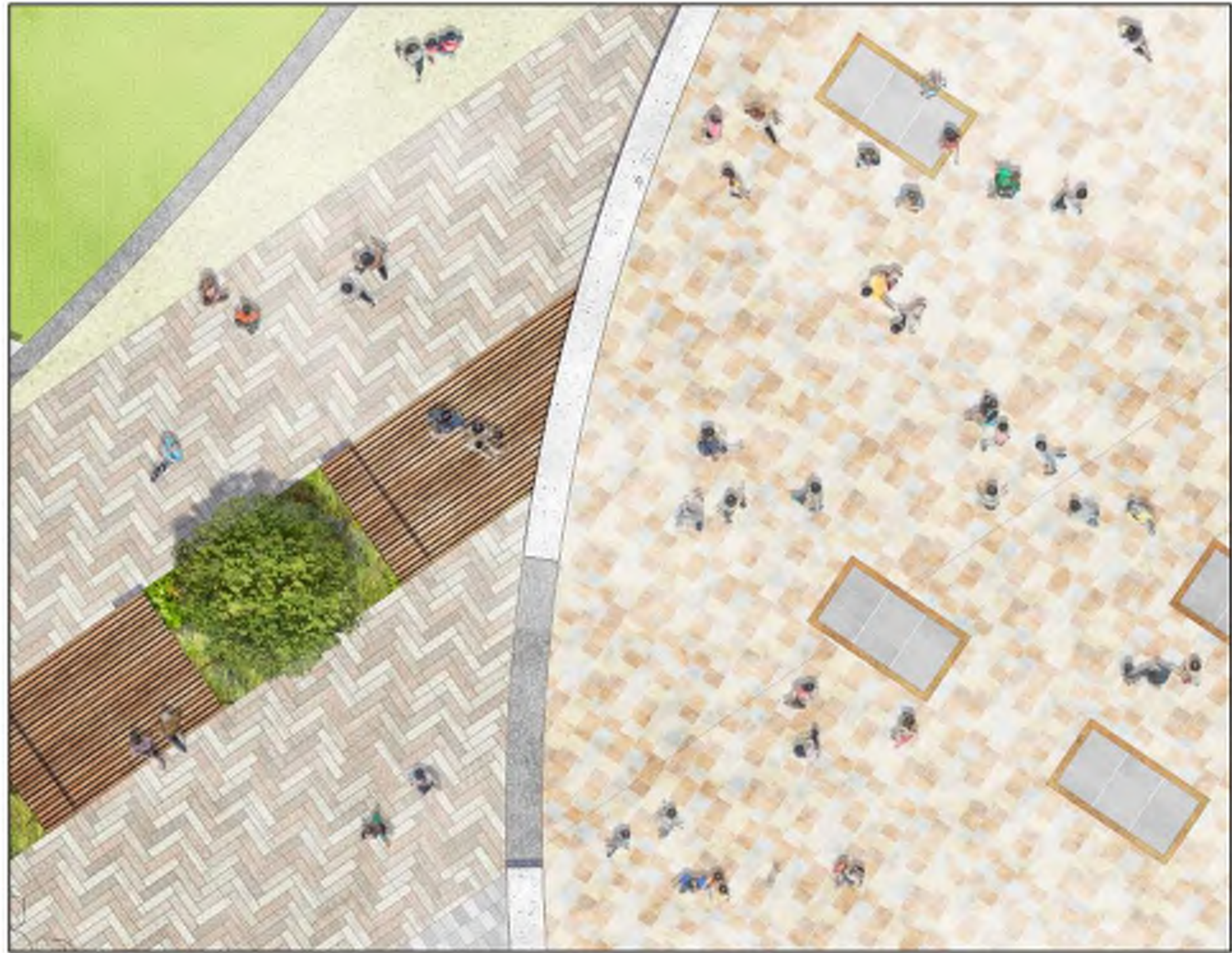
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NOTES

River edge

The planting in this zone consists of low shrubs, perennials and groundcovers. The upright, pyramidal forms of tree canopies in combination with the low layer of planting underneath allow for views through to the north.

Species to include but not limited to:
 Planting species: Mahonia 'Apollo', Hebe 'Caledonia', Euonymus fortunei 'Emerald Gaiety'
 Tree species: Liquidambar styraciflua, Gleditsia triacanthos 'Skyline', Betula pendula 'Zwitsers Glory'



Parkland islands

Lawn mounds with multi-stem trees create a complement the parkland character offering an informal opportunity for seating.


Species to include but not limited to:
 Tree species: Tilia cordata 'Green Spire', Cornus controversa, Prunus shurbittella 'Autumnalis Rosea'



The wetland

Planting species in this zone have been selected for their tolerance of wet soil conditions. Bog species will be planted at the edges of the planting bed where water levels will gradually increase to form a shallow pond edge.

Species to include but not limited to:
 Planting species: Lysimachia mummularia, Iris pseudacorus, myosotis scorpioides, Astilbe 'Fanal'
 Tree species: Betula nigra, Nyssa sylvatica, Alnus glutinosa



Interchange edge

The planting edge of the upper level consist of species with architectural forms and colourful foliage textures. A combination of shrubs, perennials and grasses give a wavy effect that contrasts with the linear wall background.


Species to include but not limited to:
 Planting species: Calamagrostis acutiflora 'Karl Foerster', Perovskia 'Little Spire', Phloxis tuberosa 'Amazona', Acanthus spinosus
 Tree species: Prunus serrula, Parrotia persica, Betula utilis jacquemontii




Recreation zone

The recreation zone consists of groundcovers and shrubs that create a robust layer of understorey planting to frame the concrete platforms. Robust evergreen shrubs and perennials have been selected for their attractive textures and spreading habit.

Species to include but not limited to:
 Planting species: Leucothoe 'Scarletta', Sarcococca hookeriana 'Humilis', Polystichum setiferum, Geranium 'Bevan's Variety'
 Trees species: Ginkgo biloba, Zelkova serrata, Cornus controversa




The Park

The planting character withing the Park is formal. Blocks of planting species create a continuous layer of colours with seasonal perennial interest. Low maintenance evergreen shrubs have been mixed with robust perennials and grasses.

Tree species with pyramidal/oval canopies are used in this area to convey a formal parkland character.


Species to include but not limited to:
 Planting: Hebe rakaiensis, Salvia nemorosa, Sedum 'Matrona'
 Trees: Metasequoia glyptostroboides, Gleditsia triacanthos 'Sunburst', Tilia cordata 'Greenspire'



Residential street

Multi-stem trees with low perennials and groundcovers frame the building and dining areas creating a formal front. The planting species are selected for their textures and hardiness. Perennial seasonality contrasts with the tree bark and foliage colours creating a stunning setting.


Species to include but not limited to:
 Planting species: Hebe rakaiensis, Geranium phaeum, Dryopteris erythrosora, Liriope muscari
 Tree species: Acer palmatum 'Atropurpureum', Betula utilis jacquemontii, Amelanchier laevis 'Prince Charles'



Residential gardens

The private terraces consist of linear blocks of sensory species that create an attractive setting with various foliage textures and blossom scents. A selection of multi-stem, flowering species add interest throughout the year with their autumn leaf and bark colour and spring blossoms.

Species to include but not limited to:
 Planting species: Achillea 'Terracotta', Lavandula angustifolia 'Hidcote', Phormium 'Maori Sunrise', Hebe pinguifolia 'Pagei'
 Tree species: Prunus serrula, Cercidiphyllum japonicum, Acer griseum



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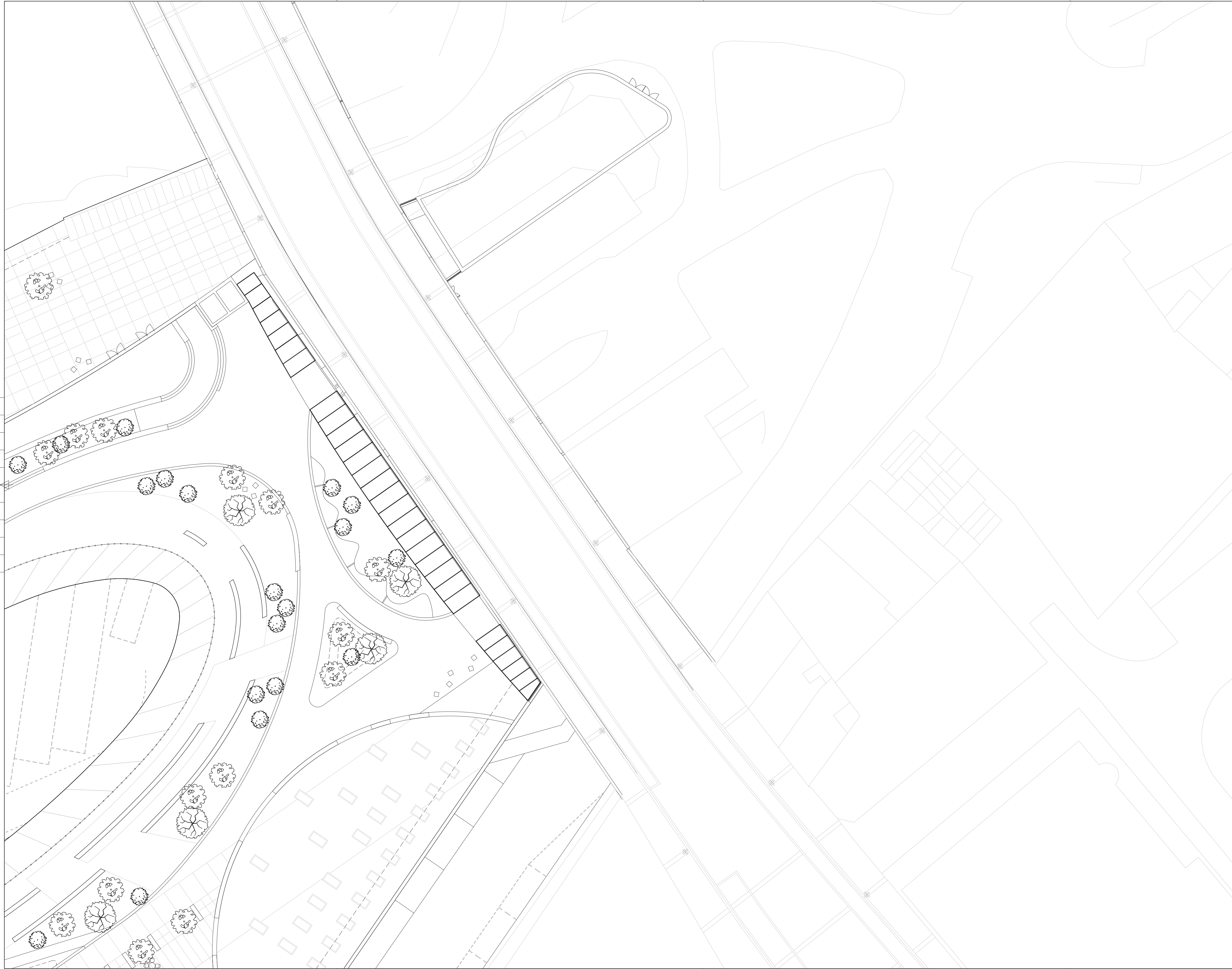
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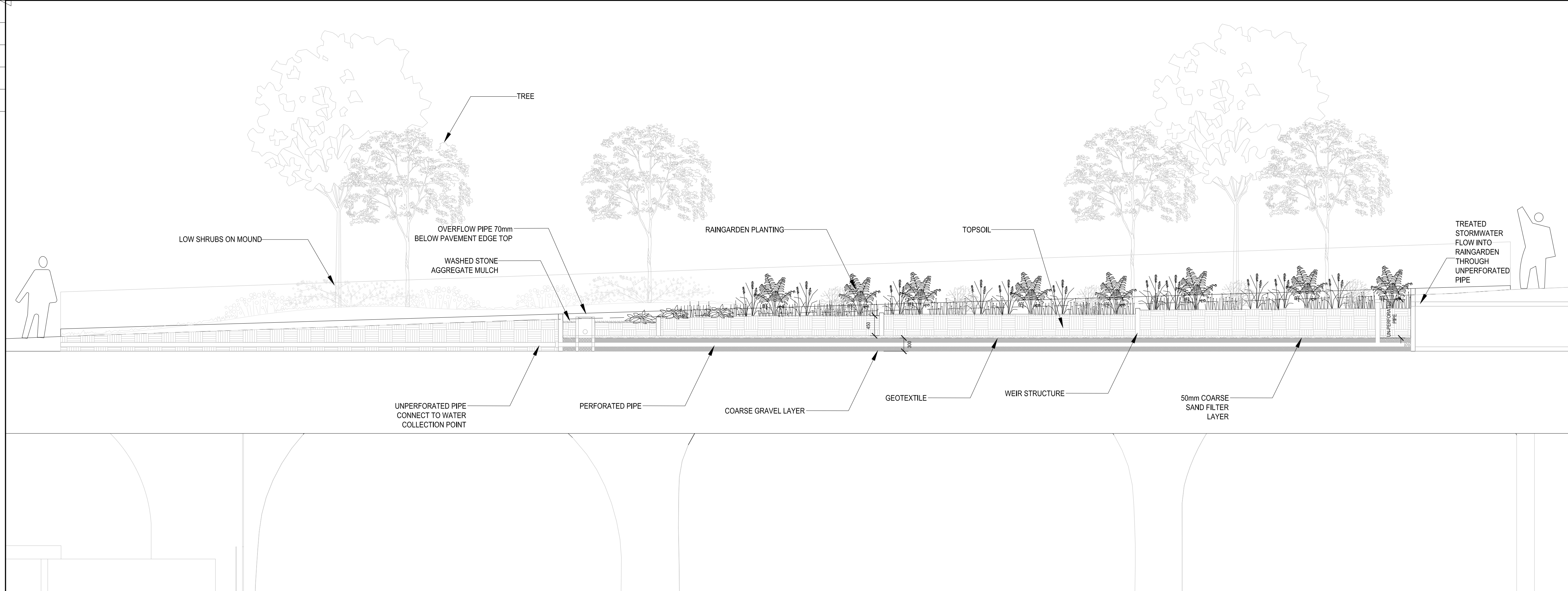
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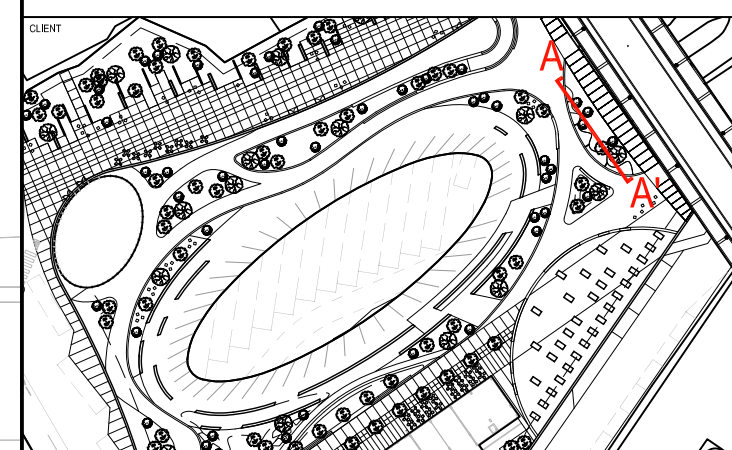


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P2007822

DRAWING NO.
STPT-BDP-T1-ZZ-DR4-ZZ_70_80-0003

REVISION
-

Appendix C



GEOTECHNICAL FACTUAL SITE
INVESTIGATION REPORT

Ground Investigation



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STOCKPORT INTERCHANGE

Factual Report

for
Transport for Greater Manchester

Engineer : WSP UK Limited

Project Number PN194052

February 2020

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Factual Report

STOCKPORT INTERCHANGE

for
Transport for Greater Manchester

Engineer :
WSP UK Limited

Project No:
PNI94052
February 2020

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STOCKPORT INTERCHANGE

Project No: PNI94052
February 2020

1.0 INTRODUCTION

A geotechnical and geo-environmental investigation was undertaken by Geotechnics Limited at the site of proposed development works at the existing Stockport Bus Interchange. The investigation was carried out to the instructions of the Engineer, WSP UK Limited on behalf of the Client, Transport for Greater Manchester. This report describes the work undertaken and presents the data obtained.

This investigation follows an earlier investigation of the site, carried out for the Client by Geotechnics Limited in 2015 to the instructions of AECOM Limited. That investigation formed the basis of a Factual Report (Ref: PNI53428), issued in March 2016.

2.0 OBJECT AND SCOPE OF THE INVESTIGATION

The object of this investigation was to obtain further information on the ground and groundwater conditions relating to the design of the proposed works within the limitations posed by trial hole numbers, locations, depths, methods adopted and the scope of approved in situ and laboratory testing. The investigation comprised dynamic sample boreholes, some with rotary cored follow-on, foundation inspection pits, in situ and laboratory testing and reporting. A Factual Report was also commissioned.

3.0 PRESENTATION

A description of the site and a summary of the procedures followed during the investigation process are presented in Sections 4 to 6. The factual data so obtained are presented in Appendices 2 to 10 of this report. Attention is drawn to the General Notes and Investigation Procedures presented in Appendix II to aid an understanding of the procedures followed and the context in which the report should be read.

In addition, data in electronic format in accordance with "The Electronic Transfer of Geotechnical Data from Ground Investigations" published by the AGS (the AGS Format) are presented separately.

4.0 THE SITE

4.1 Location

The site is located in Stockport town centre, extending from Wood Street northwards to the River Mersey and from Swaine Street eastwards to Mersey Square. The approximate Ordnance Survey National Grid Reference for the centre of the site is SJ 892 902 and an extract from the relevant 1:50,000 Scale O.S. Map is included as Appendix I.

4.2 Description

The site is irregular in shape with maximum dimensions of approximately 120m (north-west to south-east) and 220m (north-east to south-west). The River Mersey bounds the northernmost part of the site. Ground levels across the site generally fall towards the river, such that levels fall from around 47mOD on Wood Street to around 42mOD on the banks of the River Mersey.

The site comprises Stockport Bus Station which remained operational at the time of the investigation works. The A6 Wellington Road crosses the easternmost part of the site on a viaduct which trends roughly north-west to south-east. Beyond this viaduct lies the primarily hard landscaped public open space of Mersey Square. The River Mersey flows in culvert below Mersey Square.

The Site is bounded to the north by the River Mersey, to the east/south-east by Mersey Square and Wood Street and to the west by Swaine Street.

4.3 Site Geology

The 1:50,000 scale map of Stockport published by the British Geological Survey, Sheet 98 Drift edition dated 1962, shows the site to be underlain by Glacial Till (recorded on the map as Boulder Clay).

Towards the River Mersey, River Terrace Deposits are indicated (recorded on the map as First Terrace).

The 1:50,000 Solid edition map (dated 1977) indicates that the site is underlain by rocks of the Chester Formation (recorded on the map as Chester Pebble Beds Formation), part of the Sherwood Sandstone Group of Triassic age. The conjectured trace of a north-north-west to south-south-east trending fault is shown approximately 150m west of Swaine Street, the strata to the east of this fault being downthrown. The conjectured trace of a second fault is shown approximately 200m to the east of the site. This fault trends roughly parallel to the other fault and the strata to the east are again downthrown.

The British Geological Survey maps do not show the presence of Made Ground below the site. However, Made Ground may be present for which the British Geological Survey have no records or which are too shallow for incorporation into the maps. Given historical land uses of this site, a thickness of Made Ground would be anticipated across the site.

4.4 Hydrogeology

The Government's DEFRA MagicMap website, <https://magic.defra.gov.uk/MagicMap.aspx>, accessed on 9th January 2020, shows the Glacial Till to be classed as a Secondary (undifferentiated) Aquifer. The River Terrace Deposits are shown to be classed as a Secondary A Aquifer whilst the Chester Formation rocks are shown to be classed as a Principal Aquifer.

5.0 PROCEDURE

5.1 Commissioning

The work was awarded following submission of a tender for work designed by the Engineer for ground investigation of the site in accordance with the Client's requirements.

5.2 General

The procedures followed in this site investigation are based on *BS 5930: 2015 – Code of Practice for Site Investigations* and *BS 10175:2011+A2:2017 – Investigation of Potentially Contaminated Sites*. The soils and rocks encountered have been described in accordance with BS5930:2015 and BS EN ISO 14688-1:2018 and BS EN ISO 14689:2018. The exploratory hole records are included in

Appendices 2, 4 and 5 and their positions are shown on the Exploratory Hole Location Plan in Appendix 10.

The Exploratory Hole locations were specified by the Engineer. The co-ordinates and levels shown on the Exploratory Hole Records were measured using a Leica GPS survey device. The depths quoted on the exploratory hole records are in metres below ground level.

Prior to the investigation, a survey was carried out by CMS Surveys Limited utilising Ground Penetrating Radar (GPR) techniques to check for the presence of buried services at the proposed exploratory hole locations.

At each exploratory hole location an inspection pit was excavated using hand tools to a depth of 1.20m below ground level to check for the presence of underground services. Prior to and on completion of the excavation, the location was scanned using a cable avoidance tool (CAT).

5.3 Dynamic Sample Boreholes with Rotary Follow-on

Three (3 No.) boreholes (numbered BH301, BH302A and BH302B), up to 120mm in diameter, were sunk utilising a combination of dynamic sampling and rotary coring techniques to depths ranging between 6.90m (BH302A) and 25.10m (BH301) below ground level. Borehole 302A was terminated at a depth of 6.90m below ground level due to poor core recovery and the rig was moved to a revised location (BH302B). A fourth borehole (BH302) was terminated within the inspection pit on encountering a concrete obstruction and the rig was moved to a revised location (BH302A). The work was carried out between 11th and 21st November 2019.

The dynamic sample sections of the boreholes were carried out using a compressed air percussive apparatus fitted to the rotary drilling rig which drives lined steel tubes into the ground in 1.00m lengths. Samples are retrieved in the plastic liners. The liners are extruded from the sampler and placed into suitable core boxes. The retrieved liners were split and the recovered soils described before being sub-sampled into ES, D and B samples as shown on the Borehole Records. The Borehole Records are presented in Appendix 2.

Rotary coring, commenced at depths of 3.80m (BH302A) and 4.00m (BH301 and BH302B) below ground level. The drilling equipment used in the

rotary sections of the boreholes on this particular contract utilised water as the flushing medium.

Rock cores were extruded horizontally in transparent liners and placed into suitable core boxes. Photographs of the individual core boxes are included in Appendix 3.

Standard Penetration Tests (SPTs) were undertaken at the depths indicated on the borehole records in accordance with BS EN ISO 22476-3:2005+A1:2011 to obtain a measure of the engineering properties of the proved strata.

Groundwater observations are included on the Borehole Records where appropriate. It should be noted that the addition of water to the borehole as part of the drilling process may have masked the presence of groundwater in the borehole. Where water was added it has been noted on the Borehole Records.

The boreholes were backfilled with bentonite on completion and the surface reinstated with concrete.

5.4 Dynamic Sample Boreholes

Seven (7 No.) Dynamic Sample Boreholes (numbered WS301 to WS305, WS301A and WS302A) were undertaken at the site to depths ranging between 0.45m (WS301) and 5.22m (WS305) below ground level. WS301 and WS302 were both terminated on encountering obstructions and the rig was moved to revised locations WS301A and WS302A, respectively. The work was carried out between 11th and 14th November 2019.

The Dynamic Samples were taken using the super-heavy Dynamic Probe apparatus which drives lined steel tubes into the ground in 1.00m lengths. Samples are retrieved in the plastic liners. The retrieved liners were split and the recovered soils described before being sub-sampled into ES, D and B samples as shown on the Borehole Records. The Borehole Records are presented in Appendix 4. The hole is not cased and progress depends on the nature of the strata penetrated.

Standard Penetration Tests (SPTs) were undertaken at the depths indicated on the borehole records in accordance with BS EN ISO 22476-3:2005+A1:2011 to obtain a measure of the engineering properties of the proved strata.

Groundwater observations are included on the Borehole Records where appropriate.

On completion, standpipes were installed in Boreholes WS301A, WS303 and WS305 (see Section 5.5). The other boreholes were backfilled with bentonite and their inspection pits were filled with arisings.

5.5 Trial Pits

Four (4 No.) Trial Pits (numbered TP301 to TP304) were each excavated to a depth of 1.20m below ground level using hand tools on 15th November 2019. This work was supervised on site by a geotechnical / geo-environmental engineer.

The profiles of strata or other features were recorded as excavation proceeded and measurements taken from ground level. Representative samples were taken, where appropriate, for laboratory examination and analysis and in addition, Environmental Soil samples (ES) were recovered at the depths indicated on the Trial Pit Records. Samples were taken directly from excavated materials deposited at the surface. Groundwater observations and trench stability notes are included on the Trial Pit Records, presented in Appendix 5. Photographs of the pits are presented in Appendix 6.

5.6 Instrumentation and Monitoring

Long-term monitoring of the gas and groundwater levels was made possible by the installation of standpipes as follows:

Exploratory Hole	Standpipe Slotted Pipe & Filter Zone (m)
WS301A	1.00 to 2.50
WS303	1.00 to 3.00
WS305	1.00 to 4.00

Monitoring of the gas and groundwater levels at the site commenced on 8th January 2020 with further visits on 17th, 21st and 28th January and 12th February 2020.

On each of the monitoring visits a record of the groundwater level in the standpipes was obtained. In addition to the groundwater levels, the following parameters were measured and recorded in each standpipe using a Geotechnical Instruments GA5000 Gas Analyser:-

- Concentrations (% Vol) of CH₄, O₂, CO₂, along with (ppm) H₂S, CO
- Flow Rate

- Barometric Pressure

The results of the monitoring are presented in Appendix 7.

6.0 LABORATORY TESTING

6.1 Geotechnical

The laboratory testing schedule was specified by the Engineer. Unless otherwise stated, the tests were carried out in Geotechnics Limited's UKAS accredited Laboratory (Testing No. 1365) and were undertaken in accordance with the appropriate Standards as indicated below and on the Laboratory Test Certificate in Appendix 8. Any descriptions, opinions and interpretations are outside the scope of UKAS accreditation.

The tests undertaken can be summarised as follows:-

BS EN ISO 17892-1:2014

6 No. Water Content Determination

BS EN ISO 17892-4:2016

1 No. Particle Size Distribution Determination – Sieving Method

BS EN ISO 17892-8:2018

3 No. Unconsolidated Undrained Triaxial Test

BS EN ISO 17892-12:2018

5 No. Determination of Liquid and Plastic Limits

BS 1377:1990

Test No. Test Description

Part 3

5.3, 5.5 5 No. Sulphate Analysis - Water Extract

9.5 5 No. pH Determination

ISRM Testing Methods

85 No. Point Load Determination

The following testing was carried out at the laboratories of Derwentside Environmental Testing

Services Limited (UKAS Accredited Laboratory, Number 2139).

1 No. Asbestos Screen

1 No. Soluble Sulphate

1 No. pH

The following testing was carried out at the laboratories of MATtest Limited (UKAS Accredited Laboratory, Number 2643).

ASTM Testing Methods

5 No. Uniaxial Compressive Strength Determination

15 No. Point Load Determination

The results of these tests are also presented in Appendix 8.

6.2 Contamination

Selected samples of soil were tested at the laboratories of Derwentside Environmental Testing Services Limited (UKAS accredited Laboratory Testing No. 2139) for a number of determinands in order to check on potential site contamination. The determinands were specified by the Engineer and are detailed on the results sheets in Appendix 9 together with the test result as well as the test method, accreditation and detection limit.

Signed for and on behalf of Geotechnics Limited.

Prepared by:
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Principal Engineer

Reviewed by:
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Principal Engineer

APPENDIX I

Site Location Plan

SITE LOCATION PLAN



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STOCKPORT INTERCHANGE
for
Transport for Greater Manchester

GEOTECHNICS
geotechnical and geoenvironmental specialists

APPENDIX 2

Dynamic Sample/Rotary Follow-on Borehole Records

DATA SHEET - Symbols and Abbreviations used on Records



Sample Types

B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample (tub/jar)
E	Environmental test sample
ES	Environmental soil sample
EW	Environmental water sample
G	Gas sample
L	Liner sample
LB	Large bulk disturbed sample
P	Piston sample (PF - failed P sample)
TW	Thin walled push in sample
U	Open Tube - 102mm diameter with blows to take sample. (UF - failed U sample)
UT	Thin wall open drive tube sampler - 102mm diameter with blows to take sample. (UTF - failed UT sample)
V	Vial sample
W	Water sample
#	Sample Not Recovered

Insitu Testing / Properties

CBRP	CBR using TRL probe
CHP	Constant Head Permeability Test
COND	Electrical conductivity
TC	Thermal Conductivity
TR	Thermal Resistivity
HV	Strength from Hand Vane
ICBR	CBR Test
IDEN	Density Test
IRES	Resistivity Test
MEX	CBR using Mexecon Probe Test
PKR	Packer Permeability Test
PLT	Plate Load Test
PP	Strength from Pocket Penetrometer
Temp	Temperature
VHP	Variable Head Permeability Test
VN	Strength from Insitu Vane
w%	Water content
(All other strengths from undrained triaxial testing)	
S	Standard Penetration Test (SPT)
C	SPT with cone
N	SPT Result
-/-	Blows/penetration (mm) after seating drive
-*/-(mm)	Total blows/penetration
()	Extrapolated value

Groundwater

Water Strike	
Depth Water Rose To	

Instrumentation

Seal	
Filter	
Seal	

Strata Legend

Made Ground Granular	
Made Ground Cohesive	
Topsoil	
Cobbles and Boulders	
Gravel	
Sand	
Silt	
Clay	
Peat	
Note: Composite soil types shown by combined symbols	
Chalk	
Limestone	
Sandstone	
Coal	

Strata, Continued

Mudstone	
Siltstone	
Metamorphic Rock	
Fine Grained	
Medium Grained	
Coarse Grained	
Igneous Rock	
Fine Grained	
Medium Grained	
Coarse Grained	

Backfill Materials

Arisings	
Bentonite Seal	
Concrete	
Fine Gravel Filter	
General Fill	
Gravel Filter	
Grout	
Sand Filter	
Tarmacadam	

Rotary Core

RQD	Rock Quality Designation (% of intact core >100mm)
FRACTURE INDEX	
Fractures/metre	
FRACTURE SPACING (m)	Maximum
NI	Non-intact core
NR	No core recovery
AZCL	Assumed zone of core loss
(where core recovery is unknown it is assumed to be at the base of the run)	

BOREHOLE RECORD - Dynamic Sampler and Rotary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION **Engineer** WSP **Borehole** BH301
Client WSP **National Grid Coordinates** 389226.0 E 390150.7 N **Project No** PN194052
Ground Level 45.37 m OD

Sampling			Properties			Strata		Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (FI)	Description	Depth	Legend	Level m OD	
0.20- 1.00	B					MADE GROUND: Red block paving.	G.L.		45.37	
0.20	D					MADE GROUND: Black fine to coarse sand.	0.10		45.27	
0.20	ES						0.15		45.22	
0.50	D					MADE GROUND: Grey concrete.	0.30		45.07	
0.50	ES									
1.00- 1.20	B					MADE GROUND: Brown very sandy slightly clayey angular to subangular fine to coarse gravel of limestone. (Sub base). Below 0.60m, greyish brown.	1.00		44.37	
1.10	D									
1.10	ES									
1.20- 1.50	B	(ADDED)			S15	MADE GROUND: Medium dense brown mottled grey gravelly silty fine to medium sand. Gravel is angular to subangular fine to coarse of siltstone, sandstone and limestone.	1.50		43.87	
1.20	D									
1.20- 1.65	D									
1.50- 1.70	B									
1.70	ES									
1.90- 2.20	B					MADE GROUND: Brown slightly clayey fine to coarse sand with some rootlets (Relict Topsoil). At 1.70m, pocket of angular to subangular fine to coarse gravel of coal. Below 1.80m, brown mottled red.	1.90		43.47	
2.00	D									
2.00	ES									
2.10	HV		Av=106	16						
2.20- 2.70	B					MADE GROUND: Firm to stiff light yellowish brown mottled grey very sandy CLAY with some rootlets.	2.20		43.17	
2.20	D									
2.20- 2.65	D	(ADDED)			S25	Medium dense light yellowish brown mottled grey slightly silty fine to medium SAND.	2.70		42.67	
2.50	D									
2.50	ES									
2.70- 3.20	B					Firm to stiff grey mottled orange slightly sandy CLAY with many rootlets. Below 3.20m, grading to slightly sandy clayey silt.	3.60		41.77	
3.00	D									
3.10	HV		Av=51	21						
3.20- 3.65	UT	3.20	120	8.7		Light grey slightly silty fine to medium SAND.	3.80		41.57	
3.65- 3.80	D						4.00		41.37	
3.80- 4.00	D					Extremely weak reddish brown fine to coarse grained SANDSTONE. (Recovered as sand and gravel).				
3.80	D									
4.00- 4.11	#	3.20 (ADDED)			S50/31					
Core Run/Depth (Core Dia/Time)						Continued by Rotary techniques General		Detail		
4.00- 5.00 (92mm)	3.20 (ADDED)	98	0.29	71	(4)	Very weak to weak reddish brown fine to coarse grained SANDSTONE with occasional horizontal to subhorizontal black bands (up to 10mm thick). Discontinuities are horizontal to subhorizontal, very closely to closely spaced, occasionally medium spaced, undulating, smooth, clean.	Between 5.00-6.30m, no recovery.			
4.73- 4.85		83	0.04							
5.00- 6.50 (92mm)	3.20 (ADDED)	13	0.09	0	(NR)		Between 6.50-7.10m, no recovery.			
5.00- 5.09		7	0.01							
6.50- 7.50 (92mm)	3.20 (ADDED)	38	0.05	0	(15)					
6.50- 6.59		20	0.01		(NR) C50/16					
7.50- 8.50 (92mm)	3.20 (ADDED)	78	0.13	23	(NI)		Between 7.30-7.50m, recovered as gravel.			
7.50- 7.59		49	0.02		(NR) C50/11					
7.97- 8.09		C			(10)					
8.50- 9.50 (92mm)	3.20 (ADDED)	36	0.13	23	(8)		At 8.20m, subhorizontal black band (10mm thick).			
8.50- 8.59		36	0.05		C50/17					
8.60- 8.70		C								
9.50-10.50 (92mm)	3.20 (ADDED)	35	0.07	0	(NR)					
9.50- 9.58		23	0.03		C50/9					

Boring				Progress				Groundwater						
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	JB/SW	G.I.			11/11/19	08:00						Possible inflows masked by drilling flush.
4.00	0.10	Dynamic Sampler	JB/SW	2.65	2.20	DRY	11/11/19	18:00						
25.10	0.09	Rotary Core	JB/SW	2.65	2.20	DRY	12/11/19	08:00						
				10.70	3.20	4.80	12/11/19	18:00						
				10.70	3.20	4.20	13/11/19	08:00						
				20.10	3.20	7.40	13/11/19	18:00						

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
 AGES sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub.
 Backfill details from base of hole: bentonite seal up to 1.20m, arisings up to 0.20m, concrete up to ground level.
 Flush: 4.00-6.50m, Water, 100% returns; 6.50-8.50m, Water, 80% returns; 8.50-10.50m, Water, 70% returns; 10.50-11.50m, Water, 80% returns; 11.50-14.50m, Water, 70% returns; 14.50-15.50m, Water, 50% returns; 15.50-16.50m, Water, 100% returns; 16.50-17.50m, Water, 70% returns; 17.50-20.00m, Water, 60% returns; 20.00-20.50m, Water, 50% returns; 20.50-23.50m, Water, 100% returns; 23.50-25.00m, Water, 50% return.
 Logged in accordance with BS930:2015


Logged by PC
 Figure 1 of 3
 23/01/2020

BOREHOLE RECORD - Dynamic Sampler and Rotary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION Engineer WSP Borehole BH301 Project No PN194052
 Client WSP National Grid Coordinates 389226.0 E 390150.7 N Ground Level 45.37 m OD


Drilling		Properties/Sampling				Strata		Scale 1:50		
Core Run/Depth (Core Dia/Time)	Depth Cased & (to Water)	Type TCR/SCR%	Length Max/Min	RQD %	SPT N (F)	Description General	Description Detail	Depth	Legend	Level m OD
					(17)					
10.50-11.50 (92mm)	3.20 (ADDED)	75	0.20	56	(NI)		Between 10.50-10.80m, many non-intact bands, recovered as gravel. Below 10.80m, discontinuities are horizontal to subhorizontal, closely to medium spaced, planar occasionally undulating, smooth, clean. Between 11.50-11.70m, subhorizontal black bands (up to 5mm thick). Between 12.10-12.30m, subhorizontal black bands (up to 5mm thick). Between 13.00-20.50m, many non-intact bands, recovered as gravel. Below 13.00m, discontinuities are horizontal to subhorizontal, extremely closely to very closely spaced, planar, rough, clean. Between 20.00-20.50m, no recovery.			
10.50-10.59	3.20 (ADDED)	70	0.03		C50/16					
10.60-10.70		C			(8)					
11.50-13.00 (92mm)	3.20 (ADDED)	92	0.29	80						
11.79-11.90		89	0.06		(5)					
13.00-14.50 (92mm)	3.20 (ADDED)	23	0.11	7						
14.22-14.38		17	0.04		(14)					
14.50-15.50 (92mm)	3.20 (ADDED)	7	0.07	0						
14.50-14.60	3.20 (ADDED)	7	0.07		C50/21					
15.50-16.50 (92mm)	3.20 (ADDED)	33	0.03	0						
15.50-15.59	3.20 (ADDED)	3	0.01		(>30) C50/19					
16.50-17.50 (92mm)	3.20 (ADDED)	43	0.13	13						
16.70-16.82		22	0.01		(12)					
16.50-16.61	3.20 (ADDED)	C			C50/32					
17.50-18.50 (92mm)	3.20 (ADDED)	9	0.06	0						
17.50-17.59	3.20 (ADDED)	6	0.01		(11) C50/13					
18.50-19.50 (92mm)	3.20 (ADDED)	14	0.01	0						
18.50-18.60	3.20 (ADDED)	0	0.01		C50/21 (>30)					
19.50-20.00 (92mm)	3.20 (ADDED)	76	0.08	0						
19.50-19.60	3.20 (ADDED)	28	0.01		C50/29					
19.90-19.99		C								

Drilling				Progress				Groundwater						
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
				20.10	3.20	8.30	14/11/19	08:00						
				25.10	8.50	8.50	14/11/19	18:00						

Remarks 

Symbols and abbreviations are explained on the accompanying key sheet.
 All dimensions are in metres. Logged in accordance with BS5930:2015

Logged by PC
 Figure 2 of 3
 23/01/2020



BOREHOLE RECORD - Dynamic Sampler and Rotary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION
 Engineer WSP
 Borehole BH301
 Project No PN194052
Client WSP
 National Grid Coordinates 389226.0 E 390150.7 N
 Ground Level 45.37 m OD

Drilling		Properties/Sampling				Strata		Scale 1:50		
Core Run/Depth (Core Dia/Time)	Depth Cased & (to Water)	Type TCR/SCR%	Length Max/Min	RQD %	SPT N (F)	Description General	Description Detail	Depth	Legend	Level m OD
20.00-20.50 (92mm)	3.20 (ADDED)	0			(NR)					
20.00-20.10	3.20 (ADDED)				C50/27		Below 20.50m, discontinuities are horizontal to subhorizontal, closely spaced occasionally very closely spaced, planar, rough, clean. Some extremely weak bands.			
20.50-21.00 (92mm)	3.20 (ADDED)	84	0.21	42	(5)					
20.74-20.82		66	0.02		C50/9					
20.50-20.58	3.20 (ADDED)	C								
21.00-22.00 (92mm)	3.20 (ADDED)	100	0.20	68	(NI)					
21.00-21.20		82	0.02		(NR)		Between 21.70-22.00m, sand infill in discontinuities. Between 22.00-22.70m, no recovery.			
22.00-23.50 (92mm)	3.20 (ADDED)	50	0.17	18	(10)					
22.00-22.10		50	0.04				Below 22.70m, discontinuities are horizontal, very closely to closely spaced, undulating, rough, clean.			
23.50-25.00 (92mm)	3.20 (ADDED)	54	0.29	38	(NR)					
23.50-23.61	3.20 (ADDED)	52	0.04		C50/30		Between 23.50-24.15m, no recovery.			
23.78-23.89		C			(12)					
24.50-24.68		C			(4)		Below 24.50m, discontinuities are horizontal, closely to medium spaced, planar, rough, clean.			
24.87-25.00		C								
25.00-25.10	3.20 (ADDED)				C50/20	End of Borehole		25.10		20.27

Drilling				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

 Logged by **PC**
 Figure **3 of 3**
 23/01/2020

Symbols and abbreviations are explained on the accompanying key sheet.
 All dimensions are in metres. Logged in accordance with BS5930:2015

TRIAL PIT RECORD

Inspection Pit

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Engineer WSP

Trial Pit **BH302**
Project No PN194052

Client WSP

National Grid Coordinates 389218.9 E
390142.5 N

Ground Level 45.64 m OD

Samples and Tests				Strata		Scale 1:50	
Depth	Type	Stratum No	Results	Description	Depth	Legend	Level m OD
0.00- 0.30	B			<p>MADE GROUND: Black tarmacadam.</p> <hr/> <p>MADE GROUND: Pinkish brown sandy slightly clayey angular to subangular fine to coarse gravel of limestone and sandstone. (Sub base).</p> <p>Below 0.15m, greyish brown.</p> <p>At 0.30m, blue geotextile.</p> <hr/> <p>MADE GROUND: Light greyish brown sandy slightly clayey angular to subangular fine to coarse gravel of limestone and sandstone. (Sub base).</p> <p>At 0.60m, concrete obstruction.</p> <p style="text-align: center;">End of Excavation</p>	G.L.		45.64
0.20	ES				0.10		45.54
0.30- 0.60	B				0.30		45.34
0.50	ES				0.60		45.04

Excavation				Groundwater		
Plant	Hand tools.	Width (B)	0.40	Depth Observed	Depth of Pit	Details
Date	11/11/2019	Length (C)	0.40			None encountered.
Shoring	None.	Date Backfilled	11/11/2019			
Stability	stable during excavation.					

Remarks Inspection pit hand excavated to 0.60m depth and no services were found.
 ES sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub.
 Inspection Pit terminated at 0.60m depth on encountering a concrete obstruction - rig was moved to BH302A.
 Backfill details from base of hole: arisings up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres. Logged in accordance with BS5930:2015

Logged by PC
Figure 1 of 1
23/01/2020

BOREHOLE RECORD - Dynamic Sampler and Rotary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION **Engineer** WSP **Borehole** BH302B
Client WSP **National Grid Coordinates** 389219.2 E 390145.7 N **Project No** PN194052
Ground Level 45.47 m OD

Sampling		Properties			Strata		Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N (F)	Description	Depth	Legend	Level m OD
0.20- 0.80	B					MADE GROUND: Red block paving. MADE GROUND: Grey concrete.	G.L. 0.10 0.20		45.47 45.37 45.27
0.80- 1.20	B					MADE GROUND: Light grey very sandy angular to subangular medium to coarse gravel of limestone. (Sub base).	0.80		44.67
1.20- 1.70	B					MADE GROUND: Medium dense dark brown mottled red very gravelly slightly silty fine to medium sand with a low cobble content. Gravel is subangular to subrounded fine to coarse of siltstone, sandstone, ash and brick fragments.			
1.20- 1.65	D	(DRY)			S15				
1.70- 2.00	B					MADE GROUND: Firm brown slightly gravelly sandy clay. Gravel is angular to subrounded fine to coarse of siltstone, sandstone, coal and brick fragments.	1.70		43.77
1.70- 2.00	D								
2.00- 2.20	D					Firm grey mottled orange slightly gravelly sandy CLAY with some fine rootlets. Gravel is subangular to subrounded fine to medium of sandstone and quartzite. Below 2.20m, grading to slightly gravelly sandy clayey silt.	2.00		43.47
2.20- 2.80	UT		85	12					
2.60- 2.80	D					Medium dense grey mottled orange clayey fine to medium SAND.			
2.80- 3.10	D								
2.80- 3.25	D	(DRY)				Stiff light brown mottled orange slightly sandy CLAY with some decayed rootlets. Below 3.40m, grey mottled orange.	2.80		42.67
2.80- 3.25	D				S17				
3.10- 3.40	B						3.10		42.37
3.30- 3.30	D								
3.30- 3.30	HV		Av=79	21					
3.40- 4.00	B								
3.60- 3.60	D								
3.70- 3.70	HV		Av=63						
3.80- 4.00	D	(DRY)					4.00		41.47
3.80- 3.89	D								
4.00- 4.25					S50/15		4.25		41.22
Core Run/Depth (Core Dia/Time)	Depth Cased	TCR/SCR / Type	Length Max/Min	RQD %	SPT (F)	Continued by Rotary techniques General	Detail		
4.00- 4.50 (102mm)	4.00 (ADDED)	100 C	0.15	76	(8)	Extremely weak reddish brown fine to coarse grained SANDSTONE. (Recovered as sand and gravel).			
4.15- 4.26		100 C	0.05		(NI)				
4.50- 5.50 (102mm)	4.00 (ADDED)	58 C	0.13	13		Extremely weak to very weak reddish brown fine to coarse grained SANDSTONE with occasional clasts of quartzite. Discontinuities are horizontal to subhorizontal, very closely to closely spaced, planar and undulating, rough with some sand and gravel infill (up to 10mm thick).	Between 4.75-4.90m, non-intact. Between 5.50-7.00m, no recovery.		
4.50- 4.65		27 C	0.01						
4.65- 4.78		C							
5.50- 6.50 (102mm)	4.00 (ADDED)	0			(NR)		Between 7.00-9.20m, non-intact.		
5.50- 5.59	4.00 (ADDED)				C50/19				
6.50- 7.00 (102mm)	4.00 (ADDED)	0							
6.50- 6.60	4.00 (ADDED)				C50/23				
7.00- 8.00 (102mm)	7.00 (ADDED)	0							
7.00- 7.10	4.00 (ADDED)				C50/29				
8.00- 9.00 (102mm)	7.00 (ADDED)	0			(NI)				
8.00- 8.09	7.00 (ADDED)				C50/16				
9.00-10.00 (102mm)	7.00 (ADDED)	75	0.22	22		Below 9.20m, discontinuities are closely to medium spaced with some sand and gravel infill.			
9.00- 9.10	7.00 (ADDED)	44	0.05		C50/22 (16)				
9.74- 9.90		C			(3)				
9.90-10.00		C							

Boring				Progress				Groundwater						
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	JB/SW	G.I.			18/11/19	08:00						Possible inflows masked by drilling flush.
4.00	0.10	Dynamic Sampler	JB/SW	2.20		DRY	18/11/19	18:00						
25.00	0.12	Rotary Core	JB/SW	2.20		DRY	19/11/19	08:00						
				7.20	4.00	ADDED	19/11/19	18:00						
				7.20	4.00	ADDED	20/11/19	08:00						
				16.00	7.00	7.20	20/11/19	18:00						

Remarks Inspection pit hand excavated to 1.20m depth and no services were found. Logged by PC
 ABS sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub. Figure 1 of 3
 Backfill details from base of hole: bentonite seal up to 0.20m, concrete up to ground level. 23/01/2020
 Flush: 4.00-5.50m, Water, 100% returns; 5.50-7.00m, Water, 60% returns; 7.00-9.00m, Water, 70% returns; 9.00-10.00m, Water, 60% returns; 10.00-11.00m, Water, 70% returns; 11.00-12.00m, Water, 80% returns; 12.00-16.00m, Water, 70% returns; 16.00-19.50m, Water, 80% returns; 19.50-20.50m, Water, 70% returns; 20.50-25.00m, Water, 100% return.

All dimensions are in metres. Logged in accordance with BS5930:2015


BOREHOLE RECORD - Dynamic Sampler and Rotary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION Engineer WSP Borehole Project No BH302B PN194052

Client WSP National Grid Coordinates 389219.2 E 390145.7 N Ground Level 45.47 m OD

Drilling		Properties/Sampling				Strata		Scale 1:50		
Core Run/Depth (Core Dia/Time)	Depth Cased & (to Water)	Type TCR/SCR%	Length Max/Min	RQD %	SPT N (F)	Description General	Description Detail	Depth	Legend	Level m OD
10.00-11.00 (102mm)	7.00 (ADDED)	53	0.35	35	(NR)	C50/15 (10) (3)	Below 11.00m, very weak to weak. Between 11.45-11.60m, non-intact. Below 12.20m, discontinuities are extremely closely spaced. Below 12.45m, discontinuities are very closely to closely spaced.			
10.00-10.09	7.00 (ADDED)	43	0.08							
10.64-10.80		C								
11.00-12.00 (102mm)	7.00 (ADDED)	90	0.27	38	(3)					
11.00-11.08	7.00 (ADDED)	70	0.04		C50/9					
11.39-11.47		C			(11)					
12.00-13.00 (102mm)	7.00 (ADDED)	100	0.18	59	(5)					
12.00-12.13		72	0.02		(48)					
12.00-12.09	7.00 (ADDED)	C			C50/13					
12.70-12.83		C			(10)					
13.00-14.50 (102mm)	7.00 (ADDED)	82	0.21	40	(NR)	(14) (4)	Below 14.40m, some black staining on fracture surfaces.			
13.43-13.52		C								
14.00-14.20		C								
14.50-16.00 (102mm)	7.00 (ADDED)	96	0.17	30	(10)					
15.00-15.10		C			(28)	(7) (14) (>50)	Between 15.85-15.95m, band of very weak mudstone. Between 15.90-17.50m, non-intact.			
15.28-15.45		C								
15.73-15.87		C								
16.00-17.50 (102mm)	7.50 (ADDED)	0				(NI)	Between 18.30-18.50m, micaceous. Between 18.50-19.50m, non-intact Between 19.50-19.90m, no recovery.			
17.50-18.50 (102mm)	7.50 (ADDED)	22	0.08	0						
17.50-17.60	7.50 (ADDED)	15	0.05		C50/21					
18.40-18.50		C			(20)					
18.50-19.50 (102mm)	7.50 (ADDED)	0			(NI)					
18.50-18.60	7.50 (ADDED)				C50/24	(NR) C50/17				
19.50-20.50 (102mm)	7.50 (ADDED)	60	0.06	0						
19.50-19.57		25	0.03							
19.50-19.59	7.50 (ADDED)	C								


Drilling				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
				16.00	7.00	8.20	21/11/19	08:00						
				20.70	7.50	6.30	21/11/19	18:00						
				20.50	7.50	3.10	22/11/19	08:00						
				25.00	25.00	4.20	22/11/19	18:00						

Remarks 

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres. Logged in accordance with BS5930:2015

Logged by PC
Figure 2 of 3
23/01/2020



BOREHOLE RECORD - Dynamic Sampler and Rotary

Project **STOCKPORT INTERCHANGE GROUND INVESTIGATION** Engineer **WSP** Borehole **BH302B**
 Project No **PN194052**
 Client **WSP** National Grid Coordinates **389219.2 E 390145.7 N** Ground Level **45.47 m OD**

Drilling		Properties/Sampling				Strata		Scale 1:50		
Core Run/Depth (Core Dia/Time)	Depth Cased & (to Water)	Type TCR/SCR%	Length Max/Min	RQD %	SPT N (FI)	Description General	Description Detail	Depth	Legend	Level m OD
20.47-20.50		C			(>50)					
20.50-21.50 (102mm)	7.50 (ADDED)	0					Between 20.50-23.50m, non-intact			
20.50-20.59	7.50 (ADDED)				C50/17					
21.50-22.50 (102mm)	21.50 (ADDED)	0								
21.50-21.61	21.50 (ADDED)				(NI) C50/33					
22.50-23.50 (102mm)	22.50 (ADDED)	0					Below 23.80m, discontinuities are very closely to closely spaced. Between 24.10-24.35m, vertical discontinuity, stepped, rough. Below 24.60m, extremely weak. Some sand and gravel infill in discontinuities.			
22.50-22.60	22.50 (ADDED)				C50/28					
23.50-25.00 (102mm)	23.50 (ADDED)	97	0.20	34	(13)					
23.50-23.58		65	0.02							
23.50-23.61	23.50 (ADDED)	C			C50/31 (6)					
23.84-23.93		C			(6)					
24.00-24.13		C			(NI)					
					(>50)					
25.00-25.10	25.00 (ADDED)					C50/24	End of Borehole	25.00		20.47

Drilling				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.
 All dimensions are in metres. Logged in accordance with BS5930:2015

Logged by **PC**
 Figure **3 of 3**
 23/01/2020

Fieldwork Results - SPT Results Summary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No PN194052

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'						
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50		
BH301	1.20	44.17	S	-	7	5	5	4	3	3	15		*					
BH301	2.20	43.17	S	-	7	6	7	5	7	6	25			*				
BH301	4.00	41.37	S	-	25		50/31				50/31							✓
BH301	6.50	38.87	C	-	25		50/16				50/16							✓
BH301	7.50	37.87	C	-	25		50/11				50/11							✓
BH301	8.50	36.87	C	-	25		50/17				50/17							✓
BH301	9.50	35.87	C	-	25		50/9				50/9							✓
BH301	10.50	34.87	C	-	25		50/16				50/16							✓
BH301	14.50	30.87	C	-	25		50/21				50/21							✓
BH301	15.50	29.87	C	-	25		50/19				50/19							✓
BH301	16.50	28.87	C	-	25		50/32				50/32							✓
BH301	17.50	27.87	C	-	25		50/13				50/13							✓
BH301	18.50	26.87	C	-	25		50/21				50/21							✓
BH301	19.50	25.87	C	-	25		50/29				50/29							✓
BH301	20.00	25.37	C	-	25		50/27				50/27							✓
BH301	20.50	24.87	C	-	25		50/9				50/9							✓
BH301	23.50	21.87	C	-	25		50/30				50/30							✓
BH301	25.00	20.37	C	-	25		50/20				50/20							✓
Driller			James Boyd				Remarks Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005											
Hammer No.			6457 (6)															
Energy Ratio, Er (%)			66.00															
Calibration Date			01/08/2019															

-/- Blows/penetration (mm) after seating
 -*/- Total blows/penetration (mm)
 SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
 C - SPT with cone
 L - Split Spoon with liner used

GEOTECHNICS



Fieldwork Results - SPT Results Summary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No PN194052

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'					
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50	
BH302A	1.20	44.27	S	-	4	4	2	3	2	1	8	*					
BH302A	3.80	41.67	S	-	1	1	2	13	16	17	48						*
BH302A	4.80	40.67	C	-	25		50/17				50/17						∇
BH302A	5.80	39.67	C	-	25		50/22				50/22						∇
BH302A	6.30	39.17	C	-	25		50/31				50/31						∇
BH302A	6.80	38.67	C	-	25		50/26				50/26						∇
Driller			James Boyd				Remarks Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005										
Hammer No.			6457 (6)														
Energy Ratio, Er (%)			66.00														
Calibration Date			01/08/2019														

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS



Fieldwork Results - SPT Results Summary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No PN194052

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'						
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50		
BH302B	1.20	44.27	S	-	4	4	4	5	3	3	15		*					
BH302B	2.80	42.67	S	-	5	4	3	4	4	6	17		*					
BH302B	3.80	41.67	S	-	25		50/15				50/15							∇
BH302B	5.50	39.97	C	-	25		50/19				50/19							∇
BH302B	6.50	38.97	C	-	25		50/23				50/23							∇
BH302B	7.00	38.47	C	-	25		50/29				50/29							∇
BH302B	8.00	37.47	C	-	25		50/16				50/16							∇
BH302B	9.00	36.47	C	-	25		50/22				50/22							∇
BH302B	10.00	35.47	C	-	25		50/15				50/15							∇
BH302B	11.00	34.47	C	-	25		50/9				50/9							∇
BH302B	12.00	33.47	C	-	25		50/13				50/13							∇
BH302B	17.50	27.97	C	-	25		50/21				50/21							∇
BH302B	18.50	26.97	C	-	25		50/24				50/24							∇
BH302B	19.50	25.97	C	-	25		50/17				50/17							∇
BH302B	20.50	24.97	C	-	25		50/17				50/17							∇
Driller			James Boyd				Remarks Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005											
Hammer No.			6457 (6)															
Energy Ratio, Er (%)			66.00															
Calibration Date			01/08/2019															

-/- Blows/penetration (mm) after seating
 -*/- Total blows/penetration (mm)
 SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
 C - SPT with cone
 L - Split Spoon with liner used

GEOTECHNICS

APPENDIX 3

Rock Core Photographs

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



BH301 1.20m - 3.20m



BH301 4.00m - 8.50m

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



BH301 8.50m - 12.50m



BH301 12.50m - 20.50m

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



BH301 20.50m - 23.00m



BH301 23.00m - 25.00m

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



BH302A 1.20m - 3.80m



BH302A 3.80m - 4.80m

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



BH302B 1.20m - 3.80m



BH302B 4.00m - 9.00m

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



BH302B 9.00m - 11.00m



BH302B 11.00m - 13.00m

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



BH302B 13.00m - 15.00m



BH302B 15.00m - 19.50m

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



BH302B 19.50m - 24.00m



BH302B 24.00m - 25.00m

APPENDIX 4

Dynamic Sample Borehole Records

DATA SHEET - Symbols and Abbreviations used on Records



Sample Types

B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample (tub/jar)
E	Environmental test sample
ES	Environmental soil sample
EW	Environmental water sample
G	Gas sample
L	Liner sample
LB	Large bulk disturbed sample
P	Piston sample (PF - failed P sample)
TW	Thin walled push in sample
U	Open Tube - 102mm diameter with blows to take sample. (UF - failed U sample)
UT	Thin wall open drive tube sampler - 102mm diameter with blows to take sample. (UTF - failed UT sample)
V	Vial sample
W	Water sample
#	Sample Not Recovered

Insitu Testing / Properties

CBRP	CBR using TRL probe
CHP	Constant Head Permeability Test
COND	Electrical conductivity
TC	Thermal Conductivity
TR	Thermal Resistivity
HV	Strength from Hand Vane
ICBR	CBR Test
IDEN	Density Test
IRES	Resistivity Test
MEX	CBR using Mexecon Probe Test
PKR	Packer Permeability Test
PLT	Plate Load Test
PP	Strength from Pocket Penetrometer
Temp	Temperature
VHP	Variable Head Permeability Test
VN	Strength from Insitu Vane
w%	Water content
(All other strengths from undrained triaxial testing)	
S	Standard Penetration Test (SPT)
C	SPT with cone
N	SPT Result
-/-	Blows/penetration (mm) after seating drive
-*/-(mm)	Total blows/penetration (mm)
()	Extrapolated value

Groundwater

Water Strike	
Depth Water Rose To	

Instrumentation

Seal	
Filter	
Seal	

Strata

Made Ground Granular	
Made Ground Cohesive	
Topsoil	
Cobbles and Boulders	
Gravel	
Sand	
Silt	
Clay	
Peat	

Note: Composite soil types shown by combined symbols

Chalk	
Limestone	
Sandstone	
Coal	

Strata, Continued

Mudstone	
Siltstone	
Metamorphic Rock	
Fine Grained	
Medium Grained	
Coarse Grained	
Igneous Rock	
Fine Grained	
Medium Grained	
Coarse Grained	

Backfill Materials

Arisings	
Bentonite Seal	
Concrete	
Fine Gravel Filter	
General Fill	
Gravel Filter	
Grout	
Sand Filter	
Tarmacadam	

Rotary Core

RQD	Rock Quality Designation (% of intact core >100mm)
FRACTURE INDEX	
Fractures/metre	
FRACTURE SPACING (m)	Maximum
NI	Non-intact core
NR	No core recovery
AZCL	Assumed zone of core loss
(where core recovery is unknown it is assumed to be at the base of the run)	

BOREHOLE RECORD - Dynamic Sampler

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION


Engineer WSP

Borehole Project No **WS301**
PN194052



Client WSP

National Grid Coordinates 389178.0 E
390264.8 N

Ground Level 42.95 m OD

Sampling			Properties		Strata	Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description	Depth	Legend	Level m OD
0.20	ES				Grass over TOPSOIL: Dark brown slightly gravelly clayey fine to coarse sand with some rootlets. Gravel is angular to subangular fine to medium of ceramic, glass and brick fragments. MADE GROUND: Dark brown gravelly slightly clayey fine to coarse sand. Gravel is angular to subangular fine to coarse of sandstone, slag, concrete and brick fragments. MADE GROUND: Greyish yellow concrete. At 0.45m, obstruction. End of Borehole	G.L.		42.95
0.40	ES					0.10		42.85
						0.40 0.45		42.55 42.50

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
0.45	0.40	Inspection Pit	GM/MM	G.I. 0.45		DRY	11/11/19 11/11/19	08:00 18:00						None encountered.


Remarks  Inspection pit hand excavated to 0.45m depth and no services were found.
 ABS sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub.
 Inspection Pit terminated at 0.45m depth on encountering an obstruction - the rig was moved to WS301A.
 Backfill details from base of hole: arisings up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by **MM**
Figure 1 of 1
23/01/2020



BOREHOLE RECORD - Dynamic Sampler

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION Engineer WSP Borehole Project No WS301A PN194052
 Client WSP National Grid Coordinates 389178.5 E 390265.4 N Ground Level 42.91 m OD


Sampling			Properties			Strata		Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD	
0.20	D					Grass over TOPSOIL: Dark brown slightly gravelly clayey fine to coarse sand with some rootlets. Gravel is angular to subangular fine to coarse of concrete and brick fragments.	G.L.		42.91	
0.20	ES						0.10		42.81	
0.40	ES						0.40		42.51	
0.50- 1.20	B									
1.00	D				S4	MADE GROUND: Dark brown mottled orange gravelly slightly clayey fine to coarse sand with a low cobble content of bricks. Gravel is angular to subangular fine to coarse of concrete and brick fragments. Sand includes ash.	1.20		41.71	
1.00	ES									
1.20- 1.65	D					MADE GROUND: Yellow sandy angular to subangular fine to coarse gravel of limestone. Between 0.40-1.20m, concrete foundation encountered - inspection pit extended 0.20m to east.				
1.50- 1.70	D									
1.90	ES									
2.00- 2.45	D				S23	MADE GROUND: Very loose to loose dark brown mottled orange gravelly slightly clayey fine to coarse sand. Gravel is angular to subangular fine to coarse of clinker, slag, coal, concrete and brick fragments. Sand includes ash. Below 1.80m, low cobble content of bricks. Below 2.00m, medium dense.				
2.00	D									
2.50- 2.95	D					Below 2.20-2.40m, band of soft slightly gravelly clay.				
2.50	ES									
3.00- 3.44					S50/ 290	At 3.44m, obstruction - probable cobble.	3.44		39.47	
End of Borehole										

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit		G.I.			11/11/19	08:00						None encountered.
3.44	0.10	Dynamic Sampler	GM/MM GM/MM	3.44		DRY	11/11/19	18:00						

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
 ABS sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub.
 Borehole terminated at a depth of 3.44m on encountering an obstruction - probable cobble.
 A 50mm standpipe was installed to 2.50m with a geowrapped slotted section from 1.00m to 2.50m with flush lockable protective cover. Backfill details from base of hole: bentonite seal up to 2.50m, gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.
 All dimensions are in metres. Logged in accordance with BS5930:2015




Logged by MM
 Figure 1 of 1
 23/01/2020





BOREHOLE RECORD - Dynamic Sampler

Project **STOCKPORT INTERCHANGE GROUND INVESTIGATION** Engineer **WSP** Borehole Project No **WS302** PN194052

Client **WSP** National Grid Coordinates **389190.5 E 390272.5 N** Ground Level **42.94 m OD**


Sampling			Properties		Strata			Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	Description			Depth	Legend	Level m OD
					Grass over TOPSOIL: Dark brown slightly gravelly fine to coarse sand with some rootlets. Gravel is angular to subangular fine to coarse of glass, concrete and brick fragments. MADE GROUND: Yellow sandy angular to subangular fine to coarse gravel of limestone. At 0.50m, concrete obstruction. End of Borehole			G.L.		42.94
								0.30		42.64
							0.50		42.44	

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
0.50	0.40	Inspection Pit	GM/MM	G.I. 0.50		DRY	11/11/19	08:00						None encountered.

Remarks  Inspection pit hand excavated to 0.50m depth and no services were found.
 Inspection Pit terminated at 0.50m depth on encountering a concrete obstruction - the rig was moved to WS302A.
 Backfill details from base of hole: arisings up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.
 All dimensions are in metres. Logged in accordance with BS5930:2015

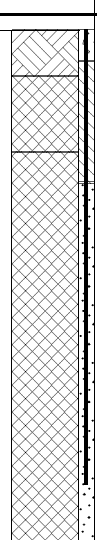
Logged by **MM**
 Figure **1 of 1**
 23/01/2020



BOREHOLE RECORD - Dynamic Sampler

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION Engineer WSP Borehole Project No WS302A PN194052

Client WSP National Grid Coordinates 389191.4 E 390272.0 N Ground Level 42.96 m OD

Sampling			Properties			Strata			Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD		
0.20	ES					Grass over TOPSOIL: Dark brown gravelly slightly clayey fine to coarse sand with some rootlets. Gravel is angular to subangular fine to coarse of glass, concrete and brick fragments.	G.L.		42.96		
0.30- 0.80	B						0.30		42.66		
0.50	ES										
0.80- 1.20	B					MADE GROUND: Yellow sandy angular to subangular fine to coarse gravel of limestone.	0.80		42.16		
1.00	ES										
1.20- 1.65	D				S22	MADE GROUND: Reddish brown gravelly slightly clayey fine to coarse sand. Gravel is subangular fine to coarse of limestone and brick fragments. Sand includes ash.					
1.90	D										
2.00- 2.50	D										
2.00	ES	2.00			S37						
2.00- 2.45	D										
2.50- 2.70	D										
3.00	ES	2.00			S50/210	At 3.00m, obstruction - probable cobble.					
3.00- 3.36						End of Borehole	3.36		39.60		

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit		G.I.			11/11/19	08:00						None encountered.
3.36	0.10	Dynamic Sampler	GM/MM	3.36		DRY	11/11/19	18:00						


Remarks Inspection pit hand excavated to 1.20m depth and no services were found. ABS sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub. Dynamic Sample Borehole terminated at 3.36m depth on encountering an obstruction - probable cobble. A 50mm gas monitoring pipe was installed to 3.00m with a geowrapped slotted section from 1.00m to 3.00m with flush lockable protective cover. Backfill details from base of hole: gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by MM
Figure 1 of 1
23/01/2020



BOREHOLE RECORD - Dynamic Sampler

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION Engineer WSP Borehole Project No WS303 PN194052

Client WSP National Grid Coordinates 389176.7 E 390248.2 N Ground Level 43.00 m OD

Sampling			Properties			Strata		Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD	
0.00- 0.30	B					Grass over TOPSOIL: Dark brown gravelly slightly clayey fine to coarse sand with some rootlets. Gravel is subangular to subrounded fine to coarse of glass, metal, concrete and brick fragments.	G.L.		43.00	
0.20	ES						0.30		42.70	
0.30- 1.20	B									
0.30	D									
0.50	ES									
1.00	D				S6	MADE GROUND: Yellowish brown very gravelly fine to coarse sand with a low subangular cobble content of limestone. Gravel is angular to subangular fine to coarse of limestone.	1.20		41.80	
1.00	ES									
1.20- 1.80	B									
1.20- 1.65	D									
1.20	D									
2.00- 2.45	D	2.00			S2	Below 2.00m, very loose.	2.50		40.50	
2.00- 2.50	D									
2.00	ES									
2.50- 2.80	D				S17	MADE GROUND: Firm to stiff dark brown slightly sandy slightly gravelly clay. Gravel is angular fine of brick fragments.	3.00			
3.00- 3.45	D	2.00								
3.00- 3.80	D									
3.00	ES									
3.80	ES				S25/25	MADE GROUND: Yellow sandy angular to subangular fine to coarse gravel of limestone. At 4.07m, obstruction - probable cobble.	3.80		39.20	
4.00- 4.07	D	2.00						4.07	38.93	
End of Borehole										


Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	GM/MM	G.I.			11/11/19	08:00						None encountered.
4.07	0.10	Dynamic Sampler	GM/MM	4.07		DRY	11/11/19	18:00						

Remarks Inspection pit hand excavated to 1.20m depth and no services were found. ABS sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub. Dynamic Sample Borehole terminated at 4.07m depth on encountering an obstruction - probable cobble. A 50mm standpipe was installed to 3.00m with a geowrapped slotted section from 1.00m to 3.00m with flush lockable protective cover. Backfill details from base of hole: bentonite seal up to 3.00m, gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet. All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by MM
Figure 1 of 1
23/01/2020



BOREHOLE RECORD - Dynamic Sampler

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION Engineer WSP Borehole Project No WS304 PN194052

Client WSP National Grid Coordinates 389196.6 E 390260.6 N Ground Level 42.67 m OD


Sampling			Properties			Strata			Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD		
0.20	D					Grass over TOPSOIL: Dark brown gravelly slightly clayey fine to coarse sand with some rootlets. Gravel is angular to subangular fine to coarse of glass and brick fragments.	G.L.		42.67		
0.20	ES				0.30		42.37				
0.30- 0.80	B				0.80		41.87				
0.50	ES										
0.80- 1.20	B				MADE GROUND: Yellow mottled dark brown sandy angular to subangular fine to coarse gravel of limestone. Low subangular cobble content of limestone.						
1.00	D										
1.00	ES										
1.20- 1.65	D										
1.20- 2.00	ES				S2	MADE GROUND: Very loose red sandy angular to subangular fine to coarse gravel of brick fragments.					
2.00- 2.45	D				S1/450						
2.00- 3.00	ES										
3.00- 3.04					S25/20	Between 2.50-3.00m, sand includes ash. Gravel includes slag and clinker.					
						End of Borehole	3.04		39.63		

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit	GM/MM	G.I.			11/11/19	08:00						None encountered.
3.04	0.10	Dynamic Sampler	GM/MM	3.04		DRY	11/11/19	18:00						

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
 ABS sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub.
 A 50mm gas monitoring pipe was installed to 3.00m with a geowrapped slotted section from 1.00m to 3.00m with flush lockable protective cover. Backfill details from base of hole: gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.
 All dimensions are in metres. Logged in accordance with BS5930:2015

Logged by MM
 Figure 1 of 1
 23/01/2020



BOREHOLE RECORD - Dynamic Sampler

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION Engineer WSP Borehole Project No WS305 PN194052
 Client WSP National Grid Coordinates 389302.8 E 390302.7 N Ground Level 43.79 m OD


Sampling			Properties			Strata			Scale 1:50		
Depth	Sample Type	Depth Cased & (to Water)	Strength kPa	w %	SPT N	Description	Depth	Legend	Level m OD		
0.20- 0.25	B					MADE GROUND: Grey concrete paving slab.	G.L.		43.79		
0.20	D						0.05		43.74		
0.20	ES					MADE GROUND: Yellow sandy angular to subangular fine gravel of limestone.	0.10		43.69		
0.25- 1.00	B						0.25		43.54		
0.50	ES					MADE GROUND: Reddish brown sandy angular to subangular fine to coarse gravel of mudstone.					
1.00	D										
1.00	ES					MADE GROUND: Medium dense black gravelly slightly clayey fine to coarse sand with a low cobble content of mudstone and brick. Gravel is angular to subrounded fine to coarse of mudstone, sandstone, coal, slag, clinker and brick fragments. Sand includes ash.					
1.20- 1.65	D	(DRY)			S17	Between 0.60-0.75m, concrete with steel reinforcing bar (3mm diameter). Below 2.00m, cobbles absent.					
1.50- 2.00	B										
2.00- 2.50	B										
2.00- 2.45	D	(DRY)			S11						
2.00	ES										
2.50- 3.00	D										
3.00- 3.45	D	(DRY)			S8	Below 3.00m, loose.					
3.00- 3.50	D										
3.00	ES										
3.50- 4.00	B										
4.00- 4.45	D	(DRY)			S8						
4.00	ES										
4.50- 5.00	D						4.50		39.29		
						Very dense reddish brown fine to coarse SAND.					
5.00- 5.22	D	(DRY)			S50/65						
						End of Borehole	5.22		38.57		

Boring				Progress					Groundwater					
Depth	Hole Dia	Technique	Crew	Depth of Hole	Depth Cased	Depth to Water	Date	Time	Depth Struck	Depth Cased	Rose to	in Mins	Depth Sealed	Remarks on Groundwater
1.20	0.40	Inspection Pit		G.I.			14/11/19	08:00						None encountered.
5.22	0.10	Dynamic Sampler	GM/MM GM/MM	5.22		DRY	14/11/19	18:00						

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
 ABS sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub.
 A 50mm standpipe was installed to 4.00m with a geowrapped slotted section from 1.00m to 4.00m with flush lockable protective cover. Backfill details from base of hole: bentonite seal up to 4.00m, gravel filter up to 1.00m, bentonite seal up to 0.20m, concrete up to ground level.

Symbols and abbreviations are explained on the accompanying key sheet.
 All dimensions are in metres. Logged in accordance with BS5930:2015

Logged by MM
 Figure 1 of 1
 23/01/2020



Fieldwork Results - SPT Results Summary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No PN194052

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'					
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50	
WS301A	1.20	41.71	S	-	1	2	1	-	1	2	4	*					
WS301A	2.00	40.91	S	-	2	6	6	5	4	8	23		*				
WS301A	3.00	39.91	S	-	11	10	9	8	12	21/65	50/290						>
Driller			Gary Martin				Remarks Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005										
Hammer No.			110.96														
Energy Ratio, Er (%)			73.00														
Calibration Date			15/01/2019														

-/- Blows/penetration (mm) after seating
 -*/- Total blows/penetration (mm)
 SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
 C - SPT with cone
 L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No PN194052

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'				
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50
WS302A	1.20	41.76	S	-	6	4	8	5	4	5	22		*			
WS302A	2.00	40.96	S	-	7	10	10	10	10	7	37			*		
WS302A	3.00	39.96	S	-	8	10	14	16	20/60		50/210					>
Driller			Gary Martin				Remarks Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005									
Hammer No.			110.96													
Energy Ratio, Er (%)			73.00													
Calibration Date			15/01/2019													

-/- Blows/penetration (mm) after seating

-*/- Total blows/penetration (mm)

SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)

C - SPT with cone

L - Split Spoon with liner used

GEOTECHNICS



Fieldwork Results - SPT Results Summary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No PN194052

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'					
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50	
WS303	1.20	41.80	S	-	3	2	2	1	2	1	6	*					
WS303	2.00	41.00	S	-	1	1	1	-	1	-	2	*					
WS303	3.00	40.00	S	-	1	2	5	4	4	4	17		*				
WS303	4.00	39.00	S	-	25/45		25/25				25/25						>
Driller			Gary Martin				Remarks Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005										
Hammer No.			110.96														
Energy Ratio, Er (%)			73.00														
Calibration Date			15/01/2019														

-/- Blows/penetration (mm) after seating
 -*/- Total blows/penetration (mm)
 SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
 C - SPT with cone
 L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No PN194052

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'					
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50	
WS304	1.20	41.47	S	-	4	4	1	-	1	-	2	*					
WS304	2.00	40.67	S	-	1	-	-	-	-	-	1/450	*					
WS304	3.00	39.67	S	-	25/20		25/20				25/20						>
Driller			Gary Martin				Remarks Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005										
Hammer No.			110.96														
Energy Ratio, Er (%)			73.00														
Calibration Date			15/01/2019														

-/- Blows/penetration (mm) after seating
 -*/- Total blows/penetration (mm)
 SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
 C - SPT with cone
 L - Split Spoon with liner used

GEOTECHNICS

Fieldwork Results - SPT Results Summary

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No PN194052

Client WSP

Hole	Depth m bgl	Level m OD	Type	SWP (mm)	Seating Drive		Test Drive				SPT 'N' Value	Uncorrected SPT 'N'					
					0-75 (mm)	75-150 (mm)	0-75 (mm)	75-150 (mm)	150-225 (mm)	225-300 (mm)		10	20	30	40	50	
WS305	1.20	42.59	S	-	1	2	2	4	5	6	17		*				
WS305	2.00	41.79	S	-	5	5	3	3	3	2	11	*					
WS305	3.00	40.79	S	-	3	2	3	2	2	1	8	*					
WS305	4.00	39.79	S	-	3	2	1	1	2	4	8	*					
WS305	5.00	38.79	S	-	3	7	50/65				50/65						>
Driller			Gary Martin				Remarks Equipment checked and calibration carried out in accordance with BS EN ISO 22476-3: 2005										
Hammer No.			110.96														
Energy Ratio, Er (%)			73.00														
Calibration Date			15/01/2019														

-/- Blows/penetration (mm) after seating
 -*/- Total blows/penetration (mm)
 SWP Penetration under own weight (mm)

S - Standard Penetration Test (SPT)
 C - SPT with cone
 L - Split Spoon with liner used

GEOTECHNICS

APPENDIX 5

Trial Pit Records

DATA SHEET - Symbols and Abbreviations used on Records



Sample Types

B	Bulk disturbed sample
BLK	Block sample
C	Core sample
D	Small disturbed sample (tub/jar)
E	Environmental test sample
ES	Environmental soil sample
EW	Environmental water sample
G	Gas sample
L	Liner sample
LB	Large bulk disturbed sample
P	Piston sample (PF - failed P sample)
TW	Thin walled push in sample
U	Open Tube - 102mm diameter with blows to take sample. (UF - failed U sample)
UT	Thin wall open drive tube sampler - 102mm diameter with blows to take sample. (UTF - failed UT sample)
V	Vial sample
W	Water sample
#	Sample Not Recovered

Insitu Testing / Properties

CBRP	CBR using TRL probe
CHP	Constant Head Permeability Test
COND	Electrical conductivity
TC	Thermal Conductivity
TR	Thermal Resistivity
HV	Strength from Hand Vane
ICBR	CBR Test
IDEN	Density Test
IRES	Resistivity Test
MEX	CBR using Mexecon Probe Test
PKR	Packer Permeability Test
PLT	Plate Load Test
PP	Strength from Pocket Penetrometer
Temp	Temperature
VHP	Variable Head Permeability Test
VN	Strength from Insitu Vane
w%	Water content
(All other strengths from undrained triaxial testing)	
S	Standard Penetration Test (SPT)
C	SPT with cone
N	SPT Result
-/-	Blows/penetration (mm) after seating drive
-*/-(mm)	Total blows/penetration (mm)
()	Extrapolated value

Groundwater

Water Strike	
Depth Water Rose To	

Instrumentation

Seal	
Filter	
Seal	

Strata Legend

Made Ground Granular	
Made Ground Cohesive	
Topsoil	
Cobbles and Boulders	
Gravel	
Sand	
Silt	
Clay	
Peat	
Note: Composite soil types shown by combined symbols	
Chalk	
Limestone	
Sandstone	
Coal	

Strata, Continued

Mudstone	
Siltstone	
Metamorphic Rock	
Fine Grained	
Medium Grained	
Coarse Grained	
Igneous Rock	
Fine Grained	
Medium Grained	
Coarse Grained	

Backfill Materials

Arisings	
Bentonite Seal	
Concrete	
Fine Gravel Filter	
General Fill	
Gravel Filter	
Grout	
Sand Filter	
Tarmacadam	

Rotary Core

RQD	Rock Quality Designation (% of intact core >100mm)
FRACTURE INDEX	
Fractures/metre	
FRACTURE SPACING (m)	Maximum
NI	Non-intact core
NR	No core recovery
AZCL	Assumed zone of core loss
(where core recovery is unknown it is assumed to be at the base of the run)	

TRIAL PIT RECORD

Inspection Pit

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Engineer WSP

Trial Pit TP301
Project No PN194052

Client WSP

National Grid Coordinates 389286.3 E
390268.2 N

Ground Level 43.57 m OD

Samples and Tests				Strata		Scale 1:50	
Depth	Type	Stratum No	Results	Description	Depth	Legend	Level m OD
0.10- 0.25	B			MADE GROUND: Black tarmacadam.	G.L.		43.57
0.20	D			MADE GROUND: Yellow sandy angular to subangular fine to coarse gravel of limestone. (Sub base).	0.10		43.47
0.20	ES				0.20		43.37
0.25- 1.20	B			MADE GROUND: Dark brown mottled brown gravelly fine to coarse sand. Gravel is angular to subangular fine to coarse of slag, clinker, concrete and brick fragments. Sand includes ash.	1.20		42.37
0.50	ES						
1.00	D						
1.00	ES			End of Excavation			

Excavation				Groundwater		
Plant	Hand tools.	Width (B)	0.30	Depth Observed	Depth of Pit	Details
Date	15/11/2019	Length (C)	0.80			None encountered.
Shoring	None.	Date Backfilled	15/11/2019			
Stability	stable during excavation.					

Remarks Inspection pit hand excavated to 1.20m depth and no services were found. ES sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub. Top of concrete footing exposed at 1.20m below ground level. Footing projects 0.25m from face of wall. Underside of footing not proven. Top of brick substructure (possible manhole) exposed at 0.40m depth. Collared pipe also exposed in trial pit.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by MM
Figure 1 of 1
23/01/2020

TRIAL PIT RECORD

Inspection Pit

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Engineer WSP

Trial Pit TP302
Project No PN194052

Client WSP

National Grid Coordinates 389287.8 E
390259.6 N

Ground Level 43.64 m OD

Samples and Tests				Strata		Scale 1:50	
Depth	Type	Stratum No	Results	Description	Depth	Legend	Level m OD
0.10- 0.25	B			MADE GROUND: Black tarmacadam.	G.L.		43.64
0.20	D				0.10		43.54
0.20	ES			MADE GROUND: Yellow sandy angular to subangular fine to coarse gravel of limestone. (Sub base).	0.25		43.39
0.25- 1.20	B						
0.50	ES			MADE GROUND: Dark brown gravelly fine to coarse sand. Gravel is angular to subangular fine to coarse of coal, slag, clinker, ceramic, plastic, concrete and brick fragments. Sand includes ash.			
1.00	D						
1.00	ES			End of Excavation	1.20		42.44

Excavation				Groundwater		
Plant	Hand tools.	Width (B)	0.40	Depth Observed	Depth of Pit	Details
Date	15/11/2019	Length (C)	0.80			None encountered.
Shoring	None.	Date Backfilled	15/11/2019			
Stability	stable during excavation.					

Remarks Inspection pit hand excavated to 1.20m depth and no services were found. ES sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub. Top of concrete footing exposed at 0.80m below ground level. Footing projects 0.25m from face of wall. Footing continues to at least 1.20m depth. Underside of footing not proven.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by MM
Figure 1 of 1
23/01/2020

TRIAL PIT RECORD

Inspection Pit

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Engineer WSP

Trial Pit TP303
Project No PN194052

Client WSP

National Grid Coordinates 389310.9 E
390277.1 N

Ground Level 44.16 m OD

Samples and Tests				Strata		Scale 1:50	
Depth	Type	Stratum No	Results	Description	Depth	Legend	Level m OD
0.10- 0.20	B			MADE GROUND: Black tarmacadam.	G.L.		44.16
0.20	D				0.10		44.06
0.20	ES			MADE GROUND: Yellow sandy angular to subangular fine to coarse gravel of limestone. (Sub base).	0.25		43.91
0.25- 1.00	B						
0.50	ES			MADE GROUND: Dark brown slightly gravelly fine to coarse sand. Gravel is angular to subangular fine to coarse of concrete and brick fragments. Sand includes ash.			
1.00	D						
1.00	ES			At 0.25m, concrete footing.	1.20		42.96
				End of Excavation			

Excavation				Groundwater		
Plant	Hand tools.	Width (B)	0.40	Depth Observed	Depth of Pit	Details
Date	15/11/2019	Length (C)	0.90			None encountered.
Shoring	None.	Date Backfilled	15/11/2019			
Stability	stable during excavation.					

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
 ES sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub.
 Top of concrete footing exposed at 0.25m below ground level. Footing projects 0.55m from face of wall, increasing to 0.75m from face of wall at 1.20m below ground level. Underside of footing not proven.

Symbols and abbreviations are explained on the accompanying key sheet.
 All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by MM
 Figure 1 of 1
 23/01/2020

TRIAL PIT RECORD

Inspection Pit

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Engineer WSP

Trial Pit TP304
Project No PN194052

Client WSP

National Grid Coordinates 389305.4 E
390281.2 N

Ground Level 43.95 m OD

Samples and Tests				Strata		Scale 1:50	
Depth	Type	Stratum No	Results	Description	Depth	Legend	Level m OD
0.10- 0.20	B			MADE GROUND: Black tarmacadam.	G.L.		43.95
0.10	D			MADE GROUND: Yellow sandy angular to subangular fine to coarse gravel of limestone. (Sub base).	0.10		43.85
0.10	ES				0.20		43.75
0.25- 1.20	B			MADE GROUND: Black gravelly fine to coarse sand with a low cobble content. Gravel is angular to subangular fine to coarse of slag, clinker and brick fragments. Sand includes ash.	1.20		42.75
0.50	ES						
1.00	D						
1.00	ES			End of Excavation			

Excavation				Groundwater		
Plant	Hand tools.	Width (B)	0.50	Depth Observed	Depth of Pit	Details
Date	15/11/2019	Length (C)	0.80			None encountered.
Shoring	None.	Date Backfilled	15/11/2019			
Stability	stable during excavation.					

Remarks Inspection pit hand excavated to 1.20m depth and no services were found.
 ES sample = 1 x 60ml amber glass jar, 2 x 258ml amber glass jars and 1 x 1L plastic tub.
 Top of concrete footing exposed at 0.20m below ground level. Footing projects 0.20m from face of wall. Footing continues to at least 1.20m depth. Underside of footing not proven.

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.

Logged in accordance with BS5930:2015

Logged by MM
Figure 1 of 1
23/01/2020

APPENDIX 6
Trial Pit Photographs

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP301 (I)

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP301 (2)

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP301 (3)

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP302 (I)

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP302 (2)

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP302 (3)

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP303 (I)

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP303 (2)

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP303 (3)

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP304 (I)

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP304 (2)

PHOTOGRAPHS

Project Number : PNI94052

Project : STOCKPORT INTERCHANGE



TP304 (3)

APPENDIX 7

Monitoring Results

FIELDWORK - Water Level Monitoring

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No PN194052

Client WSP


Sheet No 1

Borehole		WS301A		WS302A		WS303		WS304		WS305			
Instrument (dia. mm)		S (50mm)		G (50mm)		S (50mm)		G (50mm)		S (50mm)			
Depth to Base (m)		2.50		3.00		3.00		3.00		4.00			
Filter Zone (m)		1.00-2.50		1.00-3.00		1.00-3.00		1.00-3.04		1.00-4.00			
Level		42.91 m OD		42.96 m OD		43.00 m OD		42.67 m OD		43.79 m OD			
Date	Time	Depth (m)	Level	Depth (m)	Level	Depth (m)	Level	Depth (m)	Level	Depth (m)	Level	Depth (m)	Level
8 Jan 2020		DRY		DRY		DRY		DRY		DRY			
17 Jan 2020		DRY		DRY		DRY		DRY		DRY			
21 Jan 2020		DRY		DRY		DRY		DRY		DRY			
28 Jan 2020		DRY		DRY		DRY		DRY		DRY			
12 Feb 2020		DRY		DRY		DRY		DRY		DRY			

Remarks

Symbols and abbreviations are explained on the accompanying key sheet.

All dimensions are in metres.



GEO TECHNICS
geotechnical and geoenvironmental specialists

FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

08/01/2020

Client WSP

Sheet No.

1 (1 of 3)

Equipment Used									
GI Infra Red Gas Analyser		MK1	<input type="checkbox"/>	MK2	<input type="checkbox"/>	GA2000	<input type="checkbox"/>	Other GA5000;	
Weather / Site Conditions									
Wind		Still	<input type="checkbox"/>	Light	<input checked="" type="checkbox"/>	Moderate	<input type="checkbox"/>	Strong	<input type="checkbox"/>
Cloud Cover		None	<input type="checkbox"/>	Slight	<input type="checkbox"/>	Cloudy	<input checked="" type="checkbox"/>	Overcast	<input type="checkbox"/>
Precipitation		Dry	<input checked="" type="checkbox"/>	Slight	<input type="checkbox"/>	Moderate	<input type="checkbox"/>	Heavy	<input type="checkbox"/>
Borehole	Depth to Base (m)	Depth to Water (m bgl)	Current Hole Depth (m bgl)	Methane (Peak) CH4 (% VOL)	Methane (Steady) CH4 (% VOL)	Carbon Dioxide (Peak) (% VOL)	Carbon Dioxide (Steady) (% VOL)	Oxygen (Peak) (% VOL)	Remarks
WS301A	2.50	DRY	2.72	0.0	0.0	0.3	0.3	20.7	
WS302A	3.00	DRY	2.77	0.0	0.0	0.2	0.2	20.9	
WS303	3.00	DRY	3.00	0.0	0.0	0.8	0.8	20.6	
WS304	3.00	DRY	2.68	0.0	0.0	0.5	0.5	20.8	
WS305	4.00	DRY	4.10	0.0	0.0	0.7	0.7	20.7	

Remarks



FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

08/01/2020

Client WSP

Sheet No.

1 (2 of 3)

Equipment Used									
GI Infra Red Gas Analyser		MK1	<input type="checkbox"/>	MK2	<input type="checkbox"/>	GA2000	<input type="checkbox"/>	Other GA5000;	
Weather / Site Conditions									
Wind		Still	<input type="checkbox"/>	Light	<input checked="" type="checkbox"/>	Moderate	<input type="checkbox"/>	Strong	<input type="checkbox"/>
Cloud Cover		None	<input type="checkbox"/>	Slight	<input type="checkbox"/>	Cloudy	<input checked="" type="checkbox"/>	Overcast	<input type="checkbox"/>
Precipitation		Dry	<input checked="" type="checkbox"/>	Slight	<input type="checkbox"/>	Moderate	<input type="checkbox"/>	Heavy	<input type="checkbox"/>
Borehole	Depth to Base (m)	Oxygen (Steady) (% VOL)	Hydrogen Sulphide (Peak) (ppm)	Hydrogen Sulphide (Steady) (ppm)	Carbon Monoxide (Peak) (ppm)	Carbon Monoxide (Steady) (ppm)	Flow Rate (Peak) (l/hr)	Flow Rate (Steady) (l/hr)	Remarks
WS301A	2.50	20.7	0	0	0	0	0.0	0.0	
WS302A	3.00	20.9	0	0	0	0	0.0	0.0	
WS303	3.00	19.3	0	0	0	0	0.0	0.0	
WS304	3.00	20.8	0	0	0	0	0.0	0.0	
WS305	4.00	20.3	0	0	0	0	0.0	0.0	

Remarks



FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

08/01/2020

Client WSP

Sheet No.

1 (3 of 3)

Equipment Used

GI Infra Red Gas Analyser

MK1

MK2

GA2000

Other GA5000;

Weather / Site Conditions

Wind

Still

Light

Moderate

Strong

Cloud Cover

None

Slight

Cloudy

Overcast

Precipitation

Dry

Slight

Moderate

Heavy

Borehole	Depth to Base (m)	Barometric Pressure (mBars)	Remarks
WS301A	2.50	1016	
WS302A	3.00	1016	
WS303	3.00	1016	
WS304	3.00	1016	
WS305	4.00	1014	

Remarks



FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

17/01/2020

Client WSP

Sheet No.

1 (1 of 3)

Equipment Used

GI Infra Red Gas Analyser

MK1

MK2

GA2000

Other GA5000;

Weather / Site Conditions

Wind

Still

Light

Moderate

Strong

Cloud Cover

None

Slight

Cloudy

Overcast

Precipitation

Dry

Slight

Moderate

Heavy

Borehole	Depth to Base (m)	Depth to Water (m bgl)	Current Hole Depth (m bgl)	Methane (Peak) CH4 (% VOL)	Methane (Steady) CH4 (% VOL)	Carbon Dioxide (Peak) (% VOL)	Carbon Dioxide (Steady) (% VOL)	Oxygen (Peak) (% VOL)	Remarks
WS301A	2.50	DRY	2.60	0.2	0.2	0.3	0.3	20.7	
WS302A	3.00	DRY	2.72	0.2	0.2	0.2	0.1	20.3	
WS303	3.00	DRY	2.30	0.2	0.2	0.4	0.1	20.4	
WS304	3.00	DRY	2.62	0.2	0.2	0.4	0.1	20.5	
WS305	4.00	DRY	4.02	0.2	0.2	0.8	0.1	20.6	

Remarks



FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

17/01/2020

Client WSP

Sheet No.

1 (2 of 3)

Equipment Used									
GI Infra Red Gas Analyser		MK1 <input type="checkbox"/>		MK2 <input type="checkbox"/>		GA2000 <input type="checkbox"/>			
Other GA5000;									
Weather / Site Conditions									
Wind		Still <input type="checkbox"/>		Light <input checked="" type="checkbox"/>		Moderate <input type="checkbox"/>		Strong <input type="checkbox"/>	
Cloud Cover		None <input type="checkbox"/>		Slight <input type="checkbox"/>		Cloudy <input type="checkbox"/>		Overcast <input checked="" type="checkbox"/>	
Precipitation		Dry <input type="checkbox"/>		Slight <input checked="" type="checkbox"/>		Moderate <input type="checkbox"/>		Heavy <input type="checkbox"/>	
Borehole	Depth to Base (m)	Oxygen (Steady) (% VOL)	Hydrogen Sulphide (Peak) (ppm)	Hydrogen Sulphide (Steady) (ppm)	Carbon Monoxide (Peak) (ppm)	Carbon Monoxide (Steady) (ppm)	Flow Rate (Peak) (l/hr)	Flow Rate (Steady) (l/hr)	Remarks
WS301A	2.50	20.7	0	0	0	0	0.0	0.0	
WS302A	3.00	20.3	0	0	0	0	0.0	0.0	
WS303	3.00	19.1	0	0	0	0	0.0	0.0	
WS304	3.00	20.3	0	0	0	0	0.0	0.0	
WS305	4.00	20.3	0	0	0	0	0.1	0.1	

Remarks

FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

17/01/2020

Client WSP

Sheet No.

1 (3 of 3)

Equipment Used

GI Infra Red Gas Analyser

MK1

MK2

GA2000

Other GA5000;

Weather / Site Conditions

Wind

Still

Light

Moderate

Strong

Cloud Cover

None

Slight

Cloudy

Overcast

Precipitation

Dry

Slight

Moderate

Heavy

Borehole	Depth to Base (m)	Barometric Pressure (mBars)	Remarks
WS301A	2.50	1006	
WS302A	3.00	1006	
WS303	3.00	1006	
WS304	3.00	1006	
WS305	4.00	1006	

Remarks



FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

21/01/2020


Client WSP

Sheet No.

1 (1 of 3)

Equipment Used									
GI Infra Red Gas Analyser		MK1 <input type="checkbox"/>		MK2 <input type="checkbox"/>		GA2000 <input type="checkbox"/>			
Other GA5000;									
Weather / Site Conditions									
Wind		Still <input type="checkbox"/>		Light <input checked="" type="checkbox"/>		Moderate <input type="checkbox"/>		Strong <input type="checkbox"/>	
Cloud Cover		None <input type="checkbox"/>		Slight <input type="checkbox"/>		Cloudy <input checked="" type="checkbox"/>		Overcast <input type="checkbox"/>	
Precipitation		Dry <input checked="" type="checkbox"/>		Slight <input type="checkbox"/>		Moderate <input type="checkbox"/>		Heavy <input type="checkbox"/>	
Borehole	Depth to Base (m)	Depth to Water (m bgl)	Current Hole Depth (m bgl)	Methane (Peak) CH4 (% VOL)	Methane (Steady) CH4 (% VOL)	Carbon Dioxide (Peak) (% VOL)	Carbon Dioxide (Steady) (% VOL)	Oxygen (Peak) (% VOL)	Remarks
WS301A	2.50	DRY	2.60	0.2	0.2	0.3	0.3	20.0	
WS302A	3.00	DRY	2.72	0.2	0.2	0.2	0.2	19.9	
WS303	3.00	DRY	2.94	0.2	0.1	1.0	1.0	20.1	
WS304	3.00	DRY	2.62	0.2	0.2	0.7	0.7	20.2	
WS305	4.00	DRY	4.03	0.1	0.1	0.8	0.8	20.4	

Remarks



Form 002/3

FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

21/01/2020

Client WSP

Sheet No.

1 (2 of 3)

Equipment Used

GI Infra Red Gas Analyser

MK1

MK2

GA2000

Other GA5000;

Weather / Site Conditions

Wind

Still

Light

Moderate

Strong

Cloud Cover

None

Slight

Cloudy

Overcast

Precipitation

Dry

Slight

Moderate

Heavy

Borehole	Depth to Base (m)	Oxygen (Steady) (% VOL)	Hydrogen Sulphide (Peak) (ppm)	Hydrogen Sulphide (Steady) (ppm)	Carbon Monoxide (Peak) (ppm)	Carbon Monoxide (Steady) (ppm)	Flow Rate (Peak) (l/hr)	Flow Rate (Steady) (l/hr)	Remarks
WS301A	2.50	19.8	0	0	0	0	0.0	0.0	
WS302A	3.00	19.9	0	0	0	0	0.0	0.0	
WS303	3.00	19.3	0	0	0	0	0.0	0.0	
WS304	3.00	19.5	0	0	0	0	0.0	0.0	
WS305	4.00	19.9	0	0	0	0	0.0	0.0	

Remarks



FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

21/01/2020

Client WSP

Sheet No.

1 (3 of 3)

Equipment Used

GI Infra Red Gas Analyser

MK1

MK2

GA2000

Other GA5000;

Weather / Site Conditions

Wind

Still

Light

Moderate

Strong

Cloud Cover

None

Slight

Cloudy

Overcast

Precipitation

Dry

Slight

Moderate

Heavy

Borehole	Depth to Base (m)	Barometric Pressure (mBars)	Remarks
WS301A	2.50	1035	
WS302A	3.00	1035	
WS303	3.00	1036	
WS304	3.00	1036	
WS305	4.00	1035	

Remarks



FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

28/01/2020


Client WSP

Sheet No.

1 (1 of 3)

Equipment Used									
GI Infra Red Gas Analyser		MK1	<input type="checkbox"/>	MK2	<input type="checkbox"/>	GA2000	<input type="checkbox"/>	Other GA5000;	
Weather / Site Conditions									
Wind		Still	<input type="checkbox"/>	Light	<input type="checkbox"/>	Moderate	<input checked="" type="checkbox"/>	Strong	<input type="checkbox"/>
Cloud Cover		None	<input type="checkbox"/>	Slight	<input type="checkbox"/>	Cloudy	<input checked="" type="checkbox"/>	Overcast	<input type="checkbox"/>
Precipitation		Dry	<input type="checkbox"/>	Slight	<input checked="" type="checkbox"/>	Moderate	<input type="checkbox"/>	Heavy	<input type="checkbox"/>
Borehole	Depth to Base (m)	Depth to Water (m bgl)	Current Hole Depth (m bgl)	Methane (Peak) CH4 (% VOL)	Methane (Steady) CH4 (% VOL)	Carbon Dioxide (Peak) (% VOL)	Carbon Dioxide (Steady) (% VOL)	Oxygen (Peak) (% VOL)	Remarks
WS301A	2.50	DRY	2.60	0.2	0.2	0.2	0.2	20.5	
WS302A	3.00	DRY	2.72	0.2	0.2	0.2	0.2	20.6	
WS303	3.00	DRY	2.93	0.2	0.2	1.0	1.0	20.6	
WS304	3.00	DRY	2.62	0.2	0.2	0.5	0.5	20.7	
WS305	4.00	DRY	4.02	0.2	0.2	0.7	0.7	20.5	

Remarks



Form 002/3

FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

28/01/2020

Client WSP

Sheet No.

1 (2 of 3)

Equipment Used

GI Infra Red Gas Analyser

MK1

MK2

GA2000

Other GA5000;

Weather / Site Conditions

Wind

Still

Light

Moderate

Strong

Cloud Cover

None

Slight

Cloudy

Overcast

Precipitation

Dry

Slight

Moderate

Heavy

Borehole	Depth to Base (m)	Oxygen (Steady) (% VOL)	Hydrogen Sulphide (Peak) (ppm)	Hydrogen Sulphide (Steady) (ppm)	Carbon Monoxide (Peak) (ppm)	Carbon Monoxide (Steady) (ppm)	Flow Rate (Peak) (l/hr)	Flow Rate (Steady) (l/hr)	Remarks
WS301A	2.50	20.5	0	0	0	0	0.0	0.0	
WS302A	3.00	20.6	0	0	0	0	0.0	0.0	
WS303	3.00	19.4	0	0	0	0	0.0	0.0	
WS304	3.00	20.6	0	0	0	0	0.0	0.0	
WS305	4.00	20.1	0	0	0	0	0.1	0.1	

Remarks



FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

28/01/2020

Client WSP

Sheet No.

1 (3 of 3)

Equipment Used			
GI Infra Red Gas Analyser	MK1 <input type="checkbox"/>	MK2 <input type="checkbox"/>	GA2000 <input type="checkbox"/>
Other GA5000;			
Weather / Site Conditions			
Wind	Still <input type="checkbox"/>	Light <input type="checkbox"/>	Moderate <input checked="" type="checkbox"/> Strong <input type="checkbox"/>
Cloud Cover	None <input type="checkbox"/>	Slight <input type="checkbox"/>	Cloudy <input checked="" type="checkbox"/> Overcast <input type="checkbox"/>
Precipitation	Dry <input type="checkbox"/>	Slight <input checked="" type="checkbox"/>	Moderate <input type="checkbox"/> Heavy <input type="checkbox"/>
Borehole	Depth to Base (m)	Barometric Pressure (mBars)	Remarks
WS301A	2.50	987	
WS302A	3.00	987	
WS303	3.00	988	
WS304	3.00	988	
WS305	4.00	987	

Remarks	 <small>Form 002/3</small>
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FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

12/02/2020

Client WSP

Sheet No.

1 (1 of 3)

Equipment Used									
GI Infra Red Gas Analyser		MK1 <input type="checkbox"/>		MK2 <input type="checkbox"/>		GA2000 <input type="checkbox"/>			
Other GA5000;									
Weather / Site Conditions									
Wind		Still <input type="checkbox"/>		Light <input checked="" type="checkbox"/>		Moderate <input type="checkbox"/>		Strong <input type="checkbox"/>	
Cloud Cover		None <input type="checkbox"/>		Slight <input checked="" type="checkbox"/>		Cloudy <input type="checkbox"/>		Overcast <input type="checkbox"/>	
Precipitation		Dry <input checked="" type="checkbox"/>		Slight <input type="checkbox"/>		Moderate <input type="checkbox"/>		Heavy <input type="checkbox"/>	
Borehole	Depth to Base (m)	Depth to Water (m bgl)	Current Hole Depth (m bgl)	Methane (Peak) CH4 (% VOL)	Methane (Steady) CH4 (% VOL)	Carbon Dioxide (Peak) (% VOL)	Carbon Dioxide (Steady) (% VOL)	Oxygen (Peak) (% VOL)	Remarks
WS301A	2.50	DRY	2.60	0.2	0.2	0.2	0.2	20.7	
WS302A	3.00	DRY	2.72	0.1	0.1	0.2	0.2	21.1	
WS303	3.00	DRY	2.93	0.1	0.0	0.8	0.8	21.2	
WS304	3.00	DRY	2.61	0.0	0.0	0.3	0.3	21.1	
WS305	4.00	DRY	4.02	0.1	0.1	0.5	0.5	19.2	

Remarks



FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

12/02/2020

Client WSP

Sheet No.

1 (2 of 3)

Equipment Used

GI Infra Red Gas Analyser

MK1

MK2

GA2000

Other GA5000;

Weather / Site Conditions

Wind

Still

Light

Moderate

Strong

Cloud Cover

None

Slight

Cloudy

Overcast

Precipitation

Dry

Slight

Moderate

Heavy

Borehole	Depth to Base (m)	Oxygen (Steady) (% VOL)	Hydrogen Sulphide (Peak) (ppm)	Hydrogen Sulphide (Steady) (ppm)	Carbon Monoxide (Peak) (ppm)	Carbon Monoxide (Steady) (ppm)	Flow Rate (Peak) (l/hr)	Flow Rate (Steady) (l/hr)	Remarks
WS301A	2.50	20.7	0	0	0	0	0.0	0.0	
WS302A	3.00	21.1	0	0	0	0	0.0	0.0	
WS303	3.00	20.5	0	0	0	0	0.0	0.0	
WS304	3.00	20.9	0	0	0	0	0.0	0.0	
WS305	4.00	19.2	0	0	0	0	0.3	0.3	

Remarks



FIELDWORK - Insitu Gas Monitoring - Daily Record

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No

PN194052

Date

12/02/2020

Client WSP

Sheet No.

1 (3 of 3)

Equipment Used

GI Infra Red Gas Analyser

MK1

MK2

GA2000

Other GA5000;

Weather / Site Conditions

Wind

Still

Light

Moderate

Strong

Cloud Cover

None

Slight

Cloudy

Overcast

Precipitation

Dry

Slight

Moderate

Heavy

Borehole	Depth to Base (m)	Barometric Pressure (mBars)	Remarks
WS301A	2.50	1007	
WS302A	3.00	1007	
WS303	3.00	1008	
WS304	3.00	1008	
WS305	4.00	1007	

Remarks



APPENDIX 8

Laboratory Test Results - Geotechnical

Laboratory Test Certificate

Form REP008 Rev 3

Issued To	Geotechnics Ltd The Geotechnical Centre Unit 1B, Borders Industrial Estate River Lane, Saltney Chester CH4 8RJ	Date of issue	21/01/2020
		Issue No.	1
		Client Ref. No.	-
		Samples / Material Source	
		Samples Recv'd	06/01/20 & 09/01/20
Testing Start Date	06/01/2020	Sample State	As received
Testing Complete	21/01/2020	Sampled by	Geotechnics Limited
Comments	BS 1377-3:1990 is considered out of date and has been replaced. Rock Moisture Content performed according In-House procedure, not to IRSM accredited Method		
Project No	PN194052		
Project Name	STOCKPORT INTERCHANGE GROUND INVESTIGATION		

Summary of Tests

Standard	Test Description	Test Quantity	UKAS
BS EN ISO 17892-1:2014	Water Content	6	Yes
BS EN ISO 17892-12:2018 Cl. 5.3 & 5.5	Liquid Limit and Plastic Limit	5	Yes
BS EN ISO 17892-8:2018	Shear Strength by Unconsolidated Undrained Triaxial Test - Single Stage	3	Yes
BS 1377-3:1990 Cl. 5.4 & 5.5 (Standard withdrawn)	Sulphate Analysis - Ground Water	5	Yes
BS 1377-3:1990 Cl. 9.0 (Standard withdrawn)	pH	5	Yes
ISRM Suggested Method (1985)	Point Load Strength of Rock	36	Yes
BS EN ISO 17892-4:2016 Cl. 5.2	Particle Size Distribution by Sieving Method	1	Yes

Note: Any descriptions, opinions or interpretations are outside the scope of UKAS accreditation.
The results within this report relate only to the samples tested and received from the client.



Test Results checked and approved for issue.
Signed for and on behalf of Geotechnics Limited

Schiano

Stephane Schiano (Laboratory Testing Manager)

GEOTECHNICS
geotechnical and geoenvironmental specialists

203 Torrington Avenue, Tile Hill,
Coventry, CV4 9UT

Classification and Strength

Symbol	C - Clay (0 - containing organic matter) Plasticity	M - Silt L - Low I - Intermediate H - High V - Very High E - Extremely High
I_p	Plasticity Index	
%	% retained on 425 μ m sieve, shown under I_p value	
w_L	Liquid Limit	
w_p	Plastic Limit	
NP	Non-Plastic	
NAT	Sample tested in natural state	
w	Water Content	
ρ_d	Particle Density	
Test	Quick undrained triaxial tests	
	SS	Single stage - 102mm diameter.
	S3	Single stage - set of 3 38mm diameter.
	MS	Multistage - 102mm diameter.
	D	Drained Test
	HV	Hand Vane
	PP	Pocket Penetrometer (kg/cm^2)
	NST	Not suitable for test
γ_b	Bulk Density	
σ_3	Triaxial Cell Pressure	
$\sigma_1 - \sigma_3$	Deviator Stress	
##	Excessive Strain	
c_u	Undrained Cohesion	
c	Cohesion Intercept	
ϕ	Angle of Shearing Resistance	
Linear Shrink	Linear Shrinkage	
Stab add-	Stabiliser which is added	

Consolidation

m_v	Coefficient of Volume Compressibility
c_{v50}	Coefficient of Consolidation - Log t
c_{v90}	Coefficient of Consolidation - \sqrt{t}

Rock

UF	Unacceptable Failure
----	----------------------

Chemical Analysis

Acid Soluble	Total sulphate in specimen, expressed as SO_3 %, value in brackets expressed as SO_4 %
Water Soluble	Soluble sulphate in 2:1 water : soil extract, expressed as SO_3 g/l, value in brackets expressed as SO_4 g/l
In Water	Sulphate content of groundwater, expressed as SO_3 g/l, value in brackets expressed as SO_4 g/l
pH	pH value
Organic content	Organic content expressed as a percentage of dry weight
Chloride	Chloride Ion content expressed as a percentage of dry weight

MCV, Compaction, CBR

MCV	Moisture Condition Value at natural water content
MCC	Moisture Condition Calibration
CCV	Chalk Crushing Value

Compaction

Type	2.5 = 2.5 kg Rammer
	4.5 = 4.5 kg Rammer
	V = Vibrating Hammer

γ_b Bulk Density

γ_d Dry Density

CBR California Bearing Ratio

Type	2.5 = Test on Specimen Recompacted using 2.5 kg Rammer
	4.5 = As above but using 4.5 kg Rammer
	V = As above but using Vibrating Hammer
	M = Test on open drive mould specimen cut in field
	S = Soaked Specimen

Top CBR at top of mould

Bottom CBR at bottom of mould

ND None Detected


* In the Sample Description denotes a laboratory only description

LABORATORY RESULTS - Classification and Strength

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No: PN194052

Sample					Classification					Strength					
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	Symbol	I_p (>425) %	w_L %	w_p %	w (p_d) %	Test	γ_b (γ_d) Mg/m ³	σ_3 kN/m ²	$\sigma_1 - \sigma_3$ kN/m ²	c_u kN/m ²	c_{Avg} kN/m ²
BH301	2.00 (2.00)	D	N77867	Firm to stiff light yellowish brown mottled grey very sandy CLAY with some rootlets.					15.9						
BH301	3.20- 3.65 (3.20- 3.25)	UT	N77869	Stiff high strength grey mottled orange slightly sandy clayey SILT with rootlets.		(1%)	25	NP	8.7 21.4 <10.9>	SS	1.82	60	239	120	120
BH302A	2.20- 2.65 (2.20)	UT	N77870	Firm medium strength grey mottled orange slightly gravelly sandy clayey SILT.		(2%)	23	NP	11.0 8.6 <7.8>	SS	1.94	40	147	74	74
BH302A	3.60 (3.60)	D	N77872	Stiff greyish brown mottled orange slightly sandy CLAY.	CI	22 (0%)	43	21	22.7						
BH302B	2.20- 2.80 (2.20- 2.25)	UT	N77874	Firm high strength grey mottled orange slightly gravelly sandy clayey SILT.		(3%)	22	NP	 11.8 <8.6>	SS	1.92	40	170	85	85
BH302B	3.30 (3.30)	D	N77876	Stiff light brown mottled orange slightly sandy CLAY.	CL	15 (0%)	33	18	21.2						

Remarks  NST - Not suitable for Test
 For Standards followed see Laboratory Test Certificate
 ^ Rock water content test
 QUT Water Contents: <Failure Zone>, [After test]




LABORATORY RESULTS - Atterberg Limit

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No: PN194052

Sample					Results							
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	Test Type	Point Data		Sym- bol	p %	>425 sieve µm	w _L %	w _p %
						Cone Pene.	Water % (Factor)					
BH301	3.20- 3.65 (3.20)	UT	N77869	Stiff high strength grey mottled orange slightly sandy clayey SILT with rootlets.	Fall Cone 4pt with increasing water content, cone type: 80g/30, washed over 425um sieve					1%	25	NP
BH302A	2.20- 2.65 (2.20)	UT	N77870	Firm medium strength grey mottled orange slightly gravelly sandy clayey SILT.	Fall Cone 4pt with increasing water content, cone type: 80g/30, washed over 425um sieve					2%	23	NP
BH302A	3.60 (3.60)	D	N77872	Stiff greyish brown mottled orange slightly sandy CLAY.	Fall Cone 4pt with increasing water content, cone type: 80g/30, washed over 425um sieve			Cl	22	0%	43	21
BH302B	2.20- 2.80 (2.20)	UT	N77874	Firm high strength grey mottled orange slightly gravelly sandy clayey SILT.	Fall Cone 4pt with increasing water content, cone type: 80g/30, washed over 425um sieve					3%	22	NP
BH302B	3.30 (3.30)	D	N77876	Stiff light brown mottled orange slightly sandy CLAY.	Fall Cone 4pt with increasing water content, cone type: 80g/30, washed over 425um sieve			CL	15	0%	33	18

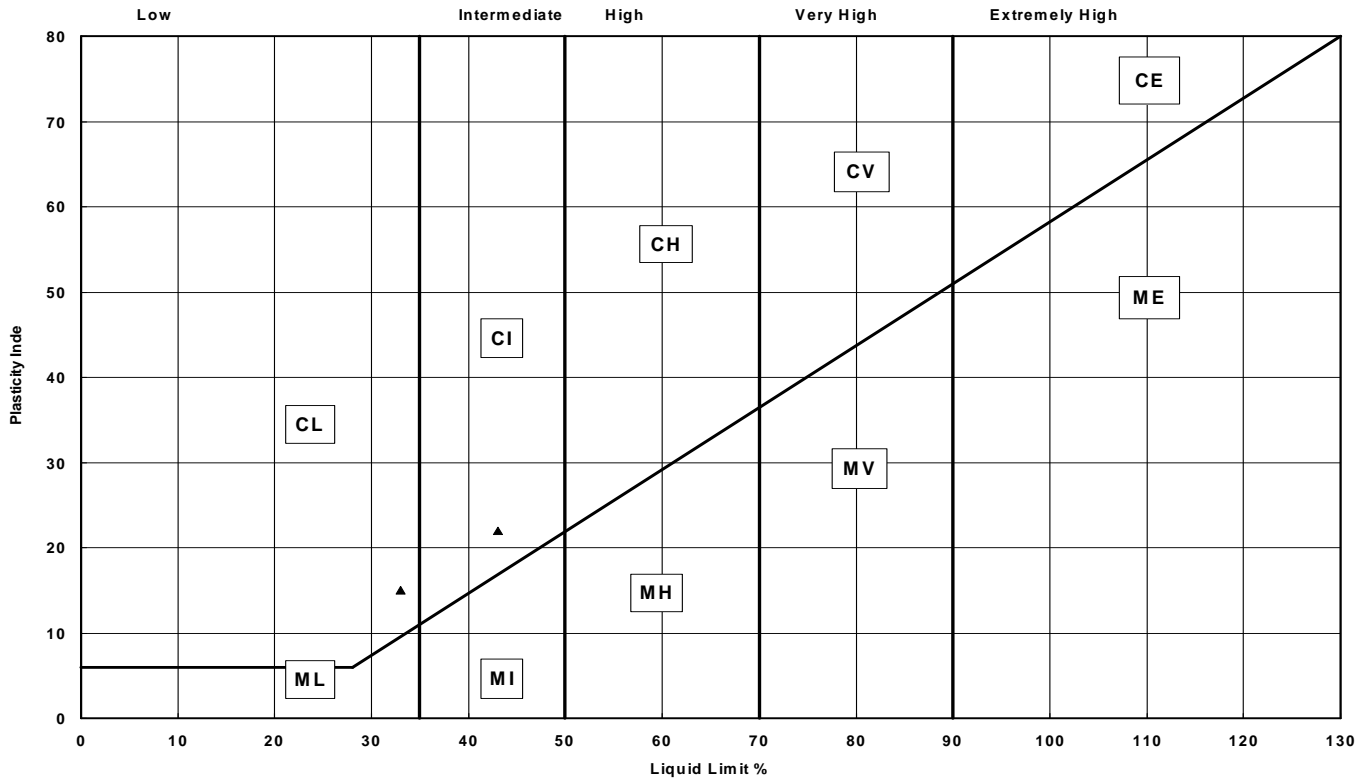
Remarks 

LABORATORY RESULTS - Classification Chart

Project: STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No: PN194052

PLOT OF PLASTICITY INDEX AGAINST LIQUID LIMIT for all items tested



Soil Type	Plasticity Characteristics
C Clay	L Low I Intermediate
M Silt	H High V Very High E Extremely High

Table of Soil Types and Plasticity Characteristics from BS 5930 : 1999

Remarks


21/01/2020

LABORATORY RESULTS - Chemical Analysis

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No: PN194052

Sample					Sulphate			pH	Organic Content %	Loss on Ignition %	Chloride		
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description	In Soil		In Water g/l				In Soil		
					Acid Soluble %	Water Soluble g/l					Acid Soluble %	Water Soluble g/l	In Water g/l
BH301	3.00 (3.00)	D	N77868	Firm to stiff grey mottled orange slightly sandy CLAY.		0.165 (0.20)		6.87					
BH302A	3.00 (3.00)	D	N77871	Grey mottled orange clayey fine to medium SAND.		0.082 (0.10)		5.30					
BH302A	3.80- 4.25 (3.80- 4.25)	D	N77873	Reddish brown SAND and GRAVEL (Sandstone).		0.031 (0.04)		7.50					
BH302B	2.60- 2.80 (2.60- 2.80)	D	N77875	Firm grey mottled orange slightly gravelly sandy CLAY.		0.130 (0.16)		4.75					
WS305	0.25- 1.00 (0.25- 1.00)	B	N77877	MADE GROUND: Black clayey sand and gravel.		0.228 (0.27)		10.40					

Remarks  For Standards followed please see Laboratory Test Certificate
Sulphate reported as SO3, results in brackets reported as SO4

LABORATORY RESULTS - Particle Size Distribution

Project: STOCKPORT INTERCHANGE GROUND INVESTIGATION

Hole: WS305

Sample Depth: 0.25-1.00m

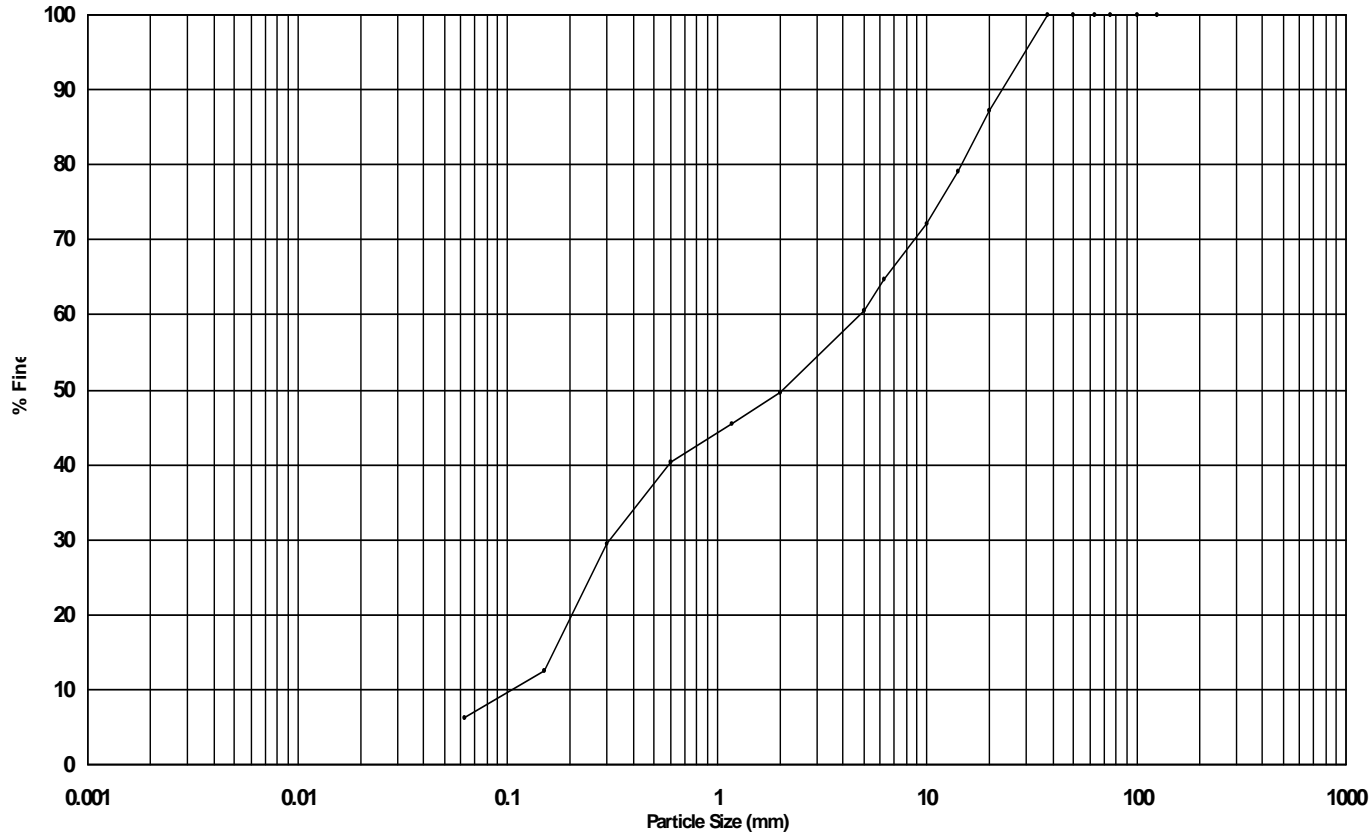
Project No: PN194052

Sample Type: B

Sample Ref: N77877

Sample Description

MADE GROUND: Black clayey sand and gravel.



Classification	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	Cobbles	Boulders
CLAY	SILT			SAND			Gravel				

Classification	% of each
SILT (including CLAY)	6
SAND	44
GRAVEL	50
COBBLES	0
BOULDERS	0

Size	% Finer
125 mm	100
100 mm	100
75 mm	100
63 mm	100
50 mm	100
37.5 mm	100
20 mm	87
14 mm	79
10 mm	72
6.3 mm	65
5 mm	60
2 mm	50
1.18 mm	45
600 µm	40
300 µm	29
150 µm	12

Size	% Finer
63 µm	6

Uniformity Coefficient	
45.18	
Sieving Method	
Wet sieve	
Fine Particle Analysis	
Method	
Pre-treated with	
% loss on Pre-treatment	
Particle Density	

Remarks: Sieve:-Test performed in accordance with BS EN ISO 17892-4:2016

21/01/2020

LABORATORY RESULTS - Unconsolidated Undrained Triaxial Test

Project: STOCKPORT INTERCHANGE GROUND INVESTIGATION

Hole BH301

Sample Depth 3.20-3.65m

Project No: PN194052

Sample Type UT

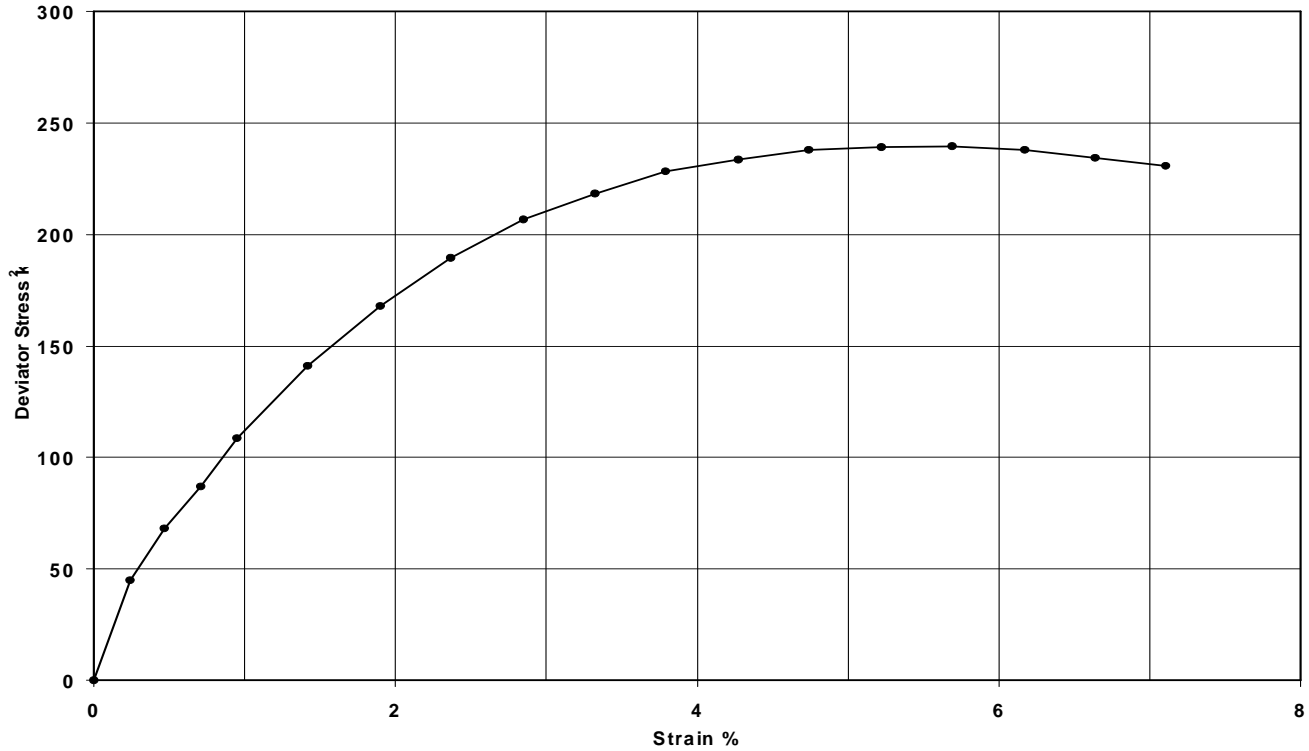
Sample Ref N77869

Sample Description

The following samples were combined to perform this test:

Stiff high strength grey mottled orange slightly sandy clayey SILT with rootlets.

BS EN ISO 17892-8:2018



	Stage 1	Stage 2	Stage 3	Strain %	Corrected Deviator Stress kN/m ²	Strain %	Corrected Deviator Stress kN/m ²
Sample Condition	Undisturbed			0.2	44.9		
Orientation of sample	Vertical			0.5	68.2		
Initial Diameter (mm)	102.70			0.7	87.0		
Initial Length (mm)	210.86			0.9	108.6		
Initial Water Content (%)	21.4			1.4	141.1		
Initial Bulk Density (Mg/m ³)	1.82			1.9	167.7		
Initial Dry Density (Mg/m ³)	1.50			2.4	189.4		
Particle Density (Mg/m ³)	2.65 Assumed			2.8	206.6		
Cell Pressure (kPa)	60			3.3	218.2		
'Specimen Height' at start of Shearing Stage (mm)	210.26			3.8	228.5		
Membrane Thickness/Correction (mm/kPa)				4.3	233.5		
Rate of Strain (%/min)	2.0			4.7	237.9		
Corrected Deviator Stress (kPa)	239			5.2	239.1		
Undrained Shear Strength (kPa)	120			5.7	239.5		
Strain at Failure (%)	5.7			6.2	237.8		
Failure Zone Water Content (%)	10.9			6.6	234.4		
Water Content (after test) (%)				7.1	230.8		
Mode of Failure	Brittle						

Remarks 

21/01/2020

GEOTECHNICS

LABORATORY RESULTS - Unconsolidated Undrained Triaxial Test

Project: STOCKPORT INTERCHANGE GROUND INVESTIGATION

Hole BH301
Sample Depth 3.20-3.65m
Sample Type UT
Sample Ref N77869

Project No: PN194052



Remarks 

21/01/2020

GEOTECHNICS

LABORATORY RESULTS - Unconsolidated Undrained Triaxial Test

Project: STOCKPORT INTERCHANGE GROUND INVESTIGATION

Hole BH302A

Sample Depth 2.20-2.65m

Project No: PN194052

Sample Type UT

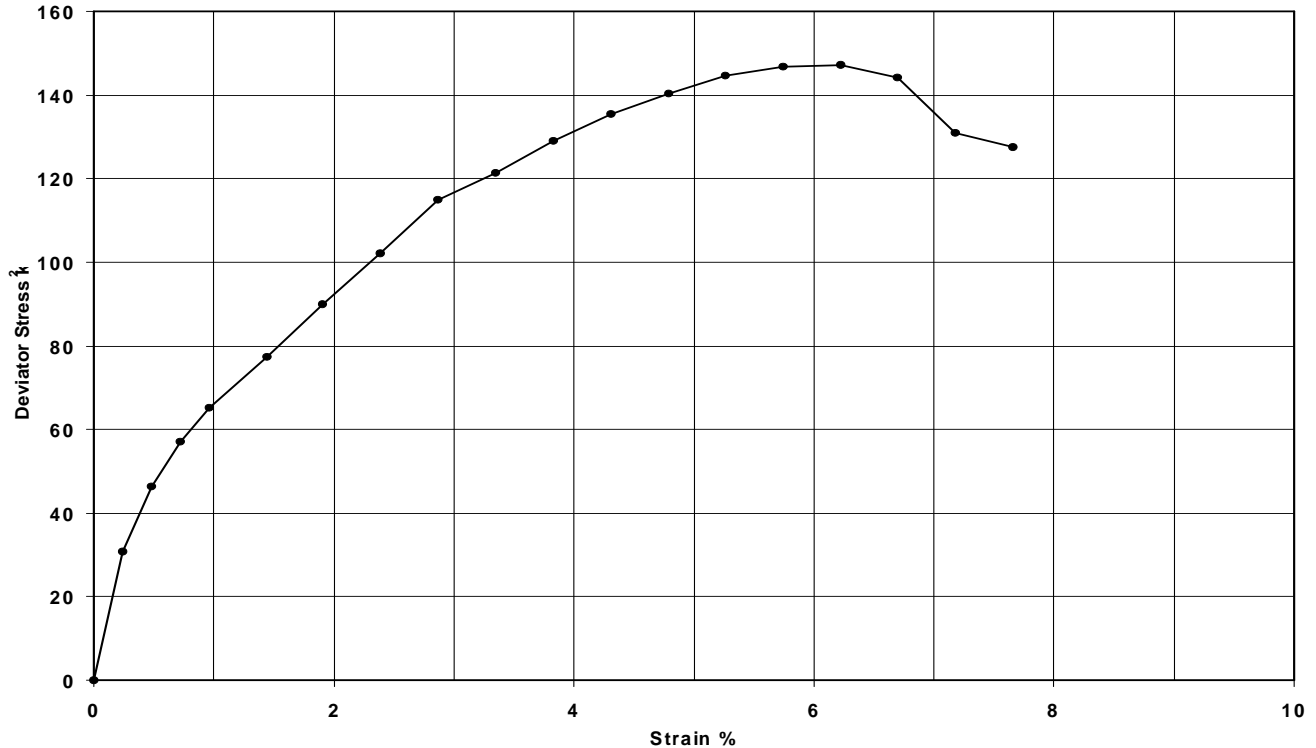
Sample Ref N77870

Sample Description

The following samples were combined to perform this test:

Firm medium strength grey mottled orange slightly gravelly sandy clayey SILT.

BS EN ISO 17892-8:2018



	Stage 1	Stage 2	Stage 3	Strain %	Corrected Deviator Stress kN/m ²	Strain %	Corrected Deviator Stress kN/m ²
Sample Condition	Undisturbed			0.2	30.7		
Orientation of sample	Vertical			0.5	46.4		
Initial Diameter (mm)	102.01			0.7	57.1		
Initial Length (mm)	208.95			1.0	65.1		
Initial Water Content (%)	8.6			1.4	77.3		
Initial Bulk Density (Mg/m ³)	1.94			1.9	90.0		
Initial Dry Density (Mg/m ³)	1.79			2.4	102.2		
Particle Density (Mg/m ³)	2.65 Assumed			2.9	115.0		
Cell Pressure (kPa)	40			3.4	121.4		
'Specimen Height' at start of Shearing Stage (mm)	208.66			3.8	129.0		
Membrane Thickness/Correction (mm/kPa)				4.3	135.3		
Rate of Strain (%/min)	2.0			4.8	140.3		
Corrected Deviator Stress (kPa)	147			5.3	144.7		
Undrained Shear Strength (kPa)	74			5.7	146.9		
Strain at Failure (%)	6.2			6.2	147.2		
Failure Zone Water Content (%)	7.8			6.7	144.3		
Water Content (after test) (%)				7.2	131.0		
Mode of Failure	Brittle			7.7	127.6		

Remarks 

21/01/2020

GEOTECHNICS

LABORATORY RESULTS - Unconsolidated Undrained Triaxial Test

Project: STOCKPORT INTERCHANGE GROUND INVESTIGATION

Hole BH302A

Sample Depth 2.20-2.65m

Project No: PN194052

Sample Type UT

Sample Ref N77870



Remarks 

21/01/2020

GEOTECHNICS

LABORATORY RESULTS - Unconsolidated Undrained Triaxial Test

Project: STOCKPORT INTERCHANGE GROUND INVESTIGATION

Hole BH302B

Sample Depth 2.20-2.80m

Project No: PN194052

Sample Type UT

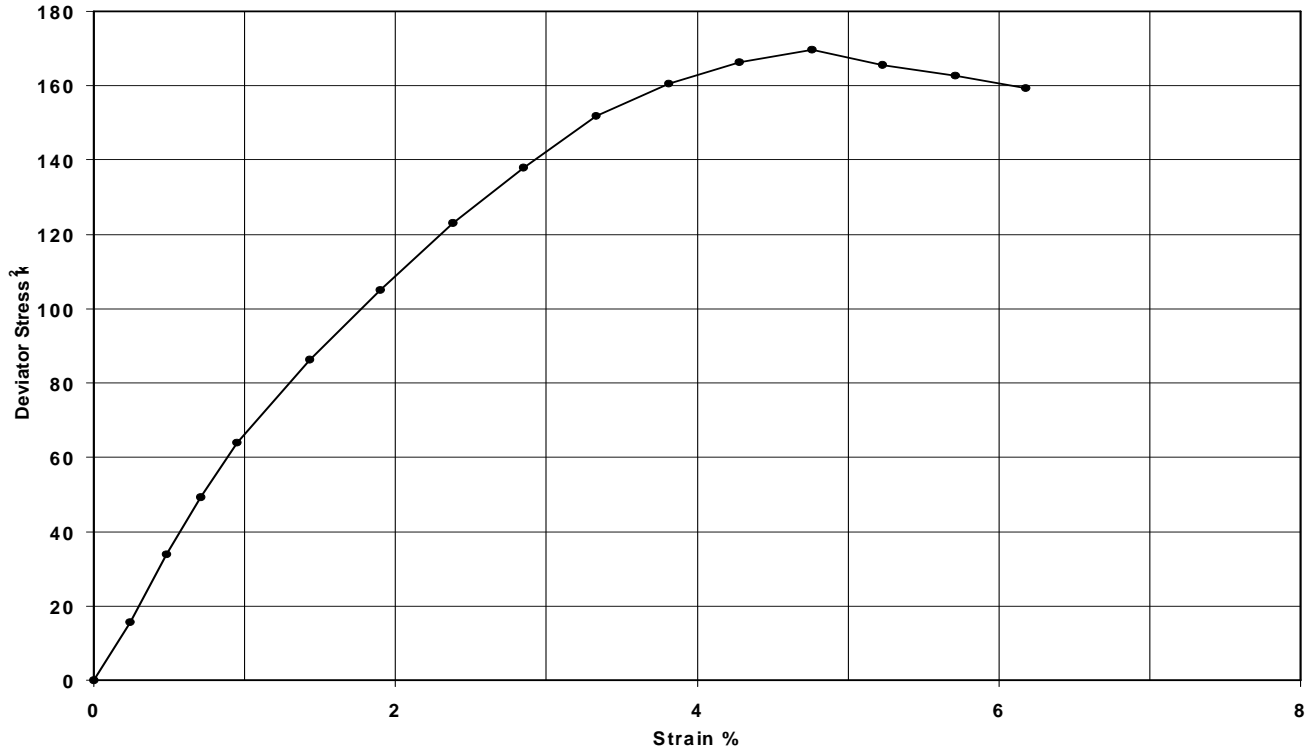
Sample Ref N77874

Sample Description

The following samples were combined to perform this test:

Firm high strength grey mottled orange slightly gravelly sandy clayey SILT.

BS EN ISO 17892-8:2018



	Stage 1	Stage 2	Stage 3	Strain %	Corrected Deviator Stress kN/m ²	Strain %	Corrected Deviator Stress kN/m ²
Sample Condition	Undisturbed			0.2	15.6		
Orientation of sample	Vertical			0.5	33.9		
Initial Diameter (mm)	103.08			0.7	49.2		
Initial Length (mm)	210.21			1.0	63.9		
Initial Water Content (%)	11.8			1.4	86.3		
Initial Bulk Density (Mg/m ³)	1.92			1.9	105.0		
Initial Dry Density (Mg/m ³)	1.72			2.4	123.1		
Particle Density (Mg/m ³)	2.65 Assumed			2.9	137.8		
Cell Pressure (kPa)	40			3.3	151.9		
'Specimen Height' at start of Shearing Stage (mm)	210.13			3.8	160.4		
Membrane Thickness/Correction (mm/kPa)				4.3	166.3		
Rate of Strain (%/min)	2.0			4.8	169.6		
Corrected Deviator Stress (kPa)	170			5.2	165.6		
Undrained Shear Strength (kPa)	85			5.7	162.6		
Strain at Failure (%)	4.8			6.2	159.4		
Failure Zone Water Content (%)	8.6						
Water Content (after test) (%)							
Mode of Failure	Brittle						

Remarks 

21/01/2020

GEOTECHNICS

LABORATORY RESULTS - Unconsolidated Undrained Triaxial Test

Project: STOCKPORT INTERCHANGE GROUND INVESTIGATION

Hole BH302B

Sample Depth 2.20-2.80m

Project No: PN194052

Sample Type UT

Sample Ref N77874



Remarks 

21/01/2020


GEOTECHNICS

LABORATORY RESULTS - Point Load Strength Determination

Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No: PN194052

Sample					w %	W mm	D mm	Fail Load kN	Test Type/ Direction	De mm	De ² mm ²	Is MN/m ²	F	Is ₅₀ MN/m ²
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description										
BH301	4.73- 4.85 (4.73- 4.85)	C	N78004	Extremely weak to very weak reddish brown fine to coarse grained SANDSTONE.	11.0	86	85	0.15	D/PL	85.00	7225	0.021	1.270	0.027
						85	51	0.19	A/PD	74.29	5519	0.034	1.195	0.041
						85	46	0.15	A/PD	70.56	4978	0.030	1.168	0.035
BH301	5.00- 5.09 (5.00- 5.09)	C	N78005	Very weak reddish brown fine to coarse grained SANDSTONE.	9.8	85	79	0.40	A/PD	92.47	8550	0.047	1.319	0.061
BH301	7.97- 8.09 (7.97- 8.09)	C	N78006	Very weak reddish brown fine to coarse grained SANDSTONE.	13.6	86	86	0.84	D/PL	86.00	7396	0.113	1.276	0.144
						86	62	0.95	A/PD	82.39	6789	0.140	1.252	0.176
						86	48	0.56	A/PD	72.50	5256	0.106	1.182	0.125
BH301	8.60- 8.70 (8.60- 8.70)	C	N78007	Very weak reddish brown fine to coarse grained SANDSTONE.	13.5	85	85	0.32	D/PL	85.00	7225	0.044	1.270	0.056
						85	51	0.42	A/PD	74.29	5519	0.076	1.195	0.091
						85	50	0.47	A/PD	73.56	5411	0.086	1.190	0.102
BH301	10.60- 10.70 (10.60- 10.70)	C	N78008	Very weak reddish brown fine to coarse grained SANDSTONE.	16.1	85	85	0.48	D/PL	85.00	7225	0.066	1.270	0.084
						85	81	0.77	A/PD	93.63	8766	0.088	1.326	0.116
						85	76	0.65	A/PD	90.69	8225	0.080	1.307	0.104
BH301	11.79- 11.90 (11.79- 11.90)	C	N78009	Very weak reddish brown fine to coarse grained SANDSTONE.	16.5	86	86	0.27	D/PL	86.00	7396	0.036	1.276	0.046
						86	62	0.66	A/PD	82.39	6789	0.097	1.252	0.122
						86	57	0.45	A/PD	79.00	6241	0.072	1.229	0.088
BH301	14.22- 14.38 (14.22- 14.38)	C	N78010	Very weak reddish brown fine to coarse grained SANDSTONE.	13.7	86	86	0.46	D/PL	86.00	7396	0.062	1.276	0.079
						86	71	0.65	A/PD	88.17	7774	0.084	1.291	0.108
						86	57	0.54	A/PD	79.00	6241	0.086	1.229	0.106
BH301	16.70- 16.82 (16.70- 16.82)	C	N78011	Extremely weak to very weak reddish brown fine to coarse grained SANDSTONE.	13.9	85	85	0.18	D/PL	85.00	7225	0.024	1.270	0.031
						85	69	0.35	A/PD	86.41	7468	0.046	1.279	0.059
						85	53	0.17	A/PD	75.74	5736	0.029	1.206	0.035
BH301	19.90- 19.99 (19.90- 19.99)	C	N78012	Very weak reddish brown fine to coarse grained SANDSTONE.	12.6	86	81	0.63	A/PD	94.18	8869	0.071	1.330	0.095
BH301	20.74- 20.82 (20.74- 20.82)	C	N78013	Very weak reddish brown fine to coarse grained SANDSTONE.	11.8	86	68	0.53	A/PD	86.29	7446	0.071	1.278	0.091
BH301	21.00- 21.20 (21.00- 21.20)	C	N78014	Very weak reddish brown fine to coarse grained SANDSTONE.	12.0	86	86	0.48	D/PL	86.00	7396	0.065	1.276	0.082
						86	86	0.38	D/PL	86.00	7396	0.052	1.276	0.066
						86	79	0.65	A/PD	93.01	8650	0.076	1.322	0.100
						86	71	0.71	A/PD	88.17	7774	0.091	1.291	0.118

Remarks  Test Type D - Diametral, A - Axial, I - Lump or Irregular Test
 Direction PL - parallel to planes of weakness, R - Random or unknown orientation,
 PD - perpendicular to planes of weakness
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 For Standards followed see Laboratory Test Certificate


GEOTECHNICS
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Project STOCKPORT INTERCHANGE GROUND INVESTIGATION

Project No: PN194052

Sample					w %	W mm	D mm	Fail Load kN	Test Type/ Direction	De mm	De ² mm ²	Is MN/m ²	F	Is ₅₀ MN/m ²
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description										
BH301	22.00- 22.10 (22.00- 22.10)	C	N78015	Very weak reddish brown fine to coarse grained SANDSTONE.	10.8	85	84	0.26	D/PL	84.00	7056	0.037	1.263	0.047
							51	0.28	A/PD	73.85	5455	0.051	1.192	0.061
							49	0.20	A/PD	72.39	5241	0.038	1.181	0.045
BH301	23.78- 23.89 (23.78- 23.89)	C	N78016	Very weak reddish brown fine to coarse grained SANDSTONE.	9.4	85	85	0.45	D/PL	85.00	7225	0.062	1.270	0.078
							58	0.52	A/PD	79.23	6277	0.083	1.230	0.102
							57	0.50	A/PD	78.54	6169	0.081	1.225	0.100
BH301	24.50- 24.68 (24.50- 24.68)	C	N78017	Very weak reddish brown fine to coarse grained SANDSTONE.	13.7	80	79	0.32	D/PL	79.00	6241	0.052	1.229	0.063
							73	0.56	A/PD	85.69	7343	0.076	1.274	0.097
							72	0.58	A/PD	85.10	7242	0.081	1.270	0.102
BH301	24.87- 25.00 (24.87- 25.00)	C	N78018	Very weak reddish brown fine to coarse grained SANDSTONE.	13.0	85	83	0.24	D/PL	83.00	6889	0.035	1.256	0.044
							56	0.33	A/PD	76.93	5918	0.055	1.214	0.067
BH302A	4.30- 4.43 (4.30- 4.43)	C	N78019	Very weak reddish brown fine to coarse grained SANDSTONE.	9.5	100	64	0.26	A/PD	90.27	8149	0.032	1.305	0.042
							65	0.35	A/PD	90.97	8276	0.043	1.309	0.056
BH302B	4.15- 4.26 (4.15- 4.26)	C	N78020	Extremely weak reddish brown fine to coarse grained SANDSTONE.	12.5	100	61	0.19	A/PD	88.13	7767	0.024	1.291	0.032
							52	0.16	A/PD	81.37	6621	0.024	1.245	0.030
BH302B	4.50- 4.65 (4.50- 4.65)	C	N78021	Extremely weak to very weak reddish brown fine to coarse grained SANDSTONE.	12.6	100	100	0.17	D/PL	100.00	10000	0.017	1.366	0.023
							61	0.26	A/PD	88.13	7767	0.034	1.291	0.044
							59	0.31	A/PD	86.67	7512	0.041	1.281	0.053
BH302B	4.65- 4.78 (4.65- 4.78)	C	N78022	Extremely weak reddish brown fine to coarse grained SANDSTONE.	10.2	100	89	0.18	A/PD	106.45	11332	0.016	1.405	0.023
BH302B	9.74- 9.90 (9.74- 9.90)	C	N78023	Extremely weak reddish brown fine to coarse grained SANDSTONE.	14.5	100	100	0.14	D/PL	100.00	10000	0.014	1.366	0.019
							66	0.18	A/PD	91.67	8403	0.021	1.314	0.028
							58	0.23	A/PD	85.93	7385	0.031	1.276	0.040
BH302B	9.90- 10.00 (9.90- 10.00)	C	N78024	Extremely weak reddish brown fine to coarse grained SANDSTONE.	13.6	90	66	0.07	I/R	86.97	7563	0.009	1.283	0.012
							47	0.08	I/R	64.72	4189	0.020	1.123	0.023
BH302B	10.64- 10.80 (10.64- 10.80)	C	N78025	Extremely weak to very weak reddish brown fine to coarse grained SANDSTONE.	12.0	100	96	0.12	D/PL	96.00	9216	0.013	1.341	0.018
							64	0.71	A/PD	88.45	7823	0.090	1.293	0.117
							64	0.83	A/PD	88.45	7823	0.106	1.293	0.136

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Sample					w %	W mm	D mm	Fail Load kN	Test Type/ Direction	De mm	De ² mm ²	Is MN/m ²	F	Is ₅₀ MN/m ²
Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description										
BH302B	11.39- 11.47 (11.39- 11.47)	C	N78026	Very weak reddish brown fine to coarse grained SANDSTONE.	14.3	100	70	0.79	A/PD	94.41	8913	0.088	1.331	0.118
BH302B	12.00- 12.13 (12.00- 12.13)	C	N78027	Very weak reddish brown fine to coarse grained SANDSTONE.	13.2	100 100 100	100 91 57	0.63 0.89 0.52	D/PL A/PD A/PD	100.00 107.64 85.19	10000 11586 7257	0.063 0.077 0.071	1.366 1.412 1.271	0.087 0.109 0.091
BH302B	12.70- 12.83 (12.70- 12.83)	C	N78028	Very weak reddish brown fine to coarse grained SANDSTONE.	13.1	100 101 101	101 79 49	0.33 0.71 0.45	D/PL A/PD A/PD	101.00 100.79 79.38	10201 10159 6301	0.032 0.070 0.071	1.372 1.371 1.231	0.044 0.096 0.087
BH302B	13.43- 13.52 (13.43- 13.52)	C	N78029	Very weak reddish brown fine to coarse grained SANDSTONE.	12.5	100	72	0.73	A/PD	95.75	9167	0.080	1.340	0.107
BH302B	14.00- 14.20 (14.00- 14.20)	C	N78030	Very weak reddish brown fine to coarse grained SANDSTONE.	15.2	100 100 100 100	100 100 74 59	0.69 0.32 0.92 0.75	D/PL D/PL A/PD A/PD	100.00 100.00 97.07 86.67	10000 10000 9422 7512	0.069 0.032 0.098 0.100	1.366 1.366 1.348 1.281	0.094 0.044 0.132 0.128
BH302B	15.00- 15.10 (15.00- 15.10)	C	N78031	Very weak reddish brown fine to coarse grained SANDSTONE.	12.9	100	76	0.67	A/PD	98.37	9677	0.069	1.356	0.094
BH302B	15.28- 15.45 (15.28- 15.45)	C	N78032	Very weak reddish brown fine to coarse grained SANDSTONE.	15.5	100 100 100	100 77 47	0.34 0.89 0.49	D/PL A/PD A/PD	100.00 99.01 77.36	10000 9804 5984	0.034 0.090 0.082	1.366 1.360 1.217	0.046 0.123 0.100
BH302B	15.73- 15.87 (15.73- 15.87)	C	N78033	Extremely weak to very weak reddish brown fine to coarse grained SANDSTONE.	15.2	100 100 100	100 89 69	0.36 0.56 0.24	D/PL A/PD A/PD	100.00 106.45 93.73	10000 11332 8785	0.036 0.049 0.028	1.366 1.405 1.327	0.049 0.069 0.037
BH302B	18.40- 18.50 (18.40- 18.50)	C	N78034	Extremely weak reddish brown fine to coarse grained SANDSTONE.	13.7	95	74	0.14	A/PD	94.61	8951	0.016	1.332	0.021
BH302B	19.50- 19.57 (19.50- 19.57)	C	N78035	Very weak reddish brown fine to coarse grained SANDSTONE.	29.5	95	59	0.32	A/PD	84.48	7137	0.045	1.266	0.057
BH302B	20.47- 20.50 (20.47- 20.50)	C	N78036	Extremely weak to very weak reddish brown fine to coarse grained SANDSTONE.	13.5	90 60	43 36	0.15 0.13	I/R I/R	70.20 52.44	4927 2750	0.031 0.049	1.165 1.022	0.036 0.050

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Hole	Depth (Specimen Depth) m	Type	Sample Ref	Description										
BH302B	23.50- 23.58 (23.50- 23.58)	C	N78037	Very weak reddish brown fine to coarse grained SANDSTONE.	10.8	100	79	0.44	A/PD	100.29	10059	0.044	1.368	0.060
BH302B	23.84- 23.93 (23.84- 23.93)	C	N78038	Very weak reddish brown fine to coarse grained SANDSTONE.	10.5	100	101	0.69	D/PL	101.00	10201	0.067	1.372	0.093
						100	58	0.67	A/PD	85.93	7385	0.091	1.276	0.116
						100	47	0.55	A/PD	77.36	5984	0.092	1.217	0.111
BH302B	24.00- 24.13 (24.00- 24.13)	C	N78039	Extremely weak to very weak reddish brown fine to coarse grained SANDSTONE.	11.1	100	100	0.25	D/PL	100.00	10000	0.025	1.366	0.034
						100	70	0.57	A/PD	94.41	8913	0.064	1.331	0.085
						100	59	0.35	A/PD	86.67	7512	0.047	1.281	0.060

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GEOTECHNICS
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Certificate of Analysis

Certificate Number 20-00353

13-Jan-20

Client Geotechnics LTD
203 Torrington Avenue
Tile Hill
Coventry
CV4 9AP

Our Reference 20-00353

Client Reference PN194052

Order No AUTH-OL24059

Contract Title Stockport Interchange

Description 2 Soil samples.

Date Received 09-Jan-20

Date Started 09-Jan-20

Date Completed 13-Jan-20

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

A handwritten signature in black ink, appearing to read "A Fenwick", is placed over a light grey circular stamp.

Adam Fenwick
Contracts Manager





Summary of Chemical Analysis Soil Samples

Our Ref 20-00353

Client Ref PN194052

Contract Title Stockport Interchange

Lab No	1621220
Sample ID	WS305
Depth	2.00-2.45
Other ID	
Sample Type	D
Sampling Date	n/s
Sampling Time	n/s

Test	Method	LOD	Units	
Inorganics				
pH	DETSC 2008#		pH	11.1
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	270

Summary of Asbestos Analysis Soil Samples

Our Ref 20-00353

Client Ref PN194052

Contract Title Stockport Interchange

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1621219	WS305 0.25-1.00	SOIL	NAD	none	Jordan Eadington

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * - not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 20-00353
 Client Ref PN194052
 Contract Stockport Interchange

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1621219	WS305 0.25-1.00 SOIL		PT 1L		
1621220	WS305 2.00-2.45 SOIL		PT 1L	Sample date not supplied, Anions 2:1 (365 days), pH + Conductivity (7 days)	

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months



LABORATORY TEST CERTIFICATE

10 Queenslie Point
Queenslie Industrial Estate
120 Stepps Road
Glasgow
G33 3NQ

Certificate No : 20/019 - 01
To : Thomas Birch
Client : Geotechnics Limited
Unit 1B, Borders Industrial Park
River Lane
Saltney
Chester
CH4 8RJ

Tel: 0141 774 4032

email: info@mattest.org
Website: www.mattest.org

Dear Sirs,

LABORATORY TESTING OF ROCK

Introduction

We refer to samples taken from Stockport Interchange GI and delivered to our laboratory on 08th January 2020.

Material & Source

Sample Reference : See Report Plates
Sampled By : Client
Sampling Certificate : Not Supplied
Location : See Report Plates
Description : Rock Cores
Date Sampled : Not Supplied
Date Tested : 08th January 2020 Onwards
Source : PN194052 - Stockport Interchange GI

Test Results;

As Detailed On Page 2 to Page 6 inclusive

Comments;

Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
All remaining samples for this project will be disposed of 28 days after issue of this test certificate

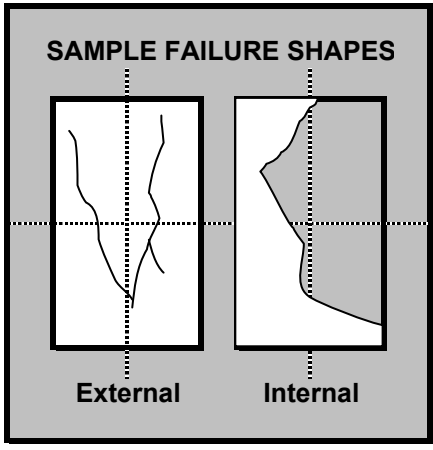
Remarks;

Approved for Issue

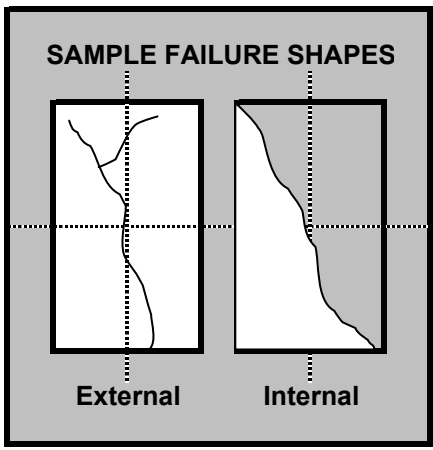
T McLelland (Director)

Date 03/02/2020

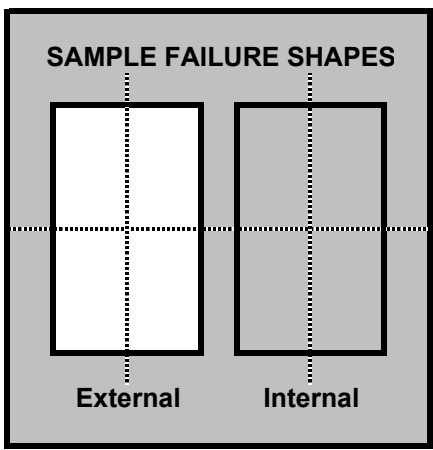


BOREHOLE		BH301	
SAMPLE		C	
DEPTH	m	10.97-11.06	
SAMPLE DIAMETER	mm	84.44	
SAMPLE HEIGHT	mm	151.40	
TEST CONDITION		As Received	
RATE OF LOADING	kN/s	0.1	
TEST DURATION	min.sec	8.01	
DATE OF TESTING		31/01/2020	
LOAD FRAME USED		2000kN	
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Unknown	
FAILURE LOAD	kN	38.5	
UNCONFINED COMPRESSIVE STRENGTH	MPa	6.9	
WATER CONTENT (ISRM Suggested Methods)	%	14.3	
BULK DENSITY (ISRM Suggested Methods)	Mg/m ³	2.18	
DRY DENSITY (ISRM Suggested Methods)	Mg/m ³	1.91	

Test specimen does not meet specified length / diameter ratio requirements

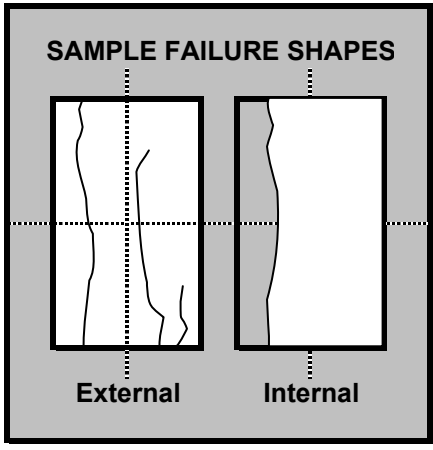
BOREHOLE		BH301	
SAMPLE		C	
DEPTH	m	12.50-12.80	
SAMPLE DIAMETER	mm	85.81	
SAMPLE HEIGHT	mm	154.39	
TEST CONDITION		As Received	
RATE OF LOADING	kN/s	0.1	
TEST DURATION	min.sec	7.33	
DATE OF TESTING		31/01/2020	
LOAD FRAME USED		2000kN	
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Unknown	
FAILURE LOAD	kN	41.0	
UNCONFINED COMPRESSIVE STRENGTH	MPa	7.1	
WATER CONTENT (ISRM Suggested Methods)	%	11.9	
BULK DENSITY (ISRM Suggested Methods)	Mg/m ³	2.17	
DRY DENSITY (ISRM Suggested Methods)	Mg/m ³	1.94	

Test specimen does not meet specified length / diameter ratio requirements

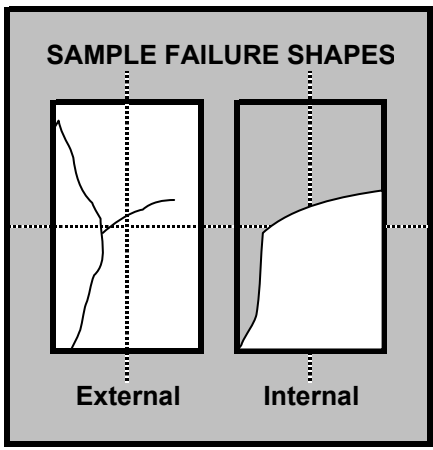
BOREHOLE			
SAMPLE			
DEPTH	m		
SAMPLE DIAMETER	mm		
SAMPLE HEIGHT	mm		
TEST CONDITION			
RATE OF LOADING	kN/s		
TEST DURATION	min.sec		
DATE OF TESTING			
LOAD FRAME USED			
LOAD DIRECTION WITH RESPECT TO LITHOLOGY			
FAILURE LOAD	kN		
UNCONFINED COMPRESSIVE STRENGTH	MPa		
WATER CONTENT (ISRM Suggested Methods)	%		
BULK DENSITY (ISRM Suggested Methods)	Mg/m ³		
DRY DENSITY (ISRM Suggested Methods)	Mg/m ³		

Tested in accordance with ASTM D7012 - 14

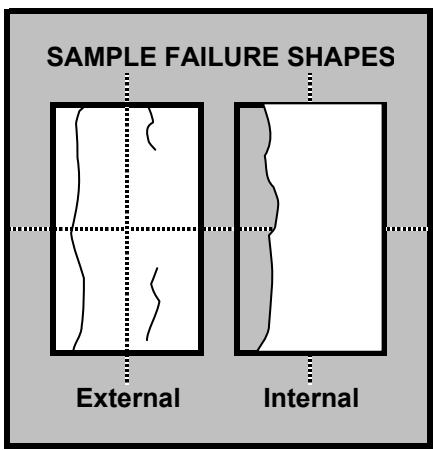
SUMMARY OF UNCONFINED COMPRESSIVE STRENGTH

BOREHOLE		BH302B	
SAMPLE		C	
DEPTH	m	11.00-11.28	
SAMPLE DIAMETER	mm	100.42	
SAMPLE HEIGHT	mm	160.17	
TEST CONDITION		As Received	
RATE OF LOADING	kN/s	0.1	
TEST DURATION	min.sec	8.31	
DATE OF TESTING		31/01/2020	
LOAD FRAME USED		2000kN	
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Unknown	
FAILURE LOAD	kN	38.9	
UNCONFINED COMPRESSIVE STRENGTH	MPa	4.9	
WATER CONTENT (ISRM Suggested Methods)	%	12.3	
BULK DENSITY (ISRM Suggested Methods)	Mg/m ³	2.11	
DRY DENSITY (ISRM Suggested Methods)	Mg/m ³	1.88	

Test specimen does not meet specified length / diameter ratio requirements

BOREHOLE		BH302B	
SAMPLE		C	
DEPTH	m	13.52-13.74	
SAMPLE DIAMETER	mm	100.49	
SAMPLE HEIGHT	mm	127.94	
TEST CONDITION		As Received	
RATE OF LOADING	kN/s	0.1	
TEST DURATION	min.sec	7.12	
DATE OF TESTING		31/01/2020	
LOAD FRAME USED		2000kN	
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Unknown	
FAILURE LOAD	kN	39.0	
UNCONFINED COMPRESSIVE STRENGTH	MPa	4.9	
WATER CONTENT (ISRM Suggested Methods)	%	16.4	
BULK DENSITY (ISRM Suggested Methods)	Mg/m ³	2.10	
DRY DENSITY (ISRM Suggested Methods)	Mg/m ³	1.80	

Test specimen does not meet specified length / diameter ratio requirements

BOREHOLE		BH302B	
SAMPLE		C	
DEPTH	m	24.37-24.54	
SAMPLE DIAMETER	mm	100.06	
SAMPLE HEIGHT	mm	97.77	
TEST CONDITION		As Received	
RATE OF LOADING	kN/s	0.1	
TEST DURATION	min.sec	6.07	
DATE OF TESTING		31/01/2020	
LOAD FRAME USED		2000kN	
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		Unknown	
FAILURE LOAD	kN	40.3	
UNCONFINED COMPRESSIVE STRENGTH	MPa	5.1	
WATER CONTENT (ISRM Suggested Methods)	%	13.7	
BULK DENSITY (ISRM Suggested Methods)	Mg/m ³	2.11	
DRY DENSITY (ISRM Suggested Methods)	Mg/m ³	1.85	

Test specimen does not meet specified length / diameter ratio requirements

Tested in accordance with ASTM D7012 - 14

SUMMARY OF UNCONFINED COMPRESSIVE STRENGTH

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	TYPE OF TEST * (see below)	CORE DIAMETER (mm)	EQUIVALENT DIAMETER (mm)	PLATEN SEPARATION (mm)	FAILURE LOAD (kN)	Is (MPa)	Is(50) (MPa)
BH301	C	4.14-4.48	As Received	D	85.39	85.39	85.39	0.14	0.02	0.02
				A	85.39	74.70	51.32	0.38	0.07	0.08
				A	85.39	73.82	50.12	0.27	0.05	0.06
	C	20.50-20.74	As Received	D	85.22	85.22	85.22	0.25	0.03	0.04
				A	85.22	69.29	44.25	0.14	0.03	0.03
				A	85.22	73.38	49.63	0.14	0.03	0.03
	C	24.58-24.87	As Received	D	77.83	77.83	77.83	0.05	0.01	0.01
				A	7.83	23.14	53.72	0.15	0.29	0.20
				A	77.83	78.50	62.18	0.32	0.05	0.06

NOTE: N/M - Not measured
NOTE: A dash (-) signifies that scale did not register a reading

* I = IRREGULAR TEST
D = DIAMETRICAL TEST
A = AXIAL TEST

Mean Is(50) - Axial tests	0.08
Mean Is(50) - Diametrical tests	0.03
la(50)	3.09

Tested in accordance with ISRM (2007)

SUMMARY OF POINT LOAD TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	TYPE OF TEST * (see below)	CORE DIAMETER (mm)	EQUIVALENT DIAMETER (mm)	PLATEN SEPARATION (mm)	FAILURE LOAD (kN)	Is (MPa)	Is(50) (MPa)
BH302A	C	3.98-4.30	As Received	D	104.81	104.81	104.81	0.14	0.01	0.02
				A	104.81	79.17	46.97	0.08	0.01	0.02
				A	104.81	75.91	43.18	0.10	0.02	0.02

NOTE: N/M - Not measured

NOTE: A dash (-) signifies that scale did not register a reading

* I = IRREGULAR TEST
D = DIAMETRICAL TEST
A = AXIAL TEST

Mean Is(50) - Axial tests	0.02
Mean Is(50) - Diametrical tests	0.02
Ia(50)	1.08

Tested in accordance with ISRM (2007)

SUMMARY OF POINT LOAD TEST RESULTS

BOREHOLE	SAMPLE	DEPTH (m)	MOISTURE CONTENT (%)	TYPE OF TEST * (see below)	CORE DIAMETER (mm)	EQUIVALENT DIAMETER (mm)	PLATEN SEPARATION (mm)	FAILURE LOAD (kN)	Is (MPa)	Is(50) (MPa)
BH302B	C	10.80-11.00	As Received	D	85.15	85.15	85.15	0.12	0.02	0.02
				A	85.15	64.41	38.27	0.21	0.05	0.06
				A	85.15	66.76	41.11	0.26	0.06	0.07

NOTE: N/M - Not measured

NOTE: A dash (-) signifies that scale did not register a reading

* I = IRREGULAR TEST
D = DIAMETRICAL TEST
A = AXIAL TEST

Mean Is(50) - Axial tests	0.06
Mean Is(50) - Diametrical tests	0.02
la(50)	2.99

Tested in accordance with ISRM (2007)

SUMMARY OF POINT LOAD TEST RESULTS

APPENDIX 9

Laboratory Test Results - Contamination



Certificate of Analysis

Certificate Number 19-23460

28-Nov-19

Client Geotechnics LTD
203 Torrington Avenue
Tile Hill
Coventry
CV4 9AP

Our Reference 19-23460

Client Reference PN194052

Order No (not supplied)

Contract Title Stockport Interchange GI

Description 8 Soil samples, 4 Leachate samples.

Date Received 19-Nov-19

Date Started 19-Nov-19

Date Completed 28-Nov-19

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

A handwritten signature in black ink, appearing to read "Adam Fenwick".

Adam Fenwick
Contracts Manager



Summary of Chemical Analysis

Soil Samples

Our Ref 19-23460

Client Ref PN194052

Contract Title Stockport Interchange GI

Lab No	1599589	1599590	1599591	1599592	1599593	1599594
Sample ID	WS301A	WS301A	WS302A	WS302A	WS303	WS303
Depth	1.00	2.50	0.20	1.00	0.20	3.00
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	11/11/19	11/11/19	11/11/19	11/11/19	11/11/19	11/11/19
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Metals									
Arsenic	DETSC 2301#	0.2	mg/kg	3.0	5.8	6.3	18	11	3.9
Barium	DETSC 2301#	1.5	mg/kg	47	100	130	630	160	50
Beryllium	DETSC 2301#	0.2	mg/kg	< 0.2	0.3	0.5	0.8	0.5	0.4
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	< 0.2	< 0.2	< 0.2	< 0.2	0.2	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	0.1	0.1	0.2	0.5	0.4	0.2
Chromium	DETSC 2301#	0.15	mg/kg	4.6	6.6	12	19	24	9.2
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	10	15	31	71	48	23
Lead	DETSC 2301#	0.3	mg/kg	16	13	64	300	100	32
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	< 0.05	0.11	0.06	< 0.05
Nickel	DETSC 2301#	1	mg/kg	4.0	12	12	18	15	9.4
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	5.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	6.2	9.7	22	23	33	12
Zinc	DETSC 2301#	1	mg/kg	19	23	66	160	81	43
Inorganics									
pH	DETSC 2008#		pH	11.7	7.5	9.7	8.0	10.4	7.9
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1	0.1	0.7	0.3	< 0.1
Cyanide, Free	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Total Organic Carbon	DETSC 2084#	0.5	%	< 0.5			4.9	3.9	
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	10	46	44	27	110	41
Petroleum Hydrocarbons									
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	1.2	1.3
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	3.9	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	71	< 3.4	25	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	76	< 10	26	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5	1.4	< 0.5	0.9	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	< 0.6	12	< 0.6	5.2	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	< 1.4	190	< 1.4	68	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	200	< 10	74	< 10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	< 10	< 10	280	< 10	100	< 10
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01



Summary of Chemical Analysis

Soil Samples

Our Ref 19-23460

Client Ref PN194052

Contract Title Stockport Interchange GI

Lab No	1599589	1599590	1599591	1599592	1599593	1599594
Sample ID	WS301A	WS301A	WS302A	WS302A	WS303	WS303
Depth	1.00	2.50	0.20	1.00	0.20	3.00
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	11/11/19	11/11/19	11/11/19	11/11/19	11/11/19	11/11/19
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	0.81	< 0.01
PAHs									
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	0.1	2.9	< 0.1	< 0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	< 0.1	3.4	< 0.1	< 0.1
Acenaphthene	DETSC 3301	0.1	mg/kg	0.1	< 0.1	0.5	12	0.4	< 0.1
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	0.4	15	0.3	< 0.1
Phenanthrene	DETSC 3301	0.1	mg/kg	0.3	< 0.1	3.5	85	1.7	< 0.1
Anthracene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1	1.1	37	0.5	< 0.1
Fluoranthene	DETSC 3301	0.1	mg/kg	0.4	< 0.1	5.7	140	2.7	< 0.1
Pyrene	DETSC 3301	0.1	mg/kg	0.4	< 0.1	5.3	180	2.5	< 0.1
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	0.2	< 0.1	2.3	76	1.2	< 0.1
Chrysene	DETSC 3301	0.1	mg/kg	0.2	< 0.1	2.6	81	1.3	< 0.1
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	0.2	< 0.1	2.1	46	1.2	< 0.1
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	0.1	< 0.1	1.1	25	0.6	< 0.1
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	0.2	< 0.1	2.8	71	1.4	< 0.1
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	0.1	< 0.1	1.8	37	< 0.1	< 0.1
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	0.2	< 0.1	0.4	8.0	< 0.1	< 0.1
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	0.1	< 0.1	1.8	37	< 0.1	< 0.1
PAH Total	DETSC 3301	1.6	mg/kg	2.6	< 1.6	32	860	14	< 1.6
Phenols									
Phenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	0.58	< 0.01	< 0.01
4-Chloro-3-methylphenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4-Dichlorophenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4-Dimethylphenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
p-cresol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	1.6	< 0.01	< 0.01
2,6-Dimethylphenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,6-Dichlorophenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,4,6-Trichlorophenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
VOCs									
Vinyl Chloride	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,1 Dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Trans-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,1-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Cis-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Bromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chloroform	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,1,1-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,1-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Carbon tetrachloride	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01



Summary of Chemical Analysis

Soil Samples

Our Ref 19-23460

Client Ref PN194052

Contract Title Stockport Interchange GI

Lab No	1599589	1599590	1599591	1599592	1599593	1599594
Sample ID	WS301A	WS301A	WS302A	WS302A	WS303	WS303
Depth	1.00	2.50	0.20	1.00	0.20	3.00
Other ID						
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	11/11/19	11/11/19	11/11/19	11/11/19	11/11/19	11/11/19
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units						
Trichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibromomethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Bromodichloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
cis-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
trans-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,1,2-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Tetrachloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,3-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Dibromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2-dibromoethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Chlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,1,1,2-tetrachloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
m+p-Xylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
o-Xylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Styrene	DETSC 3431*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Bromoform	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Isopropylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Bromobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2,3-trichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
n-propylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
2-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,3,5-trimethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
4-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Tert-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2,4-trimethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
sec-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
p-isopropyltoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,3-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,4-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
n-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2-dibromo-3-chloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2,4-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Hexachlorobutadiene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2,3-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
MTBE	DETSC 3431*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

Summary of Chemical Analysis

Soil Samples

Our Ref 19-23460

Client Ref PN194052

Contract Title Stockport Interchange GI

Lab No	1599595	1599596
Sample ID	WS304	WS304
Depth	0.50	2.00-3.00
Other ID		
Sample Type	SOIL	SOIL
Sampling Date	11/11/19	11/11/19
Sampling Time	n/s	n/s

Test	Method	LOD	Units		
Metals					
Arsenic	DETSC 2301#	0.2	mg/kg	5.6	3.1
Barium	DETSC 2301#	1.5	mg/kg	47	35
Beryllium	DETSC 2301#	0.2	mg/kg	0.3	< 0.2
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	< 0.2	< 0.2
Cadmium	DETSC 2301#	0.1	mg/kg	< 0.1	< 0.1
Chromium	DETSC 2301#	0.15	mg/kg	6.1	6.8
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	18	5.6
Lead	DETSC 2301#	0.3	mg/kg	42	11
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05
Nickel	DETSC 2301#	1	mg/kg	4.9	3.3
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	8.4	5.9
Zinc	DETSC 2301#	1	mg/kg	33	8.9
Inorganics					
pH	DETSC 2008#		pH	9.4	9.6
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1
Cyanide, Free	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1
Total Organic Carbon	DETSC 2084#	0.5	%		< 0.5
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	25	35
Petroleum Hydrocarbons					
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	2.4	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	11	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	130	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	140	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	0.6	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	14	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	210	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	220	< 10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	360	< 10
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01

Summary of Chemical Analysis

Soil Samples

Our Ref 19-23460

Client Ref PN194052

Contract Title Stockport Interchange GI

Lab No	1599595	1599596
Sample ID	WS304	WS304
Depth	0.50	2.00-3.00
Other ID		
Sample Type	SOIL	SOIL
Sampling Date	11/11/19	11/11/19
Sampling Time	n/s	n/s

Test	Method	LOD	Units		
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01
PAHs					
Naphthalene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1
Acenaphthene	DETSC 3301	0.1	mg/kg	0.1	< 0.1
Fluorene	DETSC 3301	0.1	mg/kg	< 0.1	< 0.1
Phenanthrene	DETSC 3301	0.1	mg/kg	0.7	< 0.1
Anthracene	DETSC 3301	0.1	mg/kg	0.2	< 0.1
Fluoranthene	DETSC 3301	0.1	mg/kg	1.2	0.1
Pyrene	DETSC 3301	0.1	mg/kg	1.3	< 0.1
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg	0.7	< 0.1
Chrysene	DETSC 3301	0.1	mg/kg	0.8	< 0.1
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg	0.9	< 0.1
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg	0.4	< 0.1
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	1.2	< 0.1
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg	1.0	< 0.1
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg	0.2	< 0.1
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg	1.2	< 0.1
PAH Total	DETSC 3301	1.6	mg/kg	10	< 1.6
Phenols					
Phenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01
4-Chloro-3-methylphenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01
2,4-Dichlorophenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01
2,4-Dimethylphenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01
p-cresol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01
2,6-Dimethylphenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01
2,6-Dichlorophenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01
2,4,6-Trichlorophenol	DETSC 3451*	0.01	mg/kg	< 0.01	< 0.01
VOCs					
Vinyl Chloride	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,1 Dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Trans-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,1-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Cis-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
2,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Bromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Chloroform	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,1,1-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,1-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Carbon tetrachloride	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Benzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,2-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01

Summary of Chemical Analysis

Soil Samples

Our Ref 19-23460

Client Ref PN194052

Contract Title Stockport Interchange GI

Lab No	1599595	1599596
Sample ID	WS304	WS304
Depth	0.50	2.00-3.00
Other ID		
Sample Type	SOIL	SOIL
Sampling Date	11/11/19	11/11/19
Sampling Time	n/s	n/s

Test	Method	LOD	Units		
Trichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Dibromomethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Bromodichloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
cis-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Toluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
trans-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,1,2-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Tetrachloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,3-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Dibromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,2-dibromoethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Chlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,1,1,2-tetrachloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Ethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
m+p-Xylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
o-Xylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Styrene	DETSC 3431*	0.01	mg/kg	< 0.01	< 0.01
Bromoform	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Isopropylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Bromobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,2,3-trichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
n-propylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
2-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,3,5-trimethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
4-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Tert-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,2,4-trimethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
sec-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
p-isopropyltoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,3-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,4-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
n-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,2-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,2-dibromo-3-chloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,2,4-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
Hexachlorobutadiene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
1,2,3-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.01
MTBE	DETSC 3431*	0.01	mg/kg	< 0.01	< 0.01

WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 19-23460
Client Ref PN194052
Contract Title Stockport Interchange GI
Sample Id WS301A 1.00

Sample Numbers 1599589 1599597 1599598
Date Analysed 27/11/2019

Test Results On Waste		
Determinand and Method Reference	Units	Result
DETSC 2084# Total Organic Carbon	%	< 0.5
DETSC 2003# Loss On Ignition	%	1.3
DETSC 3321# BTEX	mg/kg	< 0.04
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01
DETSC 3311# TPH (C10 - C40)	mg/kg	< 10
DETSC 3301 PAHs	mg/kg	2.6
DETSC 2008# pH	pH Units	11.7
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1

WAC Limit Values		
Inert Waste	SNRHW	Hazardous Waste
3	5	6
n/a	n/a	10
6	n/a	n/a
1	n/a	n/a
500	n/a	n/a
100	n/a	n/a
n/a	>6	n/a
n/a	TBE	TBE
n/a	TBE	TBE

Test Results On Leachate				
Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached* mg/kg	
	2:1	8:1	LS2	LS10
DETSC 2306 Arsenic as As	13	2.4	0.026	0.042
DETSC 2306 Barium as Ba	3.7	7.6	< 0.02	< 0.1
DETSC 2306 Cadmium as Cd	0.04	< 0.03	< 0.004	< 0.02
DETSC 2306 Chromium as Cr	3.2	0.8	< 0.02	< 0.1
DETSC 2306 Copper as Cu	8.3	1.3	0.017	0.025
DETSC 2306 Mercury as Hg	0.02	< 0.01	< 0.0004	< 0.002
DETSC 2306 Molybdenum as Mo	78	3.4	0.16	0.16
DETSC 2306 Nickel as Ni	0.9	1.5	< 0.02	< 0.1
DETSC 2306 Lead as Pb	3.1	0.59	< 0.01	< 0.05
DETSC 2306 Antimony as Sb	0.87	0.33	< 0.01	< 0.05
DETSC 2306 Selenium as Se	0.47	< 0.25	< 0.006	< 0.03
DETSC 2306 Zinc as Zn	2.3	37	0.005	0.311
DETSC 2055 Chloride as Cl	1600	760	< 20	< 100
DETSC 2055* Fluoride as F	210	< 100	0.42	0.36
DETSC 2055 Sulphate as SO4	6900	1400	< 20	< 100
DETSC 2009* Total Dissolved Solids	66000	27000	132	336.4
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1
DETSC 2085 Dissolved Organic Carbon	9900	3200	19.8	< 50

WAC Limit Values		
Limit values for LS10 Leachate		
Inert Waste	SNRHW	Hazardous Waste
0.5	2	25
20	100	300
0.04	1	5
0.5	10	70
2	50	100
0.01	0.2	2
0.5	10	30
0.4	10	40
0.5	10	50
0.06	0.7	5
0.1	0.5	7
4	50	200
800	15,000	25,000
10	150	500
1000	20,000	50,000
4000	60,000	100,000
1	n/a	n/a
500	800	1000

Additional Information

DETSC 2008 pH	7.2	7.8
DETSC 2009 Conductivity uS/cm	93.9	39.2
* Temperature*	18	17

Mass of Sample Kg*	0.130
Mass of dry Sample Kg*	0.123

Stage 1

Volume of Leachant L2*	0.24
Volume of Eluate VE1*	0.21

Stage 2

Volume of Leachant L8*	0.987
Volume of Eluate VE2*	0.927

TBE - To Be Evaluated
SNRHW - Stable Non-Reactive
Hazardous Waste

Disclaimer: The WAC limit values are provided for guidance only. DETS does not accept responsibility for errors or omissions. Values are correct at time of issue.

* DETS are accredited for the testing of leachates and not the leachate preparation stage which is unaccredited.

WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 19-23460

Client Ref PN194052

Contract Title Stockport Interchange GI

Sample Id WS304 2.00-3.00

Sample Numbers 1599596 1599599 1599600

Date Analysed 28/11/2019

Test Results On Waste		
Determinand and Method Reference	Units	Result
DETSC 2084# Total Organic Carbon	%	< 0.5
DETSC 2003# Loss On Ignition	%	0.80
DETSC 3321# BTEX	mg/kg	< 0.04
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01
DETSC 3311# TPH (C10 - C40)	mg/kg	< 10
DETSC 3301 PAHs	mg/kg	< 1.6
DETSC 2008# pH	pH Units	9.6
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1

WAC Limit Values		
Inert Waste	SNRHW	Hazardous Waste
3	5	6
n/a	n/a	10
6	n/a	n/a
1	n/a	n/a
500	n/a	n/a
100	n/a	n/a
n/a	>6	n/a
n/a	TBE	TBE
n/a	TBE	TBE

Test Results On Leachate				
Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached* mg/kg	
	2:1	8:1	LS2	LS10
DETSC 2306 Arsenic as As	2.4	0.51	0.005	< 0.01
DETSC 2306 Barium as Ba	19	11	0.04	0.12
DETSC 2306 Cadmium as Cd	< 0.03	< 0.03	< 0.004	< 0.02
DETSC 2306 Chromium as Cr	2	< 0.25	< 0.02	< 0.1
DETSC 2306 Copper as Cu	1.8	0.4	< 0.004	< 0.02
DETSC 2306 Mercury as Hg	0.03	0.02	< 0.0004	< 0.002
DETSC 2306 Molybdenum as Mo	64	12	0.13	0.21
DETSC 2306 Nickel as Ni	< 0.5	< 0.5	< 0.02	< 0.1
DETSC 2306 Lead as Pb	1.2	0.53	< 0.01	< 0.05
DETSC 2306 Antimony as Sb	0.44	< 0.17	< 0.01	< 0.05
DETSC 2306 Selenium as Se	0.29	< 0.25	< 0.006	< 0.03
DETSC 2306 Zinc as Zn	3	2.3	0.006	0.024
DETSC 2055 Chloride as Cl	1600	620	< 20	< 100
DETSC 2055* Fluoride as F	190	490	0.38	4.39
DETSC 2055 Sulphate as SO4	45000	1800	90	< 100
DETSC 2009* Total Dissolved Solids	120000	28000	240	435.2
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1
DETSC 2085 Dissolved Organic Carbon	5300	2100	10.6	< 50

WAC Limit Values		
Limit values for LS10 Leachate		
Inert Waste	SNRHW	Hazardous Waste
0.5	2	25
20	100	300
0.04	1	5
0.5	10	70
2	50	100
0.01	0.2	2
0.5	10	30
0.4	10	40
0.5	10	50
0.06	0.7	5
0.1	0.5	7
4	50	200
800	15,000	25,000
10	150	500
1000	20,000	50,000
4000	60,000	100,000
1	n/a	n/a
500	800	1000

Additional Information

DETSC 2008 pH	7.5	7.8
DETSC 2009 Conductivity uS/cm	174	39.6
* Temperature*	17	18

Mass of Sample Kg*	0.140
Mass of dry Sample Kg*	0.122

Stage 1

Volume of Leachant L2*	0.226
Volume of Eluate VE1*	0.206

Stage 2

Volume of Leachant L8*	0.977
Volume of Eluate VE2*	0.917

TBE - To Be Evaluated
SNRHW - Stable Non-Reactive
Hazardous Waste

Disclaimer: The WAC limit values are provided for guidance only. DETS does not accept responsibility for errors or omissions. Values are correct at time of issue.

* DETS are accredited for the testing of leachates and not the leachate preparation stage which is unaccredited.

Summary of Asbestos Analysis

Soil Samples

Our Ref 19-23460

Client Ref PN194052

Contract Title Stockport Interchange GI

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1599589	WS301A 1.00	SOIL	NAD	none	Lee Kerridge
1599591	WS302A 0.20	SOIL	NAD	none	Lee Kerridge
1599594	WS303 3.00	SOIL	NAD	none	Lee Kerridge
1599595	WS304 0.50	SOIL	NAD	none	Lee Kerridge

Crocidolite = Blue Asbestos, Amosite = Brown Asbestos, Chrysotile = White Asbestos. Anthophyllite, Actinolite and Tremolite are other forms of Asbestos. Samples are analysed by DETSC 1101 using polarised light microscopy in accordance with HSG248 and documented in-house methods. NAD = No Asbestos Detected. Where a sample is NAD, the result is based on analysis of at least 2 sub-samples and should be taken to mean 'no asbestos detected in sample'. Key: * - not included in laboratory scope of accreditation.

Information in Support of the Analytical Results

Our Ref 19-23460
 Client Ref PN194052
 Contract Stockport Interchange GI

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1599589	WS301A 1.00 SOIL	11/11/19	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days), VOC (7 days)	
1599590	WS301A 2.50 SOIL	11/11/19	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days), VOC (7 days)	
1599591	WS302A 0.20 SOIL	11/11/19	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days), VOC (7 days)	
1599592	WS302A 1.00 SOIL	11/11/19	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days), VOC (7 days)	
1599593	WS303 0.20 SOIL	11/11/19	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days), VOC (7 days)	
1599594	WS303 3.00 SOIL	11/11/19	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days), VOC (7 days)	
1599595	WS304 0.50 SOIL	11/11/19	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days), VOC (7 days)	
1599596	WS304 2.00-3.00 SOIL	11/11/19	GJ 250ml, GJ 60ml, PT 1L	pH + Conductivity (7 days), VOC (7 days)	
1599597	WS301A 1.00 LEACHATE	11/11/19	GJ 250ml, GJ 60ml, PT 1L		
1599598	WS301A 1.00 LEACHATE	11/11/19	GJ 250ml, GJ 60ml, PT 1L		
1599599	WS304 2.00-3.00 LEACHATE	11/11/19	GJ 250ml, GJ 60ml, PT 1L		
1599600	WS304 2.00-3.00 LEACHATE	11/11/19	GJ 250ml, GJ 60ml, PT 1L		

Key: G-Glass P-Plastic J-Jar T-Tub
 DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

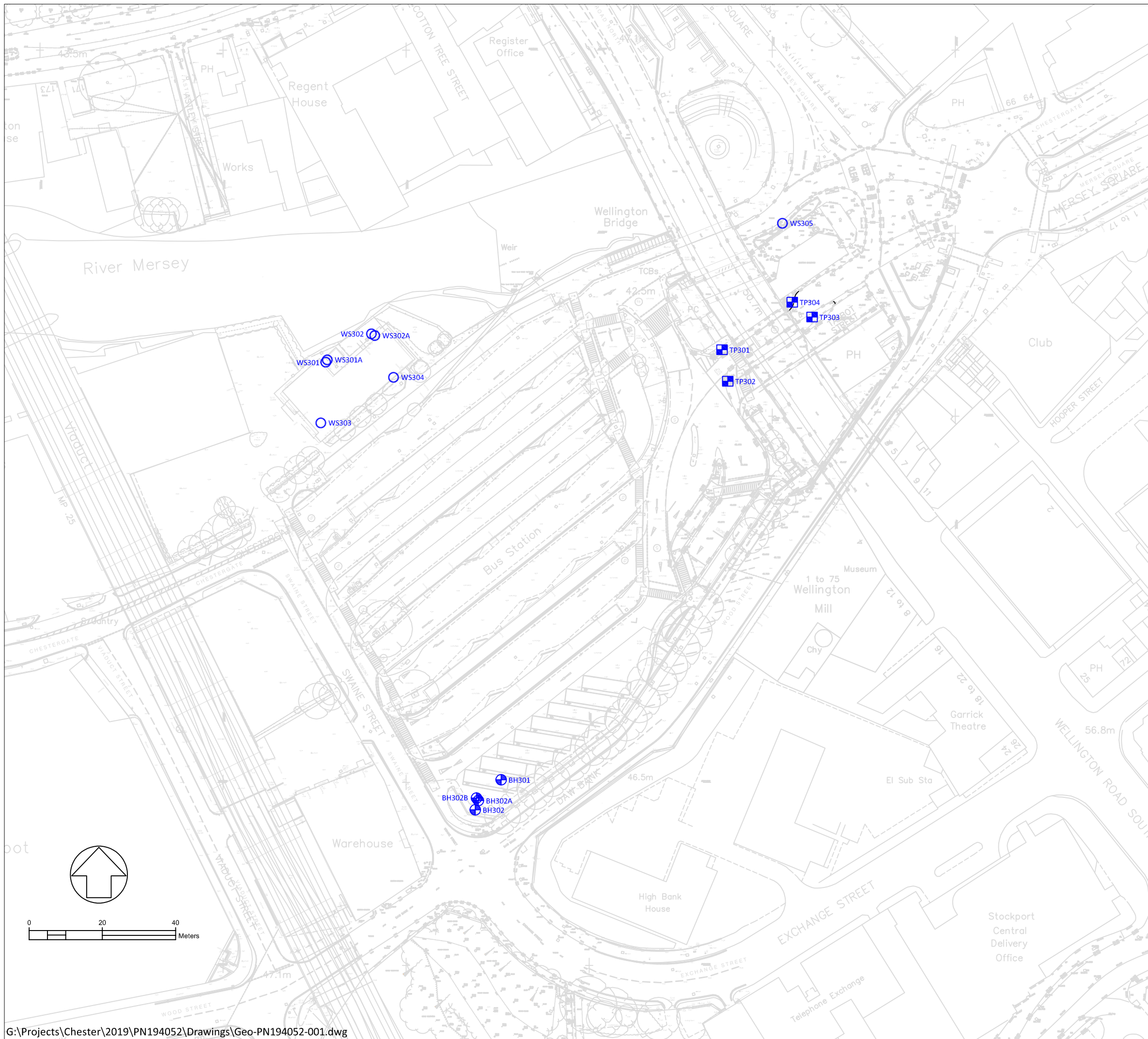
Soil Analysis Notes




Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.
 Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.
 The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-
 Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

APPENDIX 10
Exploratory Hole Location Plan



- Key**
-  Borehole
 -  Trial Pit
 -  Dynamic Sample Borehole

Hole ID	Easting (mE)	Northing (mN)	Level (mOD)
BH301	389226.0	390150.7	45.37
BH302	389218.9	390142.5	45.64
BH302A	389219.8	390145.1	45.47
BH302B	389219.2	390145.7	45.47
TP301	389286.3	390268.2	43.57
TP302	389287.8	390259.6	43.64
TP303	389310.9	390277.1	44.16
TP304	389305.4	390281.2	43.95
WS301	389178.0	390264.8	42.95
WS301A	389178.5	390265.4	42.91
WS302	389190.5	390272.5	42.94
WS302A	389191.4	390272.0	42.96
WS303	389176.7	390248.2	43.00
WS304	389196.6	390260.6	42.67
WS305	389302.8	390302.7	43.79



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Engineer:
 WSP UK Limited

Client:
 Transport for Greater Manchester

Project:
 Stockport Interchange

Drawing Title:
 Exploratory Hole Location Plan

Scale: I:1000@A3
Date: January 2020

Project No: PNI 94052
File Name: Geo-PNI94052-001(1)

APPENDIX II

Investigation Techniques and General Notes

INTRODUCTION

The following brief review of Ground Investigation techniques, generally used as part of most Site Investigations in the UK, summarises their methodology, advantages and limitations. Detailed descriptions of the techniques are available and can be provided on request. This review should be read in conjunction with the accompanying General Notes.

TRIAL PITS

The trial pit is amongst the simplest yet most effective means of identifying shallow ground conditions on a site. Its advantages include simplicity, speed, potential accuracy and cost-effectiveness. The trial pit is most commonly formed using a back-acting excavator which can typically determine ground conditions to some 4 metres below ground level. Hand excavation is often used to locate, expose and detail existing foundations, features or services. In general, it is difficult to extend pits significantly below the water table in predominantly granular soils, where flows can cause instability. Unless otherwise stated, the trial pits will not have been provided with temporary side support during their construction. Under such circumstances, entrance into the pit is not permitted and hence observations will have been made from the ground surface and samples taken from the excavator bucket.

Where access for personnel is required to allow close observation of the exposed strata, the taking of samples and the carrying out of in situ tests, the sides of the trial pits (Observation Pits in BS 5930:2015) will be made safe using temporary supports or the sides battered back to a stable angle. Some limited access to such Trial Pits (Observation Pits) at depths less than 1m may be allowed in stable conditions or where the sides are benched or battered back to a safe angle.

Trends in strata type, level and thickness can be determined, shear surfaces identified and the behaviour of plant, excavation sides and excavated materials can be related to the construction process. They are particularly valuable in land slip investigations. Some types of in situ test can be undertaken in such pits and large disturbed or block samples obtained.

CABLE PERCUSSION BORING

The light Cable Percussion technique of soft ground boring, typically at a diameter of 150mm, is a well-established simple and flexible method of boring vertical holes and generally allows data to be obtained in respect of strata conditions other than rock. A tubular cutter (for cohesive soils) or shell with a flap valve (for granular soils) is repeatedly lifted and dropped using a winch and rope operating from an "A" frame. Soil which enters these tools is regularly removed and either sampled for subsequent examination or test, or laid to one side for later removal off site and licensed disposal or, if permitted by the Client, use as backfill. Steel casing will have been used to prevent collapse of the borehole sides where necessary. A degree of disturbance of soil and mixing of layers is inevitable and the presence of very thin layers of different soils within a particular stratum may not be identified. Changes in strata type can only be detected on recognition of a change in soil samples at the surface, after the interface has been passed. For the foregoing reasons, depth measurements should not be considered to be more accurate than 0.10 metre. The technique can determine ground conditions to depths in excess of 30 metres under suitable circumstances and usually causes less surface disturbance than trial pitting.

In cohesive soils cylindrical samples are retrieved by driving or pushing in 100mm nominal diameter tubes. In soft soils, piston sampling or vane testing may be undertaken. In granular soils and often in cohesive materials, in situ Standard Penetration Tests (SPT's) are performed. The SPT records the number of standard blows required to drive a 50mm diameter open or cone ended probe for 300mm after an initial 150mm penetration. A modified method of recording is used in denser strata. Small disturbed samples are obtained throughout.

ROTARY DRILLING

Rotary Drilling to produce cores by rotating an annular diamond-impregnated tube or barrel into the ground is the technique most appropriate to the forming of site investigation boreholes through rock or other hard strata. It has the advantage of being able to be used vertically or at an angle. Core diameters of less than 100mm are most common for site investigation purposes. Core is normally retrieved in plastic lining tubes. A flushing fluid such as air, water or foam is used to cool the bit and carry cuttings to the surface. Depths in excess of 60 metres can be achieved under suitable circumstances using rotary techniques, with minimal surface disturbance.

Examination of cores allows detailed rock description and generally enables angled discontinuity surfaces to be observed. However, vertical holes do not necessarily reveal the presence of vertical or near-vertical fissures or joint discontinuities. The core type and/or techniques used will depend on the ground conditions. Where open hole rotary drilling is employed, descriptions of strata result from examination at the surface of small particles ejected from the borehole in the flushing medium. In consequence, no indication of fissuring, bedding, consistency or degree of weathering can be obtained.

DYNAMIC SAMPLING

This technique involves the driving of an open-ended tube into the ground and retrieval of the soil which enters the tube. It was previously called window or windowless sampling. The term "window sample" arose from the original device which had a "window" or slot cut into the side of the tube through which samples were taken. This was superseded by the use of a thin-walled plastic liner to retrieve the soil sample from within a sampler (windowless sampling) which has a solid wall. Line diameters range from 36 to 86mm. Such samples can be used for qualitative logging, selection of samples for classification and chemical analysis and for obtaining a rudimentary assessment of strength.

Driving devices can be hand-held or machine mounted and the drive tubes are typically in 1m lengths. Depending on the type of rig used, the hole formed can be cased to prevent collapse of the borehole sides. Where the type of rig does not allow the insertion of casing, the success of this technique can be limited when soils and groundwater conditions are such that the sides of the hole collapse on withdrawal of the sampler. Obstructions within the ground, the density of the material or its strength can also limit the depth and rate of penetration of this light-weight investigation technique. Nevertheless, it is a valuable tool where access is constrained such as within buildings or on embankments. Depths of up to 10m can be achieved in suitable circumstances depending on the rig type but depths of 5m to 6m are more common.

EXPLORATORY HOLE RECORDS

The data obtained by these techniques are generally presented on Trial Pit, Borehole, Drillhole or Dynamic Sample Records. The descriptions of strata result from information gathered from a number of sources which may include published geological data, preliminary field observations and descriptions, in situ test results, laboratory test results and specimen descriptions. A key to the symbols and abbreviations used accompanies the records. The descriptions on the exploratory hole records accommodate but may not necessarily be identical to those on any preliminary records or the laboratory summaries.

The records show ground conditions at the exploratory hole locations. The degree to which they can be used to represent conditions between or beyond such holes, however, is a matter for geological interpretation rather than factual reporting and the associated uncertainties must be recognised.

DYNAMIC PROBING

This technique typically measures the number of blows of a standard weight falling over a standard height to advance a cone-ended rod over sequential standard distances (typically 100mm). Some devices measure the penetration of the probe per standard blow. It is essentially a profiling tool and is best used in conjunction with other investigation techniques where site-specific correlation can be used to delineate the distribution of soft or loose soils or the upper horizon of a dense or strong layer such as rock.

Both machine-driven and hand-driven equipment is available, the selection depending upon access restrictions and the depth of penetration required. It is particularly useful where access for larger equipment is not available, disturbance is to be minimised or where there are cost constraints. No samples are recovered and some techniques leave a sacrificial cone head in the ground. As with other lightweight techniques, progress is limited in strong or dense soils. The results are presented both numerically and graphically. Depths of up to 10m are commonly achieved in suitable circumstances.

The hand-driven DCP probing device has been calibrated by the Highways Agency to provide a profile of CBR values over a range of depths.

INSTRUMENTATION

The most common form of instrument used in site investigation is either the standpipe or else the standpipe piezometer which can be installed in investigation holes. They are used to facilitate monitoring of groundwater levels and water sampling over a period of time following site work. Normally a standpipe would be formed using rigid plastic tubing which has been perforated or slotted over much of its length whilst a standpipe piezometer would have a filter tip which would be placed at a selected level and the hole sealed above and sometimes below to isolate the zone of interest. Groundwater levels are determined using an electronic "dip meter" to measure the depth to the water surface from ground level. Piezometers can also be used to measure permeability. They are simple and inexpensive instruments for long term monitoring but response times can limit their use in tidal areas and access to the ground surface at each instrument is necessary. Remote reading requires more sophisticated hydraulic, electronic or pneumatic equipment.

Settlement can be monitored using surface or buried target plates whilst lateral movement over a range of depths is monitored using slip indicator or inclinometer equipment.

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3. The report and/or opinion is prepared for the specific purpose stated in the document and in relation to the nature and extent of proposals made available to Geotechnics Limited at that time. Re-consideration will be necessary should those details change. The recommendations should not be used for other schemes on or adjacent to the site without further reference to Geotechnics Limited.
4. The assessment of the significance of the factual data, where called for, is provided to assist the Client and their Engineer and/or Advisers in the preparation of their designs.
5. The report is based on the ground conditions encountered in the exploratory holes together with the results of field and laboratory testing in the context of the proposed development. The data from any commissioned desk study and site reconnaissance are also drawn upon. There may be special conditions appertaining to the site, however, which are not revealed by the investigation and which may not be taken into account in the report.
6. Methods of construction and/or design other than those proposed by the designers or referred to in the report may require consideration during the evolution of the proposals and further assessment of the geotechnical and any geoenvironmental data would be required to provide discussion and evaluations appropriate to these methods.
7. The accuracy of results reported depends upon the technique of measurement, investigation and test used and these values should not be regarded necessarily as characteristics of the strata as a whole (see accompanying notes on Investigation Techniques). Where such measurements are critical, the technique of investigation will need to be reviewed and supplementary investigation undertaken in accordance with the advice of the Company where necessary.
8. The samples selected for laboratory test are prepared and tested in accordance with the relevant Clauses and Parts of BS EN ISO 17892 and BS 1377 Parts 1 to 8, where appropriate, in Geotechnics Limited's UKAS accredited Laboratory, where possible. A list of tests is given.
9. Tests requiring the use of another laboratory having UKAS accreditation where possible are identified.
10. Any unavoidable variations from specified procedures are identified in the report.
11. Specimens are cut vertically, where this is relevant and can be identified, unless otherwise stated
12. All the data required by the test procedures are recorded on individual test sheets but the results in the report are presented in summary form to aid understanding and assimilation for design purposes. Where all details are required, these can be made available.
13. Whilst the report may express an opinion on possible configurations of strata between or beyond exploratory holes, or on the possible presence of features based on either visual, verbal, written, cartographical, photographic or published evidence, this is for guidance only and no liability can be accepted for its accuracy.
14. The Code of Practice for Ground Investigations – BS 5930:2015 calls for man-made soils to be described as Anthropogenic Ground with soils placed in an un-controlled manner classified as Made Ground and soils placed in a controlled manner as Fill. In view of the difficulty in always accurately determining the origin of man-made soils in exploratory holes, Geotechnics Limited classify such materials as Made Ground. Where soils can be clearly identified as being placed in a controlled manner then further classification of the soils as Fill has been added to the Exploratory Hole Records.
15. Classification of man-made soils is based on the inspection of retrieved samples or exposed excavations. Where it is obvious that foreign matter such as paper, plastic or metal is present, classification is clear. Frequently, however, for man-made soils that arise from the adjacent ground or from the backfilling of excavations, their visual characteristics can closely resemble those of undisturbed ground. Other evidence such as site history, exploratory hole location or other tests may need to be drawn upon to provide clarification. For these reasons, classification of soils on the exploratory hole records as either Made Ground or naturally occurring strata, the boundary between them and any interpretation that this gives rise to should be regarded as provisional and subject to re-evaluation in the light of further data.
16. The classification of materials as Topsoil is generally based on visual description and should not be interpreted to mean that the material so described complies with the criteria for Topsoil used in BS 3882:2015. Specific testing would be necessary where such a definition is a requirement.
17. Ground conditions should be monitored during the construction of the works and the report should be re-evaluated in the light of these data by the supervising geotechnical engineers.
18. Any comments on groundwater conditions are based on observations made at the time of the investigation, unless specifically stated otherwise. It should be noted, however, that the observations are subject to the method and speed of boring, drilling or excavation and that groundwater levels will vary due to seasonal or other effects.
19. Any bearing capacities for conventional spread foundations which are given in the report and interpreted from the investigation are for bases at a minimum depth of 1m below finished ground level in naturally occurring strata and at broadly similar levels throughout individual structures, unless otherwise stated. Typically they are based on serviceability criteria taking account of an assessment of the shear strength and/or density data obtained by the investigation. The foundations should be designed in accordance with the good practice embodied in BS 8004:2015 - Foundations, supplemented for housing by NHBC Standards. Foundation design is an iterative process and bearing pressures may need adjustment or other measures may need to be taken in the context of final layouts and levels prior to finalisation of proposals.
20. Unless specifically stated, the investigation does not take account of the possible effects of mineral extraction or of gases from fill or natural sources within, below or outside the site.
21. The costs or economic viability of the proposals referred to in the report, or of the solutions put forward to any problems encountered, will depend on very many factors in addition to geotechnical or geoenvironmental considerations and hence their evaluation is outside the scope of the report.

Appendix D

LABORATORY SCREEN



Stockport Interchange - Bus Interchange

Key	
<0.00	Concentrations are below LOD
0.00	Concentrations exceed GAC

Lab No	1599589	1599590	1599591	1599592	1599593	1599594	1599595	1599596	1605663	1605667
Sample ID	WS301A	WS301A	WS302A	WS302A	WS303	WS303	WS304	WS304	WS305	BH302A
Depth	1	2.5	0.2	1	0.2	3	0.5	2.00-3.00	3	1.7
Other ID										
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
Sampling Date	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	n/s	n/s
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s

Test	Method	LOD	Units	WSP GAC	1599589	1599590	1599591	1599592	1599593	1599594	1599595	1599596	1605663	1605667
Metals														
Arsenic	DETSC 2301#	0.2	mg/kg	168	3	5.8	6.3	18	11	3.9	5.6	3.1	20	16
Barium	DETSC 2301#	1.5	mg/kg	5770	47	100	130	630	160	50	47	35	140	69
Beryllium	DETSC 2301#	0.2	mg/kg	63	0.2	0.3	0.5	0.8	0.5	0.4	0.3	0.2	2	0.6
Boron, Water Soluble	DETSC 2311#	0.2	mg/kg	46000	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.9	0.5
Cadmium	DETSC 2301#	0.1	mg/kg	555	0.1	0.1	0.2	0.5	0.4	0.2	0.1	0.1	0.2	0.1
Chromium	DETSC 2301#	0.15	mg/kg	58000	4.6	6.6	12	19	24	9.2	6.1	6.8	11	11
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	69	1	1	1	1	1	1	1	1	1	1
Copper	DETSC 2301#	0.2	mg/kg	44,400	10	15	31	71	48	23	18	5.6	120	64
Lead	DETSC 2301#	0.3	mg/kg	808	16	13	64	300	100	32	42	11	120	59
Mercury	DETSC 2325#	0.05	mg/kg	242	0.05	0.05	0.05	0.11	0.06	0.05	0.05	0.05	0.38	0.1
Nickel	DETSC 2301#	1	mg/kg	804	4	12	12	18	15	9.4	4.9	3.3	23	12
Selenium	DETSC 2301#	0.5	mg/kg	1,850	0.5	5.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Vanadium	DETSC 2301#	0.8	mg/kg	5030	6.2	9.7	22	23	33	12	8.4	5.9	39	23
Zinc	DETSC 2301#	1	mg/kg	173,000	19	23	66	160	81	43	33	8.9	91	34
Inorganics														
pH	DETSC 2008#		pH		11.7	7.5	9.7	8	10.4	7.9	9.4	9.6	8	7.5
Cyanide, Total	DETSC 2130#	0.1	mg/kg	15	0.1	0.1	0.1	0.7	0.3	0.1	0.1	0.1	0.1	0.1
Cyanide, Free	DETSC 2130#	0.1	mg/kg		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Total Organic Carbon	DETSC 2084#	0.5	%		0.5			4.9	3.9			0.5	11	4
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l		10	46	44	27	110	41	25	35	82	120
Petroleum Hydrocarbons														
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	181000	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	316000	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	21400	0.01	0.01	0.01	0.01	1.2	1.3	0.01	0.01	0.01	0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	24300	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	25700	1.2	1.2	1.2	1.2	1.2	1.2	2.4	1.2	1.2	1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	525000	1.5	1.5	3.9	1.5	1.5	1.5	11	1.5	1.5	1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg		3.4	3.4	71	3.4	25	3.4	130	3.4	3.4	3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg		10	10	76	10	26	10	140	10	10	10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	92000	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	101000	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	9290	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	10000	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	6	0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	10400	0.5	0.5	1.4	0.5	0.9	0.5	0.6	0.5	12	0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	7880	0.6	0.6	12	0.6	5.2	0.6	14	0.6	38	0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	7880	1.4	1.4	190	1.4	68	1.4	210	1.4	58	1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg		10	10	200	10	74	10	220	10	110	10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg		10	10	280	10	100	10	360	10	110	10
Benzene	DETSC 3321#	0.01	mg/kg	113	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	27200	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Toluene	DETSC 3321#	0.01	mg/kg	101000	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Xylene	DETSC 3321#	0.01	mg/kg	31500	0.01	0.01	0.01	0.01	0.81	0.01	0.01	0.01	0.01	0.01

Key: * -not accredited. # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

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Key	
<0.00	Concentrations are below LOD
0.00	Concentrations exceed GAC

Lab No	1599589	1599590	1599591	1599592	1599593	1599594	1599595	1599596	1605663	1605667				
Sample ID	WS301A	WS301A	WS302A	WS302A	WS303	WS303	WS304	WS304	WS305	BH302A				
Depth	1	2.5	0.2	1	0.2	3	0.5	2.00-3.00	3	1.7				
Other ID														
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL				
Sampling Date	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019				
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s				
Test	Method	LOD	Units	WSP GAC	POS Parks -	6% SOM								
PAHs														
Naphthalene	DETSC 3301	0.1	mg/kg	2950	0.1	0.1	0.1	2.9	0.1	0.1	0.1	0.1	29	0.1
Acenaphthylene	DETSC 3301	0.1	mg/kg		0.1	0.1	0.1	3.4	0.1	0.1	0.1	0.1	3	0.1
Acenaphthene	DETSC 3301	0.1	mg/kg		0.1	0.1	0.5	12	0.4	0.1	0.1	0.1	33	0.1
Fluorene	DETSC 3301	0.1	mg/kg		0.1	0.1	0.4	15	0.3	0.1	0.1	0.1	25	0.1
Phenanthrene	DETSC 3301	0.1	mg/kg		0.3	0.1	3.5	85	1.7	0.1	0.7	0.1	130	0.1
Anthracene	DETSC 3301	0.1	mg/kg		0.1	0.1	1.1	37	0.5	0.1	0.2	0.1	24	0.1
Fluoranthene	DETSC 3301	0.1	mg/kg		0.4	0.1	5.7	140	2.7	0.1	1.2	0.1	110	0.1
Pyrene	DETSC 3301	0.1	mg/kg		0.4	0.1	5.3	180	2.5	0.1	1.3	0.1	110	0.1
Benzo(a)anthracene	DETSC 3301	0.1	mg/kg		0.2	0.1	2.3	76	1.2	0.1	0.7	0.1	45	0.1
Chrysene	DETSC 3301	0.1	mg/kg		0.2	0.1	2.6	81	1.3	0.1	0.8	0.1	49	0.1
Benzo(b)fluoranthene	DETSC 3301	0.1	mg/kg		0.2	0.1	2.1	46	1.2	0.1	0.9	0.1	30	0.1
Benzo(k)fluoranthene	DETSC 3301	0.1	mg/kg		0.1	0.1	1.1	25	0.6	0.1	0.4	0.1	16	0.1
Benzo(a)pyrene	DETSC 3301	0.1	mg/kg	11	0.2	0.1	2.8	71	1.4	0.1	1.2	0.1	42	0.1
Indeno(1,2,3-c,d)pyrene	DETSC 3301	0.1	mg/kg		0.1	0.1	1.8	37	0.1	0.1	1	0.1	23	0.1
Dibenzo(a,h)anthracene	DETSC 3301	0.1	mg/kg		0.2	0.1	0.4	8	0.1	0.1	0.2	0.1	6.3	0.1
Benzo(g,h,i)perylene	DETSC 3301	0.1	mg/kg		0.1	0.1	1.8	37	0.1	0.1	1.2	0.1	27	0.1
PAH Total	DETSC 3301	1.6	mg/kg		2.6	1.6	32	860	14	1.6	10	1.6	700	1.6
Phenols														
Phenol	DETSC 3451*	0.01	mg/kg	3200	0.01	0.01	0.01	0.58	0.01	0.01	0.01	0.01	1.3	0.01
4-Chloro-3-methylphenol	DETSC 3451*	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.1	0.01
2,4-Dichlorophenol	DETSC 3451*	0.01	mg/kg	1110	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.1	0.01
2,4-Dimethylphenol	DETSC 3451*	0.01	mg/kg	9880	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	1.1	0.01
p-cresol	DETSC 3451*	0.01	mg/kg		0.01	0.01	0.01	1.6	0.01	0.01	0.01	0.01	1.6	0.01
2,6-Dimethylphenol	DETSC 3451*	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.1	0.01
2,6-Dichlorophenol	DETSC 3451*	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.1	0.01
2,4,6-Trichlorophenol	DETSC 3451*	0.01	mg/kg	1110	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.1	0.01
VOCs														
Vinyl Chloride	DETSC 3431	0.01	mg/kg	5.4	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,1 Dichloroethylene	DETSC 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Trans-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,1-dichloroethane	DETSC 3431	0.01	mg/kg	31200	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Cis-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2,2-dichloropropane	DETSC 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Bromochloromethane	DETSC 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chloroform	DETSC 3431	0.01	mg/kg	3520	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,1,1-trichloroethane	DETSC 3431	0.01	mg/kg	168000	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,1-dichloropropene	DETSC 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Carbon tetrachloride	DETSC 3431	0.01	mg/kg	1610	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Benzene	DETSC 3431	0.01	mg/kg	113	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2-dichloroethane	DETSC 3431	0.01	mg/kg	28	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Stockport Interchange - Bus Interchange

Key	
<0.00	Concentrations are below LOD
0.00	Concentrations exceed GAC

Lab No	1599589	1599590	1599591	1599592	1599593	1599594	1599595	1599596	1605663	1605667		
Sample ID	WS301A	WS301A	WS302A	WS302A	WS303	WS303	WS304	WS304	WS305	BH302A		
Depth	1	2.5	0.2	1	0.2	3	0.5	2.00-3.00	3	1.7		
Other ID												
Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL		
Sampling Date	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	11/11/2019	n/s	n/s		
Sampling Time	WSP GAC	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s		
Test	Method	LOD	Units	WSP GAC	POS Parks -							
				6% SOM								
Trichloroethylene	DETS 3431	0.01	mg/kg	115	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2-dichloropropane	DETS 3431	0.01	mg/kg	292	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Dibromomethane	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Bromodichloromethane	DETS 3431	0.01	mg/kg	81	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
cis-1,3-dichloropropene	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Toluene	DETS 3431	0.01	mg/kg	101000	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
trans-1,3-dichloropropene	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,1,2-trichloroethane	DETS 3431	0.01	mg/kg	1480	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Tetrachloroethylene	DETS 3431	0.01	mg/kg	1460	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,3-dichloropropane	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Dibromochloromethane	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2-dibromoethane	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Chlorobenzene	DETS 3431	0.01	mg/kg	3830	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,1,1,2-tetrachloroethane	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Ethylbenzene	DETS 3431	0.01	mg/kg	27200	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
m+p-Xylene	DETS 3431	0.01	mg/kg	31500	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
o-Xylene	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Styrene	DETS 3431*	0.01	mg/kg	6120	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Bromoform	DETS 3431	0.01	mg/kg	5220	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Isopropylbenzene	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Bromobenzene	DETS 3431	0.01	mg/kg	3460	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2,3-trichloropropane	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
n-propylbenzene	DETS 3431	0.01	mg/kg	43900	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
2-chlorotoluene	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,3,5-trimethylbenzene	DETS 3431	0.01	mg/kg	4290	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
4-chlorotoluene	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Tert-butylbenzene	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2,4-trimethylbenzene	DETS 3431	0.01	mg/kg	4290	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
sec-butylbenzene	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
p-isopropyltoluene	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,3-dichlorobenzene	DETS 3431	0.01	mg/kg	700	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,4-dichlorobenzene	DETS 3431	0.01	mg/kg	21300	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
n-butylbenzene	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2-dichlorobenzene	DETS 3431	0.01	mg/kg	50500	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2-dibromo-3-chloropropane	DETS 3431	0.01	mg/kg		0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2,4-trichlorobenzene	DETS 3431	0.01	mg/kg	2370	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Hexachlorobutadiene	DETS 3431	0.01	mg/kg	51	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
1,2,3-trichlorobenzene	DETS 3431	0.01	mg/kg	1570	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
MTBE	DETS 3431*	0.01	mg/kg	117000	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

Appendix E

WSP METHODOLOGY OF GENERIC
ASSESSMENT CRITERIA
DERIVATION



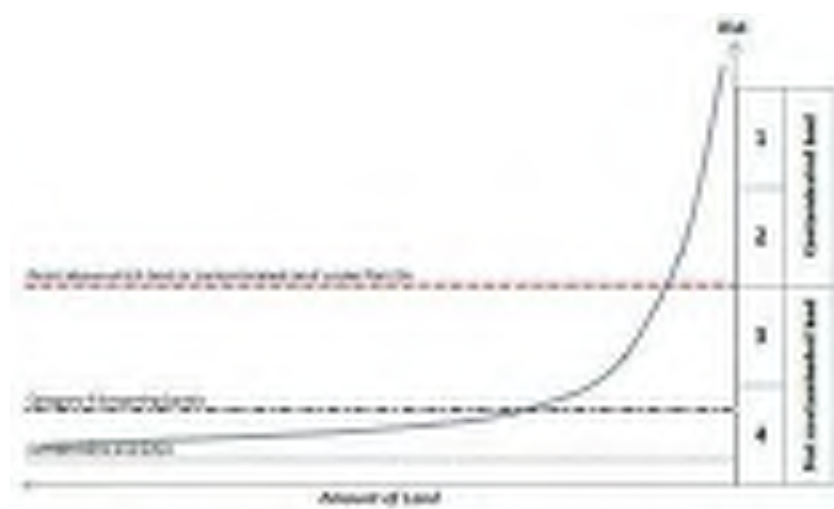
METHODOLOGY FOR THE DERIVATION OF GENERIC QUANTITATIVE ASSESSMENT CRITERIA TO EVALUATE RISKS TO HUMAN HEALTH FROM SOIL & GROUNDWATER CONTAMINATION

UK APPROACH

In the UK, the potential risks to human health from contamination in the ground are usually evaluated through a generic quantitative risk assessment (GQRA) approach. This allows generic and conservative exposure assumptions to be readily applied to risk assessments, and can be a useful tool for rapidly screening data and to identify those contaminants or scenarios that could benefit from further investigation and/or site-specific detailed quantitative risk assessment (DQRA). Current industry good practice is to use the approach presented in the Environment Agency (EA) publications SR2¹ and SR3². This approach allows the derivation of Generic Assessment Criteria (GACs), primarily for chronic exposure.

In April 2012, the Department of Environment, Food and Rural Affairs (Defra) published updated statutory guidance³ which introduced a four category approach to determining whether land in England and Wales is contaminated or not on the grounds of significant possibility of significant harm (SPOSH). **Figure 1** presents a graphical representation of the categories.

Figure 1: Four Categories for Determining if Land Represent a SPOSH



Cases classified as Category 1 are considered to be SPOSH based on actual evidence or an unacceptably high probability of harm existing. Category 4 cases are those where there is no risk, or a low risk of SPOSH.

¹ Environment Agency 'Human Health Toxicological Assessment of Contaminants in Soil', Report SC050021/SR2. January 2009.

² Environment Agency 'Updated Technical Background to the CLEA Model,' Report SC050021/SR3. January 2009.

³ Defra 'Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance'. April 2012.

GACs represent a minimal risk level, well within Category 4. A 2014 publication by Contaminated Land: Applications in Real Environments (CL:AIRE), SP1010⁴ and endorsed by Defra⁵ provided an approach to determine Category 4 Screening Levels (C4SLs) which are higher than the GACs whilst being “more pragmatic but still strongly precautionary”. It also provided C4SLs for six contaminants of concern. Although the C4SLs were designed to support Part 2A assessments to determine ‘contaminated land’ they are specifically mentioned, along with reference to the Part 2A statutory guidance, by the Department for Communities and Local Government (DCLG) for use in a planning context⁶.

An updated version the Contaminated Land Exposure Assessment (CLEA) Workbook (v1.071) was released by the EA in September 2015 to take into account the publication of SP1010. The updates comprised: additional toxicity data for the six chemicals for which C4SLs were derived; two new public open space land use scenarios; updated exposure parameters; options to run the model using C4SL exposure assumptions; and increased functionality. There were no changes to algorithms, so it is still possible to replicate the withdrawn SGVs using the input parameters held within v1.071.

It should be noted that the four category approach has not been adopted in Scotland under Part 2A or the planning regime. The Part 2A statutory guidance applicable in Scotland (Paper SE/2006/44 dated May 2006) does not reflect the changes introduced by Defra in April 2012 which allow for the use of C4SLs within Part 2A risk assessments. Additionally, it is considered that the principal of ‘minimal risk’ should still apply under planning in Scotland, based on current guidance.

WSP APPROACH

Following the withdrawal of the SGVs, and in the absence of an industry-wide, accepted set of GACs it is down to individual practitioners to derive their own soil assessment criteria. WSP has used the approach provided within SR2, SR3, SP1010, CLEA Workbook v1.071 and SR4⁷ to produce a set of minimal risk GACs. The chemical-specific data within two key publications were considered during their production: CL:AIRE 2010⁸ and LQM 2015⁹. Both documents provide comprehensive sets of GACs for different contaminants of concern.

The LQM Suitable For Use Levels (S4ULs) have selected exposure parameters consistent with the C4SL exposure scenarios. This approach was rejected by WSP as not representing minimal risk. However, the LQM S4UL document was critically reviewed and the approach and chemical input parameters were utilised where considered to be appropriate.

An industry-led C4SL Working Group is in the process of deriving a larger set of C4SLs in the near future, for approximately 20 contaminants. This will include a critical review of the chemical input data for all selected substances, and may therefore lead to further amendments to the chemical input data used in the WSP in-house screening values. It is considered likely that the contaminant list will

⁴ CL:AIRE ‘Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination’ SP1010, Final Project Report (Revision 2). September 2014.

⁵ Defra ‘SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document’. December 2014.

⁶ DCLG Planning Practice Guidance ‘Land Affected by Contamination’, particularly Paragraphs 001 and 007. Ref IDs: 33-001-20140306 & 33-007-20140612.

⁷ Environment Agency ‘CLEA Software (Version 1.05) Handbook (and Software)’, Report SC050021/SR4. September 2009.

⁸ CL:AIRE ‘The EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment’. ISBN 978-1-05046-20-1. January 2010.

⁹ Nathanail et al ‘The LQM/CIEH S4ULs for Human Health Risk Assessment’, Land Quality Press, ISBN 978-0-9931084-0-2. 2015.

crossover with the 2009 EIC/AGS/CL:AIRE GACs. As such, this document was not critically reviewed by WSP.

WSP's current approach to the assessment of risks to human health is to continue to evaluate minimal risk through the use of in-house derived GACs, and to use the published C4SLs as a secondary tier of assessment until such time as additional C4SLs are published and/or in-house values are derived.

EXPOSURE MODELS

LAND USES

WSP has largely adopted the exposure assumptions of the generic land use scenarios included within SR3, with two additional public open space scenarios included from within SP1010:

- Residential with homegrown produce consumption;
- Residential without homegrown produce consumption;
- Allotments;
- Commercial;
- Public open space near residential housing (POS_{resi}); and
- Public park (POS_{park}).

Exceptions are described in the following Sections.

SOIL PROPERTIES

SR3 assumes a sandy loam soil with a pH of 7 and a Soil Organic Matter (SOM) content of 6% for its generic land uses, based on the geographical spread of topsoils in the UK. WSP has adopted these default values. In addition, GACs based on an SOM of 1% and 2.5% have been derived, based on common experience of the nature of Made Ground and lack of topsoil on many brownfield sites.

RECEPTOR CHARACTERISTICS AND BEHAVIOURS

SP1010 provides some updated exposure parameters for long-term inhalation rates¹⁰ and the consumption rates for homegrown produce¹¹ compared to those provided in SR3. This data was used to derive WSP's GACs.

The changes in inhalation rates do not apply to the allotment generic land use scenario, as these are based on the breathing rates for short-term exposure of light to moderate intensity activity which were derived from a study that was not updated in USEPA 2011, so the SR3 rates were retained.

¹⁰ USEPA, National Centre for Environmental Assessment 'Exposure Factors Handbook: 2011 Edition' EPA/600/R-09/052F. September 2011.

¹¹ National Diet and Nutrition Survey 2008/2009 to 2010/2011.

CHEMICAL DATA

PHYSICO-CHEMICAL PARAMETERS

Physico-chemical properties for the contaminants for which GACs have been derived have been obtained following critical review of the following hierarchy of data sources:

1. Environment Agency/Defra SGV reports where available;
2. Environment Agency '*Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values*', Report SC050021/SR7, November 2008; and
3. Published fate and transport reviews within Nathanail et. al 2015 and CL:AIRE 2010.

Where appropriate, and where sufficient data is available, values were adjusted to reflect a UK soil temperature of 10°C (e.g. K_{aw}).

TOXICOLOGICAL DATA

Toxicological data for the derivation of minimal risk Health Criteria Values (HCV) for each contaminant was selected with due regard to the approach presented in SR2. Where appropriate, the following hierarchy of data sources was used:

1. UK toxicity reviews published by authoritative bodies including:
 - EA;
 - Public Health England (PHE);
 - Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT); and
 - Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC).
2. Authoritative European sources such as European Food Standards Agency (EFSA)
3. International organisations including:
 - World Health Organisation (WHO); and
 - Joint FAO/WHO Expert Committee on Food Additives (JECFA).
4. Authoritative country-specific sources including:
 - United States Environmental Protection Agency (USEPA);
 - US Agency for Toxic Substances and Disease Registry (ATSDR);
 - US Integrated Risk Information System (IRIS); and
 - Netherlands National Institute for Public Health and the Environment (RIVM).

Factors such as the applicability of the data to human health (e.g. epidemiological vs. animal studies), the quality of the data, the level of uncertainty in the results and the age of the data were also taken into account in the final selection. Details for specific substances are available on request.

MEAN DAILY INTAKES

Estimations of background exposure for each threshold substance have been updated. In line with the SR2 approach, the exposure from non-threshold substances in the soil does not take into account exposure from other sources, and as such GACs were derived without consideration of the Mean Daily Intake (MDI) for those substances.

The data published by the EA in its series of TOX reports between 2002 and 2009 was evaluated to determine whether the values were considered to remain valid today. Values from these current UK published sources were not amended unless they were considered to be significantly different so that the GACs remained as comparable as possible with the revoked SGVs.

ORAL MEAN DAILY INTAKES

Oral MDI were generally estimated as the sum of exposure via the ingestion of food and drinking water using the default adult physiological parameters presented in Table 3.3 of SR2.

Data on the exposure of substances from food ingestion was generally obtained from UK Total Diet Studies (TDS) published by the Food Standards Agency (FSA) and its predecessor the Ministry of Agriculture, Fisheries and Food (MAFF) and from studies commissioned by COT. Where no UK-specific data was available, MDI were derived from the European Food Safety Authority (EFSA), Health Canada and US sources. This was a rare occurrence, and in these instances, the data was evaluated to determine its applicability to the UK.

Data on the concentrations of substances in tap water was obtained from a variety of sources. UK data was used where available, with preference given to Drinking Water Inspectorate (DWI) 2014 data from water company tap water testing (LOD, 1st and 99th percentile data is available). Where the substance was not included in tap water testing, other UK sources of information were considered including:

- DWI data from water company tap water testing from previous years;
- COT; and
- FSA.

Where UK data was not available, a number of other data sources were considered, largely WHO International Programme on Chemical Safety (IPCS) Concise International Chemical Assessment Documents (CICADs) and background documents for the development of Guidelines for Drinking Water Quality, using professional judgement on the relevance of the data to the UK. The final decision on the MDI from drinking water was made using professional judgement on the balance of relevance and probability, taking into account the detection limit where not detected, Koc and solubility, reduction in use of the substance, banned substances, tight controls (e.g. on explosives) and with due consideration to the SR2 instruction that “if no data or information in background exposure are available, background exposure should be assumed to be negligible and the MDI set to zero....”.

Data from other countries was generally not used because it was considered that the hydrogeology of these countries along with industrial practices were unlikely to be reflective of the UK.

INHALATION MEAN DAILY INTAKES

Inhalation MDIs were based on estimates of average daily exposure by the inhalation pathway and calculated using the default adult physiological parameters presented in Table 3.3 of SR2.

The inhalation MDIs were generally estimated using background exposure data from the UK, derived from Defra's UK-AIR: Air Information Resource¹², which provides ambient air quality data from a number of sites forming a UK-wide monitoring network. The MDIs for heavy metals were based on rolling annual average metal mass concentration data from Defra's UK Heavy Metals Monitoring Network from the period October 2009 to September 2010¹³.

Information for some substances was obtained from UK sources including Environment Agency TOX reports and data from the UK Expert Panel on Air Quality Standards (EPAQS). Where recent UK data was not available, data was sourced from the International Programme on Chemical Safety (IPCS), the World Health Organisation (WHO), the Agency for Toxic Substances and Diseases Registry (ATSDR), Health Canada, and various other peer-reviewed sources summarised by LQM/CIEH¹⁴.

For other substances, where no data or information on background exposure was available, background exposure was assumed to be negligible and the MDI set at 0.5*TDI in accordance with guidance in SR2.

PLANT UPTAKE

Soil to plant concentration factors are available in CLEA v1.071 for arsenic, cadmium, hexavalent chromium, lead, mercury, nickel and selenium. For all remaining inorganic chemicals, concentration factors were obtained using the PRISM model. Substance-specific correction factors have been selected in accordance with the guidance established within SR3. This is consistent to the approach utilised in the derivation of the LQM S4UL and the EIC/AGS/CL:AIRE GAC.

Where there is a lack of appropriate data to enable the derivation of specific soil to plant concentrations factors for organic chemicals, plant uptake was modelled within CLEA v1.071 using the generic equations recommended within SR3, as follows:

- Green Vegetables – Ryan et al. (1988);
- Root Vegetables – Trapp (2002);
- Tuber Vegetables – Trapp et al. (2007); and
- Tree Fruit – Trapp et al. (2003).

There are no suitable models available for modelling uptake for herbaceous fruit or shrub fruit. Exposure is considered negligible.

¹² Crown 2016 copyright Defra via uk-air.defra.gov.uk, licenced under the Open Government Licence (OGL).

¹³ Defra, 2013 Spreadsheet of historic data for multiple years for the Metals network. Available online at: <http://uk-air.defra.gov.uk/data/metals-data>. [Accessed 13/03/2016].

¹⁴ LQM/CIEH, 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment.

SOIL SATURATION LIMITS

GACs are not limited to their theoretical soil saturation within CLEA, although where either the aqueous or the vapour-based saturation is exceeded, this is highlighted within the Workbook (compared with the lower of the two values). This affects pathways which depend on partitioning calculations so in reality this only affects the vapour pathways and is relevant to organic substances and other substances, such as elemental mercury, that have a significant volatile component. However, the Workbook highlights saturation for direct contact pathways to indicate to the user where further qualitative consideration of free phase contamination at the surface may be required.

Where the lower of the two saturation limits is exceeded and the vapour pathway is the only exposure route being considered, the chronic risks to human health are likely to be negligible. Further evaluation could be undertaken using an alternative model suitable for evaluating non-aqueous phase liquids (NAPLs), such as the Johnson & Ettinger (J&E) approach described in USEPA 2003. However, WSP considers that if NAPLs are suspected, given the known limitations and over-simplifications of J&E, soil vapour monitoring is a more accurate way of assessing potential risks.

Where the lower saturation limit is exceeded for the vapour pathway and a number of exposure routes are being considered, then the contribution from the NAPL via vapour inhalation to the overall exposure can be evaluated using the procedure provided in SR4. WSP would evaluate this as part of a DQRA process or through soil vapour monitoring on-site to determine site-specific soil vapour concentrations.

CHEMICAL SPECIFIC ASSUMPTIONS

CYANIDES

Cyanide has high acute toxicity, and short term exposure is an important consideration when assessing the risks from soils contaminated with cyanide. The primary risk to human receptors from free cyanide in soils is an acute risk.

There is no current UK guidance available for calculating acute risks from free cyanide. Consequently, GAC for acute exposure were derived using the algorithms presented in MADEP 1992¹⁵ and assuming a one-off ingestion of 10g of soil (this conservative value has been taken as an upper bound estimate for a one-off soil ingestion rate amongst children). Receptor body weights have been selected according to the critical receptor for each exposure scenario. The lowest of the chronic and acute GAC for each land use scenario were adopted by WSP.

LEAD

The SGV for lead was withdrawn by the EA in 2009, and in 2011 the EA withdrew their published TOX report in light of new scientific evidence. The C4SL for lead was derived using the latest scientific evidence from a large human dataset. As such, no chemical-specific margin was applied in the derivation of the C4SL for lead. It may be possible for WSP to derive a GAC for lead using the same dataset and applying a chemical-specific margin, but the value is likely to be lower than UK natural background concentrations. Therefore, WSP has adopted the toxicological data used to derive the C4SLs in deriving the GAC for lead until such time as alternative GACs are published by an authoritative body. The relative bioavailability was set at 100% in line with the approach taken for other GACs, whereas the C4SL assumes 60% for soil and 64% for airborne dust. Thus, the WSP GAC are lower than the C4SLs.

¹⁵ MADEP 'Background Documentation for the Development of an "Available Cyanide" Benchmark Concentration' 1992. http://www.mass.gov/dep/toxics/cn_soil.htm

POLYCYCLIC AROMATIC HYDROCARBONS

WSP's approach to the assessment of polycyclic aromatic hydrocarbons (PAHs) uses the surrogate marker approach. BaP was used as a surrogate marker for all genotoxic PAHs in line with the Health Protection Agency 2010¹⁶ recommendations and SP1010. This assumes that the PAH profile of the data is similar to that of the coal tars used in the Culp *et al* oral carcinogenicity study from which the toxicity data for BaP was produced. In reality, this profile has been shown by HPA to be applicable on the majority of contaminated sites based on assessment of sites across the country.

The alternative is the Toxic Equivalency Factor (TEF) approach which uses a reference compound and assigns TEFs for other compounds based on estimates of potency. Key uncertainties with this approach include the assumption that all compounds have the same toxic mechanism of action within the body and that no compounds with a greater potency than the reference compound are present. It is considered by the HPA that the TEF approach is likely to under predict the true carcinogenicity of PAHs and therefore favours the surrogate marker approach.

For these reasons, WSP considers that the adoption of BaP as a surrogate marker for genotoxic PAHs, as opposed to the TEF approach, is reasonable. In rare cases where the PAH profile may differ from the wide definitions of the Culp *et al* study the user should discuss their project with an experienced risk assessor. In addition, WSP has derived a GAC for naphthalene, which is commonly a risk driver due to its high volatility, relative to other PAH compounds.

TRIMETHYLBENZENES

The GAC for trimethylbenzenes can be used for the assessment of any individual isomer (1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene or 1,3,5-trimethylbenzene), or a mixture of the three isomers.

CHEMICAL GROUPS

For a number of chemical groups, the available toxicity data is for combinations of chemicals. Given that the physico-chemical parameters may differ between the chemicals, the GACs for the chemicals within the groups have been calculated and then the lowest GAC selected to represent the entire group. This was the approach taken by the EA for m-, o- and p-xylenes, and has also been adopted by WSP for:

- 2-chlorophenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol and 2,3,4,6-tetrachlorophenol;
- 2-, 3- and 4-methylphenol (total cresols);
- aldrin and dieldrin; and
- α - and β -endosulphan.

¹⁶ HPA Contaminated Land Information Sheet 'Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs) 2010

EXPOSURE TO VAPOURS

INHALATION OF MEASURED VAPOURS

WSP has derived a set of soil vapour GACs (GAC_{sv}) that allow for the assessment of measured site soil vapour concentrations, using J&E, in order to establish potential risks via indoor inhalation of vapours. This methodology enables a more robust assessment of exposure via the inhalation of soil vapours indoors than using CLEA-derived soil GAC, as it is based upon measured soil vapour concentrations beneath the site. It also allows for the assessment of vapours from all source terms (i.e. groundwater, soil or NAPL). Outdoor inhalation was not included. WSP considers that the indoor inhalation pathway is the significantly dominant risk-driver.

The generic land use scenarios within CLEA (residential and commercial) that were used to derive the soil GAC were used to define the receptor and building characteristics for the soil vapour GAC. Only residential and commercial generic land use scenarios include the indoor inhalation of vapours pathway.

The GAC_{sv} were derived for three different soil types; sand, sandy loam and clay, reflecting the importance of this parameter within the J&E model. A depth to contamination of 0.85 m below the base of the building foundation was assumed (i.e. 1 m below ground level). This differs from the depth assumed for the soil GAC (0.5 m bgl), but was selected by WSP as a reasonable worst case scenario.

It is acknowledged that the J&E commonly over-predicts indoor vapour concentrations. In particular, it will significantly over-predict vapour concentrations for suspended floor slabs, which many new builds are constructed with, it does not take into account lateral migration and assumes an infinite source of contamination at steady state conditions. In addition, it is common for soil gas/vapour wells to be installed with at least 1 m of plain riser at the surface and this equates to a total depth of 0.85 m below the building foundation plus a 0.15 m thick foundation, and so is more representative of the depth that samples will be taken from.

The TDSIs and IDs for each substance were converted from $\mu\text{gkg}^{-1}\text{bwday}^{-1}$ to μgm^{-3} using the standard conversions quoted in Table 3.3 of SR2, thereby replacing the need to model C_{air} in the equation:

$$C_{air} = \alpha \cdot C_{vap} \cdot 1,000,000 \text{cm}^3 \text{m}^{-3}$$

Where:

C_{air} is the concentration of vapours within the building, mgm^{-3}

α is the steady state attenuation coefficient between soil and indoor air, dimensionless

C_{vap} is the soil vapour concentration, mgcm^{-3}

The target concentrations within indoor air for each substance (C_{air}) are a function of receptor inhalation rates and occupancy periods, as defined by the site conceptual exposure model (assuming standard CLEA occupancy periods and receptors).

The attenuation factor was calculated using J&E (Equation 10.4 in SR3) and the resulting C_{vap} is equivalent to the GAC_{sv} for the modelled exposure scenario.

Where reported soil vapour concentrations exceed the relevant saturated vapour concentration, free product may occur, and the user should discuss their project with an experienced risk assessor.

INHALATION OF GROUNDWATER-DERIVED VAPOURS

WSP has derived a set of groundwater GACs (GAC_{gw}) to evaluate the potential risks through the indoor inhalation of groundwater-derived vapours by first applying the approach described above for the derivation of the WSP GAC_{sv} to determine the acceptable concentration in soil vapour directly above the water table.

The depth to groundwater was assumed to be 1 m bgl (i.e. 0.85 m below the base of the building foundation). This depth was considered to be more representative of commonly encountered groundwater conditions than the 0.5 m below the base of the building foundation (i.e. 0.65 m bgl) that is used by CLEA for an unsaturated source present in the overlying soil.

The GAC_{gw} was then back-calculated from the GAC_{sv} using the air-water partition coefficient (K_{aw}) for each substance.

The WSP Groundwater Vapour GAC are protective against a dissolved phase contaminant source only. If the presence of NAPL is suspected, the risks from this source will need to be assessed. Where reported groundwater concentrations exceed the relevant solubility limit, free product may occur, and the user should discuss their project with an experienced risk assessor.

Appendix F

LIMITATIONS





REPORT LIMITATIONS - GROUND RISK AND REMEDIATION

GENERAL

1. WSP UK Limited has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report.
2. Unless explicitly agreed otherwise, in writing, this report has been prepared under WSP UK Limited standard Terms and Conditions as included within our proposal to the Client.
3. Project specific appointment documents may be agreed at our discretion and a charge may be levied for both the time to review and finalise appointments documents and also for associated changes to the appointment terms. WSP UK Limited reserves the right to amend the fee should any changes to the appointment terms create an increase risk to WSP UK Limited.
4. The report needs to be considered in the light of the WSP UK Limited proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report and any previous works referenced within the report.

PHASE 1 GEO ENVIRONMENTAL AND PRELIMINARY RISK ASSESSMENTS

Coverage: *This section covers reports with the following titles or combination of titles: phase 1; desk top study; geo environmental assessment; development appraisal; preliminary environmental risk assessment; constraints report; due diligence report; geotechnical development review; environmental statement; environmental chapter; project scope summary report (PSSR), program environmental impact report (PEIR), geotechnical development risk register; and, baseline environmental assessment.*

5. The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walk over inspection of the Site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. WSP UK Limited cannot be held responsible for any disclosures that are provided post production of our report and will not automatically update our report.
6. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, WSP UK Limited reserves the right to review such information and, if warranted, to modify the opinions accordingly.
7. It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the site.
8. WSP UK Limited does not warrant work / data undertaken / provided by others.



REPORT LIMITATIONS - GROUND RISK AND REMEDIATION

INTRUSIVE INVESTIGATION REPORTS

Coverage: *The following report titles (or combination) may cover this category of work: geo environmental site investigation; geotechnical assessment; GIR (Ground Investigation reports); preliminary environmental and geotechnical risk assessment; and, geotechnical risk register.*

9. The investigation has been undertaken to provide information concerning either:
 - i. The type and degree of contamination present at the site in order to allow a generic quantitative risk assessment to be undertaken; or
 - ii. Information on the soil properties present at the site to allow for geotechnical development constraints to be considered.
10. The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.
11. For contamination purposes, the objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters.
12. For geotechnical investigations the purpose is to broadly consider potential development constraints associated with the physical property of the soils underlying the site within the context of the proposed future or continued use of the site, as stated within the report.
13. The amount of exploratory work, soil property testing and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the Site, and as such can only provide a general indication of conditions.
14. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, 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.
15. The inspection, testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. As part of this assessment, WSP UK Limited has used reasonable skill and care to extrapolate conditions between these points based upon assumptions to develop our interpretation and conclusions. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation. Conditions can change between investigation points and these interpretations should be considered indicative.
16. The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated



REPORT LIMITATIONS - GROUND RISK AND REMEDIATION

with the WSP UK Limited risk assessment process have been outlined within the body or associated appendix of the report.

17. Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.
18. Where soil contamination concentrations recorded as part of this investigation are used for commentary on potential waste classification of soils for disposal purposes, these should be classed as indicative only. Due consideration should be given to the variability of contaminant concentrations taken from targeted samples versus bulk excavated soils and the potential variability of contaminant concentrations between sampling locations. Where major waste disposal operations are considered, targeted waste classification investigations should be designed.
19. The results of the asbestos testing are factually reported and interpretation given as to how this relates to the previous use of the site, the types of ground encountered and site conceptualisation. This does not however constitute a formal asbestos assessment. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and / or trace loose asbestos fibres within the soil matrix at the site.
20. If costs have been included in relation to additional site works, and / or site remediation works these must be considered as indicative only and must be confirmed by a qualified quantity surveyor.

EUROCODE 7: GEOTECHNICAL DESIGN

21. On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 1) became the mandatory baseline standard for geotechnical ground investigations.
22. In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. The report is likely to represent a Ground Investigation Report (GIR) under the Eurocode 7 guidance.

DETAILED QUANTITATIVE RISK ASSESSMENTS AND REMEDIAL STRATEGY REPORTS

23. These reports build upon previous report versions and associated notes. The scope of the investigation, further testing and monitoring and associated risk assessments were selected on the basis of the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.



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