AVISON YOUNG

Environmental Statement Addendum Volume 3: Appendices

Red Bank Neighbourhood, Victoria North, Manchester

Creation of Future Development Platforms and Green Infrastructure

April 2022

Environmental Statement Volume 3 - Appendices

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Appendix 8.1a

Ground Conditions Desk Based Assessment

FEC

Northern Gateway

Ground Conditions Desk Study

MNG-ARP-SW-RP-CG-102

Issue | 15 August 2019

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 257920-00

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1 Introduction

1.1 Commission

Ove Arup and Partners Ltd (Arup) has been commissioned by the Far East Consortium (FEC) to provide engineering support to assist in assessing the feasibility of redeveloping an area of land located in north-east Manchester, known as Northern Gateway. Arup's commission includes the provision of engineering support and identifying constraints and opportunities to assist in refining the masterplan and development options and supporting the development of a cost plan as part of a wider team.

1.2 Scope

The objectives of this desk study are to review existing readily available data and information for the site and its immediate area and highlight specific site conditions and geotechnical and geoenvironmental constraints that may affect the proposed development. An initial assessment of the ground related hazards and their implications for the proposed development has been undertaken to input into a cost plan and the development of a site masterplan being prepared by others. Recommendations have been presented for further assessment of these hazards and constraints in the future to verify the assumptions made and refine cost estimates.

1.3 Sources of information

The following sources of information has been reviewed as part of this desk study:

- Published geological information (BGS);
- Information obtained as part of an earlier intrusive ground investigation by AEG in 2019.
- Historical ground investigation data provided by the client team, and
- Groundsure reports including historical mapping and environmental data.

Details of the sources used are indicated in subsequent sections and are provided in the references section.

Supporting information has been included in the appendices where appropriate.

1.4 Report structure

This report has the following structure:

- Section 2: Provides a description of the site in its current condition;
- Section 3: Documents the known site history
- Section 4: Summarises a previous ground investigation undertaken in 2019

- Section 5: Outlines the ground conditions and environmental setting of the site
- Section 6: Discusses the proposed development and assumptions made at this stage of optioneering;
- Section 7: Provides a summary of the key geotechnical constraints identified in relation to the proposed development;
- Section 8: Develops a conceptual site model of the site
- Section 9: Provides a summary of the environmental risk assessment
- Section 10: Concludes findings within this report and recommendations for subsequent works.

1.5 Use and limitations of this report

This report was prepared by Arup on behalf of the FEC in connection with their Northern Gateway site. It also takes into account our Client's particular instructions and requirements and addresses their priorities at the time. This report was not intended for, and should not be relied on, by any third party and no responsibility is undertaken to any third party in relation to it.

All reasonable skill, care and diligence have been exercised within the timescale available and in accordance with the technical requirements of the brief.

This report has been produced from a large volume and variety of data sources. Certain data gaps have been identified and are documented within Section 10 but include ground investigations and site surveys. Assumptions have been made which will require further validation and these are presented within Sections **Error! Reference source not found.**. Notwithstanding the efforts made by the professional team in preparing the report it is possible that other ground contamination or conditions as yet undetected may exist and consequently reliance on this report must be limited accordingly.

2 Site Description

2.1 Site location and extent

The full Northern Gateway area comprises approximately 155 hectares of land to the north-east of Manchester city centre. The site covered by this report is the first phase of the Northern Gateway development and is situated in the southern part of the larger site. The site is in an area known as Red Bank. The site measures approximately 12.4ha and is centred at National Grid reference SJ8461 9954.

The site is bound to the east by Collyhurst Road; to the south by the Hope Valley Line railway viaduct; to the northwest by Red Bank Street and for alignment of the disused Red Bank Viaduct adjacent to Collingham Street, and to the northeast by an historical pedestrian railway bridge. The River Irk and Dantzic Street run through the site. The approximate site boundary is presented in

Figure 1.



Figure 1: Site Location

For the purposes of this report, the site has been divided into four development zones, shown in Figure 2: Red Bank North (north-western area, located on a

topographical high); Red Bank Central (central plot, adjacent and west of the River Irk); Red Bank South (south-western area adjacent to the NR viaduct), and Red Bank East (central plot, adjacent and east of the River Irk, comprised of two plots split by Warford Street). These zones represent the areas proposed for development.

The remaining areas within the red line boundary comprise an existing railway viaduct in the southern part of the site (Red Bank Viaduct), which is to be retained as part of the development, and an area of woodland in the north-eastern part of the site called St. Catherine's Wood, which is also to be retained. The remaining areas comprise steep vegetated slopes.



Figure 2: Site development zones: Yellow (Red Bank North), Blue (Red Bank Central), Orange (Red Bank South) and Green (Red Bank East).

2.2 Topography

The topography of the site has been interpreted from 1m resolution government LiDAR data [1]. The site is spread across a valley, with topographical highs in the north and south-east of the site and a topographical low represented by the River Irk. The River Irk runs from north-east to south-west through the site, from 30mOD to 26.8mOD. Red Bank North is located on a topographical high which slightly slopes south-west, with elevations of 43.3mOD in the north-east to

40.5mOD in the south-west. It is bound by a steep slope along its southern flank, and slopes and retaining walls along its northern edge. Red Bank Central and East are at similar elevations of 30.2mOD to 31.4mOD. Red Bank South is relatively flat with an elevation of 29mOD. A more detailed 3D topographical survey of the site would be recommended.

2.3 Current site usage and key site features

The majority of Red Bank North is currently vacant land. The north of this area is comprised of tarmac and light vegetation, and the south is covered with dense vegetation. Historical rail features have been observed in this zone, such as the structure of a rail turn-table in the centre of the zone. A small spur of land is attached to this zone, which is the route of a proposed new access road into the site. This spur is on land currently occupied by Creamline Dairies. In the far south of this zone is a disused railway viaduct, Red Bank Viaduct, which is overgrown on the top but has small businesses operating from the arches beneath.

Red Bank Central is comprised of multiple independently-owned car parking businesses.

Red Bank South comprises a gated building and associated car park and is occupied by The Game Larder (GLM Foods). The site is constrained by two Network Rail viaduct structures, an active viaduct to the south and the disused Red Bank viaduct to the north. The River Irk runs in a covered culvert adjacent to and partially under the live viaduct to the south.

Located in the south-west of Red Bank East is a travellers site. The north-east of this zone comprises a large building occupied by Theo's Timber. Both these sites back on to retaining walls adjacent to the River Irk.

2.4 Utilities and drainage

The existing site utilities and drainage have been reviewed by Arup as part of a study to support the submission of a Housing Infrastructure Fund application for Northern Gateway. The study identified maximum utility demands anticipated for the developments within the Red Bank area for electricity, gas, potable and foul water, to determine the likely network requirements required to support the proposed scheme [18]. A report on SuDS drainage has also been developed for the scheme [19].

3 Site History

The history of the site has been summarised below based on historical mapping, aerial photography and satellite imagery. The following information has been reviewed:

- Published Ordnance Survey (OS) mapping dating from 1848 to 1992 obtained from Groundsure [2];
- Aerial photographs sourced from Historic England [6] and
- Satellite imagery from Google Earth.

Review of the data has identified an industrial history dating back to the 1840's. Since the 1840's, the River Irk's flow path has been modified and minor channels infilled, and the north of the site has seen large scale earthworks and raising of ground levels.

3.1 Red Bank North

In 1848, the River Irk meandered into the north east of this zone. A divergent channel, off the River Irk, also flowed through the east/south of this zone, re-joining with the River Irk within Red Bank Central further downstream. In the west of Red Bank North, a small stream ran through the area, from north to south, and two large reservoirs were also present in the west of the zone. The ground level in 1848 appeared to be continuous with the River Irk, and no steep banks were indicated. The Collyhurst Dye Works were located partially within the north of this zone. No rail infrastructure is evident in 1848.

In 1891, there was large-scale re-development of this zone including significantly raised ground levels, resulting in the steep banks running along the southeast of the zone today, and installation of rail sidings, a viaduct and buildings across the entire zone. The River Irk was also diverted to its current alignment (east of the site boundary). Since 1891, development within Red Bank North has included a small gasworks (likely to have been associated with the railway, to produce gas for lighting railway carriages) which included two gasometers shown on the 1906 mapping, and the infilling of the two western reservoirs. By 1992, most of the rail sidings had been removed, and by 2000, all rail infrastructure had been removed. The land is now largely vacant and overgrown.

3.2 Red Bank Central

From 1848 to 2013, Red Bank Central has had a wide variety of industrial uses including: plate works, dye works, chemical works, a metal foundry, glass works, timber works and scrap yards. There is indication of residential properties in the north of this area prior to the 1938 map. The land is now predominantly used for car parking.

3.3 Red Bank South

The zone was already fully developed with unlabelled development on the earliest 1848 map. Since 1892, Red Bank South has been the location of industries including: an oil works, tannery, print/dye works, joinery works, engineering works, iron works and garage. A subway is marked on historical mapping in the 1930s, which appeared to pass under the railway viaduct, but no evidence of this feature is now visible within the site. The site is now occupied by a commercial property and some small businesses occupy the railway arches under Red Bank Viaduct.

3.4 Red Bank East

The site was developed with unlabelled development, possibly residential, on the earliest 1848 map. In 1891, two large gasometers (associated with the nearby Rochdale Road Gas Works) were developed in the west of this zone. These gasometers are indicated on the 1964 map but were no longer shown on 1972 mapping, and the land left vacant until around 2000, at which point it became a travellers site. Residential property and a rope walk occupied the land in the east of this zone until the 1933 mapping, after which a large garage was constructed. This property is now occupied by Theo's Timber.

3.5 Summary of site history for each date of mapping

A more detailed summary of the site history is presented in Table Error**! Unknown switch argument.** below. The mapping with overlaid boundaries of the zone locations is presented in Appendix A:

Table **Error! Unknown switch argument.**: Summary of site history (See Figure 2 for zone locations)

Map	Observations
1848 Ordnance Survey 1:10,560	Red Bank North: mainly comprises fields. The River Irk meanders into the zone in the north, and splits with a minor river running along the southern edge of the zone. The Collyhurst Dye Works is located in the north of the site, to the east of Red Bank North, and Travis Isle Corn Mill is located in the area known as St. Catherine's Wood today. In the south-west of the North zone are unidentified works, with two water bodies. The eastern linear area comprises residential property. Red Bank Central: comprised of small densely packed unidentified buildings, possibly residential and small factories. Red Bank South: comprised of small densely packed unidentified buildings and tanks, possibly tanneries. Red Bank East: comprised of long unidentified buildings, likely to be residential.

Map	Observations
1891 Ordnance Survey 1:10,560	Red Bank North: All but the south of the zone is occupied by rail sidings. A rail turn-table is present in the south of the zone. A large carriage shed is present in the north, and some smaller buildings are present in the south. The River which ran via Travis Isle Mill has been infilled to St. Catherine's Wood. Red Bank Central and South: No data Red Bank East: Two large gasometers now make up the south-west of the site (south-west of Warford Street), labelled Rochdale Road gas works.
1892 Ordnance Survey 1:2,500	Red Bank North, Central and East: No Data Red Bank South: A tannery is located in the south-west of the zone.
1893 Ordnance Survey 1:2,500	Red Bank North: the area is occupied by railway sidings, a large carriage shed and other smaller buildings. In the south of this zone some unidentified buildings are present. Travis Isle Mill, a school and a church are present to the south of this zone, in the area which is now St. Catherine's Wood. Red Bank Central: a dye works and chemical works are located within this zone. Red Bank East: the area of land north of Warford Street is occupied by residential properties. Red Bank South: no data.
1906-1908 Ordnance Survey 1:10,560	Red Bank North: Two small gasometers and a gasworks are shown in the north-eastern corner of the zone. More railway lines have been laid within this zone and a fireproof plate works is located in the far south. The spur is occupied by residential properties. Red Bank Central: The north and east of the zone is comprised of works (fireproof plate works, dye works (labelled as disused), chemical works), the west remains residential. Red Bank South: A large iron works (Union Bridge Iron Works) is labelled to the north of this zone but it is possible the works extend into this zone. Red Bank East: a rope walk is shown behind the residential buildings in the eastern part of this zone. The Gasometers are still shown in the west.
1922 Ordnance Survey 1:2,500	Red Bank North: Few significant changes. Removal of some structures from west of zone, removal of reservoirs and extension to fill platform. Red Bank Central: Demolition of the disused dye works Red Bank South: Removal of former structures within this zone. Red Bank East: Removal of some of housing within the eastern part of this zone.
1931 Ordnance Survey	Red Bank North: Few changes from 1922.

Map	Observations
1:10,250 & 1: 2,500	Red Bank Central: Works have changed and now comprises a metal foundry and glass works. Red Bank South: Several new small structures present. Re Bank East: No significant changes.
1933 Ordnance Survey 1: 10,560 & 1: 2,500	Red Bank South: A joinery works and subway are shown in this area. The Union Bridge iron works is still shown to the north but no longer extends inside this zone. No significant changes in other zones.
1949 Ordnance Survey 1: 2,500	Red Bank North: Few significant changes Red Bank Central: A timber works, Metal Foundry and Glue works are now present. The residential properties have been removed. Red Bank East: The housing has been removed and replaced by a large single building (garage) Gas holders labelled as 'Rochdale Road Gasworks'. Red Bank South: Subway no longer indicated. Two small works, an engineering works and Spring and Axle works present in part of zone.
1952 Ordnance Survey 1:2,500	Red Bank North: Carriage shed no longer present. Red bank Central: An additional structure is indicated in north west of zone. Red Bank East: No significant changes. Red Bank South: No significant changes
1964 Ordnance Survey 1:1,250	Red Bank North: No significant changes. Red bank Central: Former timber yard is now a depot. Crane is situated on former vacant land Red Bank East: No significant changes. Red Bank South: Some additional small structures present.
1972 Ordnance Survey 1: 10,000	Red Bank East: The two large gasometers have been removed and the land left vacant. No significant changes to other zones.
1990 Ordnance Survey 1: 2,500	Red Bank North: the two small gasometers in the north-east of the site have been replaced by a depot.
1992 Ordinance Survey 1: 2,500	Red Bank South: A garage now occupies the zone.
2000 Google Earth Imagery	Red Bank North: All rail sidings have been removed and the area has been cleared. Red Bank Central: Comprises a car park and two buildings. Red Bank South: single building and car park.

Map	Observations
	Red Bank East: The land where the gasometers were located is now occupied by caravans.
2009 Google Earth Imagery	Red Bank North: The south of the area has become densely vegetated. Red Bank Central: a building has been removed and the land made into a car park. Scrap yards are present in the north of this zone.
2018 Google Earth Imagery	Red Bank Central: There are buildings in the south-east and north of this zone. The area is mainly used for car parking, with scrap yards in the north.

4 Ground Investigations

4.1 Historical ground investigation data

The following data has been reviewed and used to inform the ground conditions section of this desk study (see Section 5). The locations of the data points are shown in Figure 3.

4.1.1 BGS borehole records

The BGS holds records of historical boreholes drilled in the area of the site, of which many are confidential and the detail cannot be viewed. However, two records lie within the site boundary itself (both of which are in the Central zone), together with over 20 publicly-available records from the area immediately surrounding the site. These records have been reviewed as part of this desk study. The boreholes were drilled to depths ranging between 4.1 and 117m.

4.1.2 Other investigations

The records of other ground investigations within, or close to, the site have been reviewed, including:

- Planning application 066297/Site Ref. 110 Cheetham Hill Road. Geotechnical Developments (UK) Ltd 1998 Factual Report on Ground Investigation at Cheetham Hill, Strangeways, Manchester, included three records possibly within the boundary of Red Bank South, which confirmed the presence of made ground over alluvial deposits. Bedrock was sandstone. Groundwater was found to contain hydrocarbons. Planning records confirm that hydrocarbon contaminated soils were removed from an area outside the site boundary in 2003 as part of new residential development on Cheetham Hill Road, which may have had a positive impact on groundwater quality within Red Bank South;
- WSPE (2010) Due diligence assessment, Dantzic Street, Manchester. Prepared for Network Rail. The investigation comprised six windowless sampling boreholes up to 6m bgl in the eastern part of Red Bank East (Theo's Timber site). Made ground was encountered over Glacial Till and bedrock of mudstone (Manchester Marl) and sandstone (Collyhurst Sandstone). Three trial pits were also dug on land to the north, locations not specified but possibly in the St. Catherine's Wood area. Note this report identifies that the Theo's Timber building has a basement;
- Planning application 082285 Fairholme caravan park, forms part of the northern boundary of Red Bank North. Made ground was proven up to a maximum of 12.2m, together with elevated methane and carbon dioxide in the ground, believed to be migrating from the adjacent Queens Road Tip landfill;
- Planning application 083788 Irish World Heritage Centre, Queens Road. Investigation of former landfill site (Queens Road landfill) which is located on the northern site boundary. The investigation confirmed made ground up to

10.2m thickness, together with elevated methane and carbon dioxide concentrations in the ground, and hydrocarbon contamination believed to be associated with a former petrol station and garage. A remediation strategy was approved for implementation during construction of the Irish World Heritage Centre, but no record of validation is available.

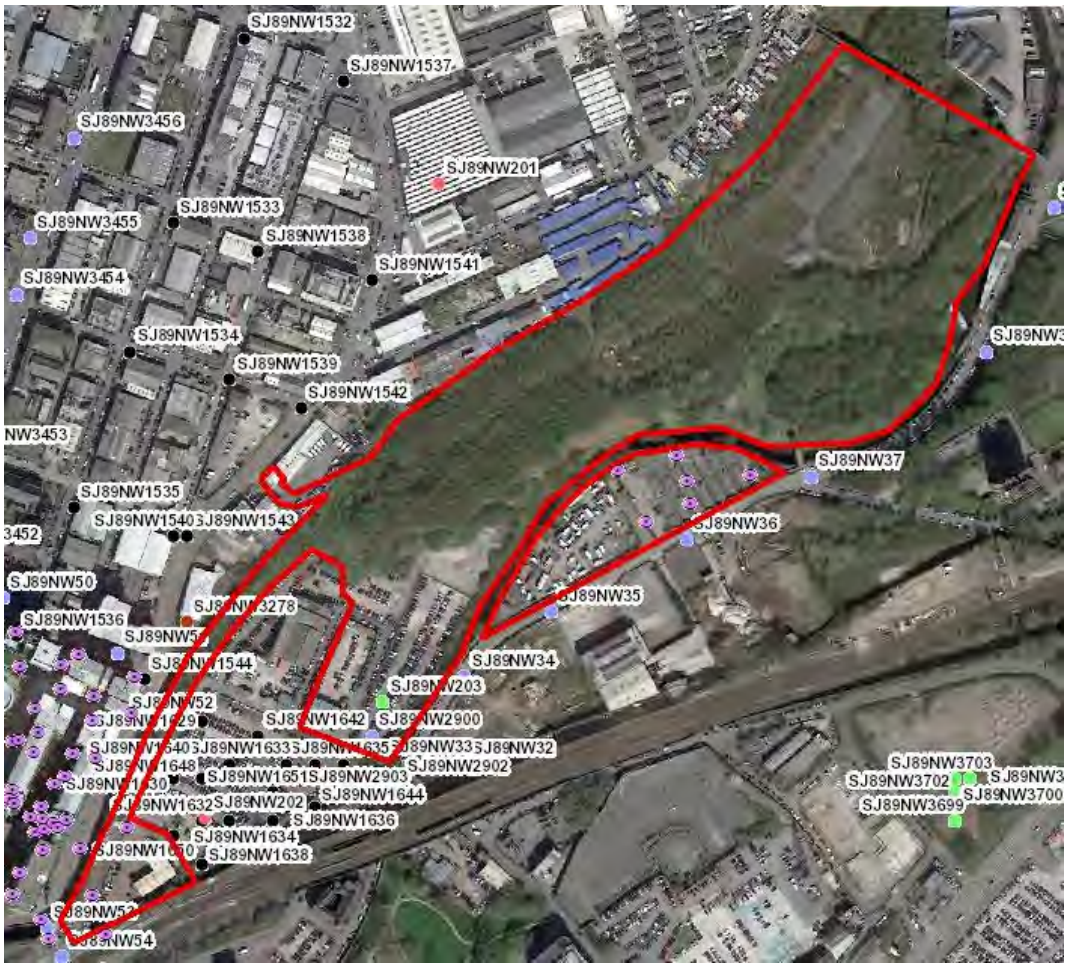


Figure 3 Locations of BGS boreholes (labelled) and other investigation records

4.2 2019 AEG ground investigation

A ground investigation was undertaken within the site during January 2019 by contractor AEG on behalf of FEC. The investigation was designed to provide information on ground conditions within the site boundary to inform a high-level cost plan for the proposed Northern Gateway development.

The investigation included 37 intrusive locations (as shown in Figure 4 and summarised in Table 2); soil testing, summarised in Table 3; and groundwater monitoring across seven locations between 07/01/2019 and 24/01/2019 (Table 4).

No rotary coring was conducted as part of this work therefore penetration into rockhead was limited. This should be conducted in any further GI stages.



Figure 4: Locations of AEG's 2019 ground investigation

Table 2: 2019 AEG ground investigation summary table

Ground investigation technique	Quantity (Nr)	Installation (Nr)	Maximum Depth (mbgl)	Average depth (mbgl)
Cable-percussion borehole	10	7 (Groundwater)	15	8.1
Trial Pit	21	N/A	5.45	4.9
Window-Sample Borehole	6	N/A	4.5	3.5

Table 3: 2019 AEG soil geochemical testing summary

Geochemical Testing	Samples Tested
Asbestos	56
Metals and metalloids (As, Be, Cd, Cr, Cr (VI), Cu, Hg, Ni, Pb, Sb, Se, V, Zn)	64
Phenol	3
Free cyanide	64
TPH-CWG (aliphatic and aromatic speciation)	59
PAH (US EPA Priority 16)	57

VOC and SVOC	5

Table 4: 2019 AEG groundwater monitoring summary

Monitoring well ID	Monitoring dates	Average GW level (mAOD)
BH101	7th, 8th, 9th, 24th January 2019	38.49
BH102	7th, 8th, 9th, 24th January 2019	Wet at tip
BH103	8th, 9th, 24th January 2019	40.01
BH104	9th, 24th January 2019	33.07
BH105	9th, 24th January 2019	36.15
BH106	9th, 24th January 2019	Dry
BH112	11th, 24th January 2019	Dry

Groundwater levels were only recorded at four locations. All groundwater monitoring wells are in the North, and groundwater depths ranged from 32.64 to 41.66mAOD. These groundwater levels may represent perched water and therefore subsequent GI installations and monitoring over a range of isolated depths is recommended.

5 Ground Conditions and Environmental Setting

5.1 Geology

The following sources of information have been reviewed:

- British Geological Survey (BGS) GeoIndex online viewer
- Groundsure GeoInsight report [3] which included 1:10,000 and 1:50,000 geological maps;
- BGS map sheet SJ89NW [7];
- Historical ground investigation data and reports from the planning portal, and
- AEG's 2019 ground investigation data.

5.1.1 Superficial deposits

The 1:10,000 scale geological map indicates that Glacial Till underlies the site in the area south-east of the River Irk and along the north-western site boundary. Although not indicated, it was assumed that alluvial deposits are found in association with the River Irk running NE-SW through the centre of the site.

The 2019 ground investigation identified Glacial Till in the north and west of the site. The Glacial Till was thickest in the north and pinched out towards the south west. Glacial Till was generally absent south of the River Irk, with made ground directly overlying bedrock. Alluvium was encountered in St. Catherine's Wood and other locations located close to the River Irk.

5.1.2 Solid geology

The bedrock varies from east to west across the site, which has also been proven with available ground investigation data. The Chester Pebble Beds Formation makes up the west of the site; The Manchester Marls Formation makes up the centre of the site; and the Collyhurst Sandstone Formation makes up the north-eastern corner of the site [7]. All three units are shown on mapping to be gently dipping (5 degrees) SSW although there is insufficient GI available to confirm this.

A fault, trending NNW-SSE, cuts across the centre of the site, within the Manchester Marl Formation. The BGS map indicates that this is a normal fault, downthrown to the west, with limited displacement.

5.1.3 Coal mining

A Coal Authority mining report was obtained for the entire Northern Gateway area from Groundsure [3]. This reports that the site is within an area affected by past coal mining at depth, with the last date of working being 1967. The depth to the worked seams is quoted as between 110m and 970m, but within the Red Bank

area specifically, data from other sources [14] indicates that the depth to worked seams is around 300m to 700m. No mine entries are recorded within the site boundary and no historical shallow mineworkings.

5.1.4 2019 AEG ground investigation

In January 2019, AEG completed a ground investigation within the Red Bank area (summarised in Table 2 above). The ground conditions from the 2019 investigation have been summarised in Table 5 below. It should be noted that differentiation between Alluvium, Glacial Till deposits, and weathered bedrock proved challenging and multiple lithologies were often logged for single strata (refer to factual report presented in Appendix B).

Table 5: Ground conditions summary (from 2019 ground investigation)

Stratum	Thickness (range) (m)	Typical thickness (m)	Top of strata (mbgl)	Description and distribution
Made ground	0.8 – 10	3.3	0	Grey brown fine to coarse sand and gravel with high cobble contents. Includes sandstone, limestone, concrete, brick and clinker.
Alluvium	0.5 – 6.2	2.5	2.4	Soft brown very sandy slightly gravelly clay. Gravel is firm to medium sub-rounded sandstone and mudstone Located adjacent to the River Irk, in St. Catherine's Wood and in Central. Also present in the south-west of North.
Glacial till deposit	0.5 – 3.9	2.4	2.5	Firm brown very sandy slightly gravelly clay with interbeds of sand. Located in North and Central, pinching out towards the south-west. Generally absent south of the River Irk, expect at high elevations (e.g. in the west of New Town)
Bedrock	Not proven	N/A	4.8 – 10.8	Chester Pebble Beds Formation: Very weak to weak red fine to coarse grained partially weathered sandstone Manchester Marl Formation: Extremely weak red brown slightly sandy calcareous mudstone Collyhurst Sandstone Formation: Extremely weak to very weak red fine to coarse grained sandstone with occasional lenses of red marl

				Generally, ~5mbgl. Found at >10m depth in the south-west of Red Bank North.

As can be seen in Table 5 and Figure 5 there is significant variation across the site. Made ground thickness was found to be highly variable, with a maximum thickness of 10m (in the south-west of Red Bank North). The 2019 ground investigation indicates that the entire site is likely underlain by made ground.

Alluvial deposits comprised of sandy gravelly clay have been found in association with the River Irk in St. Catherine's Wood and the south-west of North. They are typically 2.5m thick and found at 2 – 3mbgl.

Glacial Till is extensive across the north and west of the site. It is typically 2.4m thick and found at 2.5mbgl. It has a limited lateral extent and pinches from NE to SW, becoming absent south-west of Central. South of the River Irk it was only identified at high elevations in the west of New Town.

Three lithological units comprise the bedrock across the site. The depth to bedrock was identified to be between 4.8 – 10.8mbgl but is typically ca. 5mbgl. The upper layer of the bedrock was found to be highly weathered.

Two indicative cross sections indicating a summary of the inferred geology are shown in Figure 5.

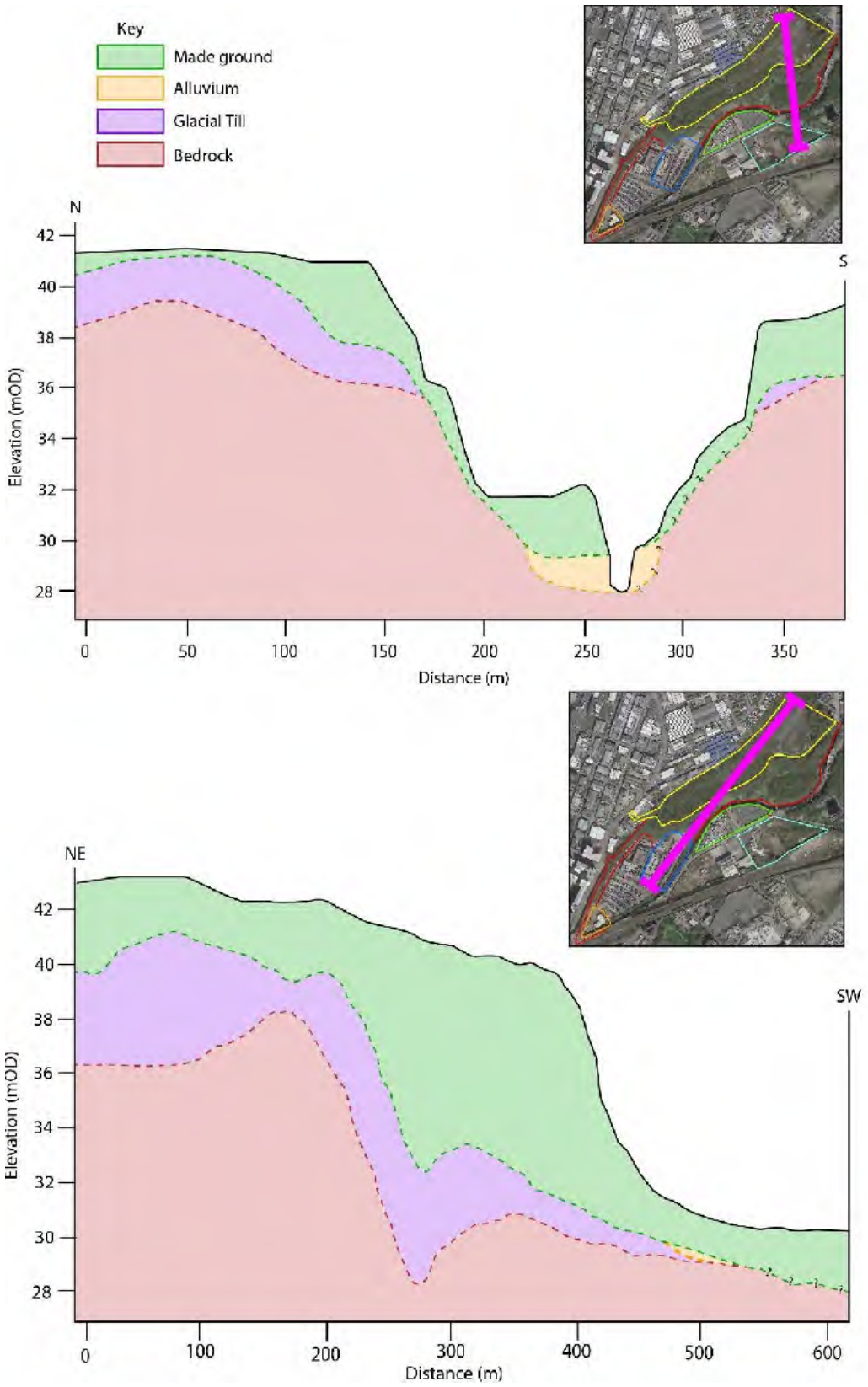


Figure 5: Inferred geological cross sections across the Northern Gateway site. Top image: N-S orientation, Bottom image: NE-SW orientation.

5.2 Hydrogeology & hydrology

The superficial geology within the site is classified as a Secondary (A) Aquifer (Undifferentiated). There is small area in St. Catherine's Wood which is classified as a Secondary (A) Aquifer (Permeable layers), associated with Alluvial deposits. Secondary Aquifers are defined as permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.

The Manchester Marl bedrock is classified as a Secondary (B) Aquifer – Lower Permeability Layers, whereas the Chester Pebble Beds Formation and Collyhurst Sandstone Formation are classified as Principal Aquifers. Principal Aquifers are defined as geology of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale.

No Source Protection Zones are located within 500m of the site. Four abstraction wells are present within 500m of the site (to the west).

5.3 Flooding

The Red Bank Central, South, and East zones are within a Zone 2 Floodplain, and the land immediately adjacent to the River Irk is a Zone 3 Floodplain.

A hydraulic modelling exercise for the proposed development has been undertaken by Arup [15] which has identified that Scotland Street weir, located outside the south-west of the site, acts as a flow limiting location during flooding, causing flooding upstream. It was recommended that the weir be removed and the river bed level regraded along a 460m stretch upstream of the weir, to protect against flooding.

5.4 Environmental permits & incidents

There are nine on-site locations with existing licensed discharge consents (sewage discharge) along the River Irk. There are further discharge consents (sewage discharge) along the River Irk within 250m of the site boundary. There are multiple recorded pollution incidents (involving asbestos) on Honey Street, immediately north of the site boundary.

5.5 Landfills

5.5.1 Queens Road Tip

Queens Road Tip immediately borders the Red Bank North zone. The Queens Road Tip site was originally excavated for brick making, then a planning consent was granted in 1948 for private tipping on the site. Manchester Council acquired the site in 1954 for domestic tipping purposes. The site was permitted to receive inert, industrial, commercial, household, special and liquid sludge waste.

Landfilling by Manchester Council was carried out between 1960 and 1972, with a reported depth of tipping up to 45 feet (13.7m).

Site investigations carried out for planning application 082285 (Fairholme caravan park) and 083788 (Irish World Heritage Centre) proved made ground up to a maximum of 12.2m, together with elevated methane and carbon dioxide in the ground [14].

5.5.2 Sand Street landfill

Sand Street landfill is located approximately 50m east of the site boundary and was part of a former quarry filled before 1974. The nature of the fill placed within the landfill is not known, but reportedly the made ground has a maximum depth of 22m [14]. The land was later used for industrial purposes and remediation carried out for use of the site as public open space included the installation of a cut-off trench and topsoil capping.

5.5.3 Fitzgeorge Street landfill

This landfill is located approximately 150m east of the site boundary. The landfill was completed prior to 1974 and no details of the waste type are known. The site is now used as public open space [14].

5.6 Unexploded Ordnance (UXO)

A preliminary UXO risk assessment report was obtained for the site and was prepared by Dynasafe BACTEC Ltd [8]. The report indicates that as Manchester was a bombing target during WWII the entire of Manchester, including the site, potentially has a medium UXO risk.

A similar medium UXO risk was identified from the online UXO risk map provided by Zetica [9]. The Zetica risk map also identified two Luftwaffe bombing targets onsite, the large historical gasometers in Red Bank East, and the land in Red Bank Central. A map of recorded bomb damage in Manchester [10] shows seven recorded bomb strikes within the site boundary, five of which are concentrated on the gasometers formerly present in Red Bank East, off Dantzic Street. Given the heavy industrial usage of the site pre war and the proximity to Victoria Station the areas are very likely to have been targeted and there is the potential for further unrecorded strikes having taken place.

A detailed, site-specific risk assessment was carried out by Zetica in line with CIRIA C681 for the entire Northern Gateway area [16], which identified the site to be at low risk of UXO. This is lower than would be expected for a site of similar history and further clarifications should be sought from the specialist.

5.7 Archaeology and heritage features

A high level archaeological appraisal was carried out for the entire Northern Gateway area in December 2017 by Orion Heritage Ltd [17]. The report concluded that the potential for significant archaeological remains within the site

is low and the potential for remains pre-dating the Post-Medieval period is low. There is potential for localised survival of below-ground remains relating to the Post-Medieval and earlier Modern periods.

The report identifies two HER records that in the 1890s, two dome-shaped caves or chambers were identified in Hargreaves Street, in a plot previously occupied by W. Clemson & Company (located in the Central zone). A local antiquarian interpreted the remains as prehistoric caves.

6 Development Assumptions

6.1 Summary of development proposals

The current masterplan for the site comprises a mixture of high-density residential properties and soft-landscaping. The current plan identifies six development plots within Red Bank North (01 to 05b), two within Red Bank Central (06 and 07), one within Red Bank South (10) and two within Red Bank East (16 and 17).

St. Catherine's Wood and the existing steep slope that forms the southern boundary of Red Bank North is proposed to remain as a vegetated/wooded area. The existing disused Red Bank viaduct along the south-western site boundary is to be developed into a high level walkway with soft landscaping. Figure 6 outlines the proposed masterplan below.



Figure 6: Proposed masterplan. Each development zone is split into sub-plots. The site areas outside of the defined development zones are to be developed into a park and walkways with soft landscaping.

Parts of the site close to the River Irk lie within a flood zone. Current development proposals include the removal of the weir at the southern end of the site (known as Scotland Weir) and reducing river bed levels upstream, in order to alleviate flooding upstream of the weir.

7 Geotechnical Considerations

7.1 Approach

This section presents a high-level summary of geotechnical constraints and ground-related hazards that have been identified as a result of reviewing the desk-based information available for the site. This section should be read in conjunction with the geotechnical constraints drawing (Drawing 2). Note that due to the density of historical developments, site wide constraints such as historical buildings and foundations are not indicated on this drawing.

7.2 Buried obstructions

Given the past usages of the site including heavy and light industry, rail and residential properties there is a high potential for the presence of buried obstructions. These include:

- Former rail infrastructure located in Red Bank North. Rail sleepers and foundations for a historical railway turn-table were encountered during the 2019 ground investigation. Below-ground structures may be present associated with the former gasworks and carriage works within this zone;
- Former basements/cellars associated with historical residential and industrial buildings;
- Structures associated with the former course of the River Irk and divergent water courses, e.g. retaining walls, weirs, basins, and former bridge and foundations which may have been filled and/or build over;
- Redundant utilities;
- Made ground which may contain demolition rubble and large boulder sized obstructions of concrete and former brick structures.

These types of obstruction, if not dealt with prior to development, would have a significant impact on the ability to construct piled foundations, retaining walls and substructure for new developments as well as forming hardspots for new building slabs and external pavements and roads.

It is recommended that this risk is mitigated as part of an Enabling earthworks/remediation works.

7.3 Voids

A review of the available site information indicated the potential for voids resulting from uncontrolled backfill of historical below ground structures, for example basements to former industrial buildings, former gasholder bases and chimneys (Red Bank North and East), a former subway in Red Bank South, infilled water bodies and the former channels and streams which ran through Red Bank North in the 1800s.

It should be noted that the existing Theo's Timber building (Red Bank East) is reported to have a basement and the Archaeological Appraisal report [17] mentions that prehistoric caves were found on land off Hargreaves Street (Red Bank Central).

Is hasn't been possible to inspect the existing basement to Theo's to determine its extent and general condition. This should be surveyed such that its included in any earthworks volumetric assessment and a suitable foundation removal strategy developed.

Voids resulting from poor historical backfilling may result in instabilities during excavation and the potential for these features within made ground means this stratum is unlikely to be suitable for founding shallow foundations, and potentially even external works, without some form of treatment such as excavation/replacement.

Further investigation of potential voided ground would need to be conducted prior to development. The investigation could include probing or non-intrusive surveys (e.g. geophysical surveys) to provide greater certainty in relation to the nature and extent of the voids to determine mitigation requirements.

Remediation methods could include excavation and replacement with compacted suitable engineering fill or grouting of the voids where these are at depth.

Where voided ground straddles the phasing areas it would be preferable to undertake the remediation concurrently on both sides of the phasing line.

7.4 Tunnels and culverts

The River Irk was culverted by 1906 in the south-western tip of the site and runs beneath the rail viaducts. The Irk is within sections of both closed culvert and open channel along the southern edge of the site. The southern edge of the channel is adjacent to a live Network Rail viaduct and MCC land.

There is currently no information available on the structure and foundations of the existing Network Rail viaduct and Irk culvert although searches are ongoing with Network Rail.

Further intrusive investigation may be needed to confirm the existing geometry of these elements and inform a structural analysis to determine the impact of any new development on these NR and MCC assets.

Mitigation measures may be required to reduce the impact of the new development and provide further stabilisation to the river walls and other adjacent structures.

A subway, present on historical mapping until 1938, also runs beneath the south-western tip of the site. It is unknown whether this feature is still present on site or if it has been infilled. Further searches should be carried out by Network Rail and intrusive GI conducted to confirm the presence and condition and allow remedial works to be developed.

7.5 Soft ground

Some areas of the site, such as St. Catherine's Wood, are underlain by alluvium/ soft superficial deposits. Soft deposits may also exist within the areas of the infilled reservoirs and the former river Irk channel (1848 map). Made ground may also contain soft spots where historical compaction has not been to a controlled specification. These materials are unlikely to provide sufficient strength for shallow building foundations and potentially are unsuitable for external works without some form of treatment/ground improvement. Without ground improvement or earthworks to an appropriate performance specification, ground floor slabs are likely to be required to be designed as suspended rather than ground bearing.

7.6 Shallow rockhead

The depth to bedrock is generally found at ca. 5mbgl. However, bedrock was encountered at depths up to 10mbgl in the Red Bank North area of the site, where ground levels are high. The ease of excavation of the bedrock is determined by the degree of weathering and cementation, strength and discontinuity spacing. All three bedrock lithologies were found to be extremely weak to weak within their shallow highly weathered surfaces (top 2 metres). Therefore, excavation using typical excavation plant is likely to be possible, but this assumption should be validated by a further ground investigation which should include rock coring and detailed logging.

The shallow rockhead could present opportunity in relation to the foundations to buildings but may restrict the use of driven sheet piles which may be required for temporary works.

7.7 New foundations

Given the historical uses of the site and the likely magnitudes of loads from the proposed development it is unlikely that shallow foundations will be suitable for anything other than lightweight ancillary structures which are insensitive to ground movements.

The use of bored piles, either conventional bored or Contiguous Flight Auger (CFA) is recommended, with pile lengths socketed in to the underlying bedrock.

Further investigation to include rotary coring of the bedrock and detailed logging will be required in order to inform the foundation design at each plot location.

The pile installation will require the building areas to be largely de-obstructed and free of any significant voids. The Conventional Bored pile method is more adept at dealing with unforeseen obstructions in the ground but is more expensive than the CFA method.

Initial discussions should be held with experienced piling contractors following further intrusive GI to assist in the development of an outline design for the site and construction advice for cost plan purposes.

Given the thickness and variability of the Made Ground deposits, the use of suspended floor slabs should be assumed. It may be possible to develop engineered fill platforms which would facilitate ground bearing slabs of low to moderate capacity as part of an earthworks/remediation phase in advance of plot development.

7.8 Steep slopes and retaining walls

Bounding the southern edge of Red Bank North are steep slopes. In addition, slopes are also present along part of the northern edge of Red Bank North. These slopes are assumed to be comprised of made ground, placed to form the railway sidings area. Some of these slopes appear of an unnatural angle and may not be suitable for any new loading regime placed by the proposed development. In addition, the slopes are highly vegetated and this vegetation may be enhancing the existing stability and cannot be relied upon long term.

The stability of the slopes needs to be assessed following future ground investigations.

Retaining walls are present along the northern edge of Red Bank North and along the majority of the River Irk. The geometry and founding levels of these structures in unknown. The stability of these retaining walls needs to be assessed following future ground investigations.

7.9 Groundwater

During the 2019 ground investigation four monitoring wells, all located in Red Bank North, recorded groundwater at depths ranged from 32.64mOAD (8.95mbgl) to 41.66mAOD (0.91mbgl). Given the large range of values within a small area, it is likely that some of these values represent perched water. Details of the groundwater monitoring can be found in Table 4**Error! Reference source not found.**, and in Appendix B.

Groundwater can have a significant impact on earthworks and excavations and further installations and monitoring will be needed as part of any future intrusive ground investigation to allow the ground water to be better understood and any ground water control measures to be developed.

7.10 Earthworks balance and phasing

7.10.1 Cut and fill balance

The proposed development levels for the site are not known at present, however it is likely that some cut and fill will be required to create the final landform.

Changes in levels will result in a requirement for either importation of new engineered materials, on site reuse or off-site disposal, all of which have cost implications for a development of this size.

A topographical 3D survey should be conducted to replace/update the current LIDAR ground surface model.

7.10.2 Earthworks phasing

Phasing the development may lead to inefficiencies and costs associated with undertaking earthworks in small areas. This may include:

- Reduced flexibility for reusing potentially suitable fills resulting in additional offsite disposal or import of suitable fill materials.
- The need for additional temporary earthworks batters or retaining structures at the edges of plots.

Materials which are to be re-used or imported materials will need to be suitable from both a geotechnical and geoenvironmental perspective.

Given that it is likely that site levels will be altered, temporary retaining structures may be required to form the final site levels while maintain adjacent existing site levels.

7.11 Easements and party wall

There are potentially sensitive structures within and adjacent to the site which are likely to have specific easements. These include the two Network Rail viaducts as well as existing retaining walls with adjacent properties. Party wall issues may also need to be resolved which may result in additional costs and implications to programme whilst solutions are agreed.

Working adjacent to these structures may affect ground investigations, foundation design/construction and earthwork activities.

7.12 Archaeology

There is potential for archaeological interest in parts of the site, which may result in delays during earthworks and additional costs associated with surveys. The details of any intrusive investigations or mitigation measures will be covered in a separate archaeological desk study report, in preparation.

7.13 UXO

Preliminary UXO risk assessment provided by Groundsure suggested there was a medium risk of encountering UXO at the site. This may impact on below ground construction activity including ground investigation (boreholes and probe holes, trial excavations), utility trenches, excavations for earthworks and foundations and piling.

However, a detailed risk assessment carried out by Zetica in line with CIRIA C681 for the entire Northern Gateway area identified the Red Bank site to be at low risk of UXO. The Zetica assessment reported an estimated bomb penetration

depth on average between 4m and 8,5m, depending on the weight of the bomb. They recommended the following mitigation measures:

- Industry good practice is to raise the awareness of those involved in excavations so that in the unlikely event that a suspect item is discovered, appropriate action is taken. This can be achieved through UXO awareness briefings to staff, and
- Clearance certification for borehole or pile locations is only prudent if a zero tolerance to risk is adopted.

Further clarification should be sought from Zetica in relation to the UXO risk.

7.14 Utilities

Existing utilities present a constraint to the development in some areas of the site. Diversion and protection works will be needed in advance of earthworks and remediation.

The site utilities and drainage have been reviewed by Arup as part of a study to support the submission of a Housing Infrastructure Fund application for Northern Gateway. The study identified maximum utility demands anticipated for the developments within the Red Bank area for electricity, gas, potable and foul water, to determine the likely network requirements required to support the proposed scheme. A sustainable urban drainage strategy report has also been prepared for the study area.

7.15 Vibration

Network Rail should be consulted in relation to works conducted close to their assets (including the viaducts) as vibration limitations are likely to be stipulated and will require monitoring.

8 Conceptual Site Model

8.1 Introduction

The Environment Agency has developed guidance that defines the approach for assessing and managing land affected by contamination (CLR11) [12]. The guidance presents a procedure to assess whether land is suitable for use. One of the key requirements in assessing this is the conceptual site model. A conceptual site model (CSM) is a method of describing the linkages between potential sources of contamination and receptors at a site. The conceptual model considers the interaction of contaminants in the natural environment and transport in media including soil, groundwater and air. The linkage between a potential source of contamination and a receptor is considered in the CSM and a risk exists and requires further investigation only if a complete pollutant linkage is identified.

8.2 Sources of contamination

Potential sources of site-based contamination are principally associated with historical land uses which may have resulted in contamination. The primary potential contamination sources within the site boundary are rail sidings (in Red Bank North), historical works (in Red Bank Central, South and East), gasworks and gasometers (in Red Bank North and East). Potential sources external to the site include the former Queens Road Tip landfill and Sand Street landfill. A summary of the contamination potential is in Drawing 1.

Ground investigations have identified that made ground is present across the site, which was found to contain various materials such as clinker which may be potential sources of contamination with chemicals such as heavy metals, inorganics and polycyclic aromatic hydrocarbons (PAH). Asbestos was identified within a few soil samples. The Department of Environment (DoE) Industry Profiles [11] were used to identify potential contaminants associated with historical land uses. The potential sources of contamination are summarised in Table 6 below.

Table 6: Potential sources of contamination

Potential Source	Potentially Contaminative Materials	Comments
Made ground from site historical site operations including: Rail sidings [1] Historical works [2,3,4,5,6,7] Gasworks and gasometers [8]	Organic compounds Metals and metalloids including lead, arsenic, mercury, nickel, copper, zinc, and iron Asbestos PAHs Total petroleum hydrocarbons (TPH) including lubricating oils, heating oils, petrol and diesel range organics Solvents (VOCs and SVOCs) Cyanide (free and complex) Phenol Extremes of pH	The ground investigation identified material such as clinker in the made ground. Asbestos was identified at TP105, TP120, TP125, TP126, TP127, BH110, WS104 and it may also be present in other areas of contaminated soil not yet identified Hydrocarbon odours were noted in TP101, TP120, BH103, WS106 (Table 10). WS106 was drilled through a former gasholder in Red Bank East. Further contamination is evidenced in Table 9. Works include: chemical works, dye works, oil works, engineering works, garage, glass works, metal works, printing works, tannery, and timber works
Historical demolition rubble in made ground	Asbestos	Previous buildings within the site boundary may have contained asbestos, which may have become of the made ground during demolition
Perched groundwater within made ground/relic structures Leachate from adjacent landfill sites (predominantly Queens Road Tip landfill)	Potential for leachable contaminants from made ground	No leachate data is available It is recommended that soil leachate tests are included within the scope of subsequent ground investigations to investigate this
Made ground containing degradable materials Former landfill sites (offsite, including Queens Road tip, Sand Street landfill and Fitzgeorge Street landfill)	Hazardous ground gases (methane, carbon dioxide, hydrogen sulphide, carbon monoxide)	No gas data is available within the site boundary, but monitoring carried out at Queens Road Tip on the northern site boundary indicated elevated methane and carbon dioxide concentrations. It is recommended that gas monitoring is undertaken in subsequent ground investigations to assess the gas risk.

DoE Industrial Profile document titles:

[1] Railway Land

[2] Chemical works – coatings, paints and printing inks manufacturing works

[3] Timber treatment works

[4] Timber manufacturing works

[5] Road vehicle fuelling, service and repair – garages and filling stations

[6] Metal manufacturing, refining and finishing works – iron and steel works

[7] Textile and dye works

[8] Gas works, coke works and other coal carbonisation plants

8.3 Receptors

Receptors both during construction and after completion of the development include:

- Construction workers;
- Future site users (residents, public);
- Groundwater within Chester Pebble Beds Formation, Collyhurst Sandstone Formation (Principal Aquifers) and Manchester Marls, alluvium (Secondary Aquifers);
- River Irk;
- Buried structures, buildings and services;
- Plants in new soft landscaped areas.

8.4 Pathways

Potential pathways that may be present during redevelopment and operation include:

- Human health – ingestion of soils and dust;
- Human health – inhalation of dust, vapour, fibres or ground gas;
- Human health – dermal contact with soils;
- Controlled waters – migration of dissolved or free phase contamination within groundwater (preferential flow paths may exist such as abandoned drainage channels);
- Ground gas – ingress of ground and landfill gas into the buildings
- Building and services – building materials such as concrete and plastic pipework may be subject to attack by aggressive ground conditions, where present.

8.5 Plausible pollutant linkages

8.5.1 Human Health

The development includes the construction of new high density residential properties, together with external landscaping and car parking. Based on the current proposals, human contact with soil is likely in landscaped areas.

The construction phase will include cut and fill earthworks to create the required development platforms. During this phase dermal, inhalation and ingestion pathways will be present to construction workers and site neighbours.

Pathways present post-construction include dermal, inhalation and ingestion pathways between future site users and near surface soils.

8.5.2 Controlled waters

There is a potential for pathways to exist between any mobile contaminants in the made ground and groundwater, as made ground has been noted to directly overlie bedrock or alluvium in some areas of the site (Red Bank South, Central and East). However, Glacial Till, typically 2.4m thick, covers much of the site and therefore may act as an aquitard preventing this pathway in some areas (e.g. in Red Bank North).

Two former landfill sites, Queens Road Tip and Sand Street landfill, are present to the north and east of the site boundary, which may be potential sources of contaminated groundwater entering the site, assuming groundwater flow is towards the River Irk.

The River Irk runs through the site and therefore a potential pathway exists between contaminants and the river, particularly any contaminants released during construction e.g. from accidental spillages or runoff from stockpiles.

The primary controlled waters receptors within the site are considered to be the River Irk and the principal aquifers in the sandstone bedrock.

8.5.3 Planting

Plants being grown in new soft landscaping areas may be at risk of phytotoxicity from any contamination present within the soil or groundwater via root uptake of dissolved contaminants or leaf uptake of vapours.

8.5.4 Building materials and services

A potential pollutant linkage exists between below-ground building materials such as water pipes and concrete foundations and areas of contamination within the made found. All buildings also have a potential for ground gas ingress.

8.6 Summary

A summary of the plausible pollutant linkages requiring assessment in relation to the site is presented in Table 7 and Table 8 below:

Table 7: Potential pollutant linkages during construction

Source		Pathway		Receptor	Linkage?
Made Ground (containing solid contaminants, asbestos fibres and possible hydrocarbons)	→	Dermal contact	→	Construction worker	Yes
		Ingestion of soil/ soil dust	→		Yes
		Inhalation of soil vapour	→		Yes
		Inhalation of soil and soil dust	→	Construction worker	Yes
			→	Site users and neighbours	Yes
	→	Leaching and runoff	→	Surface water drainage	Yes

Source		Pathway		Receptor	Linkage?
Temporary stockpiles of excavated arisings Accidental leaks and spills during construction			→	River Irk	Yes
		Leaching and infiltration	→	Principal aquifers in bedrock River Irk	Yes
Impacted shallow groundwater, including groundwater entering the site from landfill to the north	→	Dermal contact	→	Construction worker	Yes
		Ingestion	→	Construction worker	Yes
		Lateral migration	→	River Irk	Yes
Ground gases/landfill gases	→	Ingress and accumulation of toxic, asphyxiating or explosive concentrations within excavations	→	Construction worker in deep trenches and chambers	Yes

Table 8: Potential pollutant linkages during operation

Source		Pathway		Receptor	Linkage?
Made Ground (containing solid contaminants and possible hydrocarbons from historical spills)	→	Dermal contact	→	Future site user in soft landscaping areas only Pathways broken where hard surfacing and buildings present	Yes
		Ingestion of soil/ soil dust	→		Yes
		Inhalation of soil vapour	→		Yes
		Inhalation of soil and soil dust	→		Yes
		Leaching and infiltration	→	Principal aquifers River Irk	Yes, where Glacial Till absent
		Direct contact	→	Buried structural concrete	Yes
			→	Potable water supply pipes	Yes
Impacted shallow groundwater, including groundwater entering the site from landfill to the north	→	Dermal contact	→	Future site resident	No
		Ingestion	→	Future site resident	No
		Direct contact	→	River Irk	Yes

Ground gases/landfill gases	→	Ingress and accumulation to toxic, asphyxiating or explosive concentrations within buildings	→	Future site user Building structures	Yes

9 Environmental Risk Assessment

9.1 Introduction

Several plausible pollutant linkages have been identified at the site (Section 328). An environmental risk assessment has been undertaken for each of the receptors for which a plausible pollutant linkage has been identified. The process outlined in the CLR11 guidance [12] follows a tiered approach to assessing risk which begins with an initial screening assessment known as a generic quantitative risk assessment (GQRA). The GQRA makes use of published assessment criteria and when a soil/ groundwater concentration exceeds the screening value then further consideration is required. The GQRA is presented in the following sections.

The potential environmental risks have been considered in the context of a conceptual source-pathway-receptor (SPR) model of the site. A preliminary evaluation of the level of risk to each receptor from the identified plausible pathways and the level of mitigation that would be required for the proposed academic development is also provided.

Only data from the 2019 GI was included in the assessment.

9.2 Human Health

9.2.1 Assessment

A human health risk assessment has been undertaken in accordance with the Environment Agency Contaminated Land Exposure Assessment (CLEA) framework. The CLEA software estimates human exposure to soil contaminants for those potentially living, working and/or playing on contaminated sites over long-time periods (chronic exposure). A detailed account of the risk assessments carried out for the site are presented in Table 9 and Appendix C.

The soil chemical data was screened against generic assessment criteria (GAC) appropriate for residential developments (without plant uptake), which is considered appropriate for the proposed developments discussed in this report. The average soil organic matter (SOM) found across the site was found to be 14.65% and therefore generic assessment criteria at 6% SOM were used for screening. The high SOM value may derive from high quantities of coal present on site. A summary of the Soil GAC exceedances is presented in Table 9 below.

During the GI, evidence of contamination was noted. A summary of olfactory evidence is summarised in Table 10.

Table 9: Summary of Soil GAC exceedances identified from the 2019 ground investigation

Contaminant	GAC	Units	Total > LOD	Total > GAC	Max Conc.
Asbestos (Presence of)	Presence	mass %	7 of 56	7	<0.001%
Mercury	13.6	mg/kg	46 of 64	1	18

Contaminant	GAC	Units	Total > LOD	Total > GAC	Max Conc.
Arsenic	39.9	mg/kg	64 of 64	6	71
Beryllium	1.72	mg/kg	62 of 64	13	3.9
Lead	310	mg/kg	64 of 64	15	12000
Dibenz(ah)anthracene	0.32	mg/kg	18 of 57	2	2.4
Naphthalene	13.2	mg/kg	25 of 59	1	18
Benzo(b)fluoranthene	4.06	mg/kg	39 of 57	2	17
Benzo(a)pyrene	3.23	mg/kg	35 of 57	2	17
Benzo(a)anthracene	15	mg/kg	38 of 57	1	19
Dibenzofuran	3.23	mg/kg	2 of 3	1	8.3

The 2019 investigation encountered olfactory evidence of contamination in four locations. These are summarised below:

Table 10: Olfactory evidence encountered during the 2019 investigation

Hole ID	Depth	Occurrence type
BH103	0.1 – 1.3	Hydrocarbon odour (within former railway sidings)
WS106	2.8	Hydrocarbon (benzene) odour (within former gasholder base)
TP101	0.8 – 0.9	Slight hydrocarbon odour (within former railway sidings)
TP120	0.7 – 1.8	Strong hydrocarbon odour (within former engineering works)

9.2.2 Evaluation – Construction phase

A plausible pollutant linkage was identified in the conceptual model relating to construction workers and site users (direct contact/ingestion and inhalation) as excavation and re-use of made ground is to be undertaken.

The 2019 ground investigation provided a high-level overview of the ground conditions and it is possible that areas of contamination may exist which have not yet been identified. Mitigation measures will be required to deal with the potential for encountering unidentified contamination during construction.

It is recommended that specific precautions are taken during any future earthworks to reduce potential exposure to potentially contaminated soils in accordance with the principle of ‘as low as reasonably practical’ (ALARP). This would include appropriate briefings, dust suppression and protective equipment (PPE). Risk assessments to protect construction workers and the use of good construction practices will be required.

Assuming that appropriate mitigation measures are implemented during construction, it is assessed that the risk of harm to construction workers and neighbours can be reduced to acceptable levels.

9.2.3 Evaluation – Operational phase

The soil screening assessment identified several metal and PAH exceedances which pose an unacceptable risk to future site users. Asbestos contamination may pose a potential risk to the health of future site users if present in soils exposed at the surface.

Given that soil exceedances are present on site, it is recommended that a subsequent ground investigation is undertaken to assess the made ground in greater detail. Following this ground investigation, the data will be reassessed, and a detailed quantitative assessment will be undertaken if chemical exceedances persist.

Assuming that appropriate mitigation measures are implemented during construction, it is assessed that the risk of harm to human health during operation will be negligible.

9.3 Controlled waters

A plausible pollutant linkage was identified between surface run-off from stockpiles, or surface spillages during construction and the River Irk. This remains a potential risk and all materials will need to be managed to ensure that soil or other construction materials are not washed directly into the River Irk.

Another plausible pollutant linkage is between leached soil contaminants in shallow groundwater and the principal aquifers where Glacial Till is absent, and the River Irk. It is noted that groundwater quality entering the site from the north and east, from the former Queens Road Tip and Sand Street landfills, may be impacted by landfill leachate. To assess this risk, groundwater quality monitoring is required as part of future ground investigation.

9.4 Ground gas

No gas monitoring data is available and hence no gas risk assessment could be undertaken. Thick made ground deposits, particularly those with a significant degradable content, can be a potential source of ground gas.

In addition, the adjacent Queens Road Tip landfill, which immediately borders the site to the north, and Sand Street landfill which is close to the eastern part of the site, may be potential sources of landfill gas that could pose a risk to the proposed development. Within subsequent ground investigations it is recommended that the gas regime is assessed across the site, including the potential migration of landfill gas from adjacent sites.

9.5 Soft landscaping

9.5.1 Assessment

A plausible pollutant linkage was identified between existing site soils and plants in future landscaping areas. The risk to vegetation planted in soft landscaped soil

materials derived from site won materials has been assessed, based on the guideline values in the 1998 MAFF document "The Soil Code" [13].

The Soil Code values are pH dependent. The average pH across all samples was 8.4. Screening values relating to this pH were used and several exceedances were found. A summary of the exceedances is presented in Table 11 and the complete assessment is in Appendix D.

It is also possible that areas of contamination may exist which have not yet been identified. Mitigation measures will be required to deal with the potential for encountering unforeseen contamination during construction.

Table 11: Summary of phytotoxic soil chemical exceedances

Contaminant	Soil Code guideline value	Units	Number of samples	Number of exceedances	Maximum value
Zinc	300	mg/kg	64	7	1700
Mercury	1	mg/kg	64	5	18
Cadmium	3	mg/kg	64	1	4.7
Chromium	400	mg/kg	64	0	48
Copper	200	mg/kg	64	11	4200
Lead	300	mg/kg	64	15	12000
Nickel	110	mg/kg	64	0	53
Selenium	2	mg/kg	64	0	1
Arsenic	50	mg/kg	64	2	71
pH	-	-	64	0	11.7

9.5.2 Evaluation

The assessment has identified that site-won material may not be suitable to be re-used in the proposed soft landscaping areas without further treatment. Imported clean topsoil may be required in soft landscaping areas.

9.6 Buried structures and services

A concrete assessment has not previously been undertaken and therefore the impact of ground conditions on buried structures cannot be assessed. A concrete assessment should be included within subsequent ground investigations.

9.7 Updated conceptual site model

The conceptual site model has been updated to consider the residual risk at the site. The updated CSM is presented in Table 12, which identified the potential source-pathway-receptor linkages which are likely to be present during and post completion of the development. Mitigation measures to deal with these linkages are discusses in Section 10.

Table 12: Summary of identified pollutant linkages following risk assessment

Source	Receptor	Pathways
Made ground containing inorganic and organic contamination, including asbestos Contaminated groundwater entering site from adjacent landfill sites Landfill gases from adjacent landfill sites and deep made ground deposits	Construction workers	Dermal contact, ingestion of soil and groundwater, inhalation/ ingestion of fugitive dust, inhalation of vapours Inhalation of landfill/ground gases, causing asphyxiation/explosion
	Future site users	Dermal contact, ingestion of soil, inhalation/ ingestion of fugitive dust, inhalation of vapours Inhalation of landfill/ground gases, causing asphyxiation/explosion
	Ecology	Uptake of phytotoxic compounds by vegetation
	Buried structures	Soil or groundwater aggressive to concrete Potential damage caused by explosion of landfill/ground gases
	River Irk	Contaminated groundwater Runoff from stockpiled material into surface watercourses Accidental spillages entering surface watercourses
	Groundwater (bedrock, alluvium)	Vertical migration in areas where Glacial Till or hardstanding is absent

10 Conclusions

10.1 Geotechnical

The site was found to have several geotechnical constraints, some of which require further assessment. These constraints are summarised below:

- Buried obstructions: there is a potential for on-site obstructions from historical bridges, basements, infilled gasometers and rail infrastructure as well as redundant utilities, demolition rubble and structures associated with the River Irk;
- Voids: there is a potential for voids associated with infilled historical features;
- Tunnels: a subway and culverted River Irk are located in the southwest of the site. These areas require further investigation and subsequent assessment. They may require additional protection or stabilisation subject to final masterplan proposals in this area;
- Soft ground: Alluvium is present in St. Catherine's Wood and in other areas close to the River Irk, and provides a source for soft ground;
- Shallow rockhead: the upper layer of the bedrock was found to be extremely weak to weak and therefore likely to be highly excavatable. Further intrusive GI should include rotary coring and detailed logging;
- Steep slopes: steep slopes are present along the northern and southern edges of North. These may require stability assessments;
- Retaining walls: present along the northern site boundary and along the River Irk, these will require investigation and subsequent assessment;
- Groundwater: potential perched water was identified at a variety of depths in Red Bank North area. Groundwater quality in Red Bank area may be impacted by landfill leachate from Queens Road Tip. Further investigation required to gain better understanding of groundwater regime;
- Earthworks: In order to determine the earthworks quantities, there will need to be more certainty on the proposed site levels (See section **Error! Reference source not found.**). A topographical survey should also be conducted to replace or update the current LIDAR model;
- Easements: National Rail viaducts partially bound the site, coordination with external parties will be required;
- Archaeology: Further archaeological desk study has been commissioned by FEC for this development. It is possible that a watching brief may be required during future ground investigation, and archaeological investigation may be needed in advance of construction in some areas of the site;
- UXO: The site is at low risk of UXO although further clarification should be sought from the specialist. Awareness briefings are recommended during future investigation and construction works;

- Utilities: The existing site utilities and drainage have been reviewed by Arup as part of an earlier study and anticipated maximum utility demands estimated;
- Vibrations: Foundation construction near to viaducts and other existing structures are likely to have vibration restrictions.

10.2 Geoenvironmental

The environmental risk assessments presented in this report have identified that there are potential risks posed to human health, controlled waters, buried structures and services, and vegetation which require mitigation. These risks are typical of many brownfield redevelopments. A summary of the identified risks requiring mitigation are presented in Table 13 below.

Table 13: Summary of risks and proposed mitigation measures

Source	Receptor	Pathways	Proposed Mitigation
Made ground containing inorganic and organic contamination	Construction worker	Dermal contact, ingestion of soil, ingestion of fugitive dust	Dust control measures, measures to control dropping of mud on roads Use of PPE i.e. gloves, as appropriate Additional ground investigation to identify areas of contamination Watching brief during earthworks to identify other areas of potential contamination
		Inhalation of fugitive dust, vapours	Dust control measures as necessary e.g. damping down, grading stockpiles to prevent dust generation, road cleaning and ensuring bare surfaces are compacted and sealed. Appropriate PPE (e.g. dust masks) where necessary.
	Future site users	Dermal contact with, and ingestion of soil and soil-derived dust	Additional ground investigation to identify areas of contamination and develop remediation strategy
		Inhalation of vapours	

	Plants in soft landscaping areas	Uptake of phytotoxic compounds by vegetation	Additional ground investigation to identify areas of contamination and develop remediation strategy Use of clean imported topsoil if required
	Buried Structures	Soil aggressive to concrete	Additional ground investigation Use of protected concrete in foundations and structures in contact with the ground
	Surface waters	Runoff from stockpiled materials into River Irk Accidental spillages entering surface watercourses	Stockpiled material to be managed appropriately Spill kits to be maintained during construction
Groundwater containing dissolved and free phase contamination	Bedrock Aquifer River Irk	Vertical migration in areas where aquitard absent Lateral migration into river	Additional ground investigation to identify quality of groundwater across site and pathways
Ground gases and landfill gases migrating from offsite sources	Construction workers	Inhalation in trenches and chambers	Additional ground investigation to identify potential risk from ground gases
	Future site users	Inhalation in enclosed spaces such as buildings	

10.3 Recommendations for subsequent work

10.3.1 Ground investigation

A further phase of ground investigation is needed to obtain information for scheme and detailed design of foundations and to develop a remediation strategy for the site.

It is recommended that the subsequent investigation should focus on:

- Obtaining further soil samples, with locations targeted at key potentially contaminative historical features, to further assess contamination risks;
- Carry out groundwater level monitoring and sampling to assess the quality of groundwater, including that coming onto the site and its potential impacts on water receptors (River Irk and aquifers);
- Ensuring good spatial coverage. This will help refine the geological site model and enable assessment of each development plot;

- Installation of ground gas monitoring wells to determine the risk posed by ground gases including landfill gases from adjacent landfills and establish likely mitigation requirements;
- Geotechnical testing to enable an assessment of materials re-use to be carried out;
- Investigation of existing structures and retaining walls to assess their construction and condition;
- River investigation, to identify the depth of silt behind the weir and whether it contains contamination as a result of historical industries that were present along the river. This should include Waste Acceptance Criteria testing, as it is likely that materials from the weir removal will need to be disposed offsite. WAC tests provide insight regarding the cost of this;
- Depending on the findings of an archive search by Network Rail, further intrusive works may be needed to establish the geometry and construction type for their existing viaduct structures;
- Concrete (BRE) assessment, to inform future piling/foundation requirements.

It should be noted that the above recommendations may be sufficient to inform the development of an earthworks/remediation phase of works and the schematic design of foundations. However, follow on detailed ground investigations would be required to provide data for specific buildings, structures and external works once development plots, building footprint and other details are confirmed.

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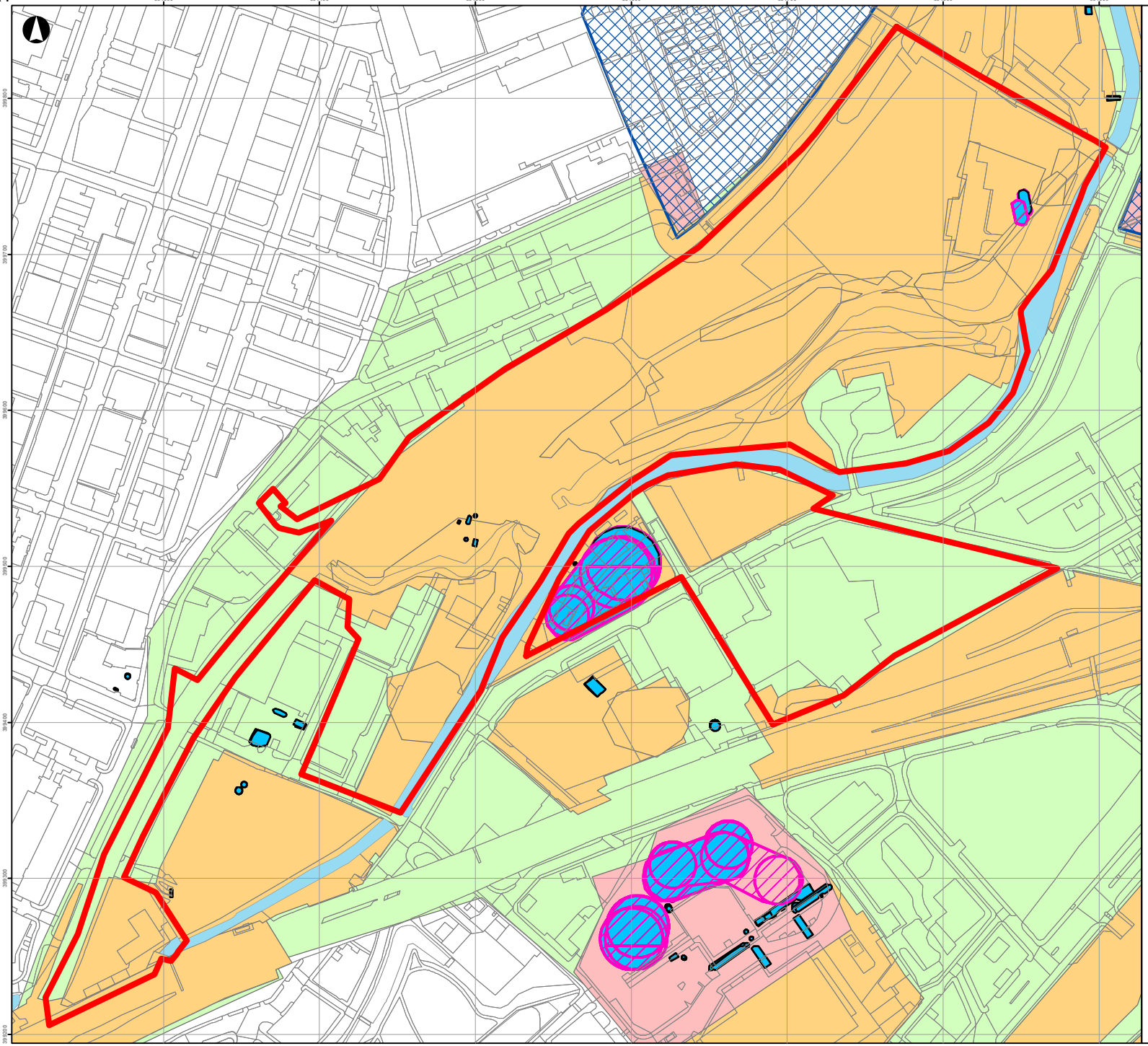
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Drawings

A4



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GS_Tanks_polygon

Use

- Gasometer
- Gasometers
- Tanks
- Unspecified Tank

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- Moderate
- Low

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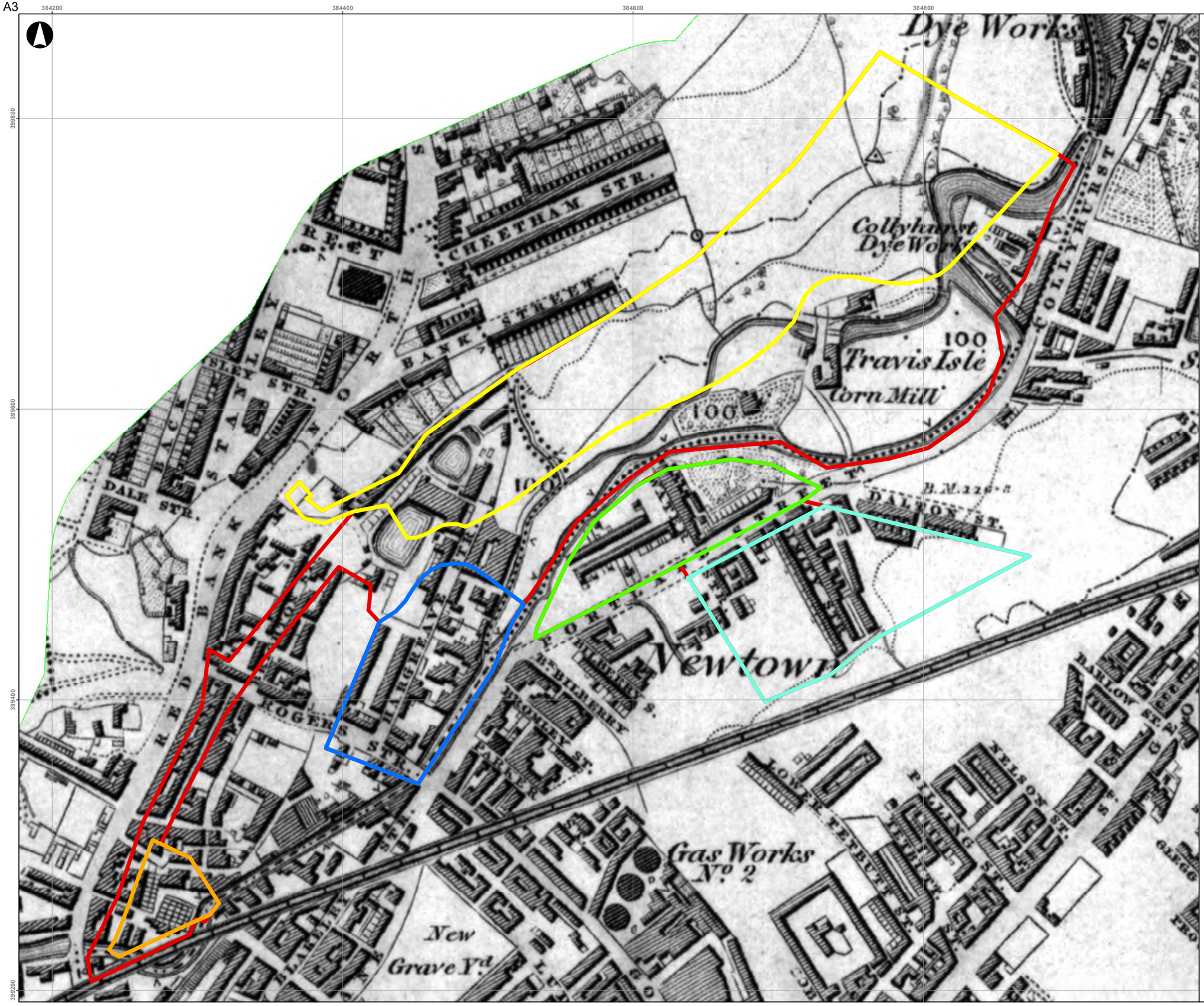
Appendix A

Historical Maps

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- New Town
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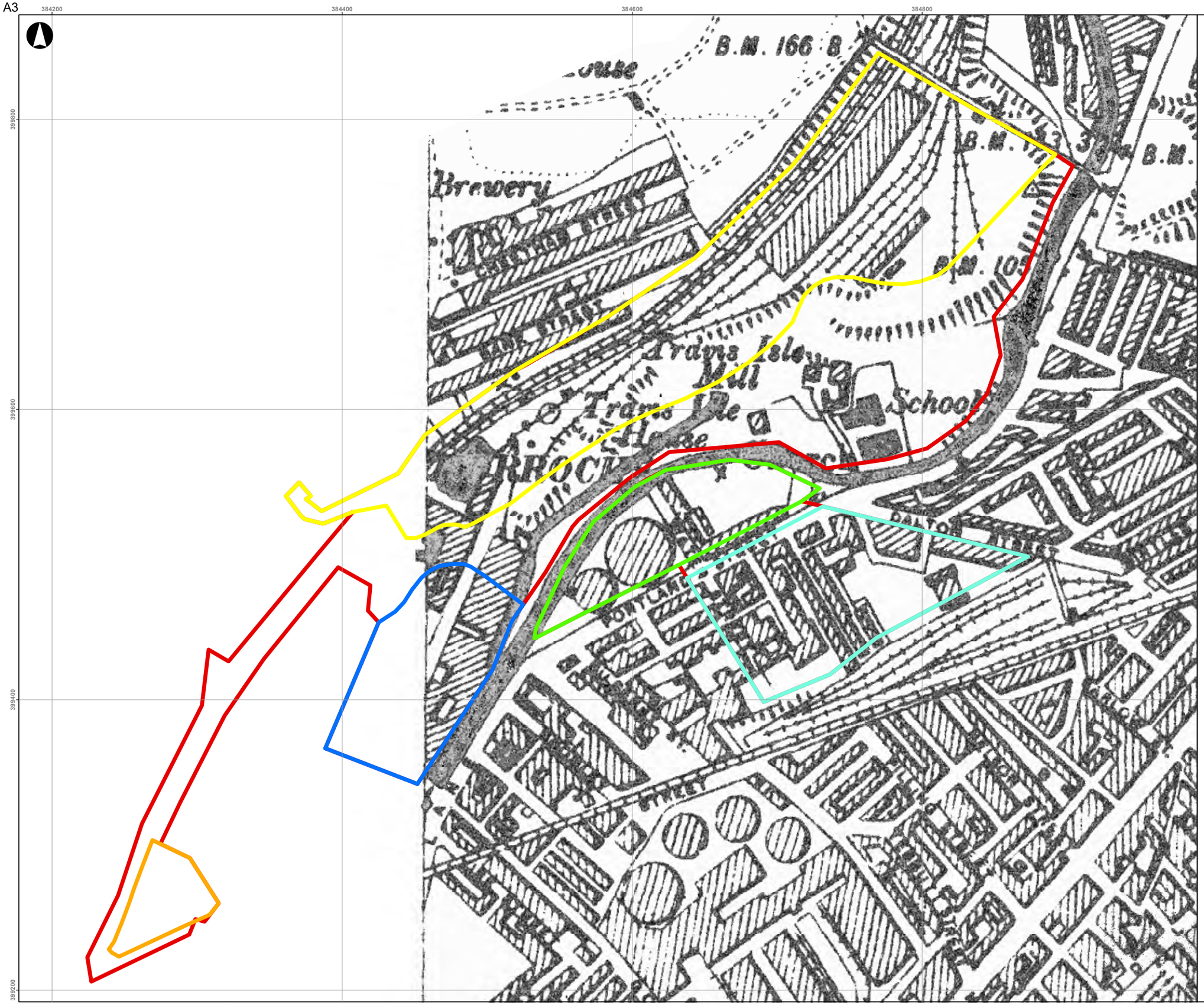
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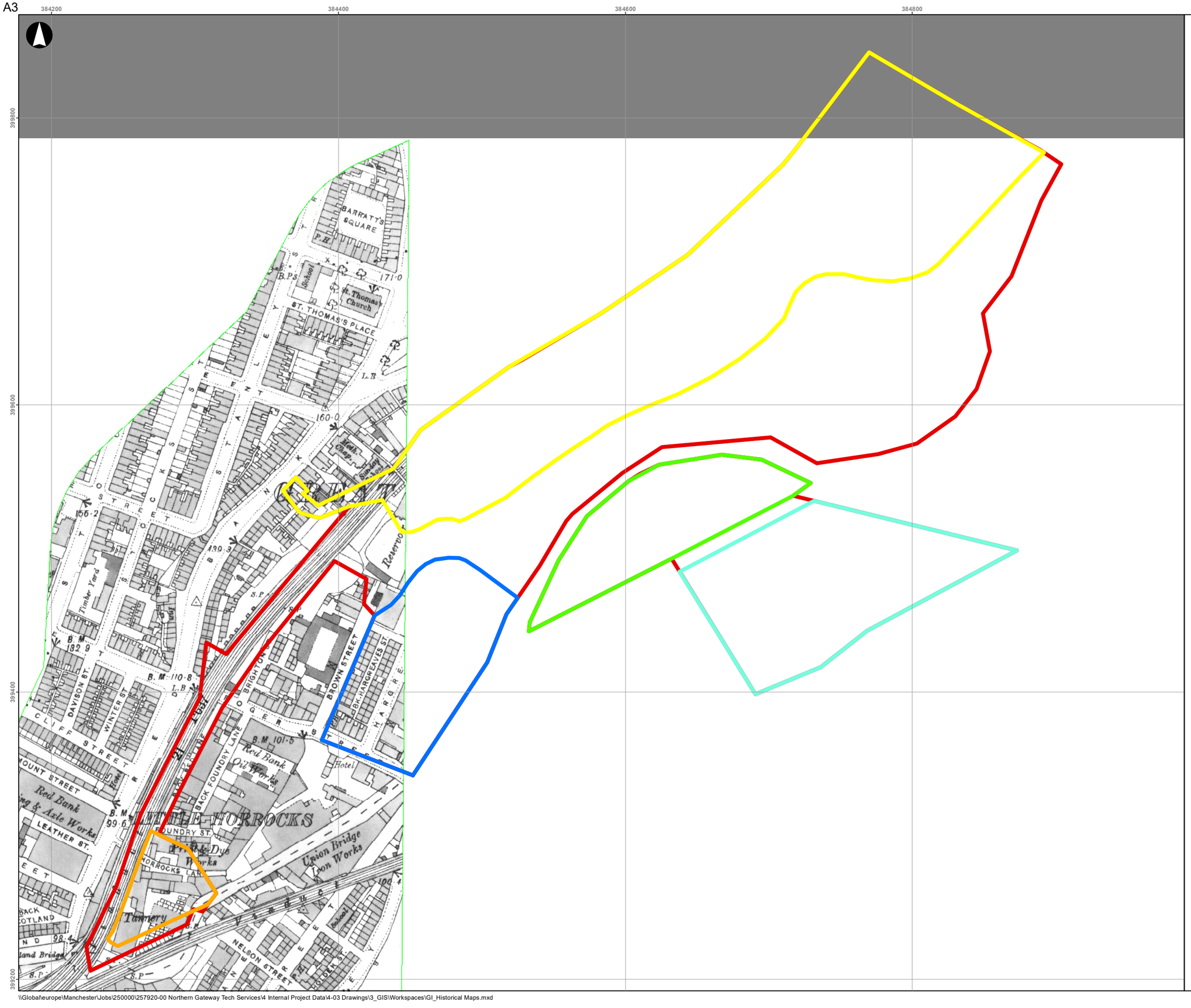
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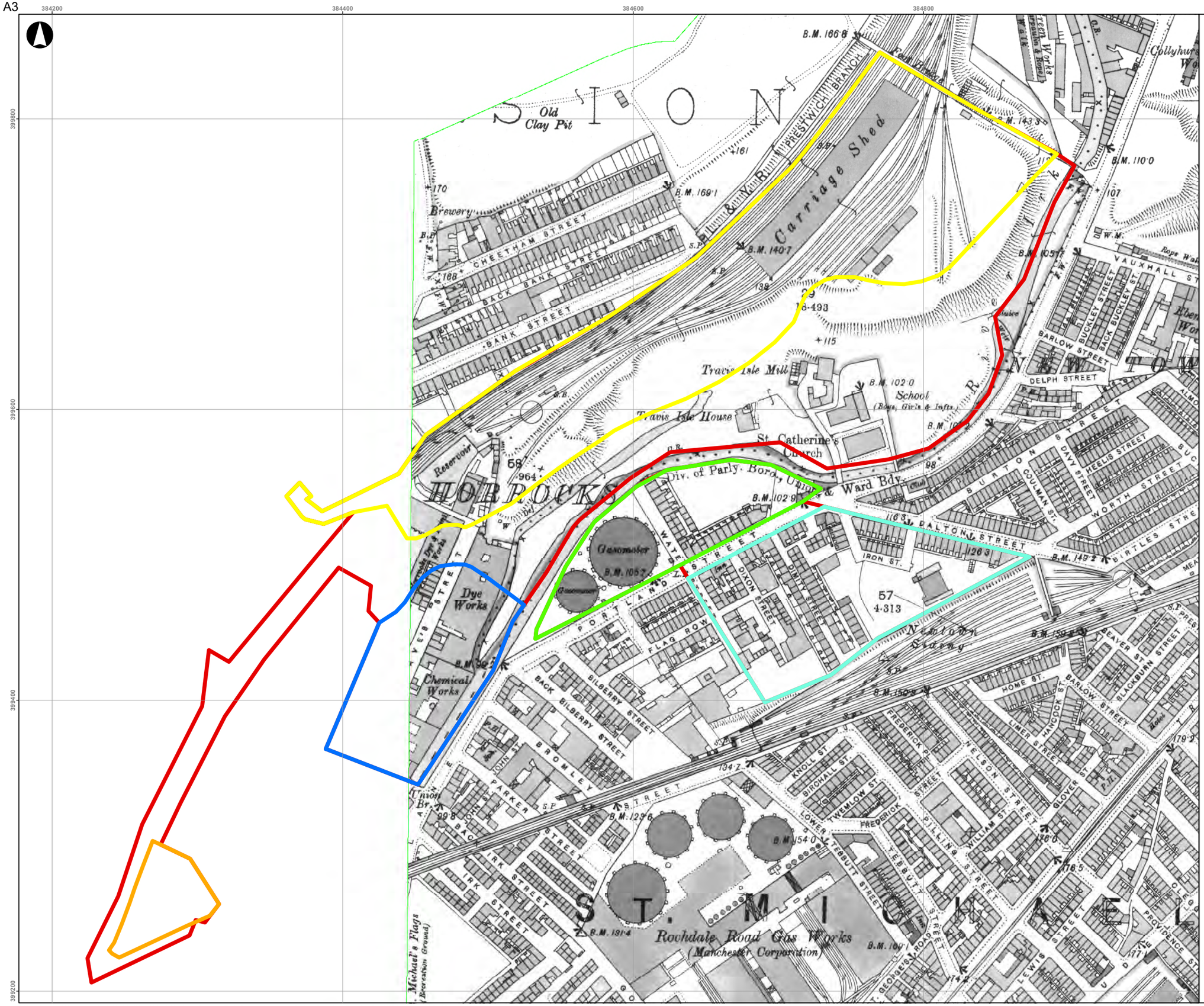
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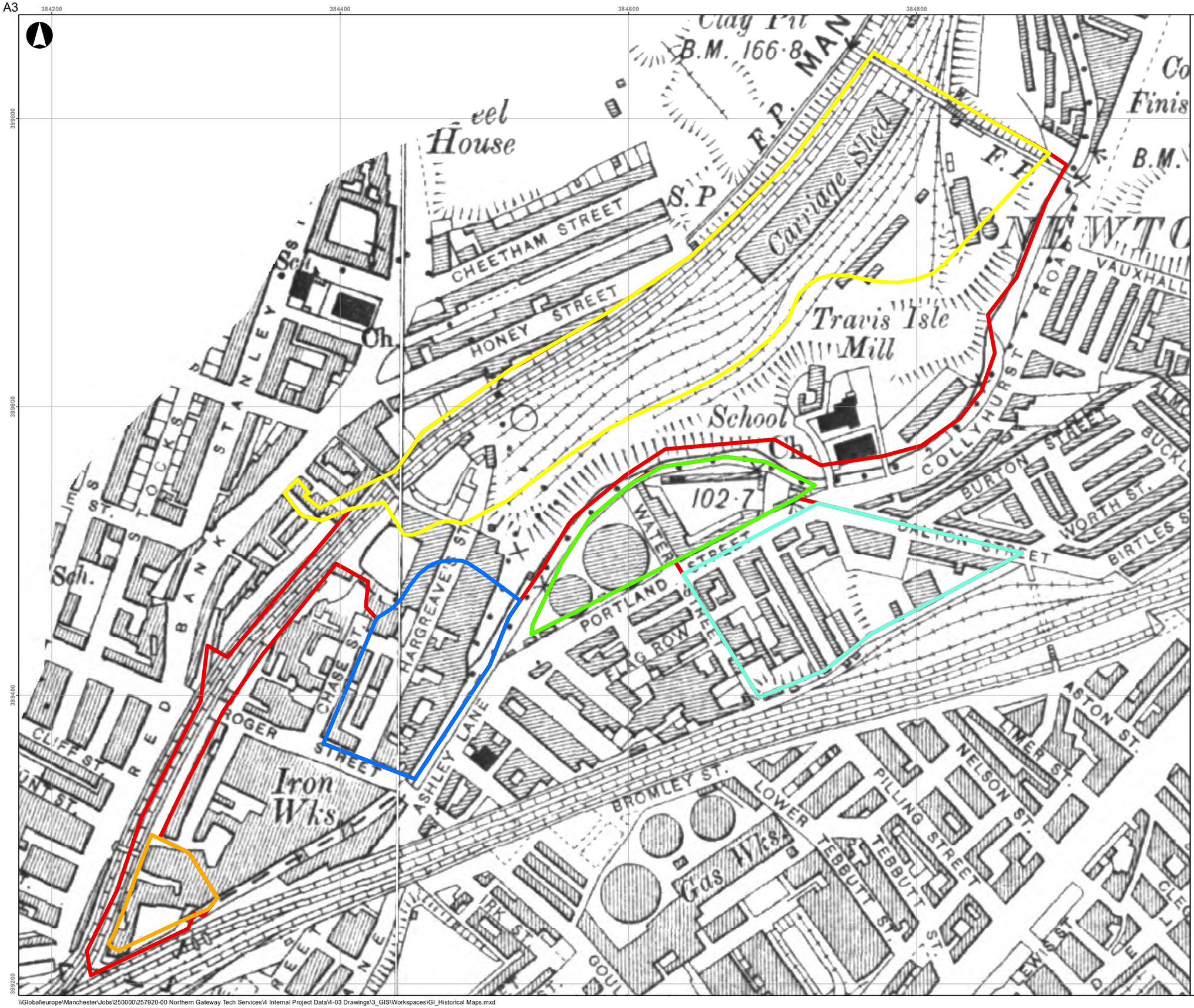
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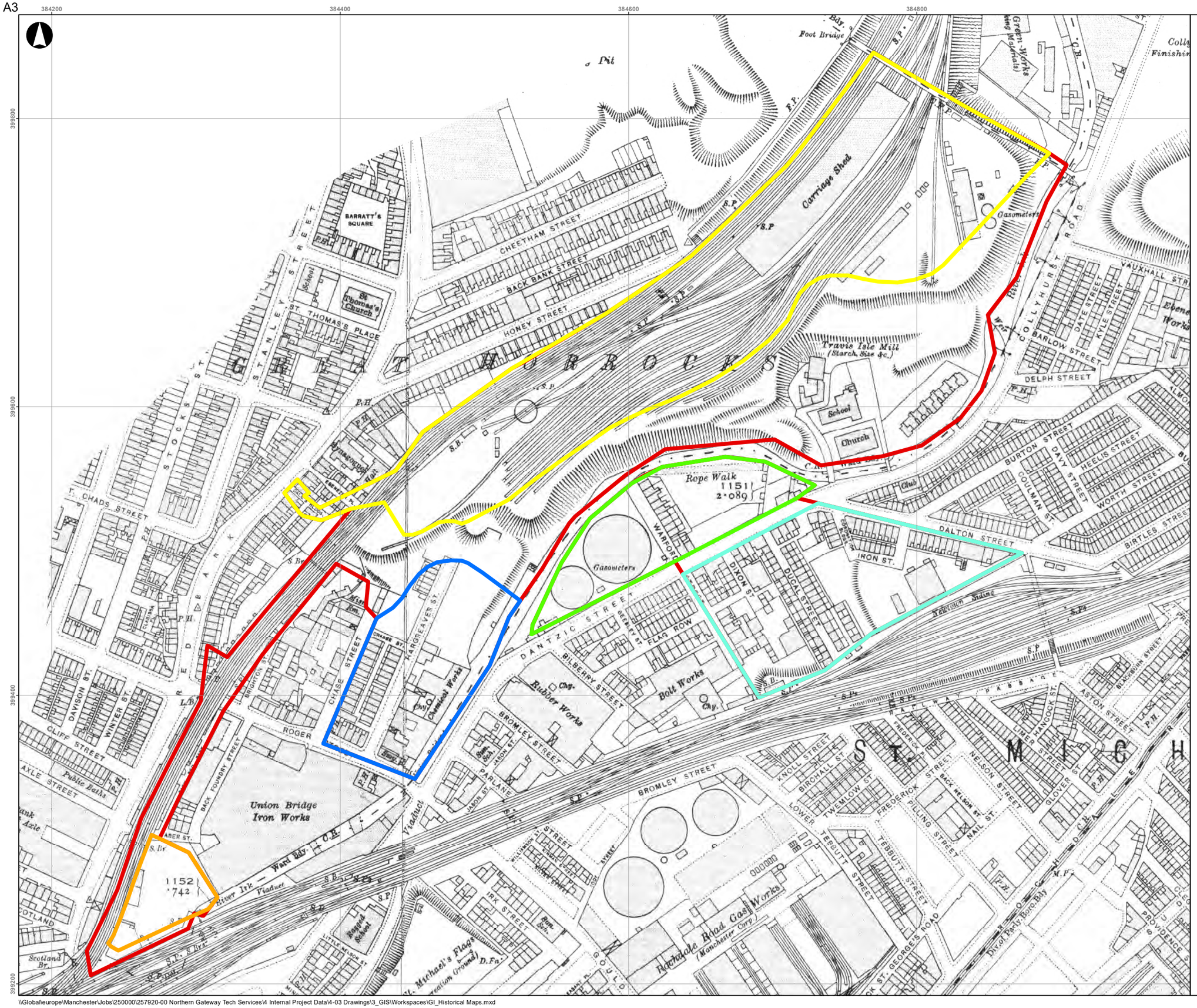
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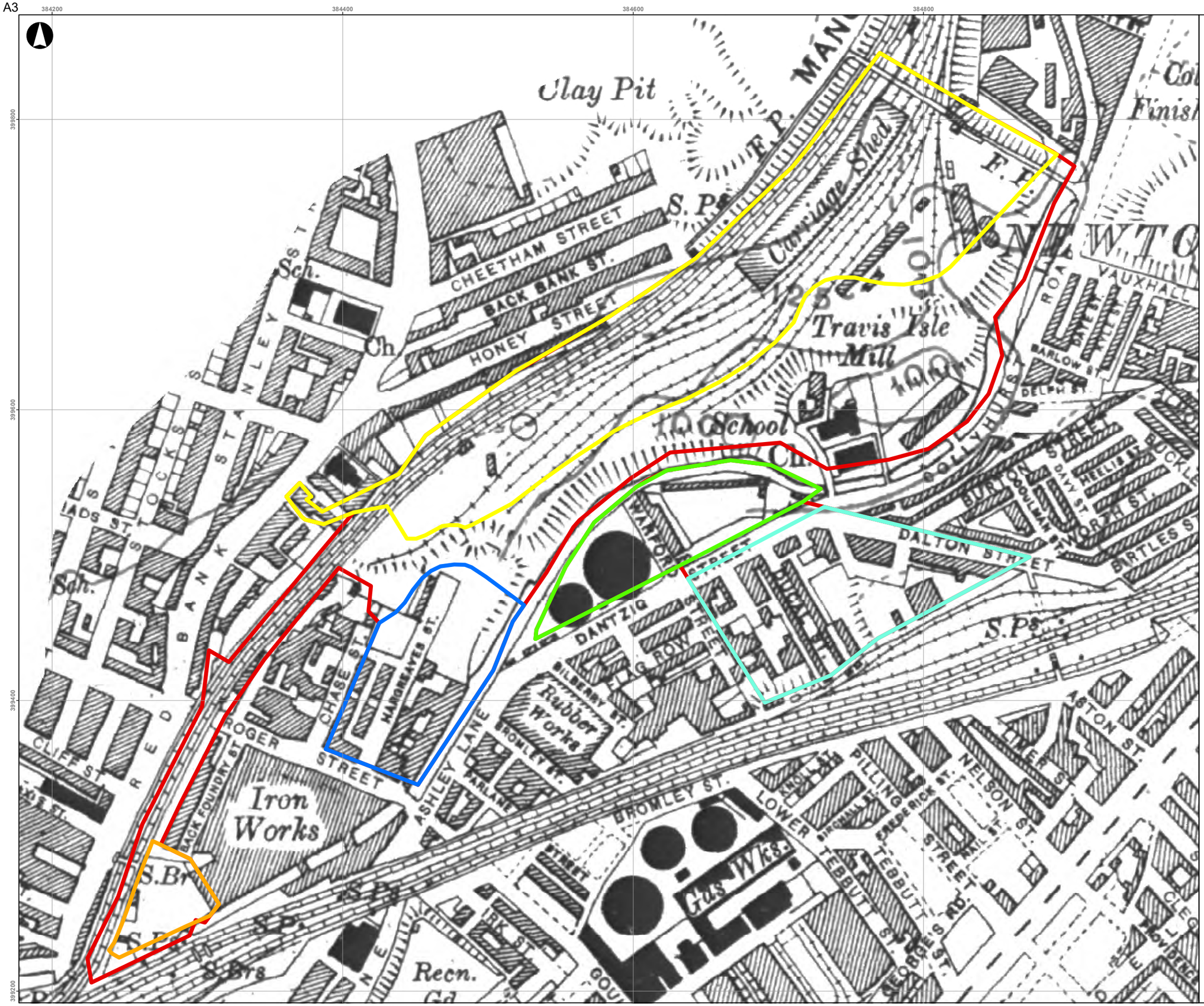
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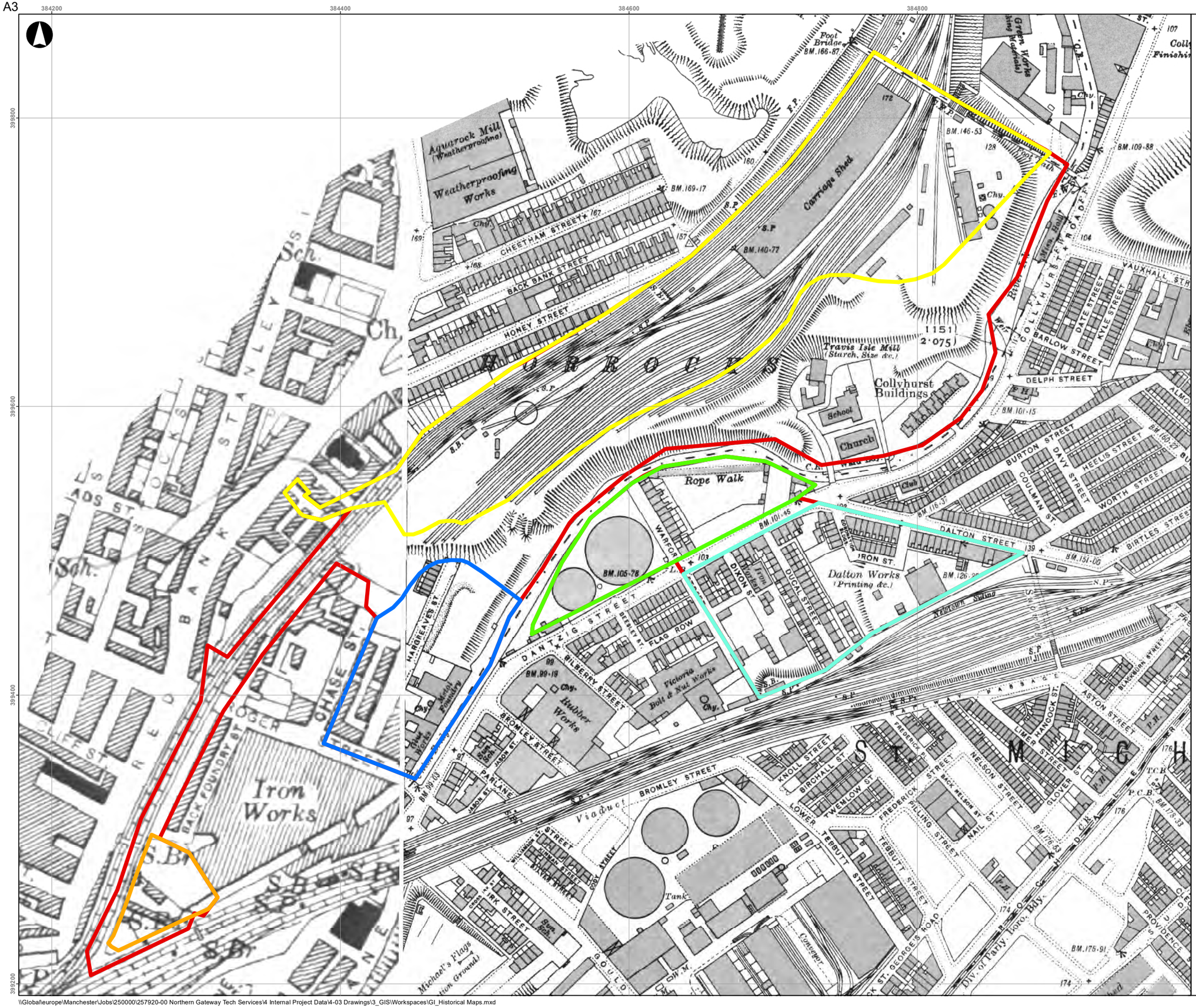
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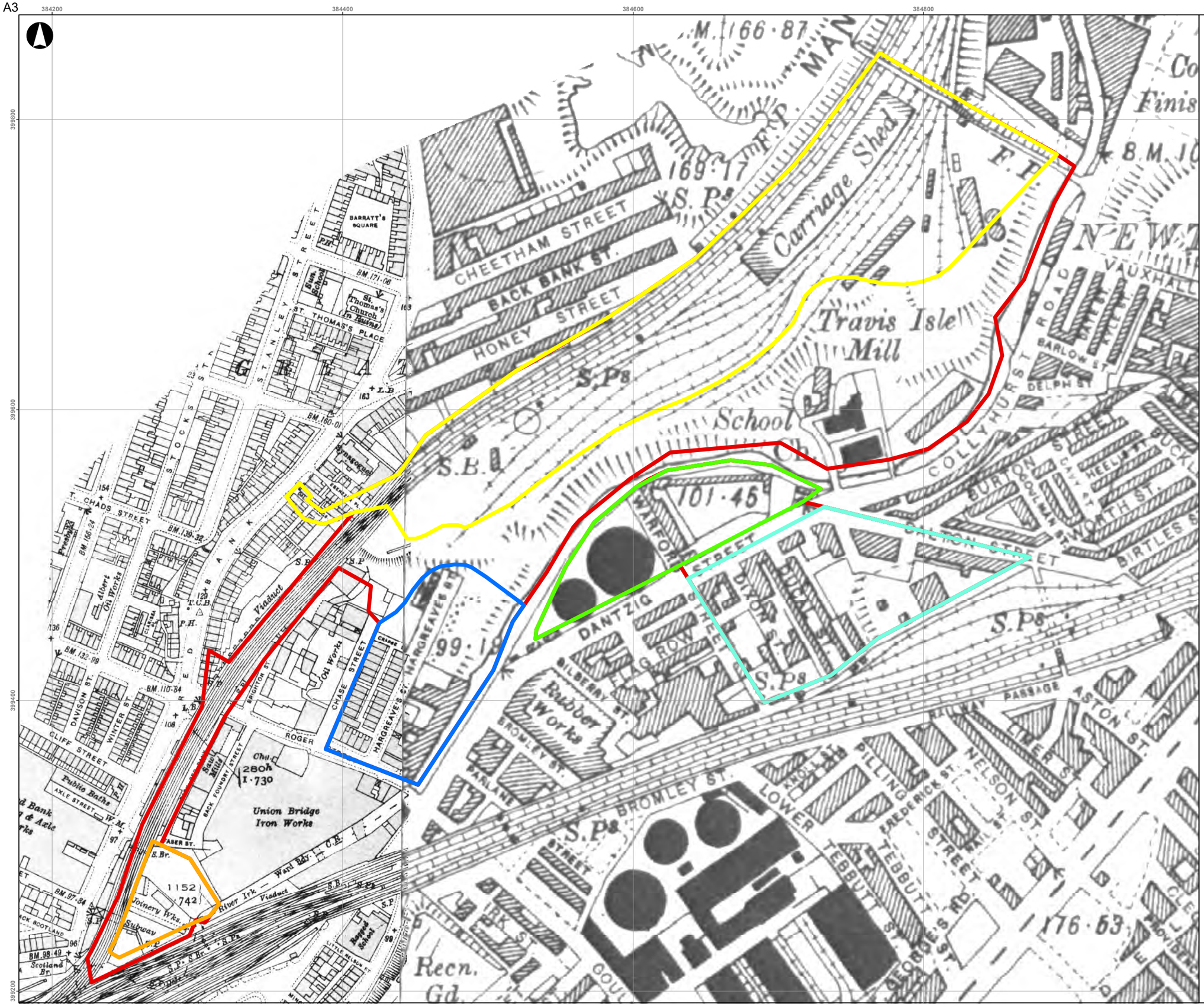
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Legend

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Metres

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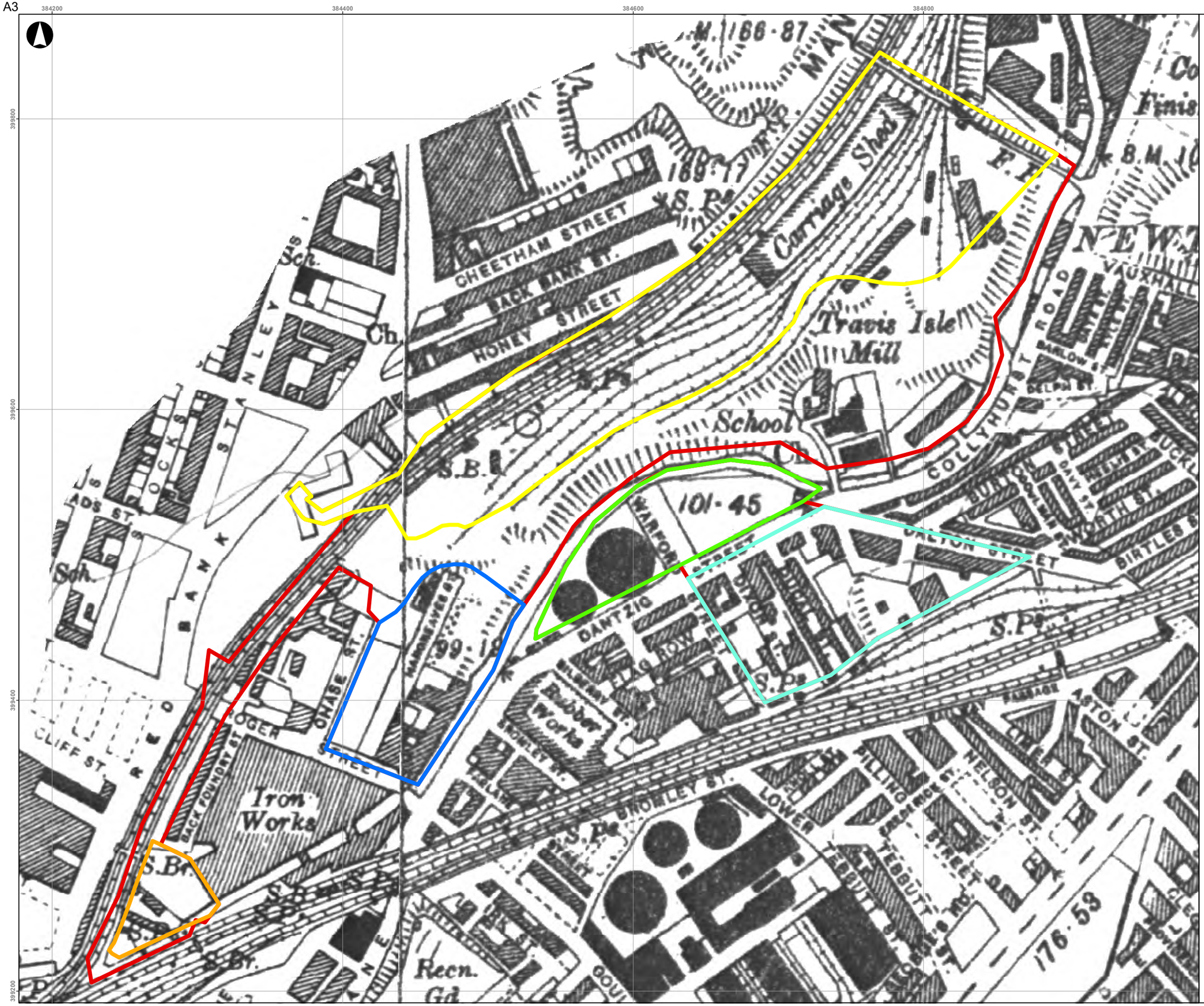
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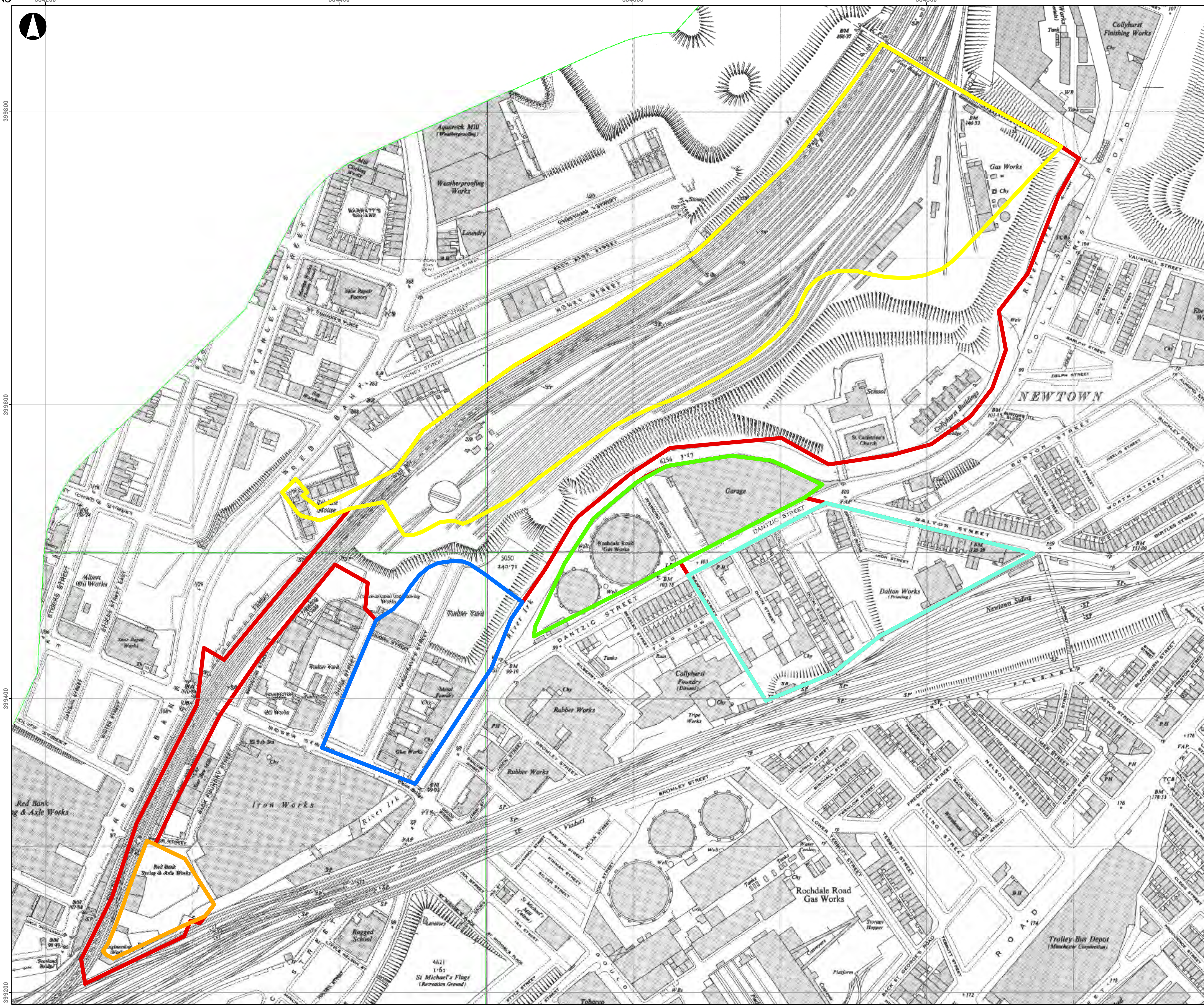
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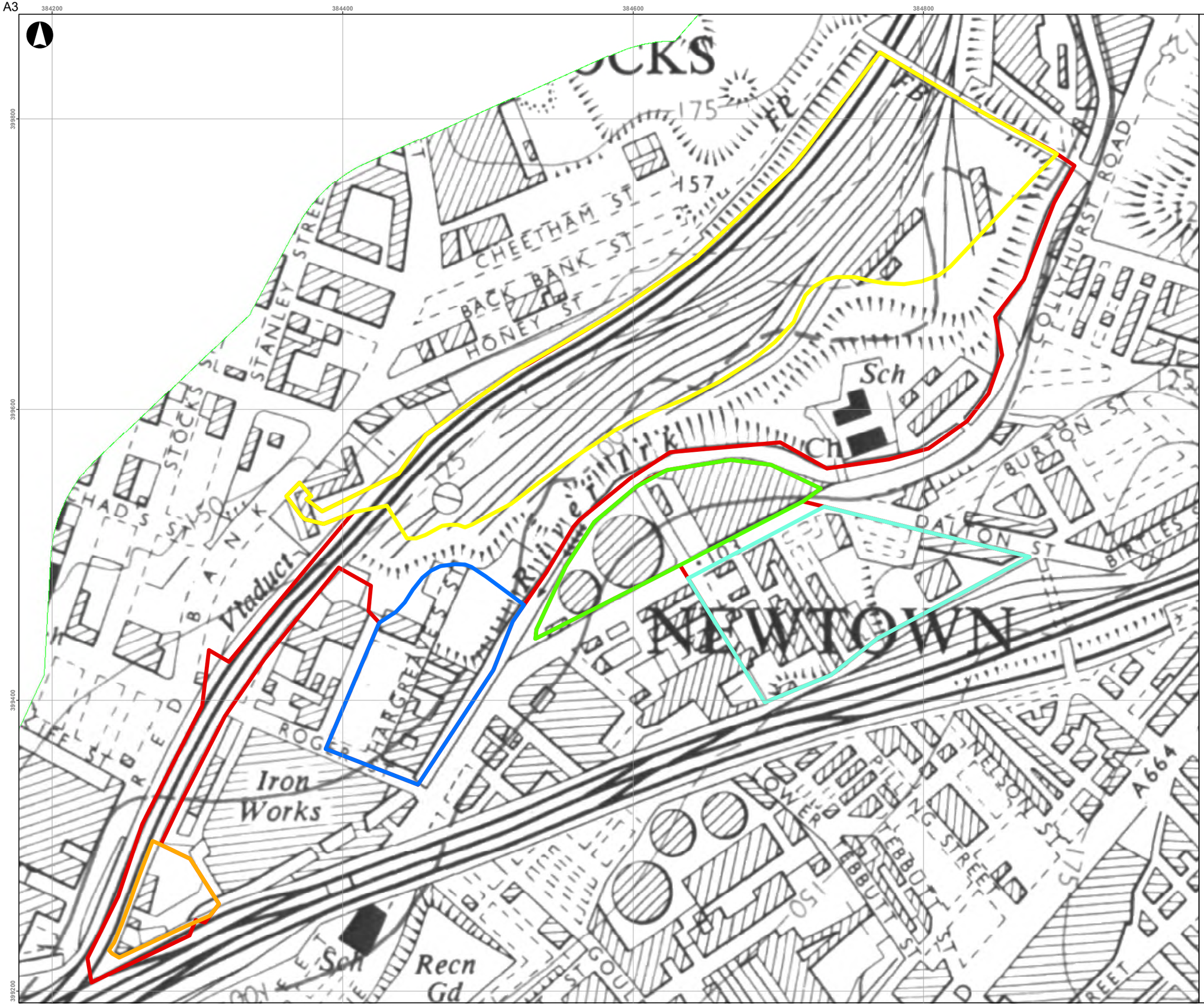
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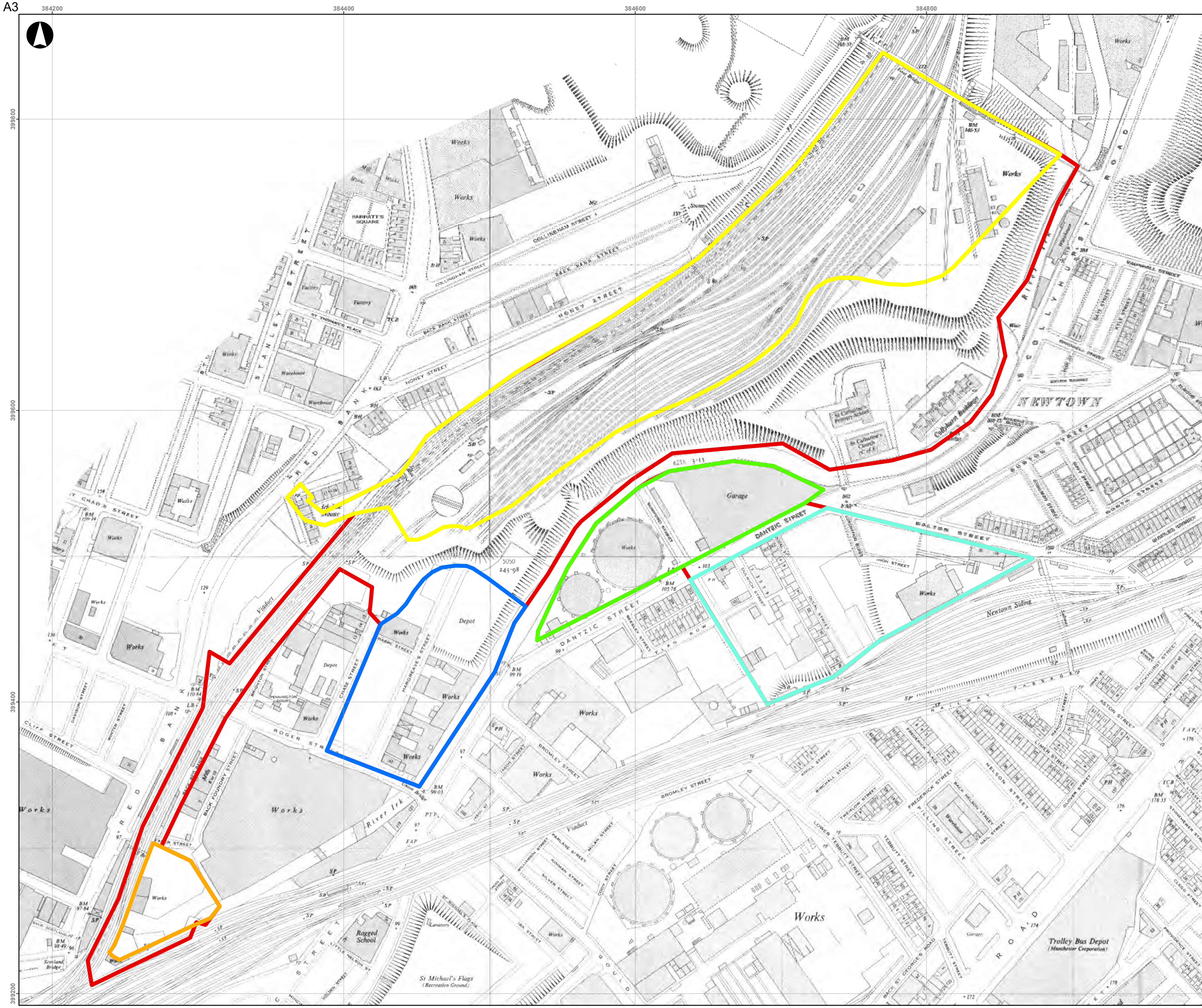
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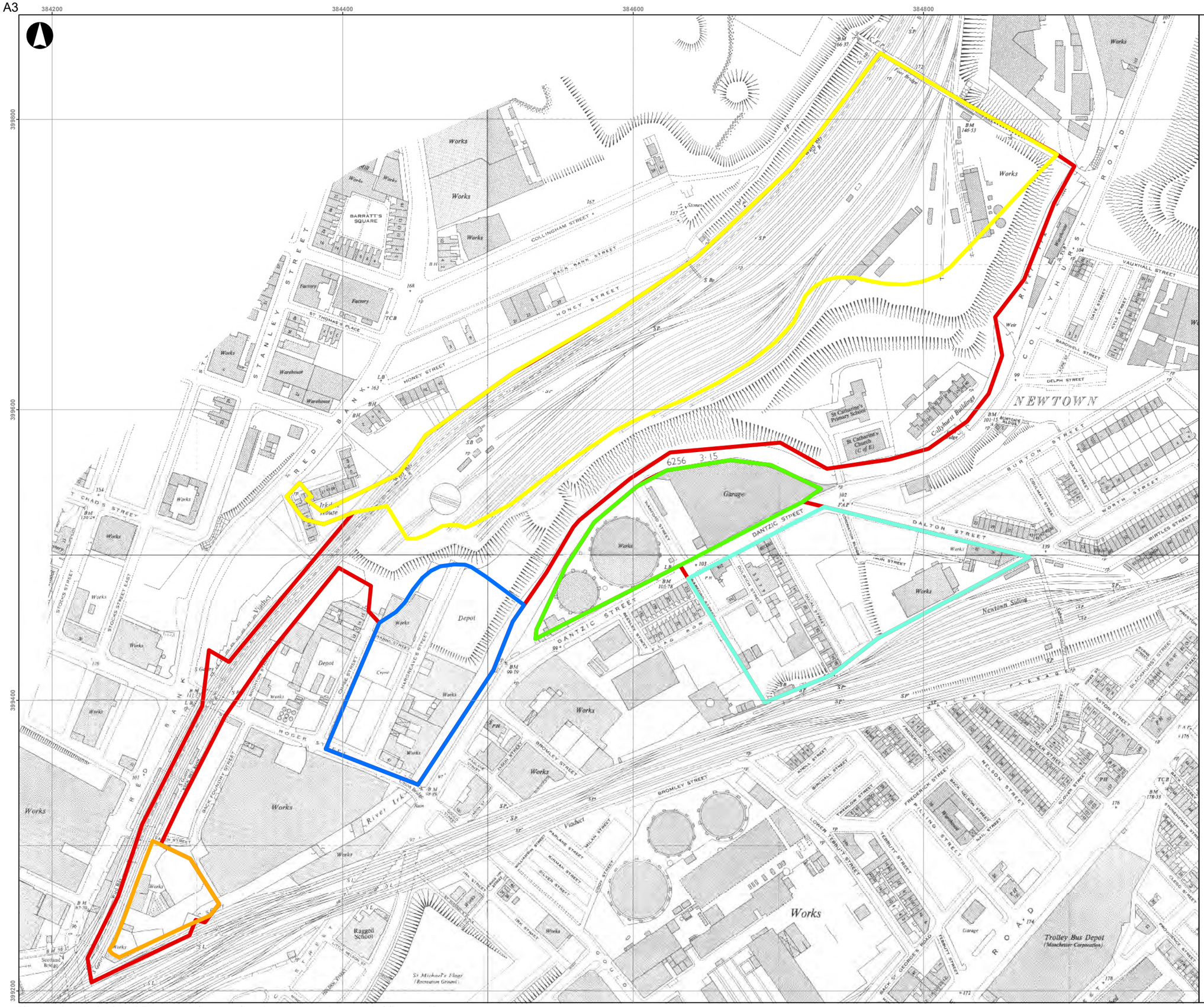
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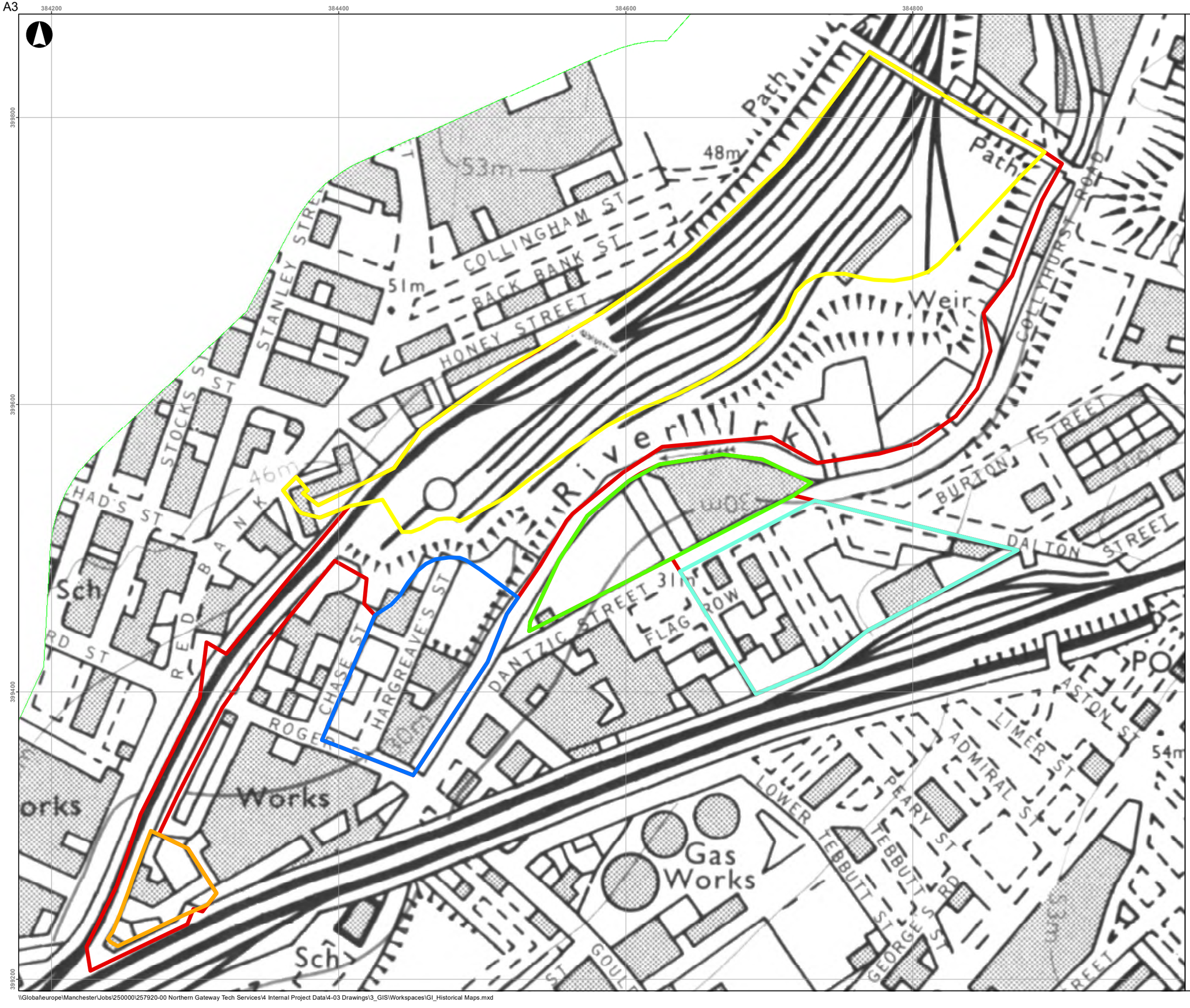
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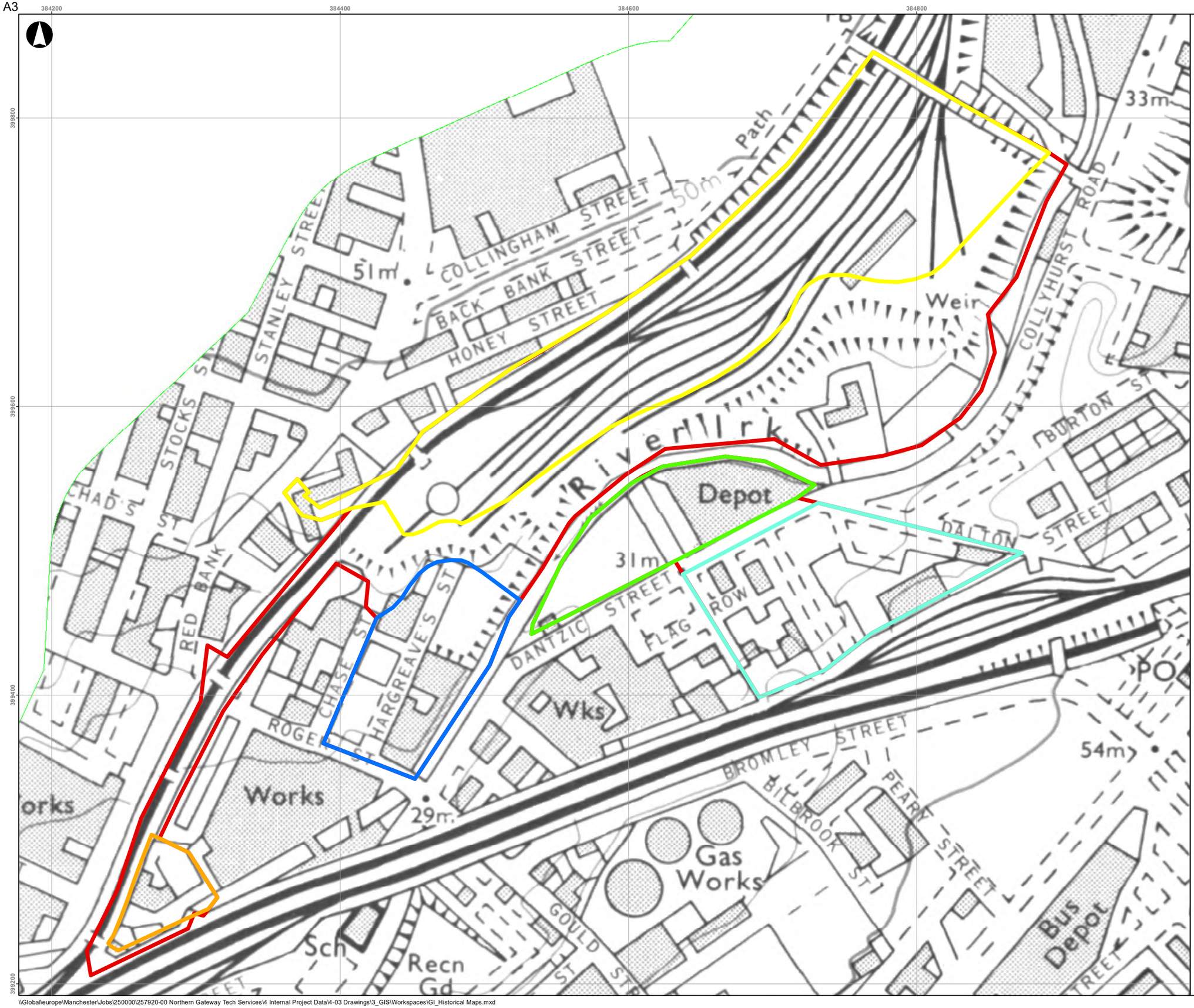
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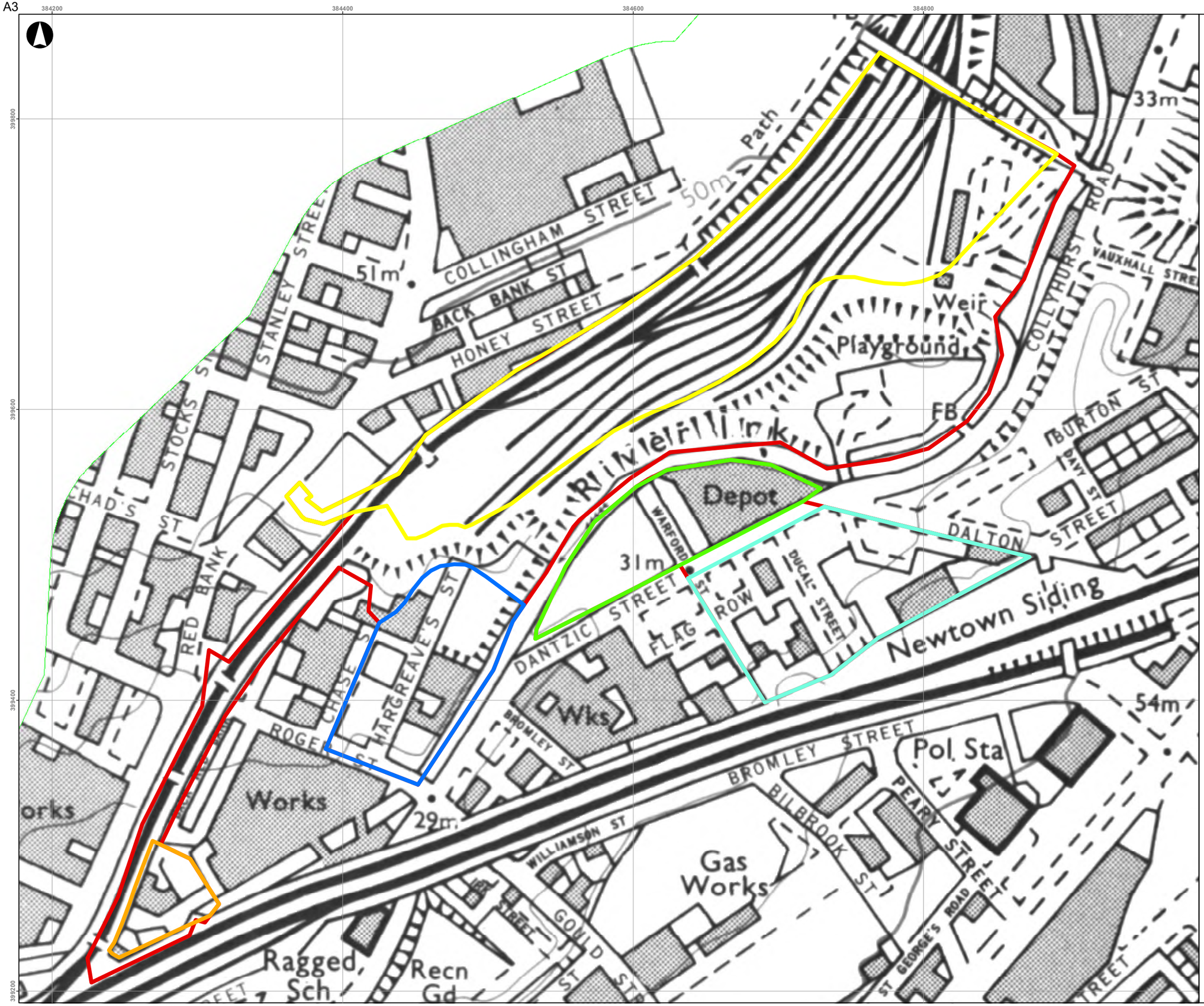
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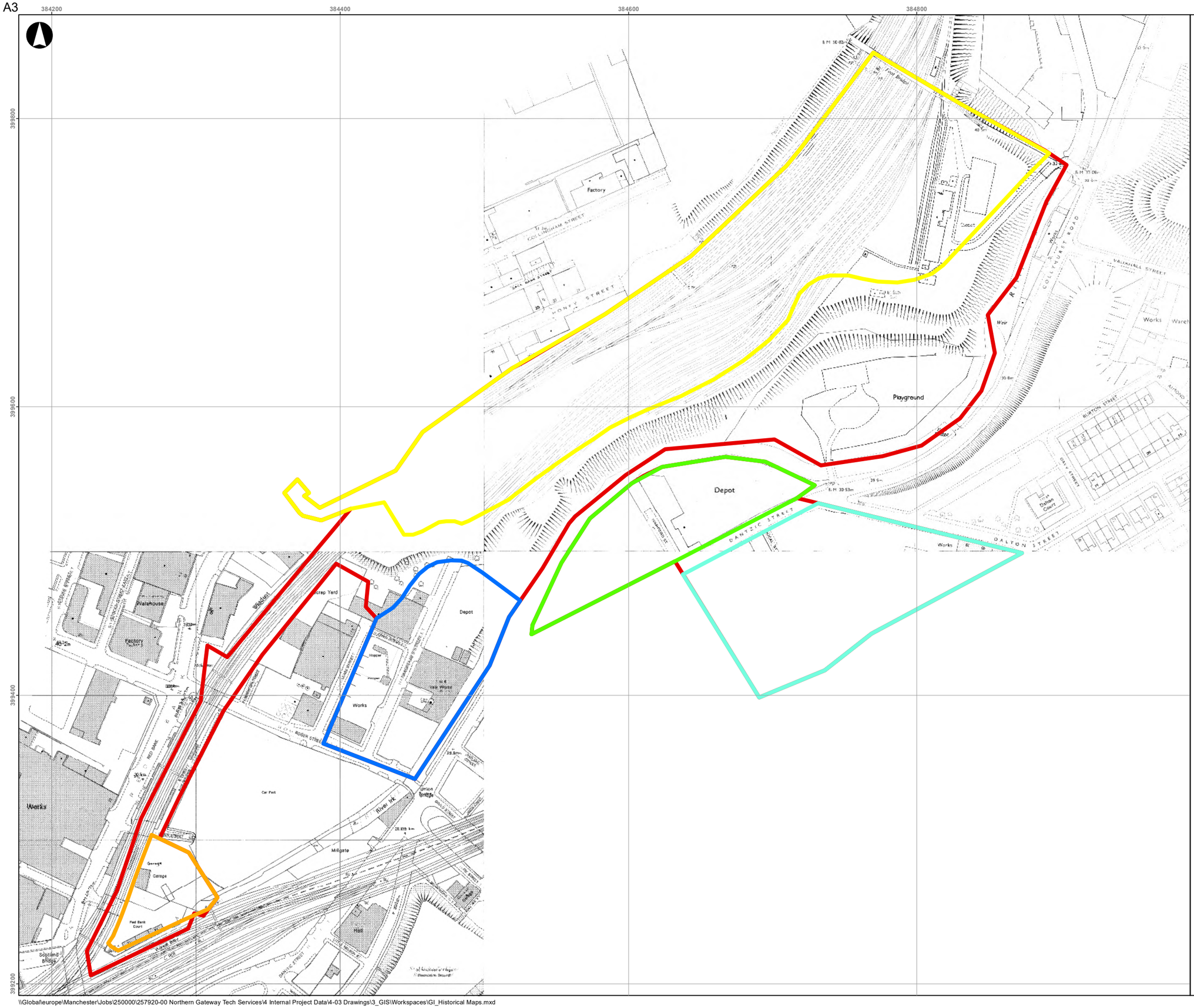
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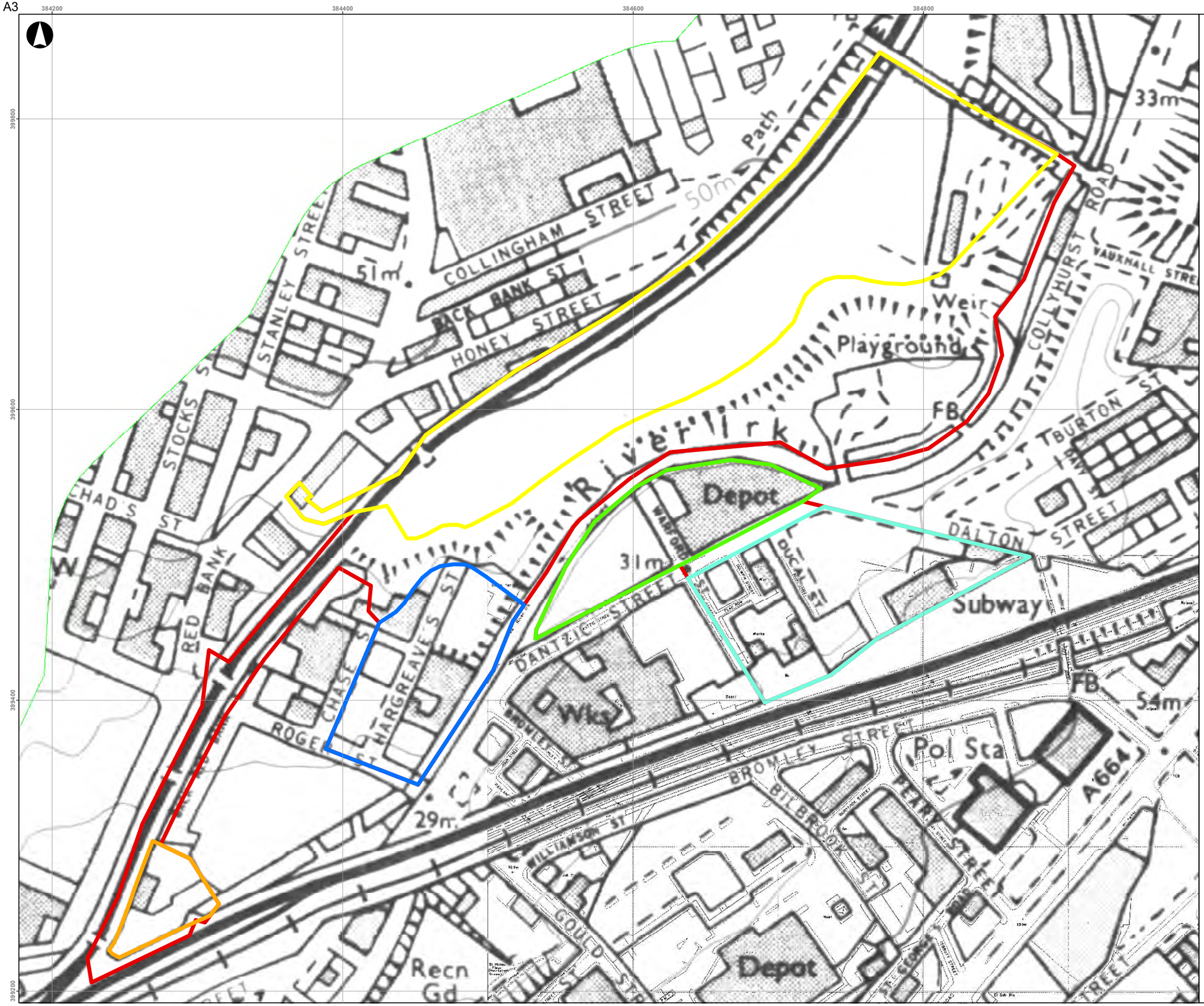
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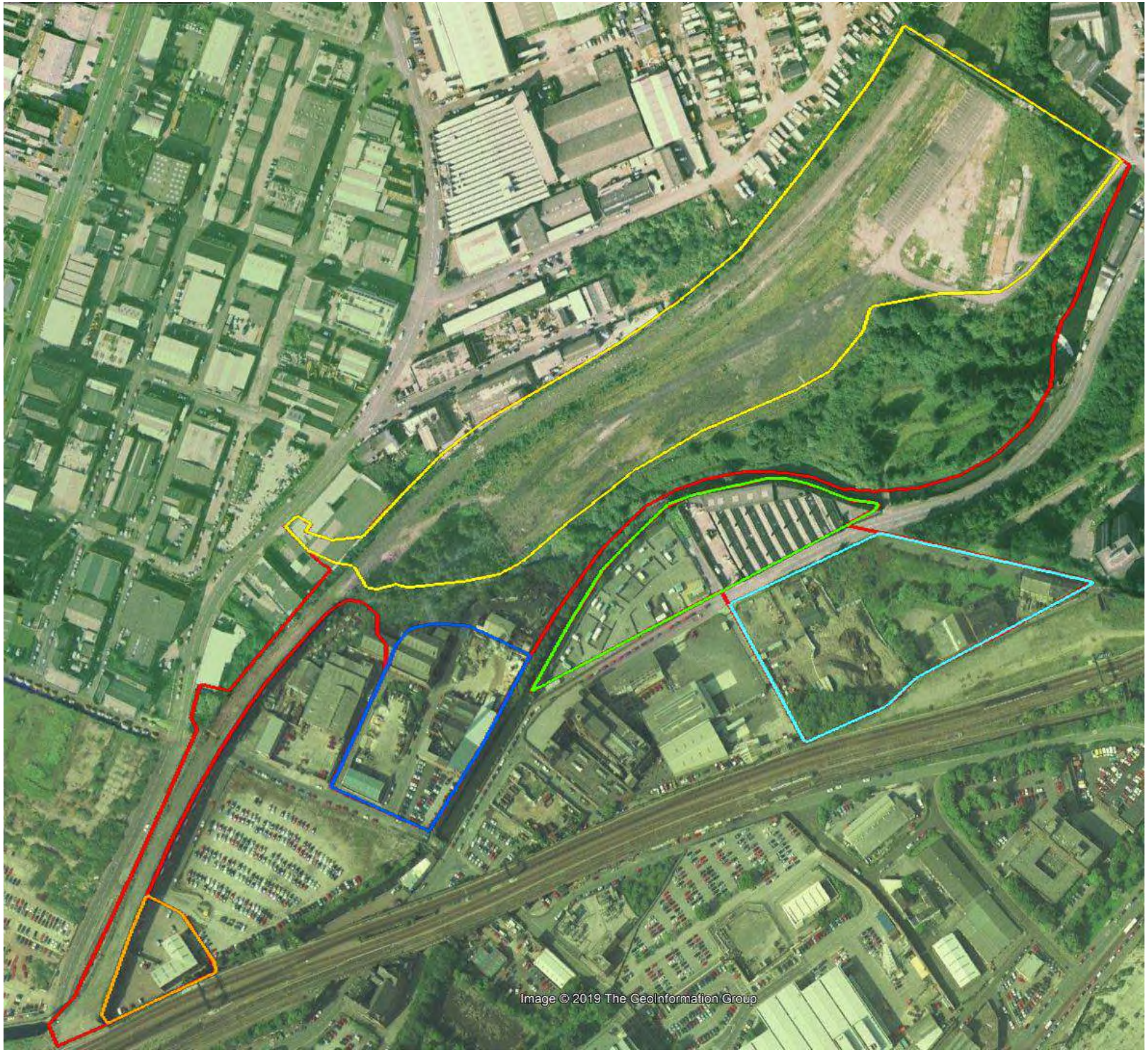
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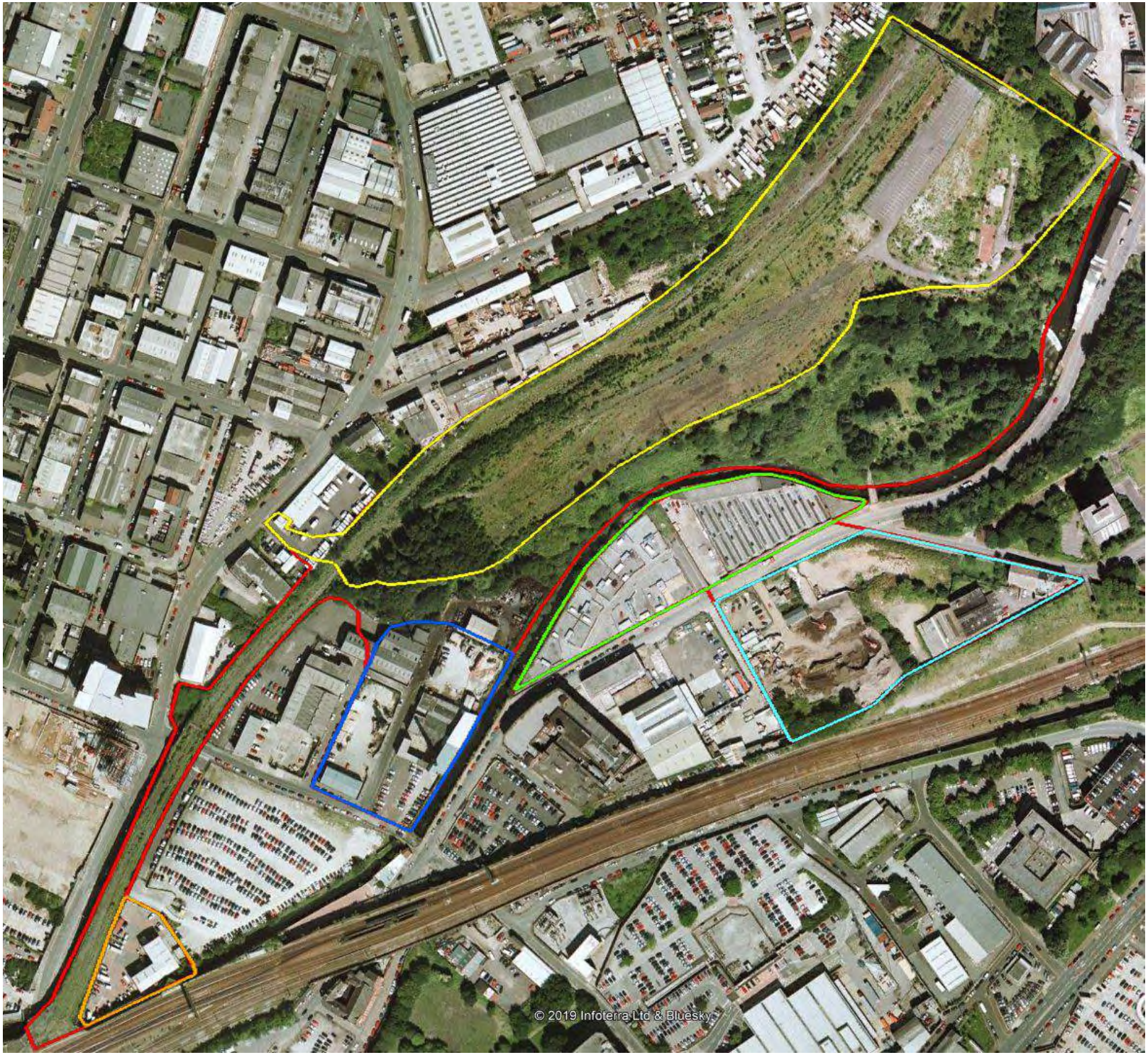
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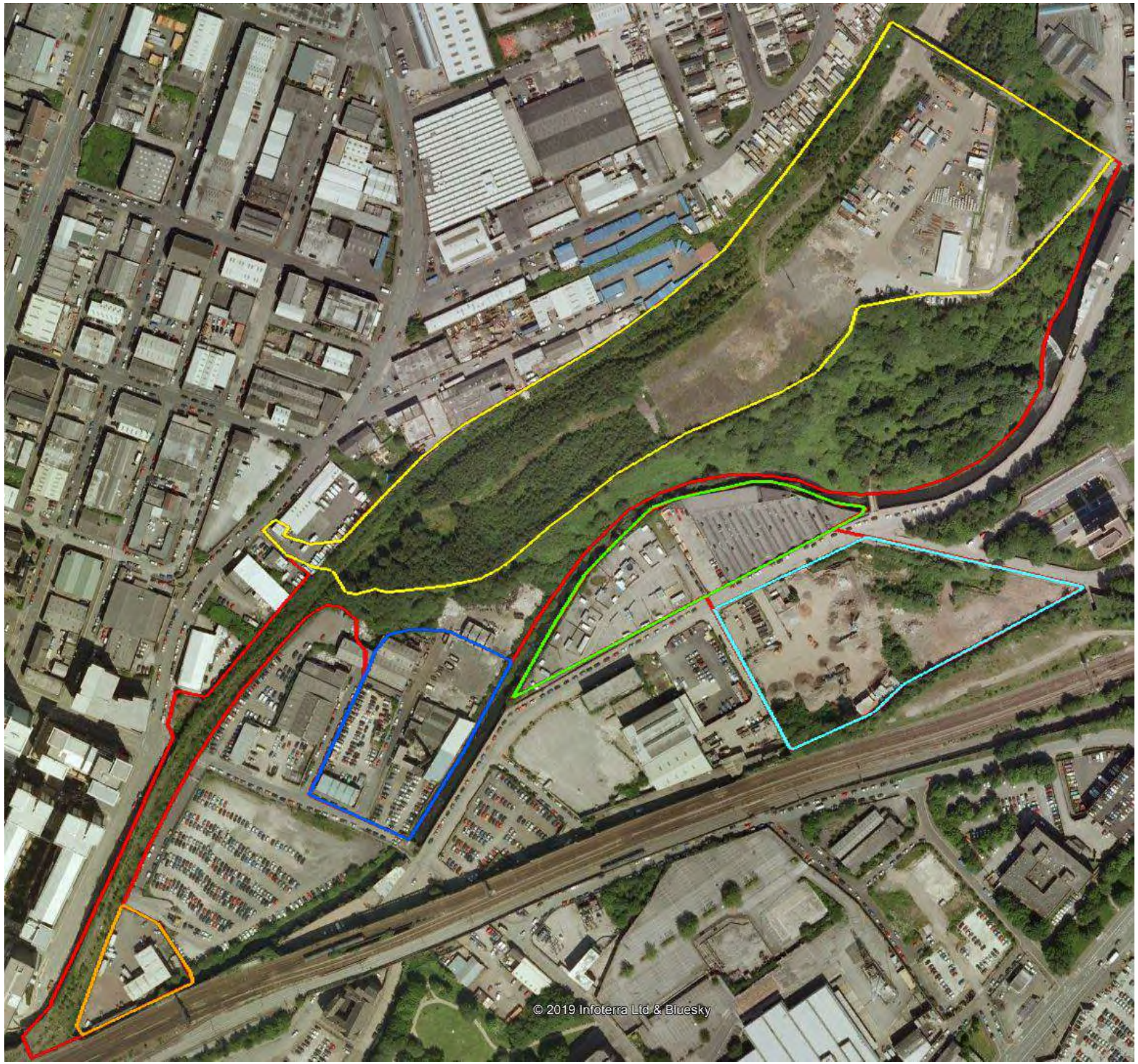
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2003
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2009
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2013
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2017
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2018
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Appendix B

AEG Factual Report (2019)

NORTHERN GATEWAY



Final Factual Report (Rev.00)

Contract Number: NW1580
Client: Far East Consortium International Limited
Consulting Engineer: Ove Arup & Partners Limited

Date: March 2019

Allied Exploration & Geotechnics Ltd.

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NORTHERN GATEWAY

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Window/Windowless Sample Hole Records	4
Trial Pit Records	5
Groundwater Observation Made at the Time of Siteworks	6
Groundwater Monitoring Results	7

***IN-SITU* TESTING ENCLOSURES:**

Test Report Certificate	0
Standard Penetration Test Results (SPT)	1
Hand Shear Vane Test Results (HSV)	2
In-situ Water Quality Parameter Test Results	3

LABORATORY ENCLOSURES:

Laboratory Report Certificate	0
Sample Description Sheets	1
Moisture Content/Plasticity Index and Moisture Content	2
Determination of Particle Density	3
Particle Size Distribution Sieving and Sedimentation	4
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APPENDICES:

Specialist Chemical Testing (Tested Externally) Appendix I

Abbreviation	Definition
CP	Cable Percussion Borehole
TP	Trial Pit
WLS	Windowless Sample Hole

Text Abbreviations

1. INTRODUCTION

It is proposed to redevelop several parcels of land situated in the Red Bank area of Manchester. The development will involve constructing new residential apartments, townhouses, associated infrastructure and road network.

Allied Exploration & Geotechnics Limited (AEG) were contracted by Far East Consortium International Limited with Ove Arup & Partners Limited acting in the capacity of Consulting Engineer to perform a ground investigation at this site in order to provide information on the subsurface ground and groundwater conditions as well as to obtain samples for geotechnical and specialist chemical testing.

1.1 Scope of Works

The investigation works consisted of the following main elements:

- Ten cable percussion boreholes
- Twenty one machine excavated trial pits
- Seven windowless sample holes
- *In-situ* standard penetration and hand shear vane testing
- Geotechnical and specialist chemical sampling
- Installation of gas and groundwater monitoring instrumentation
- Post site groundwater monitoring, sampling and associated water quality parameter testing
- Surveying

Site work was carried out between the 3rd and 11th January 2019 with subsequent post site work monitoring, laboratory testing and reporting thereafter. A factual report only was requested.

The comments and opinions expressed in this report are based on the ground conditions encountered during the site work and on the results of tests carried out in the field and in the laboratory. There may, however, be special conditions prevailing on the site which have not been disclosed by this investigation and which have not been taken into account by this report.

2. THE SITE

2.1 Location

The National Grid Reference of the approximate centre of the site is SJ 845 995. This can be found on Ordnance Survey 1:50,000 Sheet Number 109 (Manchester, Bolton & Warrington). Part of this sheet is reproduced as Figure 1, the Site Location Plan.

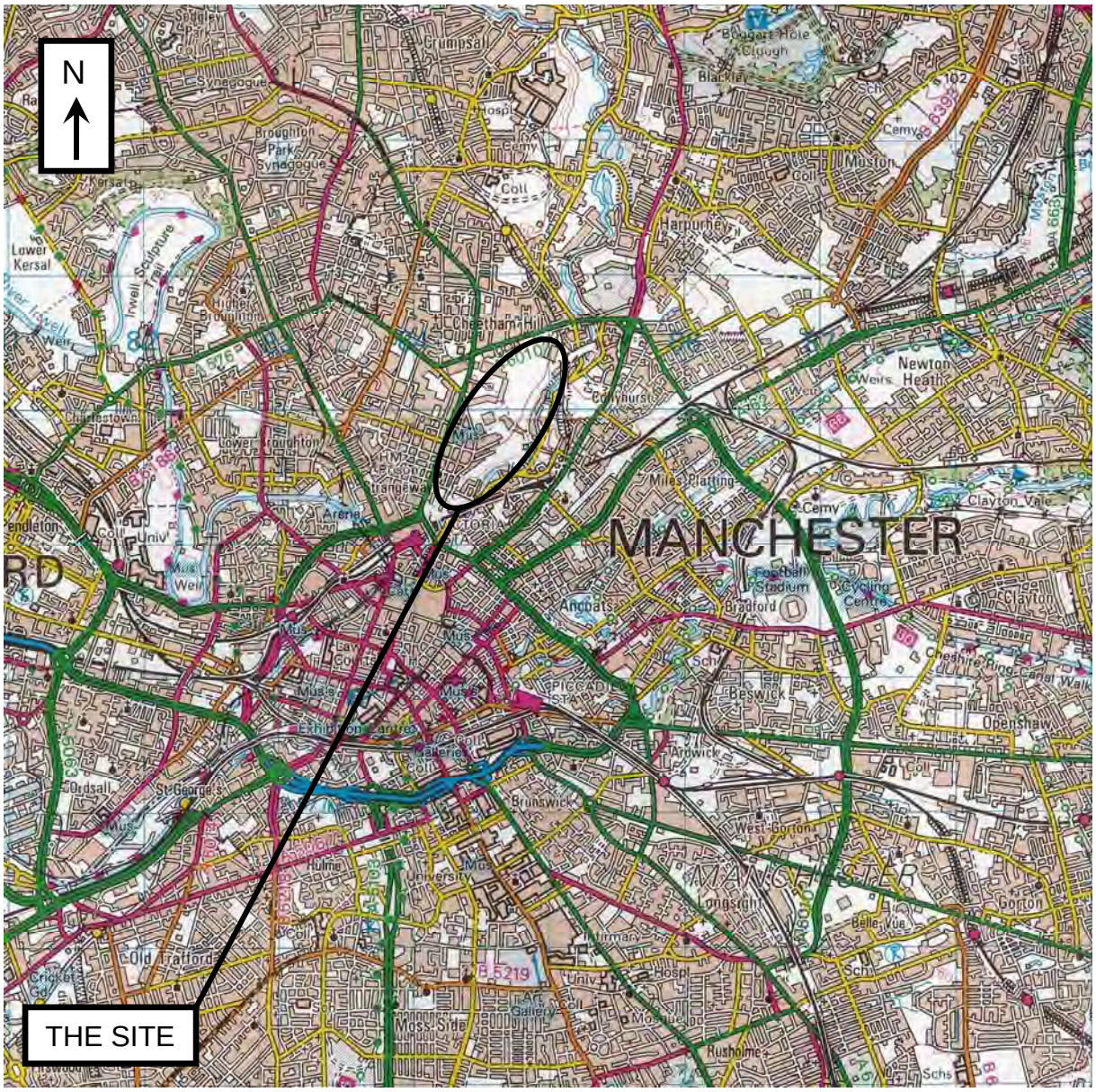


Figure 1: Site Location Plan

Reproduced from the Ordnance Survey 1:50,000 scale Landranger map by permission of Ordnance Survey on behalf of The Controller of Her Majesty's Stationery Office, Crown Copyright. All rights reserved. Licence number AL 100002282.

The site is located on the northeast outskirts of Manchester City Centre and is located approximately 0.5km to the northeast of Victoria Railway Station.

2.2 Site Description and Topography

The site comprises parcels of land with varied use situated to the east of Red Bank. Land uses within this package include former rail sidings, commercial land, a traveller site, timber merchants and former rubber works and print works. The site is of variable topography and is bound to the east by Collyhurst Road/Dantzic Street and to the south by Union Street Bridge.

3. SITE OPERATIONS

3.1 General

All exploratory hole work, associated sampling, *in-situ* testing and logging was carried out in accordance with techniques outlined in Table 1, as appropriate; at positions as near as practicable to those supplied by the Consulting Engineer. These are shown on the Exploratory Hole Location Plan, Field Data Enclosure 1.

Reference Code Number	Title
BS 1377:1990	Methods of Test for Soils for Civil Engineering Purposes (where not in contravention or superseded by Eurocode references)
BS 5930:2015	Code of Practice for Ground Investigation (where not in contravention or superseded by Eurocode references)
BS EN ISO 14688-1:2002 & 14688-2:2004	Identification and Classification of Soil
BS 10175:2011+A1:2013	Investigation of Potentially Contaminated Sites
BS EN ISO 22476-3: 2005	Geotechnical investigation and testing - Field testing - Part 3 Standard Penetration Testing

Table 1: British Standard Reference Code Number

The depths of all exploratory holes, descriptions of the material encountered, details of any groundwater encountered, samples taken and *in-situ* testing carried out together with any other relevant information can be found on the Borehole, Window/Windowless Sample Hole and Trial Pit Records, Field Data Enclosure 2, 3 and 4 respectively. A key to all symbols and abbreviations used throughout the report is included in the Key Sheets.

In accordance with the Site Investigation Steering Group publication “Guidelines for the Safe Investigation by Drilling of Landfills and Contaminated Land” the site was classified YELLOW, however the traveller site off Dantzic Street and the north western corner of the former railway sidings at Red bank was classed as RED.

Parts of the site are known to have issues with crime and vandalism therefore site operatives were accompanied by two transport police officers for the duration of the works and again during the monitoring period.

A number of positions required tree clearance works to be undertaken in order to gain access. Tree clearance was carried out by specialist tree surgeons (Sunnybank Forestry).

The Unexploded Ordnance (UXO) risk was determined as being low for this site so it was arranged for a specialist UXO company (1st Line Defence) to attend site and provide an Ordnance Awareness Briefing to all site operatives at the beginning of site works.

The primary purpose of ground investigation exploratory holes is to probe the stratified sequences of soil and/or rock. From the results of these probings no conclusion should be drawn concerning the presence of, size, lithological nature, and numbers per unit volume of ground cobbles and boulders in soil types such as glacial till (boulder clay).

Stratigraphical formation names have been appended to the Exploratory Records in accordance with the requirements of the contract. It should be stressed that these have been attributed based on the available information, therefore no assurance can be provided herein with regards to their accuracy.

3.2 Health & Safety Considerations: Services

Before the commencement of any exploratory hole a search for underground services was conducted as prescribed in HSE publication '*Avoiding Underground Services (HSG47)*' and in accordance with in-house internal safety procedure AEG-14.

Service plans were provided by the Client and were consulted prior to using a service locating device (such as a Cable Avoidance Tool or C.A.T.) to scan a working area around the proposed exploratory hole location. Where no services were indicated a '*Permit-to-Work*' form was issued by the investigation supervisor and, with the exception of trial pits, the position was commenced with a hand excavated inspection pit. The inspection pit was also scanned during the excavation procedure. It should be noted that the digging of an inspection pit only confirms or guards against the possible presence of underground public utility services within the excavated pit. Where no services were indicated by the scanning procedure or inspection pit the exploratory hole was commenced in accordance with the Contract Specification.

Where services were located or there was reasonable belief that they were present, the position was relocated in agreement with the Client. Details of any services uncovered/located during this investigation are given in Table 2.

Exploratory Hole Number	Type of Service	Orientation & Depth (size where indicated)	Status (Damaged/Undamaged)	Additional Remarks
TP106	Plastic pipe	130-290° at 0.30m BGL (100mm diameter)	Undamaged	Located 0.50m from Face C.
TP107	Plastic cable	100-280° at 0.40m BGL (25mm diameter)	Undamaged	None

Table 2: Services Encountered

3.3 Exploratory Holes: Boreholes

Ten boreholes were sunk using a Dando 2000 drilling rig, utilising cable percussive (shell and clay cutter) techniques, to depths of between 3.50m (BH109) and 15.00m BGL (BH104). The Borehole Records are presented as Field Data Enclosure 2 and a summary of the boreholes and any relevant remarks are detailed in Table 3.

Exploratory Hole Number	Drilling Method	Completion Depth (m BGL)	Installation	Remarks
BH101	CP	7.80	Yes – refer to Section 3.6	Advanced to required depth.
BH102	CP	8.50	Yes – refer to Section 3.6	Advanced to required depth.
BH103	CP	8.30	Yes – refer to Section 3.6	Advanced to required depth.
BH104	CP	15.00	Yes – refer to Section 3.6	Advanced to required depth.
BH105	CP	11.20	Yes – refer to Section 3.6	Advanced to required depth.
BH106	CP	11.30	Yes – refer to Section 3.6	Advanced to required depth.
BH107	CP	3.95	No – reinstated	Advanced to required depth.
BH109	CP	3.50	No – reinstated	Advanced to required depth.
BH110	CP	7.00	No – reinstated	Advanced to required depth.
BH112	CP	4.30	Yes – refer to Section 3.6	Advanced to required depth.
Any relevant photographs are presented after the applicable Borehole Record				

Table 3: Borehole Summary

3.4 Exploratory Holes: Window/Windowless Sample Holes

Seven windowless sample holes were sunk using a Premier Compact 110 Series tracked rig utilising a removable liner system, to depths of between 1.50m (WS105) and 5.45m BGL (WS101, WS102 and WS105A). The Window/Windowless Sample Hole Records are presented as Field Data Enclosure 3 and a summary of the windowless sample holes and any relevant remarks are detailed in Table 4.

Exploratory Hole Number	Drilling Method	Completion Depth (m BGL)	Installation	Remarks
WS101	WLS	5.45	No – reinstated	Advanced to required depth.
WS102	WLS	5.45	No – reinstated	Advanced to required depth.
WS103	WLS	3.90	No – reinstated	Terminated encountering concrete.
WS104	WLS	5.00	No – reinstated	Advanced to required depth.
WS105	WLS	1.50	No – reinstated	Terminated due to refusal.
WS105A	WLS	5.45	No – reinstated	Advanced to required depth.
WS106	WLS	4.20	No – reinstated	Terminated due to collapse from 4.20m back to 2.70m BGL.
Any relevant photographs are presented after the applicable Window/Windowless Sample Hole Record				

Table 4: Window/Windowless Sample Hole Summary

3.5 Exploratory Holes: Mechanically Excavated Trial Pits

Twenty one trial pits were mechanically excavated using the back-hoe bucket of a JCB 3CX excavator to depths of between 1.80m (TP110) and 4.50m BGL (TP103, TP106, TP107, TP108, TP109, TP111, TP115,

TP124). The Trial Pit Records are presented as Field Data Enclosure 4 and a summary of the trial pits and any relevant remarks are detailed in Table 5.

Exploratory Hole Number	Excavation Method	Completion Depth (m BGL)	Remarks
TP101	Machine Excavated	3.60	Terminated due to instability.
TP102	Machine Excavated	4.10	Terminated due to cobble obstruction
TP103	Machine Excavated	4.50	Advanced to required depth
TP104	Machine Excavated	3.80	Terminated due to instability.
TP105	Machine Excavated	3.80	Terminated due to instability.
TP106	Machine Excavated	4.50	Advanced to required depth
TP107	Machine Excavated	4.50	Advanced to required depth
TP108	Machine Excavated	4.50	Advanced to required depth
TP109	Machine Excavated	4.50	Advanced to required depth
TP110	Machine Excavated	1.80	Terminated due to groundwater ingress.
TP111	Machine Excavated	4.50	Advanced to required depth
TP112	Machine Excavated	2.80	Terminated due to groundwater ingress.
TP115	Machine Excavated	4.50	Advanced to required depth
TP119	Machine Excavated	3.15	Advanced to required depth
TP120	Machine Excavated	3.70	Advanced to required depth
TP121	Machine Excavated	3.20	Terminated due to instability.
TP122	Machine Excavated	3.00	Advanced to required depth
TP124	Machine Excavated	4.50	Advanced to required depth
TP125	Machine Excavated	2.80	Advanced to required depth
TP126	Machine Excavated	3.20	Advanced to required depth
TP127	Machine Excavated	4.00	Advanced to required depth
Any relevant photographs are presented after the applicable Trial Pit Record			

Table 5: Trial Pit Summary

3.6 Samples

Representative samples of soil were obtained from the exploratory holes and were taken to the laboratory for selected geotechnical and specialist chemical testing.

Environmental samples were taken in accordance with the contract specification during the investigation using an approved selection of container types in order to suit the encountered material properties and designated laboratory analytical parameters. Full chain of custody procedures were in place post sampling and during the transportation stage to the nominated specialist chemical laboratory. Environmental samples were administered appropriately following the best practice guidance provided in the contract specification.

3.7 Groundwater

The comments on groundwater conditions are based on the observations made at the time of investigation. It should be noted that groundwater levels may vary due to seasonal and other effects. Furthermore, water was added during advancement of the boreholes in order to facilitate drilling operations. As a consequence there is a possibility that this could have masked the discrete ingress of natural groundwater into the boreholes, which subsequently may have been sealed as a result of progressing the casing.

Groundwater was encountered in the exploratory holes during the site works operation. Where groundwater observations were made details are given on the relevant exploratory hole record and in greater detail (collectively in tabulated format) as Field Data Enclosure 5: Groundwater Observations Made at the Time of Site Works. Standing groundwater levels were recorded at the beginning and/or end of each drilling shift. The water level is indicated on the applicable Borehole and Window/Windowless Sample Hole Record as part of the boring progress information.

3.8 Instrumentation & Monitoring

Seven boreholes were installed with monitoring instrumentation in accordance with the requirements of the Consulting Engineer. Details of the installations are shown in Table 6 and on the relevant Borehole Records.

Exploratory Hole Number	Instrumentation	Installation Depth (m BGL)	Response Zone (m BGL)
BH101	1No. 50mm diameter standpipe	5.00	1.00-5.00
BH102	1No. 50mm diameter standpipe	6.50	1.90-6.70
BH103	1No. 50mm diameter standpipe	3.50	1.00-3.50
BH104	1No. 50mm diameter standpipe	9.00	1.80-9.20
BH105	1No. 50mm diameter standpipe	9.50	3.00-9.50
BH106	1No. 50mm diameter standpipe	10.00	2.00-10.00
BH112	1No. 50mm diameter standpipe	4.00	0.50-4.00

Table 6: Instrumentation Summary

Instruments were monitored for groundwater during and after the completion of the site works in accordance with the Contract Specification. A record of the readings is presented as Field Data Enclosure 7 (Groundwater Monitoring Results).

3.9 Operative Observations: Potential Contamination

For the purposes of determining the condition of the site, with regard to human health and environmental issues, reference should specifically be made to any specialist chemical testing undertaken as part of the investigation scheme, as well as any supporting desk study and risk assessment documentation. The information given herein collates the observations made by the operatives involved in the investigation only and comments that have been indicated on the engineering records.

Where there was potential evidence of contamination, principally as a consequence of olfactory and visual identification, information is provided in Table 7.

Exploratory Hole Number	Occurrence (*in-situ*/surface/ laboratory sample)	Visual / Olfactory / Laboratory Testing	Depth (m BGL)	Occurrence Type	Additional Remarks
BH103	*In-situ*	Olfactory	0.10-1.30	Hydrocarbon odour	n/a
WS106	*In-situ*	Olfactory	2.80	Hydrocarbon (benzene) odour	Noted by Arup Engineer
TP101	*In-situ*	Olfactory	0.80-0.90	Slight hydrocarbon odour	n/a
TP120	*In-situ*	Olfactory	0.70-1.80	Strong hydrocarbon odour	n/a

Table 7: Potential Contamination Encountered

It should be stressed that the information provided herein is subjective, as it is based on the perceptions of individuals and not specialists routinely involved in the chemical determination of contaminated residues, liquors, vapours or solid contaminants.

3.10 Surveying

The investigation positions were surveyed after completion of site works by Site Surveying Services Ltd These positions have been subsequently plotted in AutoCAD® software and are shown on the Exploratory Hole Location Plan, Field Data Enclosure 1.

4. *IN-SITU* TESTING

4.1 General

In-situ testing as specified by the Consulting Engineer was carried out in selected boreholes, windowless sample holes and trial pits in accordance with techniques outlined in the relevant British Standard and/or AEG Quality Procedure. The results are presented in the *In-situ* Testing Enclosures with a number of the test results summarised at the relevant depth on the Borehole, Window/Windowless Sample Hole and Trial Pit Records.

4.2 Standard Penetration Test Results

Standard Penetration Testing (SPT) was carried out in the boreholes and windowless sample holes in accordance with techniques outlined in BS EN ISO 22476-3: 2005 in order to determine the relative density and consistency of the strata encountered. The ‘N’ value (number of blows per 300mm penetration) or the penetration per blow was recorded for each test. Uncorrected ‘N’ values or penetration per blow data are provided on the applicable Borehole and Window/Windowless Sample Hole Records. (Refer to page 6 of the key sheets for further details).

More detailed information concerning the standard penetration testing is given in *In-situ* Testing Enclosure 1 which includes the following;

- Initial exploratory hole conditions prior to the test procedure.
- Calibration and energy ratio (E_m) information for the SPT hammer device used to carry out the test.
- A breakdown of blows for each 75mm penetration interval.
- Rod length (C_R) and energy (C_E) correction ratios.
- Uncorrected 'N' value.
- Corrected 'N_{60}' value that applies the rod (C_R) and energy (C_E) corrections indicated.
- Pertinent remarks corresponding to the test procedure.

In addition to the above, a graph has been prepared for each exploratory hole which plots the uncorrected and corrected 'N' value results against depth. Calibration certificates for the SPT apparatus used during the testing procedure are also presented for reference within this *In-situ* Testing Enclosure.

4.3 Hand Shear Vane

Hand shear vane testing using a calibrated Edeco Pilcon equipment was carried out in the trial pits in accordance to the ground conditions encountered. The results are presented on the relevant Trial Pit Record and in further detail within *In-situ* Testing Enclosure 2.

4.4 *In-situ* Water Quality Parameter Testing

Groundwater sampling was undertaken from the installations during the post site works monitoring in accordance with techniques outlined in the relevant British Standard and/or AEG Quality Procedure. Water Quality Parameters were recorded for the purged water prior to sampling. The parameters tested were pH, temperature, electrical conductivity, redox potential, total dissolved solids and dissolved oxygen. The results are presented in tabular format as *In-situ* Testing Enclosure 3.

5. LABORATORY TESTING

5.1 General

Laboratory testing as scheduled by the Consulting Engineer was carried out on selected samples in accordance with techniques outlined in BS 1377:1990, AEG Laboratory Quality Procedures or other appropriate standard as quoted.

5.2 Geotechnical Testing

The results are presented in the Laboratory Enclosures with an outline list of the procedures undertaken given in Table 8.

Test	Procedure
Moisture Content	BS 1377 Part 2 1990 (BS EN ISO 17892-1:2014)
Plasticity Index and Moisture Content	BS 1377 Part 2 1990 (BS EN ISO 17892-1:2014)
Determination of Particle Density	BS 1377 Part 2 1990
Particle Size Distribution Sieving	BS 1377 Part 2 1990
Particle Size Distribution Sedimentation	BS 1377 Part 2 1990
Determination of Loss on Ignition, Organic content, Total Sulphur, Sulphate and pH (Tested externally)	See External Laboratory Certificates
Determination of Dry Density/Moisture/CBR Relationship	BS 1377 Part 4 1990
Determination of MCV / Moisture Relationship	BS 1377 Part 4 1990
Determination of California Bearing Ratio	BS 1377 Part 4 1990
Determination of One Dimensional Consolidation Properties	BS 1377 Part 5 1990
Shear Strength by Hand Vane	BS 1377 Part 7 1990
Undrained Shear Strength in Triaxial Cell without Pore Water Pressure Measurement	BS 1377 Part 7 1990

Table 8: Geotechnical Testing

5.3 Specialist Chemical Testing

Selected samples have been submitted for chemical analysis as specified by the Consulting Engineer, conducted under a subcontract arrangement with Derwentside Environmental Testing Services (DETS). The results of this testing are presented as Appendix I.

5.4 Laboratory Identified Asbestos

Selected samples were analysed for asbestos content as specified by the Consulting Engineer. Any identified asbestos is presented in Table 9 which has been summarised from specialist chemical testing results (see Appendix I for further details).

Exploratory Hole Number	Occurrence	Depth (m BGL)	Occurrence Type	Additional Remarks
BH110	Laboratory Sample	0.30	Brown asbestos	Bundle of Amosite fibres
BH112	Laboratory Sample	0.30	Brown asbestos	Bundles of Amosite fibres
TP105	Laboratory Sample	0.30	White asbestos	Chrysotile in microscopic board debris
TP120	Laboratory Sample	1.00	White asbestos	Chrysotile in microscopic cement
TP125	Laboratory Sample	0.30	White and brown asbestos	Chrysotile in microscopic bitumen and bundles of Chrysotile and Amosite in soil
TP126	Laboratory Sample	0.30	White and brown asbestos	Amosite in loose fibrous asbestos debris and bundles of Chrysotile fibres in soil
TP127	Laboratory Sample	0.30	White and brown asbestos	Bundles of Chrysotile and Amosite fibres
WS103	Laboratory Sample	1.00	Brown asbestos	Amosite present in small bundles
WS104	Laboratory Sample	1.00	Brown asbestos	Amosite present in small bundles
WS106	Laboratory Sample	1.00	Brown asbestos	Amosite present in small bundles

Table 9: Laboratory Identified Asbestos

KEY SHEETS

Key Sheets

Allied Exploration and Geotechnics Limited
Key Sheets

INTRODUCTION

The following explanatory notes define the terminologies, abbreviations and symbols pertaining to each individual column or section of the Exploratory Hole records. 'Exploratory Hole' is used as a general term in this report to comprise borehole, drillhole, and trial pit. All exploratory hole records have been produced using ' gINT®', which is an integrated software environment for the storage and manipulation of subsurface data.

The primary purpose of ground investigation exploratory holes is to probe the stratified sequences of soil and/or rock. From the results of these probings no conclusion should be drawn concerning the presence of, size, lithological nature, and numbers per unit volume of ground cobbles and boulders in soil types such as glacial till (boulder clay). With respect to rotary coring, driller's records and observations of the recovered core are used to determine any zones of no recovery (core loss). These zones are based on the interpretation of the logging engineer and are therefore potentially subjective.

INFORMATION COMMON TO ALL EXPLORATORY HOLE RECORDS

Status Box
The status box in the top right hand corner of each exploratory hole record gives the status of each individual record i.e. PRELIM1, PRELIM2, PRELIM3 FINAL etc. The date shown relates to the last instance the data was revised. This information is for AEG Quality Assurance only.

Exploratory Hole No
The identity number used throughout the report.

Project
The ground investigation project name. Occasionally the project name may be shortened or abbreviated due to string length restraints imposed by the gINT® computer programme.

Client
Client's name responsible for funding the ground investigation project. The Client's name may be shortened or abbreviated due to string length restraints imposed by the gINT® computer programme.

Location
The exploratory hole position given as either national grid co-ordinates, local grid if specified, or a reference name normally pertaining to the area of investigation.

Method (Equipment)
Represents the drilling, excavation or boring method(s) or equipment used.

Ground Level (m(AOD))
The precise ground level in metres above Ordnance Datum at the exploratory hole location from which the reduced level for each stratigraphic boundary is calculated.

Date
The date relating to the start of the exploratory hole excavation.

Sheet
The sheet number and total number of sheets for the particular record.

Checked By
Printed signature of the person who has carried out the technical quality check on the log.

Logged By
The name of the engineer who has carried out the logging of the exploratory hole.

Contract No.
The Allied Exploration & Geotechnics Limited reference number for the project.

Allied Exploration and Geotechnics Limited
Key Sheets

INFORMATION RELEVANT TO BOREHOLE AND WINDOW/WINDOWLESS SAMPLE HOLE RECORDS

Sample & Tests Columns

Depth	The depth over which a sample or test is taken is shown in depth column of the exploratory hole record in a "from...to" format.
Type No	Indicates the type of sample/test and number given by the driller.
Test Result	Result of the test given in the applicable units.

Water Column

Water Strike	Level of groundwater strike within an exploratory hole. The symbol 1 denotes a water strike and is suffixed with a number, which indicates the strike order. The corresponding unfilled symbol 1 is the depth the strike rose to.
Seepage	Groundwater seepage within an exploratory hole is denoted by the symbol.

Strata Columns

Reduced Level	The corresponding reduced level of each soil or rock boundary in metres Ordnance Datum.
Legend	A graphical representation of the materials encountered using BS 5930:1999 Amendment No.2 (Aug 2010) recommended symbols for soil and rock.
Depth (Thickness)	The depth below ground level of each soil or rock boundary in metres and the thickness of each individual stratigraphic unit (given in brackets).
Description	Engineering description of each individual soil or rock type follows recommendations outlined in Section 6 of BS 5930:1999 Amendment No.2 (Aug 2010) with the following implementation:

1 The amendment of section 6 incorporates the guidance indicated in BS EN ISO 14688-1:2002, BS EN ISO 14688-2:2004 and BS EN ISO 14689-1:2003 European Standard with particular emphasis on current UK practice.

2 Supplementary laboratory or in-situ assessed measurements of undrained strength are provided where applicable information is available in parenthesis in accordance with clause 41.3.2 BS 5930:1999 Amendment No.2 (Aug 2010) after the field strength determined consistency. The description based measurement table indicating the quantitative undrained strength classification divisions is provided in Key Sheets Table 1.

Term based on measurement	**Undrained strength classification definition cu, in kPa** (from BS EN ISO 14688-2:2004, 5.3, Table 5)
Extremely low	<10
Very low	10-20
Low	20-40
Medium	40-75
High	75-150
Very High	150-300
Extremely High	300-600

KEY SHEETS TABLE 1

3 Cobble and boulder content is expressed in accordance with the terms provided in EN ISO 14688-2: 2004 where visually identified in trial pit excavations, or inferred/recovered during the drilling operations. The assessment of frequency and spatial occurrence of coarse and very coarse rock material should not be considered as precise, but only an indicator or estimate of the potential conditions. It should be noted that the recovery of coarse or very coarse particles in boreholes is dependent on the limitations imposed by the casing diameter. The terminology used is outlined in Key Sheets Table 2.

Fraction	Percent by Mass	Term
Boulders	<5	Low boulder content
	5 to 20	Medium boulder content
	>20	High boulder content
Cobbles	<10	Low cobble content
	10 to 20	Medium cobble content
	>20	High cobble content

KEY SHEETS TABLE 2

4 Rock Strength based on assessed field or measured unconfined compressive strength follows the classification scheme given in clause 44.2.1 BS5930:1999 Amendment No.2 (Aug 2010) as outlined in Key Sheets Table 3.

Term for use in field or based on measurement	Definition for field use	Definition on basis of Unconfined Compressive Strength measurement (MPa)	*Old Classification of rock strength: Terminology (Strength Range MPa)*	*Old Classification of rock strength: Determination Method*
Extremely weak	Can be indented by thumbnail. Gravel sized lumps crush between finger and thumb.	0.6-1.0	*Very Weak (<1.25)*	*Lumps can be crushed between fingers*
Very weak	Crumbles under firm blows with point of geological hammer. Can be peeled by a pocket knife.	1-5	*Weak (1.25 – 5)*	*Lumps can be broken with heavy hand pressure*
Weak	Can be peeled by a pocket knife with difficulty. Shallow indentations made by firm blow with the point of geological hammer.	5-25	*Moderately Weak (5-12.50)*	*This slab can be broken with heavy pressure*
Medium Strong	Cannot be scraped with pocket knife. Can be fractured with a single firm blow of geological hammer.	25-50	*Moderately Strong (12.50-50)*	*Rock can be broken in the hand with a hammer*
Strong	Requires more than one blow of geological hammer to fracture.	50-100	*Strong (50-100)*	*Rock can be broken on a flat surface using a hammer*
Very Strong	Requires many blows of geological hammer to fracture.	100-250	*Very Strong (100-200)*	*Rock chipped by blows with a hammer*
Extremely strong	Can only be chipped with geological hammer.	>250	*Extremely Strong (>200)*	*Rock rings when hit with a hammer*
Based on BS EN ISO 14689-1:2003 4.2.7, Table 5			*BS5930: 1999 – Section 6 (Superseded Version)*	

KEY SHEETS TABLE 3

5 Where 'rock weathering classification' can be applied it is 'Approach 4' which will be used. If any other approach is used the factual text of the report will provide details of the applicable specific approach. (Ref.: Figure 19, p143, BS 5930:1999 Amendment No.2 (Aug 2010)). An outline of the 'Approach 4' rock weathering classification scheme is provided as Key Sheets Table 4.

APPROACH 4 CLASSIFICATION INCORPORATING MATERIAL AND MASS FEATURES		
Class	**Classifier**	**Typical characteristics**
A	Unweathered	Original strength, colour, fracture spacing
B	Partially weathered	Slightly reduced strength, slightly closer fracture spacing, weathering penetrating in from fractures, brown oxidation
C	Distinctly weathered	Further weathered, much closer fracture spacing grey reduction
D	Destructured	Greatly weakened, mottled, ordered lithorelics in matrix becoming weakened and disordered, bedding disturbed.
E	Residual or reworked	Matrix with occasional altered random or 'apparent' lithorelics, bedding destroyed. Classed as reworked when foreign inclusions are present as a result of transportation.

KEY SHEETS TABLE 4

Instrument/Backfill Column

A graphical representation of backfill material or instrumentation detail using graphic legends. Its placement in the column is relative to depth in metres and corresponds to the exploratory hole in scale.

Boring Progress and Water Observations Columns

This section provides information on each day's production as a daily log.

Date	Date of shift.
Depth	Depth of hole at the start of the shift.
Casing	Casing's depth at the start of the shift.
Casing Dia	Casing's diameter at the start of the shift.
Water Depth	Water level within the borehole at the start and end of shift.

Chiselling Columns

Indicates where hard strata occurred in the borehole and breaking out was carried out to advance the borehole.

From	The depth commenced.
To	The depth finished.
Hours	The time spent for breaking out.

Water Added Columns

Indicates the depth range where water was added to the borehole to facilitate boring or to prevent stress relief disturbance "blowing/boiling" in granular soils.

From	Depth in metres from where water was added.
To	Depth in metres to where water was added.

General Remarks

Any remarks believed to be relevant to the exploratory hole.

INFORMATION RELEVANT TO PIT/TRENCH RECORDS

The pit/trench records follow the same format as the borehole and window/windowless sample hole records for the Samples & Tests, Water and Strata columns. However, in addition to these there are the following:

Plan

A schematic plan view of the pit showing its excavated dimensions together with its orientation, given as a compass bearing to magnetic north.

Groundwater

Notes on water bearing horizons.

Stability

The engineer's comments outlining the stability of the sides during pit excavation.

General Remarks

The engineer's comments of any other information relevant to construction of the pit.

Additional Information

An indication if a sketch and/or photographs accompany the record.

Allied Exploration and Geotechnics Limited
Key Sheets

Underground Services

Depth	Depth service was encountered.
Orientation	Orientation given as a compass bearing to magnetic north.
Type	Type of service encountered.
Diameter	Diameter of service encountered.
Condition	Condition the service encountered was noticed in.

INFORMATION RELEVANT TO DRILLHOLE RECORDS AND ROTARY CONTINUATION

Run Details Columns

Depth	Each drill run is highlighted by a horizontal line with the top and bottom depths shown in metres. Core diameter (C Dia) is presented also within each run.
TCR (SCR) RQD	Information provided on the total core recovery, solid core recovery and rock quality designation. Refer to Abbreviations for further details.
Fracture Index	Information given relating to the fracture index of the rock.

Strata Columns

As the strata columns for borehole and window/windowless sample hole records except for description which is as follows:

Discontinuities Detail	Information on core discontinuities, localised variations in weathering, lithology, strength and structure follows recommendations outlined in Section 6 BS 5930:1999 Amendment No.2 (Aug 2010):Clause 44.
Main	Engineering description of each individual soil or rock type follows recommendations outlined in Section 6 of BS 5930:1999 Amendment No.2 (Aug 2010).

Instrument/Backfill Column

A graphical representation of backfill material or instrumentation detail using graphic legends. Its placement in the column is relative to depth in metres and corresponds to the exploratory hole in scale.

Drilling Progress and Water Observations Columns

Date	Date of shift.
Depth	Depth of hole at the start of the shift.
Casing	Casing's depth at the start of the shift.
Water Strike	Depth at which water was encountered.
Water Standing	Depth at which water in the hole levelled off.
Water Remarks	Any remarks believed to be relevant to the water e.g. Artesian.

Standard Penetration Test

Depth	The depth commenced.
Type	Type of standard penetration test (SPT).
Result	Result of SPT.

Flush

From	The depth commenced.
To	The depth finished.
Type	Details of the type of flush used. A = Air, F = Foam, W = Water and Pol = Polymer.
Returns	An indication of the percentage of the returned flush material.

General Remarks

Any remarks believed to be relevant to the exploratory hole.

Allied Exploration and Geotechnics Limited
Key Sheets

SAMPLES

B	Bulk disturbed sample.
ES	Environmental soil sample.
EW	Environmental water sample.
G	Gas sample.
J	Small disturbed sample.
LB	Large bulk disturbed sample.
P	Piston sample.
P*	An attempted but failed undisturbed piston sample.
U	Undisturbed sample.
U*	An attempted but failed general purpose undisturbed sample.
$U_{(ss)}$	Sample has been subsampled.
$ES_{(U)}$	Brackets following a sample denotes a subsample. The sample information within the brackets is the origin of the subsample.
W	Water sample.

IN-SITU TESTS

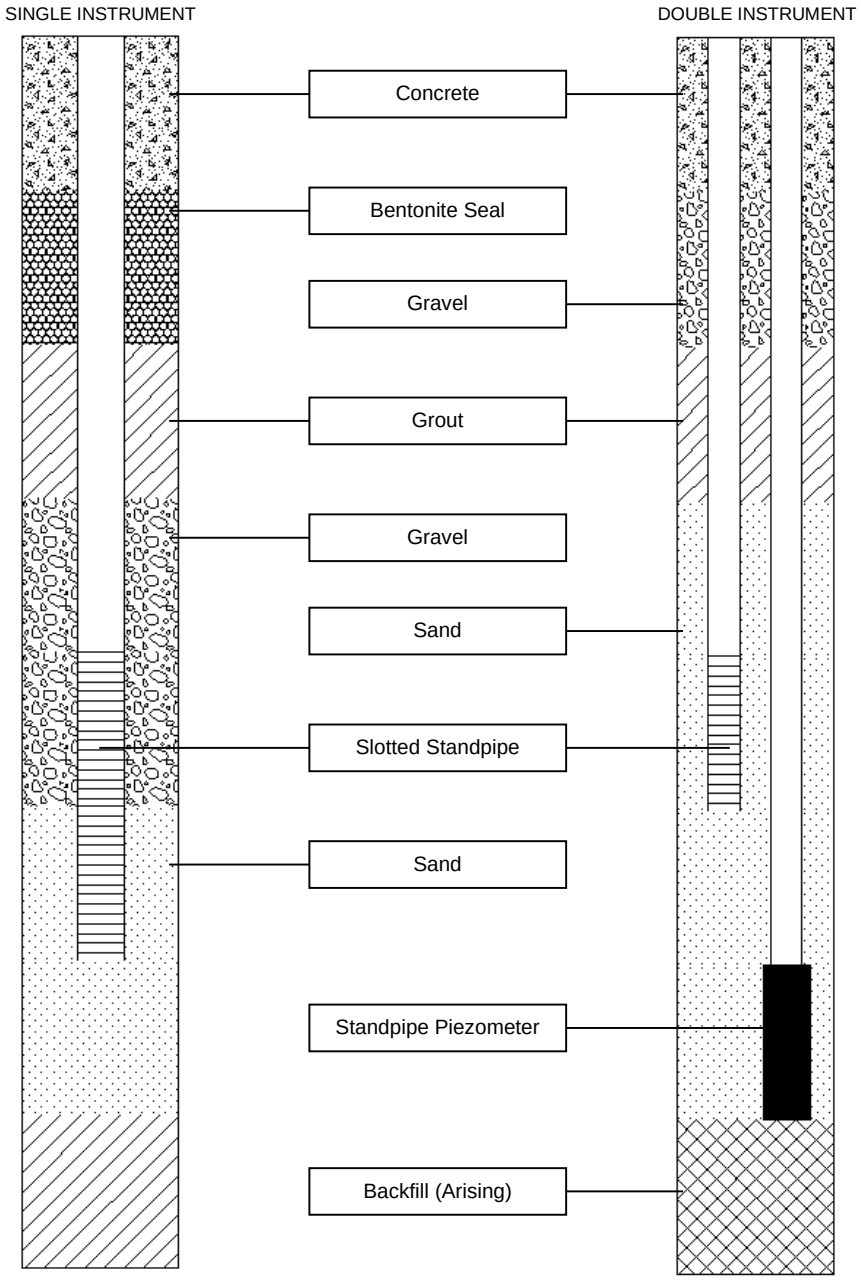
CBR	California Bearing Ratio mould sample or test.
HSV	In-situ hand shear vane.
HSV*	An attempted but failed in-situ hand shear vane.
HP	Hand penetrometer test.
K (F)	Falling head permeability test.
K (R)	Rising head permeability test.
K (C)	Constant head permeability test.
K (P)	Packer permeability test.
PT	Pressuremeter test.
PID	Photo ionisation detector test.
FID	Flame ionisation detector test.
S	Standard Penetration Test (SPT) using the split barrel sampler (shoe). The corresponding uncorrected 'N' value is given in the test result column with more detailed information provided in the In-Situ Testing Enclosures where applicable. Testing has been conducted in accordance with BS EN ISO 22476-3: 2005.
C	Denotes SPT test using a solid cone in preference to the split barrel sampler (usually in coarse granular soil) with all other reporting requirements as outlined above for the split barrel sampler.
S/C result of e.g. 1/2.94	Denotes where full penetration has not been achieved during the SPT test. In such cases the penetration (mm) per blow is recorded in the test result column e.g. 1/2.94 is 2.94mm of penetration per single blow.
SV	In-situ down-the-hole shear vane test. The remoulded shear strength is given in brackets.

ROCK QUALITY AND CORE RECOVERY

TCR	Total Core Recovery - the length of the recovered core expressed as a percentage of the length of core run.
SCR	Solid Core Recovery - the sum length of all core pieces that are recovered with at least one full diameter, expressed as a percentage of the length of core run.
RQD	Rock Quality Designation - The sum length of all core pieces that are 100mm or longer (measured along the centre of the core), expressed as a percentage of the length of core run.
FI	Fracture Index - The number of fractures per 1000mm length of solid core.
NI	Non-intact - The material recovered in a non-intact state.
NR	No recovery from the core run. These zones are based on the interpretation of the logging engineer and are therefore potentially subjective.

Allied Exploration and Geotechnics Limited
Key Sheets

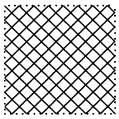
Symbols and Abbreviations: Explanation of Instrumentation Legends Used



Allied Exploration and Geotechnics Limited
Key Sheets

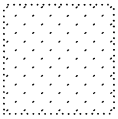
Symbols and Abbreviations: Explanation of Legends Used

Soils	Rocks		
	Sedimentary	*Metamorphic*	*Igneous*

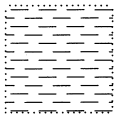

Made Ground


Cobbles and Boulders

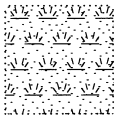

Gravel


Sand


Silt

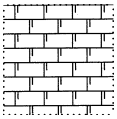

Clay

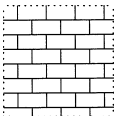

Peat

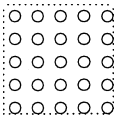

Topsoil

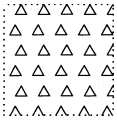
Note: Composite soil types will be signified by combined symbols e.g.

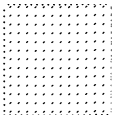

Silty Sand

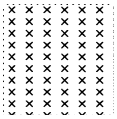

Chalk


Limestone


Conglomerate


Breccia


Sandstone


Siltstone

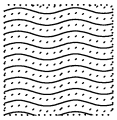

Mudstone

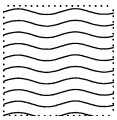

Shale


Coal

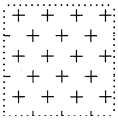

Pyroclastic (Volcanic Ash)

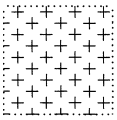

Gypsum


Coarse Grained


Medium Grained


Fine Grained

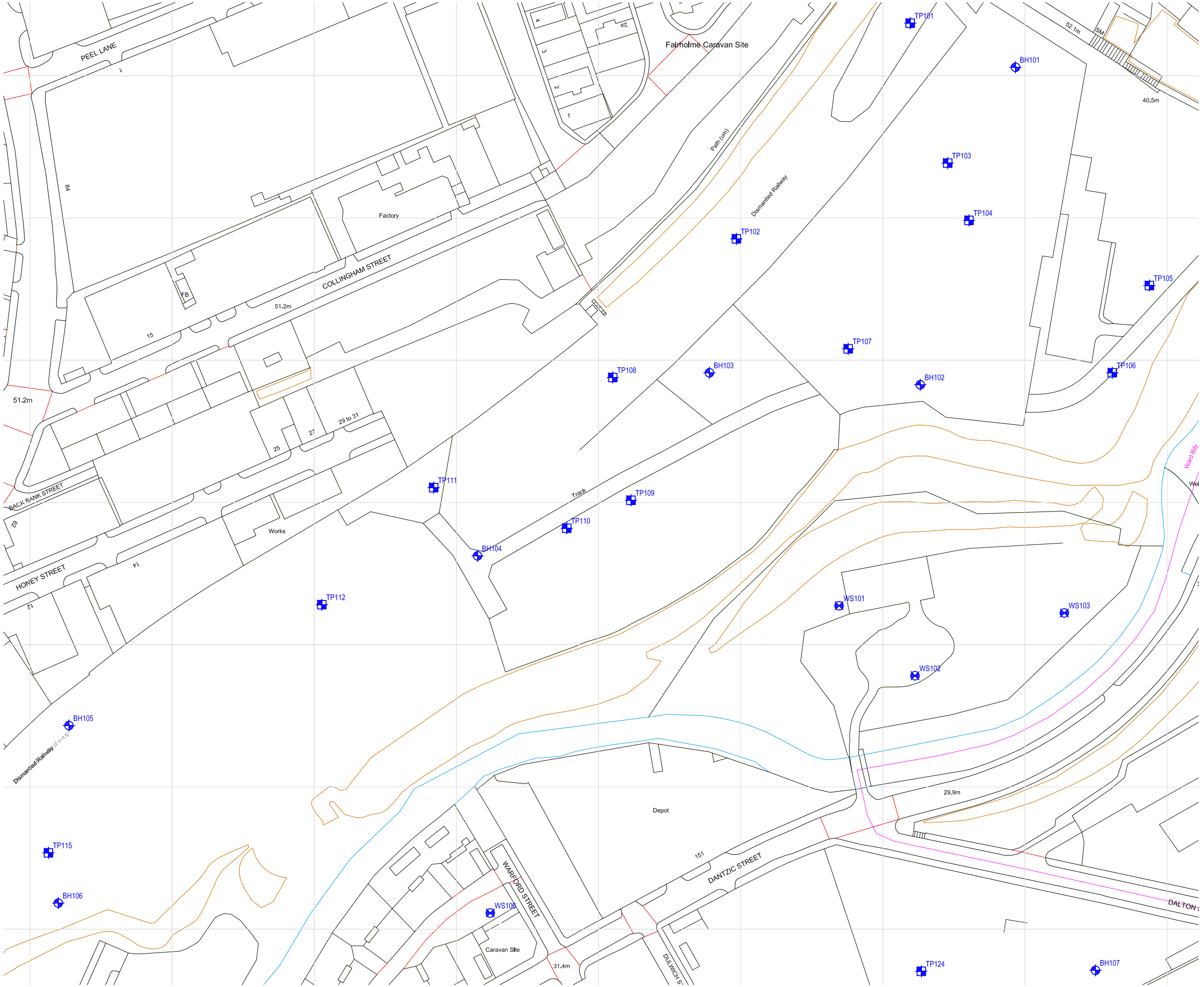

Coarse Grained


Medium Grained


Fine Grained

Exploratory Hole Location Plan

FIELD DATA ENCLOSURE 1



Allied Exploration and Geotechnics Limited

Unit 25 Stella Gill Industrial Estate
Pelton Fell
Chester - Le - Street
Co Durham
DH2 2RG
(Tel): 0191 387 4700
(Fax): 0191 387 4710
(Email): enquiries@aeg.uk.net

KEY:

BOREHOLE

WINDOW/WINDOWLESS SAMPLE HOLE

TRIAL PIT

N

W E

S

Base Plan Supplied by Consulting Engineer

Drawing Title:
ENC 01 : Exploratory Hole Location Plan

Drawing No.:
AEG/NW1580/01

Contract Title:
Northern Gateway

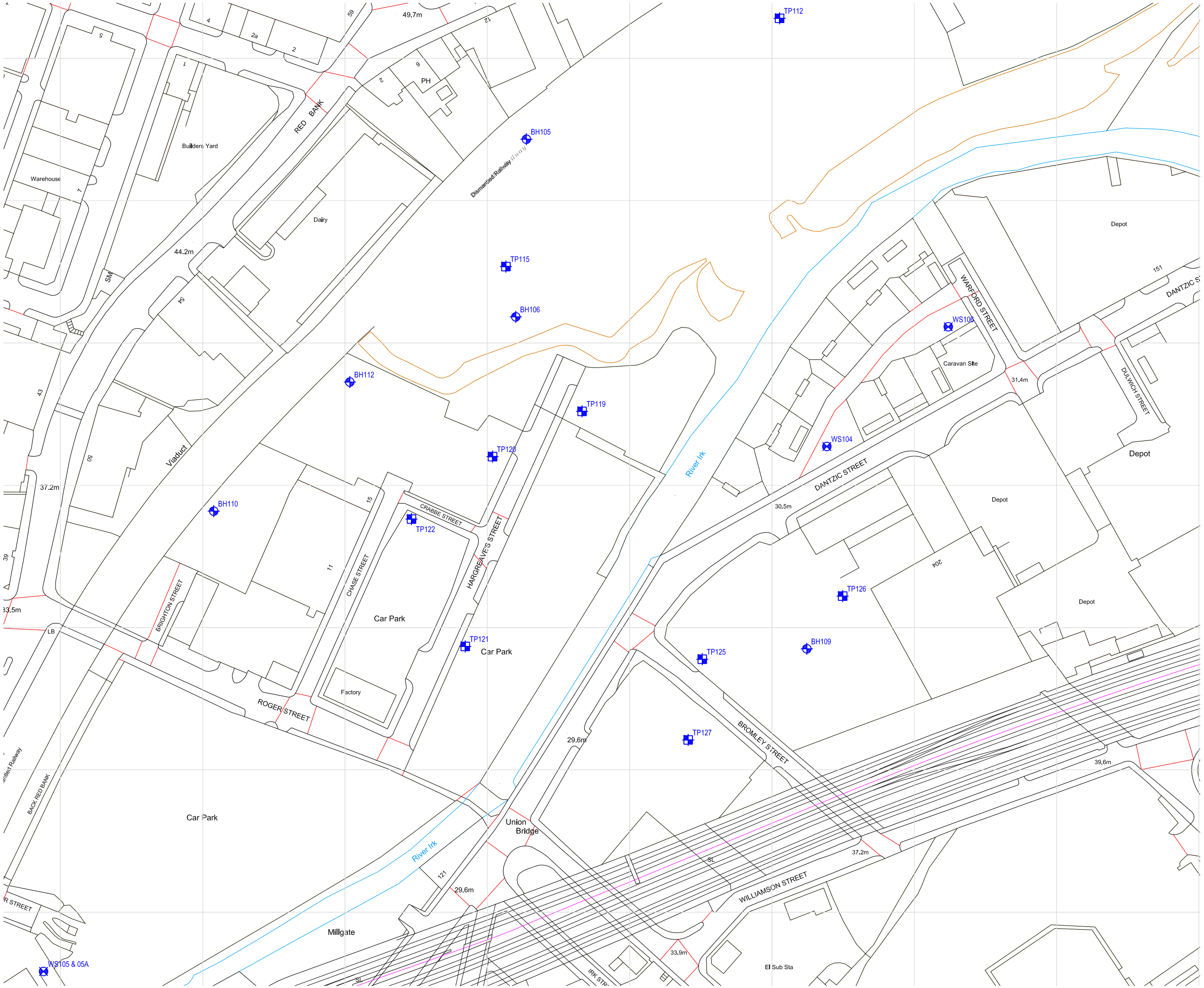
Client:
Far East Consortium International Limited
Second Floor, Northern Assurance Building,
Princess Street, Manchester, M2 4DN

Consultant:
Ove Arup & Partners Limited
9th Floor, St. Pauls Place,
Norfolk Street, Sheffield, S1 2JE

Contract No.:
NW1580

Scale:
1:1250 @ A3

Date:
05/02/2019



Allied Exploration and Geotechnics Limited
Unit 25 Stella Gill Industrial Estate
Pelton Fell
Chester - Le - Street
Co Durham
DH2 2RG
(Tel): 0191 387 4700
(Fax): 0191 387 4710
(Email): enquiries@aeg.uk.net

KEY:

BOREHOLE

WINDOW/WINDOWLESS SAMPLE HOLE

TRIAL PIT

N W E S

Base Plan Supplied by Consulting Engineer

Drawing Title:
ENC 01 : Exploratory Hole Location Plan

Drawing No.:
AEG/NW1580/02

Contract Title:
Northern Gateway

Client:
Far East Consortium International Limited
Second Floor, Northern Assurance Building,
Princess Street, Manchester, M2 4DN

Consultant:
Ove Arup & Partners Limited
9th Floor, St. Pauls Place,
Norfolk Street, Sheffield, S1 2JE

Contract No.:
NW1580

Scale:
1:1250 @ A3

Date:
05/02/2019

FIELD DATA ENCLOSURE 2

Borehole Records

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL **Tel:** 01772 735 300 **Fax:** 01772 735 999

BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384796.682 N:399802.989		**BH101**
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 43.377	**Start Date:** 03/01/2019	**Sheet:** 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
				43.327		0.05	MADE GROUND (Macadam).	
0.10	J1					(0.55)	MADE GROUND (Yellow sandy gravel. Sand is fine to coarse. Gravel is fine to coarse subangular and includes limestone).	
0.30	ES2							
0.50	B3			42.777		0.60		
0.80	ES4					(0.50)	MADE GROUND (Black brown sandy gravel with fragments of wood. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular and includes brick, clinker and concrete).	
1.00	J5			42.277		1.10		
1.20	ES6					(0.40)	MADE GROUND (Soft brown grey black slightly sandy slightly gravelly clay. Sand is fine to medium. Gravel is fine to medium and includes clinker, brick, coal and concrete).	
				41.877		1.50		
1.50-2.00	B8						MADE GROUND (Firm brown slightly sandy slightly gravelly clay with fragments of wood. Sand is fine to coarse. Gravel is fine to medium and includes clinker, brick and concrete).	
1.50-1.95	SJ7	N11					at c.1.50m BGL ... clay is of low plasticity.	
2.20	ES9							
2.30	B10					(2.00)		
2.50-3.00	B12							
2.50-2.95	SJ11	N14						
3.20	ES13							
3.30	J14			39.877		3.50		
3.50-4.00	U*B15	(22)					MADE GROUND (Firm brown sandy slightly gravelly clay with fragments of wood. Sand is fine to coarse. Gravel is fine to medium and includes sandstone and coal). (Driller notes brick).	
4.00-4.50	B17						at c.4.00m BGL ... clay is of low plasticity.	
4.00-4.45	SJ16	N14				(1.90)		
4.80	ES18							
5.00	B19							
				37.977		5.40		
5.50-6.00	B21						Medium dense red brown SAND with occasional soft interbeds of clay. Sand is fine to coarse. (Glacial Till Deposits/Weathered Collyhurst Sandstone Formation).	
5.50-5.95	SJ20	N23						
6.20	ES22					(1.60)		
6.30	B23							
				36.377		7.00		
7.00-7.50	B25						Extremely weak to very weak red fine to coarse grained SANDSTONE with occasional lenses of red marl. (Collyhurst Sandstone Formation).	
7.00	SJ24	25/7mm				(0.80)		
7.50	SJ26	50/3mm						
				35.577		7.80		
7.80	S27	100/0mm					*Complete at 7.80m BGL.*	

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
03/01/2019	0.00	0.00	200	
03/01/2019	7.80	7.80	200	Dry

Chiselling

From - To	Duration (hh:mm)
7.50 - 7.80	1:00

Water Added

From - To

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) 50mm diameter slotted standpipe installed between 1.00-5.00m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:43:45

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL **Tel:** 01772 735 300 **Fax:** 01772 735 999

BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** BH102
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384763.180 N:399691.375		
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 42.934	**Start Date:** 03/01/2019	**Sheet:** 1 of 2

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
0.30 0.30 0.50-1.00	J1 ES2 B3					(1.20)	MADE GROUND (Black brown clayey very sandy gravel with cobbles noted and fragments of wood. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular and includes brick, clinker and concrete. Cobbles are angular and include brick). at c.0.30m BGL ... clay is of low plasticity.	
				41.734		1.20		
1.20-1.70 1.20-1.65 2.00 2.20 2.50-3.00	B5 SJ4 J6 ES7 U*B8	N9 (120)				(3.40)	MADE GROUND (Soft brown grey black slightly sandy slightly gravelly clay. Sand is fine to medium. Gravel is fine to medium and includes clinker, brick, coal and concrete). (Driller notes cobbles).	
3.00-3.50 3.50 3.60-4.05 4.10	SB9 ES10 SJ11 ES12	N19 N5					at c.3.00m BGL ... clay is of low plasticity.	
				38.334		4.60		
4.60-5.05 5.10	SJ13 ES14	N8				(0.90)	MADE GROUND (Loose black brown sandy gravel. Sand is fine to coarse and includes ash. Gravel is fine to medium angular and includes coal and sandstone).	
				37.434		5.50		
5.50-5.95 6.00 6.10-6.60	SJ15 ES16 U*B17	N12 (100)				(1.30)	Firm mottled brown yellow sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to medium and includes sandstone and mudstone. (Glacial Till Deposits/Weathered Manchester Marls Formation).	
				36.134		6.80		
6.80 6.90-7.40 6.90-7.35	J18 B20 SJ19	N27				(1.70)	Red brown clayey calcareous MUDSTONE with interbeds of sandy gravelly clay. Sand is fine to medium. Gravel is fine to coarse and angular. (Manchester Marls Formation). at c.6.80m BGL ... clay fines are of Intermediate plasticity. Laboratory notes brick fragments - probable fall in from above.	

Boring Progress and Water Observations				
Date	Depth	Casing	Casing Dia (mm)	Water Standing
03/01/2019	0.00	0.00	150	

Chiselling	
From - To	Duration (hh:mm)
2.70 - 3.00	1:00

Water Added
From - To
3.80 - 5.10

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) 50mm diameter slotted standpipe installed between 1.90-6.50m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:43:46

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL **Tel:** 01772 735 300 **Fax:** 01772 735 999

BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** BH102
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384763.180 N:399691.375		
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 42.934	**Start Date:** 03/01/2019	**Sheet:** 2 of 2

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
8.00	J21			34.434		8.50		
8.50	SJ22	50/190mm					*Complete at 8.50m BGL.*	

Boring Progress and Water Observations				
Date	Depth	Casing	Casing Dia (mm)	Water Standing
03/01/2019	8.50	7.10	150	Dry

Chiselling		Water Added
From - To	Duration (hh:mm)	From - To

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) 50mm diameter slotted standpipe installed between 1.90-6.50m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:43:46

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL **Tel:** 01772 735 300 **Fax:** 01772 735 999

BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** BH103
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384689.014 N:399695.588		
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 42.570	**Start Date:** 04/01/2019	**Sheet:** 1 of 2

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
				42.470		0.10	MADE GROUND (Black brown gravel. Gravel is fine to coarse subangular and includes limestone and slag).	
0.10	J1							
0.30	ES2						MADE GROUND (Black sandy gravel with fragments of wood, metal and plastic. Sand is fine to coarse. Gravel is fine to coarse and includes brick and concrete. Hydrocarbon odour noted).	
0.50	B3					(1.20)		
0.90-3.50	EW1							
1.00	ES4			41.270		1.30		
							MADE GROUND (Firm brown slightly sandy slightly gravelly clay with metal, ceramic and glass fragments. Gravel is fine to medium subangular to subrounded and includes sandstone, coal and mudstone).	
1.50-2.00	B6						at c.1.50m BGL ... clay is of intermediate plasticity.	
1.50-1.95	SJ5	N18						
2.20	ES7							
2.30	J8					(2.20)		
2.50-3.00	B10							
2.50-2.95	SJ9	N11						
3.20	ES11							
3.30	B12			39.070		3.50		
3.50-4.00	U*B13	(33)					Brown clayey GRAVEL. Gravel is fine to coarse subangular to subrounded and includes sandstone and limestone. (Glacial Till Deposits).	
				38.570		(0.50) 4.00		
							Stiff and very stiff brown red silty slightly sandy CLAY. (Weathered Manchester Marls Formation).	
4.00-4.50	B15							
4.00-4.45	SJ14	N39						
4.80	ES16							
5.00	J17							
5.50-6.00	B19						at c.5.50m BGL ... clay is of intermediate plasticity.	
5.50-5.95	SJ18	N20				(4.00)		
6.50	J20							
7.00-7.50	B22							
7.00	SJ21	50/164mm						
				34.570		8.00		

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
04/01/2019	0.00	0.00	200	
04/01/2019	5.00	5.00	200	Dry
07/01/2019	5.00	5.00	200	4.00

Chiselling

From - To	Duration (hh:mm)
8.00 - 8.30	1:00

Water Added

From - To

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) Water strike at 0.60m BGL - water level rose to 0.30m BGL (20mins).
(4) 50mm diameter slotted standpipe installed between 1.00-3.50m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:43:47

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL **Tel:** 01772 735 300 **Fax:** 01772 735 999

BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** BH103
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384689.014 N:399695.588		
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 42.570	**Start Date:** 04/01/2019	**Sheet:** 2 of 2

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
8.00	J23						Extremely weak red brown calcareous MUDSTONE.	
				34.270		8.30	(Manchester Marls Formation).	
8.30	SJ24	100/9mm					*Complete at 8.30m BGL.*	

Boring Progress and Water Observations				
Date	Depth	Casing	Casing Dia (mm)	Water Standing
07/01/2019	8.30	8.30	200	4.00

Chiselling		Water Added
From - To	Duration (hh:mm)	From - To

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) Water strike at 0.60m BGL - water level rose to 0.30m BGL (20mins).
(4) 50mm diameter slotted standpipe installed between 1.00-3.50m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:43:47

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL **Tel:** 01772 735 300 **Fax:** 01772 735 999

BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway		**Exploratory Hole No.** BH104
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384607.460 N:399631.240	
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 41.588 / **Start Date:** 04/01/2019	**Sheet:** 1 of 2

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
0.30	J1					(0.60)	MADE GROUND (Grey black gravel. Gravel is fine to medium subangular and includes limestone, clinker and burnt shale).	
0.40	ES2			40.988		0.60		
0.60	J3						MADE GROUND (Grey red orange gravel. Gravel is fine to coarse subangular and includes clinker and burnt shale).	
0.70	ES4							
0.70-1.20	B5							
1.50-2.00	B8					(1.90)	at c.1.50m BGL ... loose.	
1.50-1.95	SJ6	N6						
1.70	ES7							
				39.088		2.50		
2.50-3.00	B11						MADE GROUND (Soft brown slightly sandy slightly gravelly clay. Sand is fine to coarse and includes ash. Gravel is fine to medium subangular and includes clinker and brick).	
2.50-2.95	SJ9	N4						
2.70	ES10							
3.50-4.00	SB12	N4						
3.70	ES13							
						(3.50)		
4.50-5.00	B16						at c.4.50m BGL ... firm.	
4.50-4.95	SJ14	N12						
4.70	ES15							
5.30-5.80	U*B17	(50)						
				35.588		6.00		
6.00-6.50	B19						MADE GROUND (Loose to medium dense black brown very clayey sand and gravel. Sand is fine to coarse and includes ash. Gravel is fine to coarse subangular and includes clinker and brick).	
6.00-6.45	SJ18	N10						
6.70	ES20							
7.00	J21							
						(3.00)		
7.50-8.00	B24							
7.50-7.95	SJ22	N13						
7.70	ES23							

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
04/01/2019	0.00	0.00	150	
04/01/2019	1.20	0.00	150	Dry
07/01/2019	1.20	0.00	150	Dry

Chiselling

From - To	Duration (hh:mm)

Water Added

From - To

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) No groundwater inflow observed.
(4) 50mm diameter slotted standpipe installed to 1.80-9.00m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. NW1580

Print Date and Time: 19/03/2019 16:43:48

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** BH104
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384607.460 N:399631.240		
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 41.588	**Start Date:** 04/01/2019	**Sheet:** 2 of 2

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
8.50	J25						MADE GROUND (Loose to medium dense black brown very clayey sand and gravel. Sand is fine to coarse and includes ash. Gravel is fine to coarse subangular and includes clinker and brick). *(continued)*	
				32.588		9.00		
9.00-9.50 9.00-9.45	B27 SJ26	N11				(1.00)	MADE GROUND (Soft and firm brown sandy gravelly clay. Sand is fine to coarse and includes ash. Gravel is fine to medium subangular and includes clinker).	
9.70	ES28			31.588		10.00		
10.00	J29						Soft brown sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is fine to medium subangular and includes coal and sandstone. (Engineer notes fine brick fragments - probable fall in from above). (Alluvium/Glacial Till Deposits). at c.10.50m BGL ... clay is of low plasticity.	
10.50-11.00 10.50-10.95 10.70	B32 SJ30 ES31	N5				(2.70)		
11.50	J33							
12.00-12.50 12.00-12.45 12.30	B35 SJ34 ES34	N6						
				28.888		12.70		
12.70	J36						Dense red brown SAND. Sand is fine to medium. (Glacial Till Deposits/Weathered Chester Formation).	
13.00-13.50 13.00-13.45	B38 SJ37	N45				(1.00)		
13.50	ES39			27.888		13.70		
13.70	J40						Firm to stiff red CLAY. (Glacial Till Deposits/Weathered Chester Formation).	
				27.588		14.00		
14.00-14.50 14.00	B42 SJ41	50/115mm				(1.00)	Very weak to weak red fine to coarse grained SANDSTONE partially weathered. (Recovered as gravel. Gravel is fine to coarse angular). (Chester Formation).	
14.80	SJ43	50/20mm		26.588		15.00		
15.00	J43						*Complete at 15.00m BGL.*	

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
07/01/2019	10.00	9.73	150	Damp
08/01/2019	10.00	9.73	150	Damp
08/01/2019	15.00	14.50	150	13.46

Chiselling

From - To	Duration (hh:mm)
14.00 - 15.00	1:00

Water Added

From - To
12.50 - 13.50
13.70 - 14.70

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) No groundwater inflow observed.
(4) 50mm diameter slotted standpipe installed to 1.80-9.00m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

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BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway		**Exploratory Hole No.** BH105
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384463.735 N:399571.588	
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 40.666 / **Start Date:** 04/01/2019	**Sheet:** 1 of 2

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
0.20	J1					(0.60)	MADE GROUND (Grey gravel. Gravel is fine to medium subangular and includes limestone).	
0.20-0.50	B3							
0.30	ES2			40.066		0.60		
0.60	J4						MADE GROUND (Soft and firm brown slightly sandy slightly gravelly clay. Sand is fine to medium. Gravel is fine to medium and includes sandstone and clinker). (Driller notes cobbles).	
0.60-1.20	B6							
0.70	ES5							
1.50-2.00	B8					(2.00)		
1.50-1.95	SJ7	N7						
2.20	J9							
2.30	ES10							
2.50-3.00	U*B11	(31)		38.066		2.60		
3.00	J12						Medium dense brown silty slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded and includes sandstone. (Alluvium)	
3.20	B13							
3.30	ES14							
3.50-4.00	B16						at c.3.50m BGL ... sandy slightly gravelly silt.	
3.50-3.95	SJ15	N12						
4.20	J17							
4.30	ES18							
4.50-5.00	B20							
4.50-4.95	SJ19	N12						
4.52-9.00	EW1					(4.70)		
5.50	J21							
5.80	ES22							
6.00-6.50	B24							
6.00-6.45	SJ23	N12						
7.00	J25			33.366		7.30		
7.50-8.00	B27						Medium dense grey SAND. Sand is fine to coarse. (Alluvium).	
7.50-7.95	SJ26	N15						

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
04/01/2019	0.00	0.00	200	
04/01/2019	1.20	0.00	200	Dry
08/01/2019	1.20	0.00	200	Dry

Chiselling

From - To	Duration (hh:mm)

Water Added

From - To
1.20 - 11.20

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) 50mm diameter slotted standpipe installed between 3.00-9.50m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. NW1580

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BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384463.735 N:399571.588		**BH105**
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 40.666	**Start Date:** 04/01/2019	**Sheet:** 2 of 2

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
						(1.50)	Medium dense grey SAND. Sand is fine to coarse. (Alluvium). *(continued)*	
8.50	J28			31.866		8.80		
9.00-9.50	B30						Medium dense red brown slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to medium and includes sandstone. (Possible Weathered Chester Formation).	
9.00-9.45	SJ29	N15				(1.10)		
				30.766		9.90		
10.00	J31						Red brown slightly silty SAND. Sand is fine to coarse. (Possible Weathered Chester Formation).	
10.50-10.80	B33					(0.90)		
10.50-10.95	SJ32	N29		29.866		10.80		
10.80	SJ34	50/11mm				(0.40)	Very weak to weak red fine to coarse grained SANDSTONE partially weathered. (Recovered as gravel. Gravel is fine to coarse angular). (Chester Formation).	
11.20	SJ35	100/0mm		29.466		11.20	*Complete at 11.20m BGL.*	

Boring Progress and Water Observations					Chiselling		Water Added
Date	Depth	Casing	Casing Dia (mm)	Water Standing	From - To	Duration (hh:mm)	From - To
08/01/2019	11.20	11.20	200	Dry	10.80 - 11.20	1:00	

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) 50mm diameter slotted standpipe installed between 3.00-9.50m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

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BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** BH106
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384459.989 N:399509.165		
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 40.671	**Start Date:** 07/01/2019	**Sheet:** 1 of 2

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
				40.471		0.20	MADE GROUND (Soft brown sandy clay with many rootlets. Sand is fine to medium).	
0.30	ES1						MADE GROUND (Loose and medium dense black brown grey clayey sandy gravel with cobble noted. Sand is fine to coarse. Gravel is fine to coarse and includes clinker, brick, coal and concrete. Cobbles are angular and includes sandstone and brick). (Driller noted poor recovery).	
0.70	J2							
1.30	ES3							
1.50	CB4	N9					at c.1.50m BGL ... cobbles with much clayey gravelly sand.	
2.30	ES5							
2.50-2.95	C6	N15				(5.60)		
3.30	ES7							
3.50-3.95	C8	N8						
4.30	ES9							
4.50-4.95	C10	N7						
5.30	ES11							
5.50-5.95	CB12	N11		34.871		5.80		
6.30	ES13					(1.10)	MADE GROUND (Soft and firm brown grey slightly sandy slightly gravelly CLAY with occasional laminae. Sand is fine to medium. Gravel is fine to medium subangular and includes clinker and brick). (Driller notes cobbles).	
6.50	J14							
6.60-6.80	B15			33.771		6.90		
7.00-7.45	CB16	N12					Firm brown very sandy slightly gravelly CLAY with interbeds of sand. Sand is fine to coarse. Gravel is fine to medium subangular and includes sandstone and coal. (Glacial Till).	
7.60	ES17							

Boring Progress and Water Observations				
Date	Depth	Casing	Casing Dia (mm)	Water Standing
07/01/2019	0.00	0.00		
07/01/2019	1.20	0.00		Dry
08/01/2019	1.20	0.00		Dry

Chiselling		Water Added
From - To	Duration (hh:mm)	From - To
		1.20 - 11.30

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) 50mm diameter slotted standpipe installed between 2.00-10.00m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

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BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** BH106
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384459.989 N:399509.165		
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 40.671	**Start Date:** 07/01/2019	**Sheet:** 2 of 2

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
8.00	J18						Firm brown very sandy slightly gravelly CLAY with interbeds of sand. Sand is fine to coarse. Gravel is fine to medium subangular and includes sandstone and coal. (Glacial Till). *(continued)*	
8.30	ES19							
8.50-9.00	U20	(26)				(3.90)	at c.8.00m BGL ... clay is of low plasticity. at c.8.50m BGL ... low strength.	
9.30	ES22							
10.00-10.45	B24							
10.00-10.45	SJ23	N15		29.871		10.80		
						(0.50)	Weak red fine to coarse grained SANDSTONE partially weathered. (Recovered as gravel. Gravel is fine to coarse angular). (Chester Formation).	
11.00	CB25	50/37mm		29.371		11.30		
11.20	J26						*Complete at 11.30m BGL.*	
11.30	C27	50/16mm						

Boring Progress and Water Observations				
Date	Depth	Casing	Casing Dia (mm)	Water Standing
08/01/2019	11.30	10.90		Dry

Chiselling		Water Added
From - To	Duration (hh:mm)	From - To
11.10 - 11.30	0:30	

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) 50mm diameter slotted standpipe installed between 2.00-10.00m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

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BOREHOLE RECORD

Status:- **FINAL**

Project: Northern Gateway		**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384824.812 N:399485.537	**BH107**
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 41.293 / **Start Date:** 04/01/2019	**Sheet:** 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
0.10 0.20-0.50 0.30	J1 B3 ES2			40.793		(0.50) 0.50	MADE GROUND (Brown black clayey very sandy gravel with fragments of wood. Sand is fine to coarse. Gravel is fine to coarse subangular and includes sandstone, brick and clinker).	
0.50 0.60-1.10 0.70	J4 B6 ES5			40.093		(0.70) 1.20	MADE GROUND (Firm brown sandy slightly gravelly clay. Sand is fine to medium Gravel is fine to medium and includes clinker, sandstone, coal and brick).	
1.50-1.95	CB7	N7		39.693		(0.40) 1.60	MADE GROUND (Brown black clayey sandy gravel with fragments of wood. Sand is fine to coarse. Gravel is fine to coarse subangular and includes sandstone, brick and clinker).	
2.00 2.10 2.20-2.40	ES8 J9 B10			39.193 38.893		(0.50) 2.10 2.40	MADE GROUND (Soft and firm brown sandy slightly gravelly clay. Sand is fine to medium. Gravel is fine to medium and includes clinker, sandstone, coal and brick). at c.1.60m BGL ... clay is of intermediate plasticity.	
2.50-2.95	CB11	N28					Firm red brown sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine to medium and includes sandstone and coal). (Possible Weathered Manchester Marl Formation).	
3.00 3.10-3.40	J12 B13					(1.55)	Extremely weak red brown slightly sandy calcareous MUDSTONE and with interbeds of weak red fine to medium grained SANDSTONE. (Manchester Marl Formation).	
3.50-3.95	C14	N37		37.343		3.95	at c.2.50m BGL ... clay fines are of low plasticity.	
							Complete at 3.95m BGL.	

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
04/01/2019	0.00	0.00	150	
04/01/2019	1.20	0.00	150	Dry
09/01/2019	1.20	0.00	150	Dry
09/01/2019	3.95	2.60	150	Dry

Chiselling

From - To	Duration (hh:mm)

Water Added

From - To
1.20 - 3.50

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

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BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384562.256 N:399392.535		**BH109**
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 31.477	**Start Date:** 09/01/2019	**Sheet:** 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
0.30 0.40 0.40-1.00	J1 ES2 B3					(1.30)	MADE GROUND (Red brown black clayey very sandy gravel with cobbles noted and fragments of wood. Sand is fine to coarse. Gravel is fine to coarse subangular and includes sandstone, brick and clinker).	
1.20 1.30-1.80	ES4 CB5	N20		30.177		1.30	MADE GROUND (Firm and stiff brown sandy slightly gravelly clay. Sand is fine to medium. Gravel is fine to medium and includes clinker, sandstone, coal and brick).	
2.00 2.30-2.80	ES6 CB7	N29				(1.70)	at c.2.00m BGL ... clay is of low plasticity.	
3.00 3.10-3.50 3.10	J8 B10 SJ9	50/95mm		28.477		3.00	Very weak to weak red fine to medium grained SANDSTONE partially weathered. (Chester Formation).	
3.50	S11	50/20mm		27.977		3.50	*Complete at 3.50m BGL.*	

Boring Progress and Water Observations				
Date	Depth	Casing	Casing Dia (mm)	Water Standing
09/01/2019	0.00	0.00	150	
09/01/2019	3.50	3.10	150	Dry

Chiselling		Water Added
From - To	Duration (hh:mm)	From - To
3.20 - 3.50	1:00	

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

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BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384353.882 N:399440.903		**BH110**
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 31.263	**Start Date:** 10/01/2019	**Sheet:** 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
0.10	J1						MADE GROUND (Red brown black sandy gravel. Sand is fine to coarse. Gravel is fine to coarse subangular and includes sandstone, brick, clinker and wood).	
0.30	ES2					(1.60)		
1.20	S3	50/190mm					at c.1.20m BGL ... very dense/possible obstruction.	
1.40	J3			29.663		1.60		
1.60	J4						MADE GROUND (Firm brown sandy gravelly clay. Sand is fine to coarse. Gravel is fine to coarse subangular and includes brick, coal, clinker and sandstone).	
2.00	ES5						(Driller notes cobbles).	
2.10-2.60	SB6	N22				(2.30)		
3.00	ES7							
3.10-3.60	B9						at c.3.10m BGL ... silty gravelly sand. Silt fines are of intermediate plasticity.	
3.10-3.55	SJ8	N15						
				27.363		3.90		
3.90	J10			27.163		4.10	MADE GROUND (Brown very clayey sand. Sand is fine to coarse).	
4.00	ES11						(Driller notes cobbles).	
4.10-4.60	SB12	N13					MADE GROUND (Firm brown sandy gravelly clay. Sand is fine to coarse. Gravel is fine to coarse subangular and includes brick, coal, clinker and sandstone).	
4.80-5.30	U*B13					(2.30)		
5.30	B15							
5.30-5.75	SJ14	N12						
6.00	ES16							
				24.863		6.40		
6.40	J17						Extremely weak red fine to medium grained SANDSTONE distinctly weathered.	
6.60	SJ18	50/40mm				(0.60)	(Recovered as red slightly gravelly sand. Sand is fine to coarse. Gravel is fine to medium angular sand	
				24.263		7.00		
7.00	S19	50/30mm					(Chester Formation).	
							Complete at 7.00m BGL.	

Boring Progress and Water Observations				
Date	Depth	Casing	Casing Dia (mm)	Water Standing
10/01/2019	0.00	0.00	150	
10/01/2019	7.00	6.70	150	4.73

Chiselling		Water Added
From - To	Duration (hh:mm)	From - To
1.20 - 1.50	0:30	5.50 - 6.70
6.70 - 7.00	1:00	

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

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BOREHOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** BH112
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384401.713 N:399486.259		
Method (Equipment): Cable Percussion (Dando 2000)	**Ground Level (m):** 32.249	**Start Date:** 10/01/2019	**Sheet:** 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
0.10	J1					(0.40)	MADE GROUND (Red brown black sandy gravel with fragments of wood. Sand is fine to coarse. Gravel is fine to coarse subangular and includes sandstone, brick and clinker).	
0.30	ES2			31.849		0.40		
0.60	B3						MADE GROUND (Red brown clayey gravelly sand. Sand is fine to coarse. Gravel is fine to medium subrounded and includes sandstone and brick).	
0.90	ES4							
1.20	J5					(1.70)		
1.50-2.00	B7						at c.1.50m BGL ... medium dense.	
1.50-1.95	SJ6	N11						
				30.149		2.10		
2.20	J8						Medium dense red brown gravelly SAND. Gravel is fine to coarse subrounded and includes sandstone. (Possible Weathered Chester Formation).	
2.30	ES9							
2.50-3.00	CB10	N18				(1.90)		
3.20	J11							
3.30	ES12							
3.50-4.00	CB13	N21						
				28.249		4.00		
4.00	SJ14	50/6mm		27.949		4.30	Extremely weak red fine to medium grained SANDSTONE distinctly weathered. (Chester Formation).	
4.30	SJ15	100/3mm					*Complete at 4.30m BGL.*	

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
10/01/2019	0.00	0.00		
10/01/2019	4.30	4.30		Dry

Chiselling

From - To	Duration (hh:mm)
4.00 - 4.30	1:00

Water Added

From - To

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) 50mm diameter slotted standpipe installed to 0.50-4.00m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Portsmouth	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:43:54

Window/Windowless Sample Hole Records

FIELD DATA ENCLOSURE 3

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384734.621 N:399613.694		**WS101**
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 32.187	**Start Date:** 08/01/2019	**Sheet:** 1 of 3

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
0.10	J1			31.987		0.20	MADE GROUND (Brown clayey sand/sandy clay with many rootlets. Sand is fine to medium).	
0.20	J2							
0.30	ES3						MADE GROUND (Red brown clayey sandy gravel with cobbles noted and fragments of wood. Sand is fine to coarse. Gravel is fine to coarse subangular and includes brick, clinker and sandstone).	
0.50-0.80	B4					(1.00)		
1.00	ES5			30.987		1.20		
1.20-2.20	U7	(110)					MADE GROUND (Medium dense brown clayey sandy gravel. Sand is medium to coarse. Gravel is fine to coarse angular to subangular and includes brick, dolomite and sandstone).	
1.20-1.65	SJ6	N11				(0.70)		
				30.287		1.90		
							MADE GROUND (Medium dense black clayey sandy gravel. Gravel is fine to coarse angular to subangular and includes brick, sandstone, clinker, coal and mudstone).	
2.20-3.20	U9	(58)						
2.20-2.65	SJ8	N11				(1.10)		
			1	29.187		3.00		
							Loose brown yellow slightly clayey SAND and GRAVEL. Sand is coarse to medium. Gravel is firm to medium subrounded to rounded and includes sandstone and mudstone. (Alluvium).	
3.20-4.20	U11	(43)						
3.20-3.65	SJ10	N5						
			1			(2.45)		
4.20-5.00	U13	(52)					from c.4.20m BGL ... loose to medium dense.	
4.20-4.65	SJ12	N10						
5.00-5.45	SJ14	N11						
				26.737		5.45		
							Complete at 5.45m BGL.	

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
08/01/2019	0.00			
08/01/2019	5.45			4.00

Liner Sample Information

From - To	Internal Dia (mm)	Recovery (%)	Subsampled
1.20 - 2.20	87	100	No
2.20 - 3.20	87	80	No
3.20 - 4.20	77	70	No
4.20 - 5.00	67	70	No

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) Water strike at 4.20m - water level rose to 3.00m BGL (20mins).
(4) Engineer notes U-Liners were not split for logging purposes on clients request.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D.P/A.R	Contract No. **NW1580**

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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** **WS101**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384734.621 N:399613.694		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 32.187	**Start Date:** 08/01/2019	**Sheet:** 2 of 3

Figure WS101.1
1.20-2.20m BGL



Figure WS101.2
2.20-3.20m BGL



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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

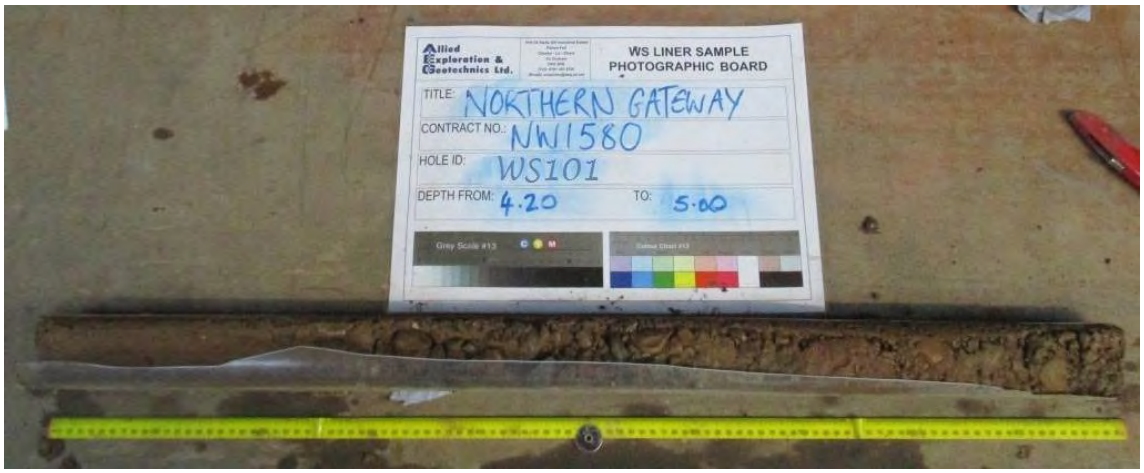
Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** WS101
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384734.621 N:399613.694		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 32.187	**Start Date:** 08/01/2019	**Sheet:** 3 of 3

Figure WS101.3
3.20-4.20m BGL



Figure WS101.4
4.20-5.00m BGL



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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384761.314 N:399589.102		**WS102**
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 32.203	**Start Date:** 07/01/2019	**Sheet:** 1 of 3

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
				32.153		0.05	MADE GROUND (Brown clayey sand/sandy clay with many rootlets. Sand is fine to medium).	
0.05	J1			32.003		0.20		
0.10	J2			31.803		0.40	MADE GROUND (Black brown sandy gravel with fragments of wood. Sand is fine to coarse. Gravel is fine to coarse subangular and includes brick, clinker and sandstone).	
0.20	J3							
0.50-0.80	B4					(1.00)	MADE GROUND (Yellow sandy gravel. Sand is fine to coarse. Gravel is fine to coarse subangular and includes sandstone and limestone).	
1.00	ES5							
1.20-2.20	U7	(89)		30.803		1.40	MADE GROUND (Red brown slightly clayey sandy gravel. Sand is fine to coarse. Gravel is fine to coarse subangular and includes brick, clinker and sandstone).	
1.20-1.65	SJ6	N12						
						(1.60)	MADE GROUND (Firm brown orange sandy gravelly clay. Sand is fine to coarse. Gravel is fine to medium angular and includes brick).	
2.20-3.20	U9	(39)						
2.20-2.65	SJ8	N17		29.203		3.00		
3.20-4.20	U11	(21)					Soft brown very sandy CLAY. (Alluvium).	
3.20-3.65	SJ10	N6						
						(2.00)		
4.20-5.00	U13	(26)						
4.20-4.65	SJ12	N5		27.203		5.00		
5.00-5.45	SJ14	N7				(0.45)	Loose brown slightly clayey SAND. (Alluvium).	
				26.753		5.45		
							Complete at 5.45m BGL.	

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
07/01/2019	0.00			
07/01/2019	5.45			Damp

Liner Sample Information

From - To	Internal Dia (mm)	Recovery (%)	Subsampled
1.20 - 2.20	87	100	No
2.20 - 3.20	87	70	No
3.20 - 4.20	77	70	No
4.20 - 5.00	67	80	No

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) Engineer notes U-Liners were not split for logging purposes on clients request.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D.P/A.R	Contract No. **NW1580**

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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** WS102
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384761.314 N:399589.102		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 32.203	**Start Date:** 07/01/2019	**Sheet:** 2 of 3

Figure WS102.1
1.20-2.20m BGL

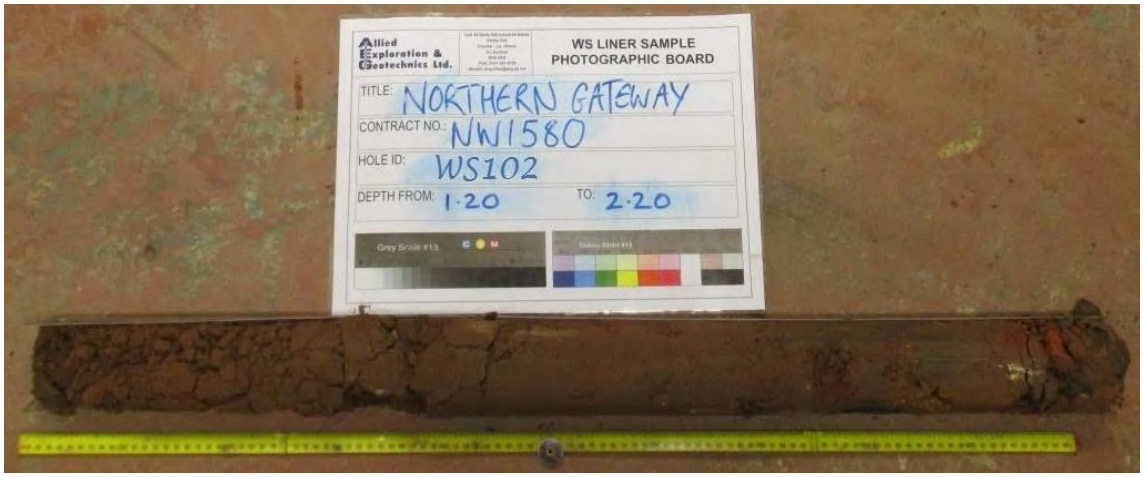


Figure WS102.2
2.20-3.20m BGL



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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** WS102
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384761.314 N:399589.102		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 32.203	**Start Date:** 07/01/2019	**Sheet:** 3 of 3

Figure WS102.3
3.20-4.20m BGL

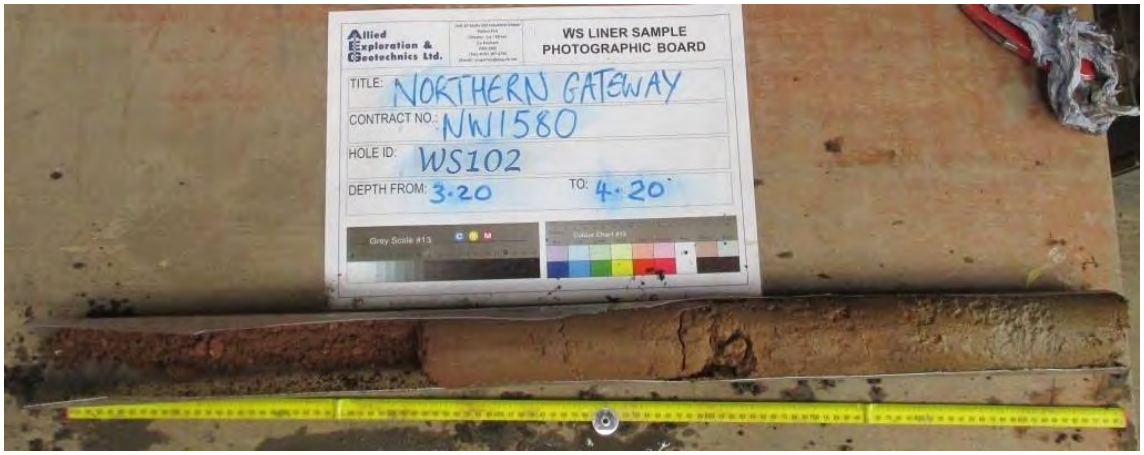


Figure WS102.4
4.20-5.00m BGL



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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384813.849 N:399611.160		**WS103**
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 32.572	**Start Date:** 07/01/2019	**Sheet:** 1 of 3

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
0.05 0.10	J1 J2			32.472		0.10	MADE GROUND (Brown clayey sand/sandy clay with many rootlets. Sand is fine to medium).	
0.50-0.80	B3					(1.10)	MADE GROUND (Red black brown sandy gravel with fragments of wood. Sand is fine to coarse. Gravel is fine to coarse subangular and includes brick, clinker and sandstone).	
1.00	ES4			31.372		1.20		
1.20-2.20 1.20-1.65	U6 SJ5	(30) N6				(1.60)	MADE GROUND (Loose black brown clayey very sandy gravel. Sand is fine to coarse. Gravel is fine to medium angular to subangular and includes brick, clinker and coal).	
2.20-3.20 2.20-2.65	U8 SJ7	(33) N11		29.772		2.80	at c.2.20m BGL ... medium dense with cobbles noted. Cobbles are angular and include brick.	
3.20-3.90 3.20-3.65	U10 SJ9	(100) N6		28.872		(0.90) 3.70	MADE GROUND (Soft brown very sandy clay). at c.3.20m BGL ... liner includes probable fall in from above.	
3.90	SJ11	100/72mm		28.672		3.90	(1) MADE GROUND (Brick and ash fill). at c.3.90m BGL ... concrete. *Terminated at 3.90m BGL - due to encountering concrete.*	

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
07/01/2019	0.00			
07/01/2019	3.90			Dry

Liner Sample Information

From - To	Internal Dia (mm)	Recovery (%)	Subsampled
1.20 - 2.20	87	70	No
2.20 - 3.20	87	80	No
3.20 - 3.90	77	70	No

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) Engineer notes U-Liners were not split for logging purposes on clients request.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D.P/A.R	Contract No. **NW1580**

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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** WS103
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384813.849 N:399611.160		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 32.572	**Start Date:** 07/01/2019	**Sheet:** 2 of 3

Figure WS103.1
1.20-2.20m BGL



Figure WS103.2
2.20-3.20m BGL



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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** **WS103**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384813.849 N:399611.160		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 32.572	**Start Date:** 07/01/2019	**Sheet:** 3 of 3

Figure WS103.3
3.20-3.90m BGL



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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway		**Exploratory Hole No.** WS104
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384569.278 N:399463.630	
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 31.490 / **Start Date:** 08/01/2019	**Sheet:** 1 of 3

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
				31.390		0.10	MADE GROUND (Macadam).	
0.10	J1						MADE GROUND (Red black brown clayey sandy gravel. Sand is fine to coarse. Gravel is fine to coarse subangular and includes brick, clinker and sandstone).	
0.20	B2							
0.30	ES3							
0.40	J4					(1.10)		
0.50-0.80	B5							
1.00	ES6			30.290		1.20		
1.20-2.20	U8	(32)					MADE GROUND (Loose black grey clayey very sandy gravel. Sand is fine to coarse and includes ash. Gravel is fine to medium subangular to subrounded and includes sandstone, brick, coal and clinker).	
1.20-1.65	SJ7	N9						
			1 ▽					
			1 ▼					
2.20-3.20	U10	(15)						
2.20-2.65	SJ9	N9						
						(3.80)	between c.2.90-3.20m BGL ... with interbeds of soft grey sandy gravelly clay of low plasticity.	
3.20-4.20	U12	(42)						
3.20-3.65	SJ11	N8						
							4.00-4.20m BGL ... with interbeds of soft grey sandy gravelly clay.	
4.20-5.00	U14	(37)					at c.4.20m BGL ... medium dense.	
4.20-4.65	SJ13	N11						
				26.490		5.00		
							Complete at 5.00m BGL.	

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
08/01/2019	0.00			
08/01/2019	5.00			2.20

Liner Sample Information

From - To	Internal Dia (mm)	Recovery (%)	Subsampled
1.20 - 2.20	87	50	No
2.20 - 3.20	87	50	No
3.20 - 4.20	77	60	No
4.20 - 5.00	77	60	No

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) Engineer notes U-Liners were not split for logging purposes on clients request.
(4) Water strike at 2.20m BGL - water level rose to 2.00m BGL (20mins).

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D.P/A.R	Contract No. **NW1580**

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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** WS104
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384569.278 N:399463.630		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 31.490	**Start Date:** 08/01/2019	**Sheet:** 2 of 3

Figure WS104.1
1.20-2.20m BGL

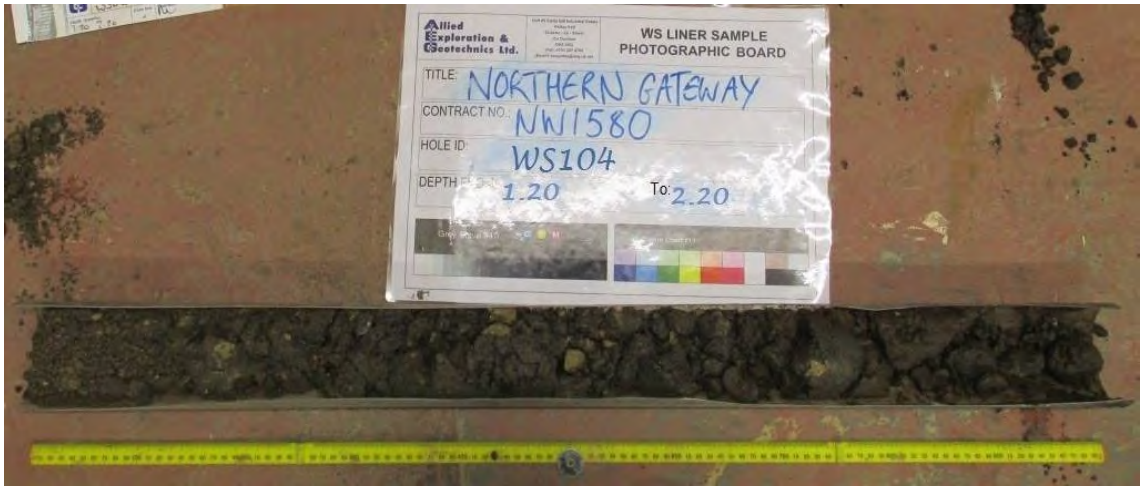


Figure WS104.2
2.20-3.20m BGL



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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** WS104
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384569.278 N:399463.630		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 31.490	**Start Date:** 08/01/2019	**Sheet:** 3 of 3

Figure WS104.3
3.20-4.20m BGL



Figure WS104.4
4.20-5.00m BGL



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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384294.085 N:399279.174		**WS105**
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 29.447	**Start Date:** 10/01/2019	**Sheet:** 1 of 1

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
0.10 0.20 0.30 0.40 0.50-0.80	J1 B2 ES3 J4 B5			29.147 29.047 28.547		0.30 0.40 (0.50) 0.90	MADE GROUND (Grass over slightly gravelly sand. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded and includes sandstone. Driller notes compact roadstone). MADE GROUND (Black gravelly sand. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded and includes clinker and brick).	
0.90 1.00 1.20-1.50	J6 ES7 SJ8	70/94mm		 27.947		(0.60) 1.50	MADE GROUND (Brown clayey sandy gravel and cobbles. Sand is fine to coarse. Gravel is fine to medium angular to subrounded and includes sandstone. Cobbles include sandstone). MADE GROUND (Black gravelly sand. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded and includes clinker and brick). (Driller notes cobbles). *Terminated at 1.50m BGL - due to refusal.*	

Boring Progress and Water Observations				
Date	Depth	Casing	Casing Dia (mm)	Water Standing
10/01/2019	0.00			
10/01/2019	1.50			Dry

Liner Sample Information			
From - To	Internal Dia (mm)	Recovery (%)	Subsampled

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: N. Waterhouse	Contract No. **NW1580**

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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway		**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384294.085 N:399279.174	**WS105A**
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 29.447 / **Start Date:** 10/01/2019	**Sheet:** 1 of 3

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
				29.147		0.30	MADE GROUND (Grass over slightly gravelly sand. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded and includes sandstone. Driller notes compact roadstone).	
				29.047		0.40		
						(0.50)	MADE GROUND (Black gravelly sand. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded and includes clinker and brick).	
				28.547		0.90		
				28.247		1.20	MADE GROUND (Brown slightly gravelly sand with low cobble content. Sand is fine to coarse. Gravel is fine to medium angular to subrounded and includes sandstone. Cobbles include sandstone).	
1.20-2.20 1.20-1.65	U9 SJ8	(46) N6				(0.60)		
				27.647		1.80	MADE GROUND (Loose black gravelly sand. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded and includes clinker and brick).	
2.20-3.20 2.20-2.65	U11 SJ10	(32) N7					MADE GROUND (Black gravelly sand. Gravel is fine to medium angular to subrounded and includes clinker and brick). (Driller notes cobbles).	
						(2.20)	MADE GROUND (Loose black clayey very gravelly sand and sandy gravelly clay. Sand is fine to coarse. Gravel is fine to medium angular to subangular and includes clinker and brick). (Driller notes cobbles).	
3.20-4.20 3.20-3.65	U13 SJ12	(41) N3					at c.2.20m BGL ... clay is of low plasticity. at c.3.20m BGL ... very loose.	
			1	25.447		4.00		
			1				Loose dark brown clayey slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded and includes sandstone, limestone and quartzite. (Alluvium).	
4.20-5.00 4.20-4.65	U15 SJ14	(109) N9				(1.45)		
5.00-5.45	SJ16	N13					at c.5.00m BGL ... medium dense.	
				23.997		5.45		
							Complete at 5.45m BGL.	

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
10/01/2019	0.00			
10/01/2019	5.45			Dry

Liner Sample Information

From - To	Internal Dia (mm)	Recovery (%)	Subsampled
1.20 - 2.20	87	90	No
2.20 - 3.20	87	80	No
3.20 - 4.20	77	100	No
4.20 - 5.00	67	90	No

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) Water strike at 4.20m BGL - water level rose to 3.90m BGL (20mins).
(4) No samples between c.0.00-1.20m - please refer to WS05.
(5) Engineer notes U-Liners were not split for logging purposes on clients request.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: N.W/A.R	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:37:48

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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** WS105A
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384294.085 N:399279.174		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 29.447	**Start Date:** 10/01/2019	**Sheet:** 2 of 3

Figure WS105A.1
1.20-2.20m BGL



Figure WS105A.2
2.20-3.20m BGL



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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** WS105A
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384294.085 N:399279.174		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 29.447	**Start Date:** 10/01/2019	**Sheet:** 3 of 3

Figure WS105A.3
3.20-4.20m BGL



Figure WS105A.4
4.20-5.00m BGL



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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384611.937 N:399505.689		**WS106**
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 31.522	**Start Date:** 08/01/2019	**Sheet:** 1 of 3

SAMPLES & TESTS			Water	STRATA				Instrument/ Backfill
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description	
0.05	J1			31.422		0.10	MADE GROUND (Macadam).	
0.10	J2						MADE GROUND (Black brown sandy gravel. Sand is fine to coarse. Gravel is fine to coarse subangular and includes brick, clinker and sandstone).	
0.30-0.80	ES3							
0.50	B4					(1.10)		
1.00	ES5			30.322		1.20		
1.20-2.20	U7	(46)					MADE GROUND (Loose brown black sand with interbeds of sandy gravel and sandy gravelly clay. Sand is medium to coarse and includes ash. Gravel is fine to coarse angular to subangular and includes sandstone, brick and clinker).	
1.20-1.65	SJ6	N9						
			1				at c.1.90m BGL ... soft brown sandy gravelly clay of intermediate plasticity.	
			1					
2.20-3.20	U9	(42)					from c.2.20m BGL ... medium dense.	
2.20-2.65	SJ8	N18				(2.80)		
							at c.2.80m BGL ... soft grey sandy gravelly clay. Arup Engineer noted hydrocarbon (benzene) odour .	
3.20-4.20	U11	(86)						
3.20-3.65	SJ10	N11						
				27.522		4.00		
				27.322		4.20	(1) Soft brown sandy CLAY. (Alluvium).	
							Terminated at 4.20m BGL - due to collapse from 4.20m back to 2.70m BGL.	

Boring Progress and Water Observations

Date	Depth	Casing	Casing Dia (mm)	Water Standing
08/01/2019	0.00			
08/01/2019	4.20			1.64

Liner Sample Information

From - To	Internal Dia (mm)	Recovery (%)	Subsampled
1.20 - 2.20	87	80	No
2.20 - 3.20	87	60	No
3.20 - 4.20	77	60	No

General Remarks

(1) Description derived from drillers daily report.
(2) Inspection pit dug prior to drilling.
(3) Water strike at 2.20m BGL - water level rose to 1.93m BGL (20mins).
(4) Engineer notes U-Liners were not split for logging purposes on clients request.
(5) Hole collapsed back to 2.70m BGL.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D.P/A.R	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:37:51

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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

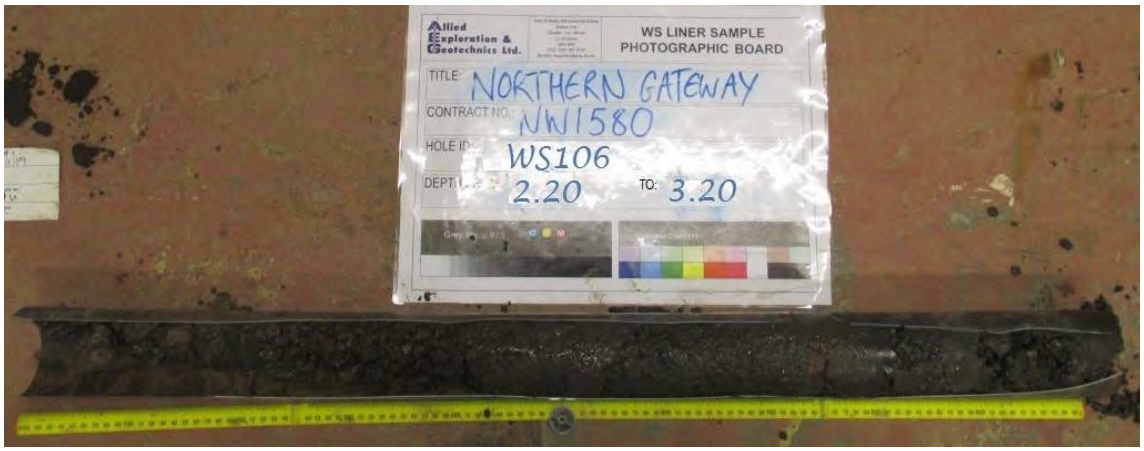
Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** WS106
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384611.937 N:399505.689		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 31.522	**Start Date:** 08/01/2019	**Sheet:** 2 of 3

Figure WS106.1
1.20-2.20m BGL



Figure WS106.2
2.20-3.20m BGL



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WINDOW/WINDOWLESS SAMPLE HOLE RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** WS106
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384611.937 N:399505.689		
Method (Equipment): Windowless Sampling (PC Tracker S110)	**Ground Level (m):** 31.522	**Start Date:** 08/01/2019	**Sheet:** 3 of 3

Figure WS106.3
3.20-4.20m BGL



FIELD DATA ENCLOSURE 4

Trial Pit Records

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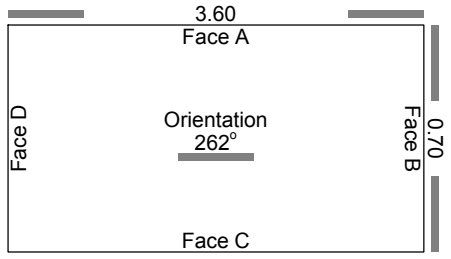
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP101
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384759.647 N:399818.495		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.457	**Start Date:** 03/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1						MADE GROUND (Black slightly clayey sandy gravel. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded and includes dolomite, granite, brick and concrete).
0.30	ES2					(0.90)	
0.80	LB3			42.56		0.90	at c.0.80-0.90m BGL ... slight hydrocarbon odour.
				42.36		1.10	MADE GROUND (Concrete and brick obstruction). (Recovered as gravel. Gravel is coarse and angular).
1.20	J4						Stiff grey sandy slightly gravelly CLAY with low cobble content. Sand is fine. Gravel is fine to medium subrounded and includes sandstone, mudstone, coal and limestone. Cobbles are subrounded and include limestone. (Glacial Till Deposits).
1.30	ES5						at c.1.20m BGL ... clay/silt of low plasticity.
1.80	LB6						
2.20	J7					(2.50)	
2.80	B8						
3.20	J9						
				39.86		3.60	at c.3.40-3.60m BGL ... limestone cobble obstruction.
							Terminated at 3.60m BGL - due to instability.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Terminated due to instability between 0.00-0.90m BGL.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. NW1580

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP101
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384759.647 N:399818.495		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.457	**Start Date:** 03/01/2019	**Sheet:** 2 of 4

Figure TP101.1
Short Face



Figure TP101.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP101
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384759.647 N:399818.495		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.457	**Start Date:** 03/01/2019	**Sheet:** 3 of 4

Figure TP101.3
Long Face



Figure TP101.4
Spoil



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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP101
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384759.647 N:399818.495		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.457	**Start Date:** 03/01/2019	**Sheet:** 4 of 4

Figure TP101.5
Spoil



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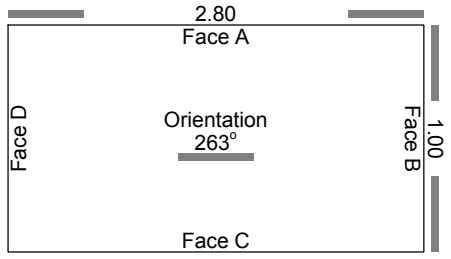
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP102
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384698.516 N:399742.661		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.621	**Start Date:** 03/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1						MADE GROUND (Black sandy gravel. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded and includes dolomite, granite, brick and concrete).
0.30	ES2					(0.90)	
0.50	LB3						
0.80	J4			41.72		0.90	
1.00	LB5			41.52		1.10	MADE GROUND (Concrete and brick obstruction). (Recovered as gravel. Gravel is coarse angular).
1.20	ES6						Stiff grey slightly sandy gravelly CLAY with interbeds of gravelly sand and low cobble content. Sand is fine. Gravel is fine to medium subrounded and includes sandstone, mudstone, coal and limestone. Cobbles are subrounded and include limestone. (Glacial Till Deposits).
1.40	J7						
1.80	LB8						
2.20	ES9						
2.40	J10					(3.00)	
2.80	B11						
3.20	J12						
3.60	LB13						at c.3.40-3.60m BGL ... limestone cobble/boulder obstruction.
4.10	J14			38.52		4.10	*Terminated at 4.10m BGL - due to cobble obstruction.*

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides moderately unstable throughout excavation.

ADDITIONAL INFORMATION		
Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP102
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384698.516 N:399742.661		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.621	**Start Date:** 03/01/2019	**Sheet:** 2 of 4

Figure TP102.1
Short Face



Figure TP102.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP102
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384698.516 N:399742.661		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.621	**Start Date:** 03/01/2019	**Sheet:** 3 of 4

Figure TP102.3
Long Face



Figure TP102.4
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP102
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384698.516 N:399742.661		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.621	**Start Date:** 03/01/2019	**Sheet:** 4 of 4

Figure TP102.5
Spoil



Figure TP102.6
Spoil



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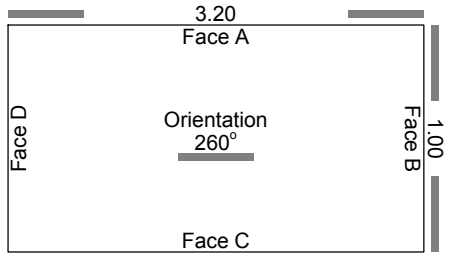
TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP103
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384772.820 N:399769.313		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.178	**Start Date:** 03/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
				43.08		0.10	MADE GROUND (Macadam).
0.20	J1						MADE GROUND (Light brown sandy gravel. Sand is fine to coarse. Gravel is fine to coarse angular and includes dolomite).
0.30	ES2			42.78		0.40	
0.50	J3					(0.40)	MADE GROUND (Black slightly clayey sandy gravel with fragments of wood and glass. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular to subrounded and includes clinker, slag, dolomite, sandstone, macadam and concrete).
0.60	ES4			42.38		0.80	
0.70	LB5						
0.90	J6			42.08		1.10	
1.00	ES7						Red orange slightly clayey gravelly SAND. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded and includes sandstone. (Alluvium).
1.10	B8						
1.20	J9						
1.50	B10						
1.80	ES11					(1.90)	Soft and firm dark grey silty slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine subangular to rounded and includes mudstone, limestone and sandstone. (Glacial Till Deposits).
2.20	J12						at c.1.20m BGL ... clay is of low plasticity.
2.60	LB13						
				40.18		3.00	
3.20	J14						Firm to stiff red and brown slightly sandy gravelly CLAY. Sand is fine to medium. Gravel is fine to medium angular to subrounded and includes sandstone. (Glacial Till Deposits).
3.60	LB15					(1.50)	at c.3.20m BGL ... clay is of intermediate plasticity.
4.20	J16						
				38.68		4.50	
							Complete at 4.50m BGL.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides stable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:46:07

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP103
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384772.820 N:399769.313		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.178	**Start Date:** 03/01/2019	**Sheet:** 2 of 4

Figure TP103.1
Short Face



Figure TP103.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP103
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384772.820 N:399769.313		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.178	**Start Date:** 03/01/2019	**Sheet:** 3 of 4

Figure TP103.3
Long Face



Figure TP103.4
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP103
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384772.820 N:399769.313		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.178	**Start Date:** 03/01/2019	**Sheet:** 4 of 4

Figure TP103.5
Spoil



Figure TP103.6
Spoil



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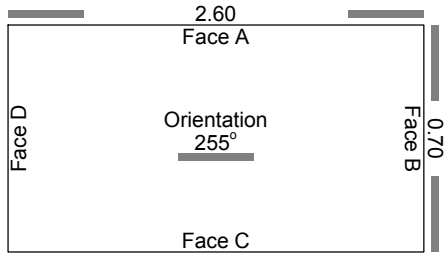
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP104
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384780.328 N:399749.164		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.131	**Start Date:** 03/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
				43.08		0.05	MADE GROUND (Brown sandy gravel with occasional rootlets. Sand is fine to coarse. Gravel is fine to coarse angular and includes concrete, brick, macadam and dolomite).
0.20	J1					(1.05)	
0.30	ES2						MADE GROUND (Black clayey very sandy gravel with fragments of wood and glass. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular to subrounded and includes brick, clinker, slag, dolomite, sandstone, macadam and concrete).
0.80	LB3			42.03		1.10	
1.20	J4					(0.90)	Red orange clayey very gravelly SAND. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded and includes sandstone. (Alluvium).
1.50	ES5						
1.80	LB6			41.13		2.00	
2.20	J7					(1.20)	Soft to firm dark grey silty slightly sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine subangular to rounded and includes mudstone, limestone and sandstone. (Alluvium). at c.2.20m BGL ... clay is of low plasticity.
2.80	LB8			39.93		3.20	
3.30	J9		≈	39.33		(0.60) 3.80	Grey slightly silty/clayey SAND. Sand is fine to medium. (Alluvium).
							Terminated at 3.80m BGL - due to instability.

PLAN



GROUNDWATER
Groundwater seepage at 3.50m BGL (Slow inflow).

STABILITY
Pit sides unstable throughout excavation - collapsed at 1.50m-3.30m BGL (included running sand).

ADDITIONAL INFORMATION		
Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP104
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384780.328 N:399749.164		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.131	**Start Date:** 03/01/2019	**Sheet:** 2 of 4

Figure TP104.1
Short Face



Figure TP104.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP104
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384780.328 N:399749.164		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.131	**Start Date:** 03/01/2019	**Sheet:** 3 of 4

Figure TP104.3
Long Face



Figure TP104.4
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP104
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384780.328 N:399749.164		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 43.131	**Start Date:** 03/01/2019	**Sheet:** 4 of 4

Figure TP104.5
Spoil



Figure TP104.6
Spoil



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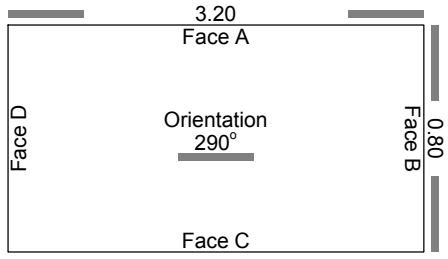
TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384843.779 N:399726.261		**TP105**
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.107	**Start Date:** 04/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1						MADE GROUND (Brown clayey slightly gravelly sand with low cobble content. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular to subrounded and includes concrete, clinker, brick and sandstone. Cobbles are angular and include concrete). between c.0.00-0.30m BGL ... occasional rootlets.
0.30	ES2						
0.80	LB3					(2.00)	
1.10	J4						
1.30	ES5						
1.80	B6		≈	39.11		2.00	
2.10	J7						MADE GROUND (Grey slightly sandy gravelly clay with low cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular and includes sandstone, concrete, clinker and brick. Cobbles are angular and includes brick).
2.30	ES8						
2.80	LB9					(1.80)	
3.10	J10						
3.30	B11						
				37.31		3.80	
							Terminated at 3.80m BGL - due to instability.

PLAN



GROUNDWATER
Groundwater seepage at 2.00m BGL.

STABILITY
Pit sides slightly unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP105
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384843.779 N:399726.261		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.107	**Start Date:** 04/01/2019	**Sheet:** 2 of 4

Figure TP105.1
Short Face



Figure TP105.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP105
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384843.779 N:399726.261		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.107	**Start Date:** 04/01/2019	**Sheet:** 3 of 4

Figure TP105.3
Long Face



Figure TP105.4
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP105
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384843.779 N:399726.261		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.107	**Start Date:** 04/01/2019	**Sheet:** 4 of 4

Figure TP105.5
Spoil



Figure TP105.6
Spoil



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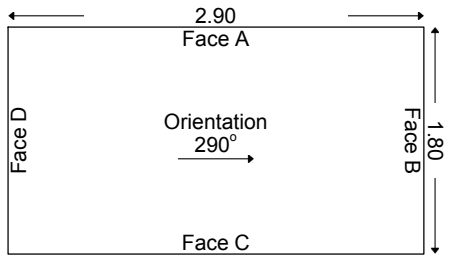
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP106
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384830.717 N:399695.601		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.654	**Start Date:** 04/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1			42.35		0.30	MADE GROUND (Brown sandy slightly gravelly topsoil with many rootlets. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular to subrounded and includes clinker, concrete and slag).
0.20	J2						
0.40	ES3						
0.80	LB4						MADE GROUND (Black slightly clayey sandy gravel with low cobble content and cobbles and fragments of wood and glass. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular to subrounded and includes clinker, slag, dolomite, sandstone, macadam and concrete. Cobbles are angular and include brick).
1.20	J5					(2.10)	
1.50	ES6						at c.0.30m BGL ... 100mm diameter plastic pipe 0.50m from Face C running 290 degrees.
1.80	B7						
2.20	J8			40.25		2.40	
2.50	J9						MADE GROUND (Red orange slightly clayey gravelly sand. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded and includes sandstone).
2.80	ES10						
3.00	LB11					(1.30)	
3.50	J12			38.95		3.70	
4.00	J13					(0.80)	MADE GROUND (Soft to firm dark grey silty slightly sandy slightly gravelly clay. Sand is fine to medium. Gravel is fine subangular to rounded and includes mudstone, limestone, sandstone and brick).
4.30	LB14			38.15		4.50	
							Complete at 4.50m BGL.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides slightly unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384830.717 N:399695.601		**TP106**
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.654	**Start Date:** 04/01/2019	**Sheet:** 2 of 4

Figure TP106.1
Short Face



Figure TP106.2
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP106
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384830.717 N:399695.601		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.654	**Start Date:** 04/01/2019	**Sheet:** 3 of 4

Figure TP106.3
Long Face



Figure TP106.4
Long Face



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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP106
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384830.717 N:399695.601		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.654	**Start Date:** 04/01/2019	**Sheet:** 4 of 4

Figure TP106.5
Spoil



Figure TP106.6
Spoil



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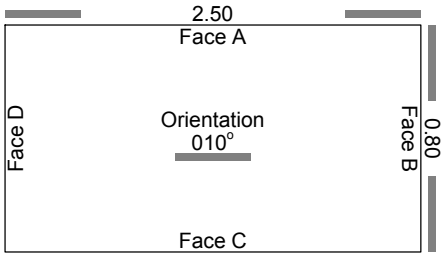
TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384737.823 N:399704.019		**TP107**
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.764	**Start Date:** 03/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
				42.66		0.10	MADE GROUND (Light brown sandy gravel with occasional rootlets. Sand is fine to coarse. Gravel is fine to coarse angular and includes dolomite).
0.20	J1						
0.30	ES2			42.36		0.40	
0.40	LB3					(0.50)	MADE GROUND (Black slightly clayey sandy gravel with occasional wood and glass fragments. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular to subrounded and includes clinker, slag, dolomite, sandstone, macadam and concrete).
0.50	J4						
0.60	ES5			41.86		0.90	
0.70	LB6						MADE GROUND (Red orange slightly clayey gravelly fine to coarse sand. Gravel is fine to medium subangular to subrounded and includes sandstone).
1.00	J7						
1.20	ES8						at c.0.40m BGL ... 25mm diameter plastic cable 0.50m from Face D running perpendicular to pit.
1.60	LB9					(2.00)	
2.00	J10						MADE GROUND (Soft and firm dark grey silty slightly sandy slightly gravelly clay. Sand is fine to medium. Gravel is fine subangular to rounded and includes mudstone, brick, limestone and sandstone).
2.50	B11			39.86		2.90	
3.00	J12						Firm and stiff red and brown slightly sandy gravelly CLAY. Sand is fine to medium. Gravel is fine to medium angular to subrounded and includes sandstone. (Glacial Till Deposits).
3.20	ES13						
3.60	LB14					(1.60)	
4.00	J15						
				38.26		4.50	
							Complete at 4.50m BGL.

PLAN



GROUNDWATER
Groundwater seepage at 0.60m BGL (slow inflow).

STABILITY
Pit sides and base slightly unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:47:20

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP107
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384737.823 N:399704.019		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.764	**Start Date:** 03/01/2019	**Sheet:** 2 of 4

Figure TP107.1
Short Face



Figure TP107.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP107
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384737.823 N:399704.019		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.764	**Start Date:** 03/01/2019	**Sheet:** 3 of 4

Figure TP107.3
Long Face



Figure TP107.4
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP107
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384737.823 N:399704.019		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.764	**Start Date:** 03/01/2019	**Sheet:** 4 of 4

Figure TP107.5
Spoil



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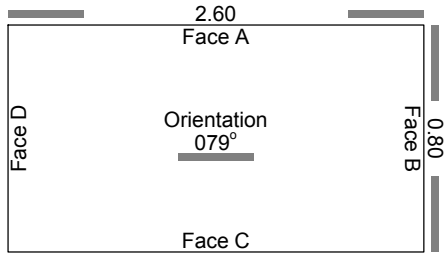
TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384655.011 N:399693.930		**TP108**
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.312	**Start Date:** 04/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1						MADE GROUND (Black slightly clayey sandy gravel with low cobble content and rootlets. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular to subrounded and includes sandstone, clinker, slag, dolomite, brick, concrete and macadam. Cobbles are subangular and include concrete and brick).
0.30	ES2					(0.90)	
0.70	LB3			41.41		0.90	
1.00	J4						Red brown clayey slightly gravelly fine to coarse SAND with interbeds of sandy slightly gravelly clay. Gravel is fine to medium subangular to subrounded and includes sandstone. (Alluvium/Glacial Till Deposits).
1.30	ES5						
1.60	LB6						at c.1.60m BGL ... sandy slightly gravelly clay.
2.00	J7						
2.50	B8					(3.60)	
3.00	J9						
3.50	B10						
4.00	J11						
				37.81		4.50	
4.50	B12						*Complete at 4.50m BGL.*

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides and base slightly unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:47:26

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384655.011 N:399693.930		**TP108**
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.312	**Start Date:** 04/01/2019	**Sheet:** 2 of 4

Figure TP108.1
Short Face



Figure TP108.2
Short Face



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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP108
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384655.011 N:399693.930		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.312	**Start Date:** 04/01/2019	**Sheet:** 3 of 4

Figure TP108.3
Long Face



Figure TP108.4
Long Face



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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP108
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384655.011 N:399693.930		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 42.312	**Start Date:** 04/01/2019	**Sheet:** 4 of 4

Figure TP108.5
Spoil



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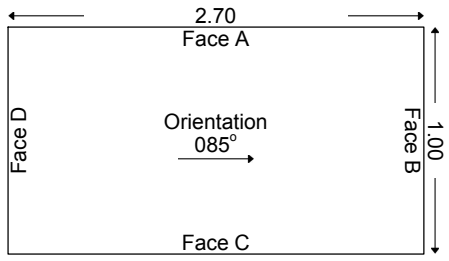
TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384661.431 N:399650.774		**TP109**
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.958	**Start Date:** 04/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1						MADE GROUND (Black clayey very sandy gravel with low cobble content and occasional fragments of glass, wood and metal fragments. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular to subrounded and includes sandstone, clinker, slag, dolomite, macadam, brick and concrete. Cobbles are subangular and include brick).
0.30	ES2						
0.60	LB3						
							at c.0.80m BGL ... occasional rootlets.
1.10	J4						
1.30	ES5						
1.60	B6						
2.10	J7					(4.50)	
2.30	ES8						
2.60	B9						
3.10	J10						
3.30	ES11						
3.60	B12						
4.10	J13						
4.30	ES14			37.46		4.50	
							Complete at 4.50m BGL.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides and base slightly unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP109
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384661.431 N:399650.774		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.958	**Start Date:** 04/01/2019	**Sheet:** 2 of 4

Figure TP109.1
Short Face



Figure TP109.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384661.431 N:399650.774		**TP109**
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.958	**Start Date:** 04/01/2019	**Sheet:** 3 of 4

Figure TP109.3
Long Face



Figure TP109.4
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP109
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384661.431 N:399650.774		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.958	**Start Date:** 04/01/2019	**Sheet:** 4 of 4

Figure TP109.5
Spoil



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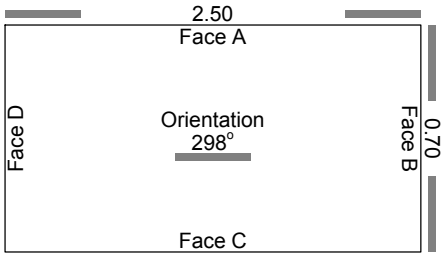
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP110
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384638.835 N:399640.942		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.427	**Start Date:** 07/01/2019	**Sheet:** 1 of 3

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1						MADE GROUND (Black slightly clayey sandy gravel with occasional wood and glass fragments. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular to subrounded and includes clinker, slag, dolomite, sandstone, macadam and concrete).
0.30	ES2						
0.80	LB3					(1.80)	
1.10	J4						
1.30	ES5						
			1	39.63		1.80	
1.80	B6						*Terminated at 1.80m BGL - due to groundwater ingress.*

PLAN



GROUNDWATER
Water strike at 1.80m BGL (moderate inflow).

STABILITY
Pit sides and base stable throughout excavation.

ADDITIONAL INFORMATION		
Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP110
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384638.835 N:399640.942		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.427	**Start Date:** 07/01/2019	**Sheet:** 2 of 3

Figure TP110.1
Short Face



Figure TP110.2
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP110
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384638.835 N:399640.942		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.427	**Start Date:** 07/01/2019	**Sheet:** 3 of 3

Figure TP110.3
Spoil



Figure TP110.4
Spoil



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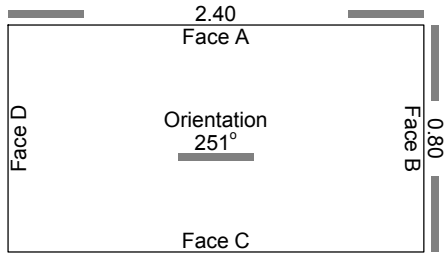
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP111
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384592.029 N:399655.215		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.467	**Start Date:** 07/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1						MADE GROUND (Black clayey very gravelly sand. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded and includes dolomite, granite, some brick and concrete).
0.30	ES2					(0.90)	
0.80	LB3			40.57		0.90	
				40.37		1.10	MADE GROUND (Concrete and brick obstruction). (Recovered as coarse angular gravel).
1.20	J4						MADE GROUND (Soft and firm grey slightly sandy gravelly clay. Sand is fine. Gravel is fine to medium subrounded and includes sandstone, brick, concrete, clinker and limestone).
1.30	ES5					(0.80)	
1.80	LB6			39.57		1.90	
2.00	J7						Red brown slightly clayey gravelly fine to coarse SAND. Gravel is fine to medium subangular to subrounded and includes sandstone. (Glacial Till Deposits/Weathered Chester Formation).
2.50	ES8						
2.80	LB9						
3.00	J10					(2.60)	
3.80	B11						
4.00	J12						
				36.97		4.50	
							Complete at 4.50m BGL.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides and base moderately unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. NW1580

Print Date and Time: 19/03/2019 16:47:37

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP111
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384592.029 N:399655.215		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.467	**Start Date:** 07/01/2019	**Sheet:** 2 of 4

Figure TP111.1
Short Face



Figure TP111.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP111
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384592.029 N:399655.215		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.467	**Start Date:** 07/01/2019	**Sheet:** 3 of 4

Figure TP111.3
Long Face



Figure TP111.4
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP111
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384592.029 N:399655.215		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 41.467	**Start Date:** 07/01/2019	**Sheet:** 4 of 4

Figure TP111.5
Spoil



Figure TP111.6
Spoil



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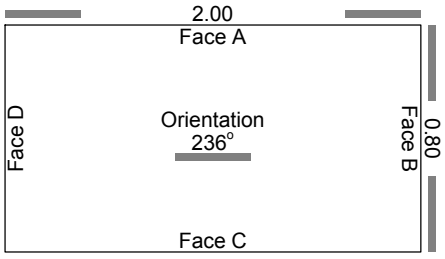
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP112
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384552.675 N:399614.062		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 40.830	**Start Date:** 07/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1						MADE GROUND (Brown and black clayey very gravelly sand with occasional wood, tile and metal fragments. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded and includes dolomite, slag, clinker, brick and concrete). Face D 0.00-0.30m BGL ... concrete. 0.30-2.80m BGL ... brick wall. between c.0.30-0.70m BGL ... 0.40 x 0.40m metal girder located 0.80m from Face D.
0.30	ES2						
0.80	LB3						
1.10	J4						
1.30	ES5					(2.80)	
1.80	B6						
2.10	J7						
2.30	ES8						
			▼1	38.03		2.80	
2.80	B9						*Terminated at 2.80m BGL - due to groundwater ingress.*

PLAN



GROUNDWATER
Water strike at 2.80m BGL (moderate inflow).

STABILITY
Pit sides and base slightly unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP112
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384552.675 N:399614.062		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 40.830	**Start Date:** 07/01/2019	**Sheet:** 2 of 4

Figure TP112.1
Short Face



Figure TP112.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP112
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384552.675 N:399614.062		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 40.830	**Start Date:** 07/01/2019	**Sheet:** 3 of 4

Figure TP112.3
Long Face



Figure TP112.4
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP112
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384552.675 N:399614.062		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 40.830	**Start Date:** 07/01/2019	**Sheet:** 4 of 4

Figure TP112.5
Spoil



Figure TP112.6
Spoil



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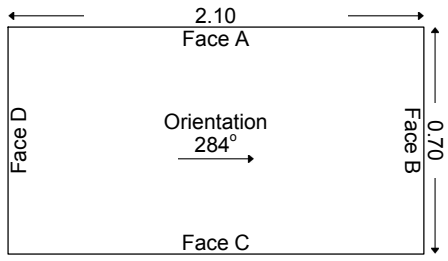
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP115
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384456.531 N:399526.838		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 40.513	**Start Date:** 07/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1						MADE GROUND (Black clayey sand and gravel with occasional wood and glass fragments. Sand is fine to coarse and includes ash. Gravel is fine to coarse angular to subrounded and includes clinker, slag, dolomite, sandstone, macadam and concrete). at c.0.80m BGL ... occasional rootlets.
0.30	ES2						
0.80	LB3						
1.10	J4						
1.30	ES5						
1.80	B6						
2.10	J7					(4.50)	
2.30	ES8						
2.80	B9						
3.10	J10						
3.30	ES11						
3.80	B12						
4.10	J13						
4.30	ES14			36.01		4.50	
							Complete at 4.50m BGL.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides and base slightly unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:47:50

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Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL **Tel:** 01772 735 300 **Fax:** 01772 735 999

TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP115
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384456.531 N:399526.838		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 40.513	**Start Date:** 07/01/2019	**Sheet:** 2 of 4

Figure TP115.1
Short Face



Figure TP115.2
Short Face



ALLIED EXPLORATION & GEOTECHNICS LIMITED

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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP115
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384456.531 N:399526.838		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 40.513	**Start Date:** 07/01/2019	**Sheet:** 3 of 4

Figure TP115.3
Long Face



Figure TP115.4
Long Face



ALLIED EXPLORATION & GEOTECHNICS LIMITED

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP115
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384456.531 N:399526.838		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 40.513	**Start Date:** 07/01/2019	**Sheet:** 4 of 4

Figure TP115.5
Spoil



Figure TP115.6
Spoil



ALLIED EXPLORATION & GEOTECHNICS LIMITED

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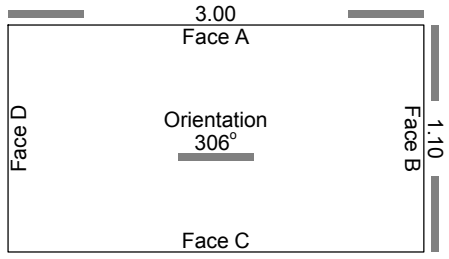
TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP119
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384483.283 N:399475.961		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.601	**Start Date:** 09/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.20 0.30 0.40 0.50	ES1 J2 B3 J4			31.10		(0.50) 0.50	MADE GROUND (Grey slightly clayey sandy gravel with high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular and includes sandstone, limestone, concrete, brick, slag and clinker. Cobbles are angular and include brick and concrete). at c.0.25m BGL ... plastic sheeting across pit.
1.00 1.50	ES5 B6					(1.50)	MADE GROUND (White grey sandy gravel with low cobble content. Sand is fine. Gravel is fine to coarse subangular to angular and includes sandstone, slag, slate and brick. Cobbles are angular and include brick and slate). (Engineer notes possibly lime kiln waste).
2.00 2.10	J7 ES8			29.60		2.00	at c.1.90m BGL ... layer of angular cobble sized slate flag stones. (Possible Floor/Basement).
2.50	B9					(1.10)	Orange brown gravelly SAND with medium cobble content. Sand is fine to coarse. Gravel is fine to coarse subrounded and includes sandstone and quartz. Cobbles are subrounded and include sandstone. (Possible Weathered Chester Formation).
3.00 3.10	ES10 J11			28.50 28.45		3.10 3.15	Weak yellow brown coarse grained SANDSTONE. (Recovered as gravel and cobbles. Gravel is coarse angular. Cobbles are angular). (Chester Formation). *Complete at 3.15m BGL.*

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Susnik	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:47:55

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP119
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384483.283 N:399475.961		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.601	**Start Date:** 09/01/2019	**Sheet:** 2 of 4

Figure TP119.1
Short Face



Figure TP119.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP119
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384483.283 N:399475.961		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.601	**Start Date:** 09/01/2019	**Sheet:** 3 of 4

Figure TP119.3
Long Face



Figure TP119.4
Spoil



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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP119
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384483.283 N:399475.961		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.601	**Start Date:** 09/01/2019	**Sheet:** 4 of 4

Figure TP119.5
Spoil



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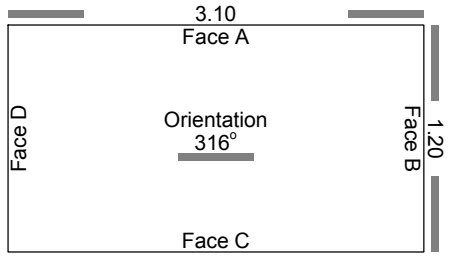
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP120
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384451.844 N:399460.069		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.069	**Start Date:** 09/01/2019	**Sheet:** 1 of 3

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.30	ES1					(0.70)	MADE GROUND (Grey brown sand and gravel with high cobble content. Sand is fine to coarse. Gravel is fine to coarse subangular to angular and includes sandstone, limestone, concrete, brick and clinker. Cobbles are angular and include brick and concrete).
0.40	J2						
0.50	B3			30.37		0.70	
0.70	J4						MADE GROUND (Very soft black brown silty slightly sandy slightly gravelly clay with some pseudo-fibrous peat content. Sand is fine. Gravel is coarse and includes brick. Strong hydrocarbon and organic odour noted. (Engineer notes possibly contaminated natural ground).
1.00	ES5					(1.10)	
1.20	B6						
				29.27		1.80	
1.80	J7						Soft orange brown CLAY. (Alluvium).
1.90	ES8					(0.50)	
2.00	B9						
2.00	HSV	23 (33)kPa		28.77		2.30	
2.30	J10						Light yellow brown SAND. Sand is fine to medium. (Alluvium/Glacial Till Deposits).
2.50	B11					(0.70)	
				28.07		3.00	
3.00	J12						Light yellow brown gravelly SAND with low cobble content. Sand is fine to coarse. Gravel is fine to coarse rounded to subrounded and includes sandstone and quartz. Cobbles are subrounded and include sandstone. (Alluvium/Glacial Till Deposits).
3.30	B13					(0.70)	
				27.37		3.70	
							Complete at 3.70m BGL.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Susnik	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:47:59

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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP120
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384451.844 N:399460.069		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.069	**Start Date:** 09/01/2019	**Sheet:** 2 of 3

Figure TP120.1
Short Face



Figure TP120.2
Short Face



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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP120
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384451.844 N:399460.069		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.069	**Start Date:** 09/01/2019	**Sheet:** 3 of 3

Figure TP120.3
Long Face



Figure TP120.4
Spoil



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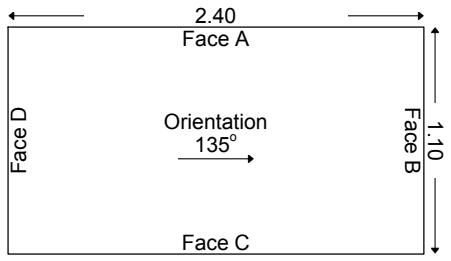
TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384442.251 N:399393.368		**TP121**
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.274	**Start Date:** 11/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1						MADE GROUND (Black clayey very gravelly sand with low cobble content and fragments of tile, metal, glass and wood. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded and includes brick, concrete, sandstone, clinker and macadam. Cobbles are angular and include brick and concrete).
0.30	ES2						
0.80	LB3					(1.80)	between c.0.10-1.40m BGL ... brick wall present in faces A and C.
1.10	J4						
1.30	ES5						between c.1.50-3.00m BGL ... brick wall present in face D.
				28.47		1.80	
1.80	B6						MADE GROUND (Red brown clayey slightly gravelly sand with fragments of tile. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded and includes sandstone, clinker, brick and concrete).
2.00	J7						
2.30	ES8					(1.40)	
2.80	LB9						
				27.07		3.20	
							Terminated at 3.20m BGL - due to instability.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides unstable throughout excavation, collapse at 3.20m BGL back to 2.40m BGL.

ADDITIONAL INFORMATION		
Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP121
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384442.251 N:399393.368		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.274	**Start Date:** 11/01/2019	**Sheet:** 2 of 4

Figure TP121.1
Short Face



Figure TP121.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP121
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384442.251 N:399393.368		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.274	**Start Date:** 11/01/2019	**Sheet:** 3 of 4

Figure TP121.3
Long Face



Figure TP121.4
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP121
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384442.251 N:399393.368		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.274	**Start Date:** 11/01/2019	**Sheet:** 4 of 4

Figure TP121.5
Spoil



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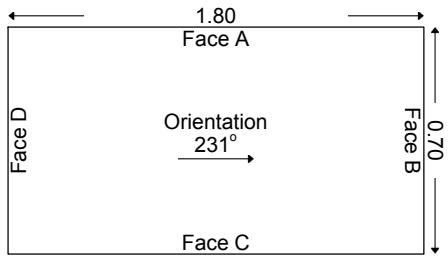
TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.**
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384423.360 N:399438.117		**TP122**
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.448	**Start Date:** 11/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10 0.30 0.80	J1 ES2 LB3			29.45		(1.00) 1.00	MADE GROUND (Black clayey very gravelly sand with fragments of tile, metal and wood. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded and includes brick, concrete, sandstone, clinker and macadam).
1.10 1.30 1.50	J4 ES5 LB6			28.75		(0.70) 1.70	MADE GROUND (Black and orange slightly clayey gravelly sand with fragments of tile. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded and includes sandstone, clinker, brick and concrete).
1.80 2.30 2.50	J7 ES8 LB9			27.45		(1.30) 3.00	MADE GROUND (Soft and firm orange and brown sandy slightly gravelly clay. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded and includes sandstone, brick and clinker).
							Complete at 3.00m BGL.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides unstable throughout excavation, repeated collapse of Faces A and C.

ADDITIONAL INFORMATION		
Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:48:08

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP122
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384423.360 N:399438.117		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.448	**Start Date:** 11/01/2019	**Sheet:** 2 of 4

Figure TP122.1
Short Face



Figure TP122.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP122
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384423.360 N:399438.117		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.448	**Start Date:** 11/01/2019	**Sheet:** 3 of 4

Figure TP122.3
Long Face



Figure TP122.4
Long Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP122
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384423.360 N:399438.117		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.448	**Start Date:** 11/01/2019	**Sheet:** 4 of 4

Figure TP122.5
Spoil



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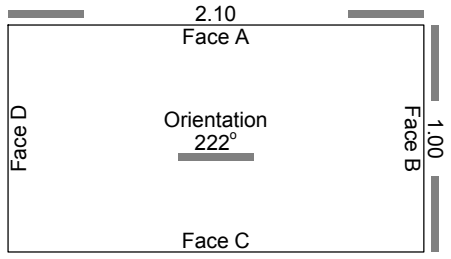
TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP124
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384763.554 N:399485.198		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 39.485	**Start Date:** 11/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.10	J1			39.39		0.10	MADE GROUND (Black sandy gravelly topsoil with occasional rootlets. Sand is fine to coarse. Gravel is fine to medium angular to subrounded and includes sandstone, brick and macadam).
0.20	J2						
0.30	ES3						MADE GROUND (Black clayey very sandy gravel with low cobble content and fragments of tile, metal, wood, plastic and glass. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded and includes concrete, clinker, slag, macadam, sandstone and brick. Cobbles are angular and include brick and concrete).
0.80	LB4					(1.40)	
1.20	J5						
1.30	ES6			37.99		1.50	
1.70	J7						MADE GROUND (Soft and firm red and grey slightly sandy gravelly clay. Sand is fine to coarse. Gravel is fine to coarse angular to subrounded and includes sandstone, concrete and brick).
2.00	ES8					(1.30)	
2.40	LB9						at c.2.40m BGL ... clay is of low plasticity.
2.70	J9			36.69		2.80	
2.90	J10						Firm red brown with occasional bands of orange and grey mottling very sandy slightly gravelly CLAY. Sand is fine to medium. Gravel is fine subrounded and includes sandstone. (Glacial Till Deposits).
3.20	ES11						
3.40	LB12					(1.70)	
3.90	J13						
4.40	B14			34.99		4.50	
							Complete at 4.50m BGL.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides slightly unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: J. Myall	Contract No. **NW1580**

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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP124
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384763.554 N:399485.198		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 39.485	**Start Date:** 11/01/2019	**Sheet:** 2 of 4

Figure TP124.1
Short Face



Figure TP124.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP124
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384763.554 N:399485.198		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 39.485	**Start Date:** 11/01/2019	**Sheet:** 3 of 4

Figure TP124.3
Long Face



Figure TP124.4
Long Face



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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP124
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384763.554 N:399485.198		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 39.485	**Start Date:** 11/01/2019	**Sheet:** 4 of 4

Figure TP124.5
Spoil



Figure TP124.6
Spoil



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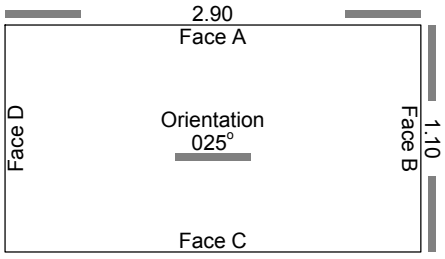
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP125
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384525.517 N:399388.873		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.685	**Start Date:** 10/01/2019	**Sheet:** 1 of 4

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.30 0.40 0.50	ES1 J2 B3						MADE GROUND (Brown very gravelly sand with high cobble content, low boulder content and fragments of metal and plastic. Sand is fine to coarse. Gravel is fine to coarse subangular to angular and includes sandstone, brick, slag and concrete. Cobbles are subangular to angular and include concrete and brick. Boulders are angular and include concrete (demolition rubble)).
1.00	ES4					(2.50)	at c.0.00-2.50m BGL ... occasional pockets of slightly sandy slightly gravelly clay.
1.40 1.50	J5 B6						
2.00	ES7						
2.20 2.30	J8 B9			28.19		2.50	
				27.89		2.80	Extremely weak red brown fine to medium grained SANDSTONE. (Recovered as sand and gravel. Sand is fine to coarse. Gravel is fine to coarse angular). (Chester Formation).
							Complete at 2.80m BGL.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Susnik	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:48:17

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL **Tel:** 01772 735 300 **Fax:** 01772 735 999

TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP125
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384525.517 N:399388.873		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.685	**Start Date:** 10/01/2019	**Sheet:** 2 of 4

Figure TP125.1
Short Face



Figure TP125.2
Short Face



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TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP125
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384525.517 N:399388.873		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.685	**Start Date:** 10/01/2019	**Sheet:** 3 of 4

Figure TP125.3
Long Face



Figure TP125.4
Long Face



ALLIED EXPLORATION & GEOTECHNICS LIMITED

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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP125
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384525.517 N:399388.873		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 30.685	**Start Date:** 10/01/2019	**Sheet:** 4 of 4

Figure TP125.5
Spoil



ALLIED EXPLORATION & GEOTECHNICS LIMITED

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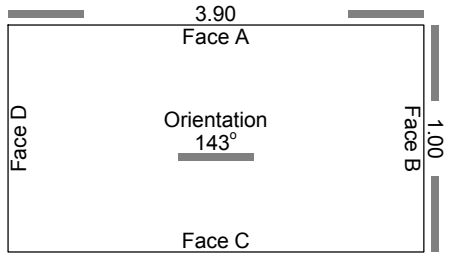
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP126
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384574.850 N:399411.048		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.374	**Start Date:** 09/01/2019	**Sheet:** 1 of 3

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.30	ES1						MADE GROUND (Brown very gravelly sand with high cobble content, low boulder content, occasional pockets of slightly sandy slightly gravelly clay and fragments of metal and plastic. Sand is fine to coarse. Gravel is fine to coarse subangular to angular and includes sandstone, brick, slag and concrete. Cobbles are subangular to angular and include concrete and brick. Boulders are angular and include concrete (demolition rubble)).
0.40	J2						
0.50	B3					(1.80)	
1.00	ES4						
1.40	J5						
1.50	B6						
1.70	ES7			29.57		1.80	
1.80	J8						MADE GROUND (Very soft to firm orange brown mottled grey slightly sandy slightly gravelly clay. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded and includes sandstone, siltstone, coal and brick).
2.00	B9					(0.50)	
2.20	ES10			29.07		2.30	
2.30	J11						Red brown and black slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded to angular and includes sandstone and coal. (Possible Weathered Chester Formation).
2.50	B12					(0.80)	
3.00	ES13			28.27		3.10	
3.20	J14			28.17		3.20	Extremely weak red brown fine to medium grained SANDSTONE. (Recovered as sand and gravel. Sand is fine to coarse. Gravel is fine to coarse angular). (Chester Formation).
							Complete at 3.20m BGL.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Susnik	Contract No. NW1580

Print Date and Time: 19/03/2019 16:48:22

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Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL **Tel:** 01772 735 300 **Fax:** 01772 735 999

TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP126
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384574.850 N:399411.048		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.374	**Start Date:** 09/01/2019	**Sheet:** 2 of 3

Figure TP126.1
Short Face



Figure TP126.2
Short Face



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TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP126
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384574.850 N:399411.048		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.374	**Start Date:** 09/01/2019	**Sheet:** 3 of 3

Figure TP126.3
Long Face



Figure TP126.4
Spoil



ALLIED EXPLORATION & GEOTECHNICS LIMITED

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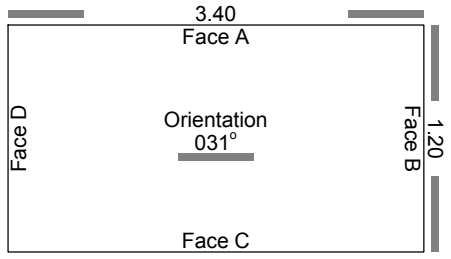
TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP127
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384520.567 N:399360.521		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.249	**Start Date:** 10/01/2019	**Sheet:** 1 of 3

SAMPLES & TESTS			Water	STRATA			
Depth	Type No	Test Result		Reduced Level	Legend	Depth (Thickness)	Description
0.30 0.40 0.50	ES1 J2 B3						MADE GROUND (Brown very gravelly sand with high cobble content, low boulder content, occasional pockets of slightly sandy slightly gravelly clay and fragments of metal and plastic. Sand is fine to coarse. Gravel is fine to coarse subangular to angular and includes sandstone, brick, slag and concrete. Cobbles are subangular to angular and includes concrete and brick. Boulders are angular and include concrete (demolition waste)).
1.00	ES4						
1.40 1.50	J5 B6					(2.90)	
2.00	ES7						
2.40 2.50	J8 B9			28.35		2.90	
2.90	J10						Red brown and black slightly gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded to angular and includes sandstone and coal. (Possible Weathered Chester Formation).
3.50 3.60	ES11 B12					(1.10)	
				27.25		4.00	
							Complete at 4.00m BGL.

PLAN



GROUNDWATER
No groundwater inflow observed.

STABILITY
Pit sides unstable throughout excavation.

ADDITIONAL INFORMATION

Sketch Diagram:	No Sketch Taken	
Photographs:	Yes	See additional sheets.

GENERAL REMARKS
N/A.

All dimensions in metres Scale 1:50	For explanation of symbols and abbreviations see Key Sheets	Checked by: KW	Logged by: D. Susnik	Contract No. **NW1580**

Print Date and Time: 19/03/2019 16:48:26

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Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL **Tel:** 01772 735 300 **Fax:** 01772 735 999

TRIAL PIT RECORD

Status:- **FINAL**

Project: Northern Gateway			**Exploratory Hole No.** TP127
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384520.567 N:399360.521		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.249	**Start Date:** 10/01/2019	**Sheet:** 2 of 3

Figure TP127.1
Short Face



Figure TP127.2
Short Face



ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL **Tel:** 01772 735 300 **Fax:** 01772 735 999

TRIAL PIT RECORD

Status:- FINAL

Project: Northern Gateway			**Exploratory Hole No.** TP127
Client: Far East Consortium International Limited	**Location:** Northern Gateway, Red Bank, Manchester E:384520.567 N:399360.521		
Method (Equipment): Machine Excavated (JCB 3CX)	**Ground Level (m):** 31.249	**Start Date:** 10/01/2019	**Sheet:** 3 of 3

Figure TP127.3
Long Face



Figure TP127.4
Spoil



FIELD DATA ENCLOSURE 5

Groundwater Observations Made at the Time of Site Works

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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GROUNDWATER OBSERVATIONS MADE AT THE TIME OF SITE WORKS (WATER STRIKES)

Exploratory Hole No.	Date	Depth of Water (m)	Depth of Casing (m)	Depth Sealed (m)	Final Depth (m)	Total Time (mins)	Depth After 5 mins	Depth After 10 mins	Depth After 15 mins	Depth After 20 mins	Remarks
BH103	04/01/2019	0.60			0.30	20	0.50	0.40	0.45	0.30	Slow inflow.
TP110	07/01/2019	1.80									Moderate inflow
TP112	07/01/2019	2.80									Moderate inflow.
WS101	08/01/2019	4.20			3.00	20	3.49	3.08	3.00	3.00	Moderate inflow.
WS104	08/01/2019	2.20			2.00	20	2.02	2.00	2.00	2.00	Moderate inflow.
WS105A	10/01/2019	4.20			3.90	20	4.20	4.15	4.03	3.90	Slow inflow.
WS106	08/01/2018	2.20			1.93	20	2.02	1.95	1.93	1.93	Moderate inflow.

Contract Title :- Northern Gateway			Client :- Far East Consortium International Limited	AEG Contract No :- NW1580
Date of Issue :- 12/03/2019	Page No. :- 1 of 1	Checked By :- LC	Approved By :-	Certificate No. :- GWOWS/NW1580/1

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

GROUNDWATER OBSERVATIONS MADE AT THE TIME OF SITE WORKS (GROUNDWATER SEEPAGES)

Monitoring Point	Date	Depth (m)	Remarks
TP104	03/01/2019	3.50	Slow inflow.
TP105	04/01/2019	2.00	Slow inflow.
TP107	03/01/2019	0.60	Slow inflow.

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Certificate No. :- GWOS/NW1580/1	Date of Issue :- 12/03/2019	Page No. :- 1 of 1
Checked By :- LC	Approved By :- KW	AEG Contract No. :- NW1580

FIELD DATA ENCLOSURE 6

Groundwater Monitoring Results

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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GROUNDWATER MONITORING RESULTS

Monitoring Point	Date and Time	Depth and Type of Well	Ground Level (mAOD)	Water Depth (mBGL)	Reduced Water Level (mAOD)	Remarks
BH101	07/01/2019 00:00	5.00m 50mm SP	43.38	4.95	38.43	
BH101	08/01/2019 00:00	5.00m 50mm SP	43.38	4.90	38.48	
BH101	09/01/2019 00:00	5.00m 50mm SP	43.38	4.81	38.57	
BH101	24/01/2019 10:25	5.00m 50mm SP	43.38	Wet at tip		
BH102	07/01/2019 00:00	6.50m 50mm SP	42.93	Wet at tip		
BH102	08/01/2019 00:00	6.50m 50mm SP	42.93	Wet at tip		
BH102	09/01/2019 00:00	6.50m 50mm SP	42.93	Wet at tip		
BH102	24/01/2019 10:32	6.50m 50mm SP	42.93	Wet at tip		
BH103	08/01/2019 00:00	3.50m 50mm SP	42.57	3.40	39.17	
BH103	09/01/2019 00:00	3.50m 50mm SP	42.57	3.36	39.21	
BH103	24/01/2019 10:40	3.50m 50mm SP	42.57	0.91	41.66	
BH104	09/01/2019 00:00	9.00m 50mm SP	41.59	8.10	33.49	
BH104	24/01/2019 10:55	9.00m 50mm SP	41.59	8.95	32.64	
BH105	09/01/2019 00:00	9.50m 50mm SP	40.67	Dry		
BH105	24/01/2019 11:06	9.50m 50mm SP	40.67	4.52	36.15	
BH106	09/01/2019 00:00	10.00m 50mm SP	40.67	Dry		
BH106	24/01/2019 11:16	10.00m 50mm SP	40.67	Dry		
BH112	11/01/2019 00:00	4.00m 50mm SP	32.25	Dry		
BH112	24/01/2019 11:27	4.00m 50mm SP	32.25	Dry		

SP = Standpipe - SPIE = Standpipe Piezometer.

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Certificate No. :-	Date of Issue :-	Page No. :-
GWMR/NW1580/1	11/03/2019	1 of 1
Checked By :-	Approved By :-	AEG Contract No. :-
	LC	NW1580

In-situ Test Report Certificate

IN-SITU TESTING ENCLOSURES

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - Tel: 0191 3874700 Fax: 0191 3874710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL – Tel: 01254 503 200 Fax: 01254 662 590

IN-SITU TESTING REPORT CERTIFICATE

UKAS TESTING
1367

Contract Title: Northern Gateway **AEG Reference:** NW1580

Client Address: Far East Consortium International Limited
Second Floor
Northern Assurance Building
Princess Street
Manchester
M2 4DN

I certify that *In-situ* testing was carried out on the above contract in accordance with techniques outlined in BS 1377: 1990: Part 9 or other appropriate standards as quoted, and the following results, given on the attached enclosures, were obtained.

The tests carried out are indicated in the attached table showing the enclosure number and the total number of pages.

For and on behalf of Allied Exploration & Geotechnics Limited

☑ Nick Vater (Technical Director)

☐ Kevin Warriner (HSE & Quality Director)

Signed _____ Date: 12 March 2019

Tests marked not UKAS accredited in this certificate are not included in the UKAS accreditation schedule for our laboratory. Any opinions and interpretations expressed herein are outside the scope of the laboratory's UKAS accreditation

IN-SITU TESTING REPORT CERTIFICATE

ENCLOSURES

Enclosure Number	Description	UKAS Accredited	Reference	No. of Pages
0	Test Report Certificate	N/A		2
1	Standard Penetration Test Results (SPT)	Yes	BS 1377 Part 9 1990	29
2	Hand Shear Vane Test Results	No		1
-	Variable Head Permeability Test Results	No	BS 5930 1999:Section 4	-
3	*In-situ* Water Quality Parameter Test Results	No		1
-	Density by Sand Replacement Method	Yes	BS 1377 Part 9 1990	-
-	Density by Core Cutter Method	Yes	BS 1377 Part 9 1990	-
-	Determination of the Vane Shear Strength (Down the Hole)	Yes	BS 1377 Part 9 1990	-
-	Shallow Pad (skip) Load Test Results	No	BS 1377 Part 9 1990	-
-	Determination of the California Bearing Ratio	Yes	BS 1377 Part 9 1990	-
-	Plate Loading Test Results	No	BS 1377 Part 9 1990	-
-	Apparent Resistivity of Soil	No	BS 1377 Part 9 1990	-
-	Redox Potential of Soil	No	BS 1377 Part 9 1990	-
-	Determination of the Soil Infiltration Rate for Soakaway Design	No	BRE Digest 365:1991	-

Standard Penetration Test Results

IN-SITU TESTING ENCLOSURE 1

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No.	Test Depth (Reduced Level)	Water Depth (Casing)	Rod Length	SPT Hammer Ref.	Energy Ratio E_m	SEATING DRIVE						TEST DRIVE										Rod Length Corr. C_R	Energy Ratio Corr. C_E	Pen (mm)/Blow	SPT'N' Value	SPT'N' Value (Corr.) N_{60}	Shoe or Cone	Remarks
						Pen	Blows	Pen	Blows	Total Pen	Total Blows	Pen	Blows	Pen	Blows	Pen	Blows	Pen	Blows	Total Pen	Total Blows							
	m	m	m		%	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.						S/C	
BH101	1.50 (41.88)	Dry (1.50)	1.50	ATH01	59	75	2	75	1	150	3	75	2	75	3	75	3	75	3	300	11	0.66	0.98	27.27	11	7	S	
BH101	2.50 (40.88)	Dry (2.50)	2.50	ATH01	59	75	3	75	2	150	5	75	3	75	4	75	4	75	3	300	14	0.70	0.98	21.43	14	10	S	
BH101	4.00 (39.38)	Dry (4.00)	4.00	ATH01	59	75	1	75	1	150	2	75	2	75	3	75	3	75	5	300	13	0.76	0.98	23.08	14	10	S	
BH101	5.50 (37.88)	Dry (5.50)	5.50	ATH01	59	75	5	75	4	150	9	75	5	75	6	75	6	75	6	300	23	0.82	0.98	13.04	23	18	S	
BH101	7.00 (36.38)	Dry (7.00)	7.00	ATH01	59	30	25			30	25	7	25							7	25	0.88	0.98	0.28	-	-	S	
BH101	7.50 (35.88)	Dry (7.50)	7.50	ATH01	59	14	25			14	25	3	50							3	50	0.90	0.98	0.06	-	-	S	
BH101	7.80 (35.58)	Dry (7.80)	7.80	ATH01	59	6	50			6	50	0	100							0	100	0.91	0.98	0.00	-	-	S	
BH102	1.20 (41.73)	Dry (1.20)	1.20	ATH03	56	75	1	75	2	150	3	75	2	75	2	75	3	75	2	300	9	0.65	0.93	33.33	9	5	S	
BH102	3.00 (39.93)	Dry (2.98)	3.00	ATH03	56	75	1	75	5	150	6	75	11	75	7	75	4	75	4	300	26	0.72	0.93	11.54	19	13	S	
BH102	3.60 (39.33)	Damp (3.10)	3.60	ATH03	56	75	1	75	0	150	1	75	1	75	1	75	1	75	2	300	5	0.74	0.93	60.00	5	3	S	

NOTE: Please refer to calibration certificate for additional information and corresponding Exploratory Hole record for sampling details. Uncorrected and corrected SPT'N' values are presented on the attached graphical plot relative to each Exploratory Hole.

Contract Title :-	Client :-	AEG Contract No :-
Northern Gateway	Far East Consortium International Limited	NW1580

Date of Issue :-	Page No. :-	Checked By :-	Approved By :-	Certificate No. :-
12/03/2019	1 of 10	LC		SPT/NW1580/1

UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS

(BS EN ISO 22476-3: 2005)

Exploratory Hole No.	Test Depth (Reduced Level)	Water Depth (Casing)	Rod Length	SPT Hammer Ref.	Energy Ratio E_m	SEATING DRIVE						TEST DRIVE										Rod Length Corr. C_R	Energy Ratio Corr. C_E	Pen (mm)/Blow	SPT'N' Value	SPT'N' Value (Corr.) N_{60}	Shoe or Cone	Remarks
						Pen	Blows	Pen	Blows	Total Pen	Total Blows	Pen	Blows	Pen	Blows	Pen	Blows	Pen	Blows	Total Pen	Total Blows							
	m	m	m		%	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No						S/C	
BH102	4.60 (38.33)	4.17 (4.48)	4.60	ATH03	56	75	1	75	1	150	2	75	1	75	2	75	3	75	2	300	8	0.78	0.93	37.50	8	6	S	
BH102	5.50 (37.43)	Damp (5.50)	5.50	ATH03	56	75	2	75	3	150	5	75	2	75	3	75	3	75	4	300	12	0.82	0.93	25.00	12	9	S	
BH102	6.90 (36.03)	Dry (6.90)	6.90	ATH03	56	75	3	75	4	150	7	75	5	75	7	75	7	75	8	300	27	0.88	0.93	11.11	27	22	S	
BH102	8.50 (34.43)	Dry (7.10)	8.50	ATH03	56	75	4	75	9	150	13	75	13	75	17	40	20			190	50	0.94	0.93	3.80	-	-	S	
BH103	1.50 (41.07)	Dry (1.50)	1.50	ATH01	59	75	2	75	4	150	6	75	4	75	5	75	4	75	5	300	18	0.66	0.98	16.67	18	12	S	
BH103	2.50 (40.07)	Dry (2.50)	2.50	ATH01	59	75	2	75	1	150	3	75	2	75	3	75	3	75	3	300	11	0.70	0.98	27.27	11	8	S	
BH103	4.00 (38.57)	Dry (4.00)	4.00	ATH01	59	75	6	75	7	150	13	75	9	75	8	75	8	75	14	300	39	0.76	0.98	7.69	39	29	S	
BH103	5.50 (37.07)	Dry (5.50)	5.50	ATH01	59	75	2	75	3	150	5	75	4	75	4	75	7	75	5	300	20	0.82	0.98	15.00	20	16	S	
BH103	7.00 (35.57)	Dry (7.00)	7.00	ATH01	59	75	7	75	12	150	19	75	15	75	22	14	13			164	50	0.88	0.98	3.28	-	-	S	
BH103	8.30 (34.27)	Dry (8.30)	8.30	ATH01	59	18	50			18	50	9	100							9	100	0.93	0.98	0.09	-	-	S	

NOTE: Please refer to calibration certificate for additional information and corresponding Exploratory Hole record for sampling details. Uncorrected and corrected SPT'N' values are presented on the attached graphical plot relative to each Exploratory Hole.

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Northern Gateway	Far East Consortium International Limited	NW1580

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UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS

(BS EN ISO 22476-3: 2005)

Exploratory Hole No.	Test Depth (Reduced Level)	Water Depth (Casing)	Rod Length	SPT Hammer Ref.	Energy Ratio E_m	SEATING DRIVE						TEST DRIVE										Rod Length Corr. C_R	Energy Ratio Corr. C_E	Pen (mm)/Blow	SPTN Value	SPTN Value (Corr.) N_{60}	Shoe or Cone	Remarks
						Pen	Blows	Pen	Blows	Total Pen	Total Blows	Pen	Blows	Pen	Blows	Pen	Blows	Pen	Blows	Total Pen	Total Blows							
	m	m	m		%	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No						S/C	
BH104	1.50 (40.09)	Dry (1.48)	1.50	ATH03	56	75	1	75	1	150	2	75	2	75	1	75	1	75	2	300	6	0.66	0.93	50.00	6	4	S	
BH104	2.50 (39.09)	Dry (2.50)	2.50	ATH03	56	75	2	75	2	150	4	75	1	75	1	75	1	75	1	300	4	0.70	0.93	75.00	4	3	S	
BH104	3.50 (38.09)	Dry (3.40)	3.50	ATH03	56	75	0	75	1	150	1	75	1	75	1	75	1	75	1	300	4	0.74	0.93	75.00	4	3	S	
BH104	4.50 (37.09)	Dry (4.48)	4.50	ATH03	56	75	1	75	2	150	3	75	3	75	3	75	3	75	3	300	12	0.78	0.93	25.00	12	9	S	
BH104	6.00 (35.59)	Dry (5.84)	6.00	ATH03	56	75	2	75	2	150	4	75	3	75	2	75	2	75	3	300	10	0.84	0.93	30.00	10	8	S	
BH104	7.50 (34.09)	Dry (7.09)	7.50	ATH03	56	75	2	75	3	150	5	75	4	75	3	75	3	75	3	300	13	0.90	0.93	23.08	13	11	S	
BH104	9.00 (32.59)	Damp (8.41)	9.00	ATH03	56	75	2	75	2	150	4	75	2	75	3	75	3	75	3	300	11	0.96	0.93	27.27	11	10	S	
BH104	10.50 (31.09)	Damp (10.50)	10.50	ATH03	56	75	0	75	1	150	1	75	1	75	2	75	1	75	1	300	5	1.00	0.93	60.00	5	5	S	
BH104	12.00 (29.59)	Damp (12.00)	12.00	ATH03	56	75	0	75	1	150	1	75	2	75	1	75	1	75	2	300	6	1.00	0.93	50.00	6	6	S	
BH104	13.00 (28.59)	Damp (13.00)	13.00	ATH03	56	75	5	75	8	150	13	75	8	75	10	75	12	75	15	300	45	1.00	0.93	6.67	45	42	S	

NOTE: Please refer to calibration certificate for additional information and corresponding Exploratory Hole record for sampling details. Uncorrected and corrected SPTN' values are presented on the attached graphical plot relative to each Exploratory Hole.

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UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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STANDARD PENETRATION TEST RESULTS

(BS EN ISO 22476-3: 2005)

Exploratory Hole No.	Test Depth (Reduced Level)	Water Depth (Casing)	Rod Length	SPT Hammer Ref.	Energy Ratio E_m	SEATING DRIVE						TEST DRIVE										Rod Length Corr. C_R	Energy Ratio Corr. C_E	Pen (mm)/Blow	SPTN' Value	SPTN' Value (Corr.) N_{60}	Shoe or Cone	Remarks
						Pen	Blows	Pen	Blows	Total Pen	Total Blows	Pen	Blows	Pen	Blows	Pen	Blows	Pen	Blows	Total Pen	Total Blows							
	m	m	m		%	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.						S/C	
BH104	14.00 (27.59)	12.43 (14.00)	14.00	ATH03	56	75	12	50	13	125	25	75	23	40	27					115	50	1.00	0.93	2.30	-	-	S	
BH104	14.80 (26.79)	14.12 (14.50)	14.80	ATH03	56	30	25			30	25	20	50							20	50	1.00	0.93	0.40	-	-	S	
BH105	1.50 (39.17)	Dry (1.50)	1.50	ATH01	59	75	2	75	3	150	5	75	2	75	1	75	2	75	2	300	7	0.66	0.98	42.86	7	5	S	
BH105	3.50 (37.17)	Dry (3.50)	3.50	ATH01	59	75	1	75	3	150	4	75	4	75	3	75	3	75	2	300	12	0.74	0.98	25.00	12	9	S	
BH105	4.50 (36.17)	Dry (4.50)	4.50	ATH01	59	75	2	75	2	150	4	75	3	75	2	75	3	75	4	300	12	0.78	0.98	25.00	12	9	S	
BH105	6.00 (34.67)	Dry (6.00)	6.00	ATH01	59	75	2	75	3	150	5	75	3	75	3	75	3	75	3	300	12	0.84	0.98	25.00	12	10	S	
BH105	7.50 (33.17)	Dry (7.50)	7.50	ATH01	59	75	3	75	4	150	7	75	3	75	3	75	4	75	5	300	15	0.90	0.98	20.00	15	13	S	
BH105	9.00 (31.67)	Dry (9.00)	9.00	ATH01	59	75	2	75	3	150	5	75	4	75	4	75	3	75	4	300	15	0.96	0.98	20.00	15	14	S	
BH105	10.50 (30.17)	Dry (10.50)	10.50	ATH01	59	75	4	75	5	150	9	75	4	75	6	75	8	75	11	300	29	1.00	0.98	10.34	29	28	S	
BH105	10.80 (29.87)	Dry (10.80)	10.80	ATH01	59	17	25			17	25	11	50							11	50	1.00	0.98	0.22	-	-	S	

NOTE: Please refer to calibration certificate for additional information and corresponding Exploratory Hole record for sampling details. Uncorrected and corrected SPTN' values are presented on the attached graphical plot relative to each Exploratory Hole.

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Northern Gateway	Far East Consortium International Limited	NW1580

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UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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STANDARD PENETRATION TEST RESULTS

(BS EN ISO 22476-3: 2005)

Exploratory Hole No.	Test Depth (Reduced Level)	Water Depth (Casing)	Rod Length	SPT Hammer Ref.	Energy Ratio E_m	SEATING DRIVE						TEST DRIVE										Rod Length Corr. C_R	Energy Ratio Corr. C_E	Pen (mm)/Blow	SPTN' Value	SPTN' Value (Corr.) N_{60}	Shoe or Cone	Remarks
						Pen	Blows	Pen	Blows	Total Pen	Total Blows	Pen	Blows	Pen	Blows	Pen	Blows	Pen	Blows	Total Pen	Total Blows							
	m	m	m		%	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.						S/C	
BH105	11.20 (29.47)	Dry (11.20)	11.20	ATH01	59	7	50			7	50	0	100							0	100	1.00	0.98	0.00	-	-	S	
BH106	1.50 (38.17)	Dry (1.50)	1.50	ATH04	59	75	1	75	1	150	2	75	2	75	2	75	2	75	3	300	9	0.66	0.98	33.33	9	6	C	
BH106	2.50 (38.17)	Dry (2.50)	2.50	ATH04	59	75	2	75	4	150	6	75	3	75	4	75	4	75	4	300	15	0.70	0.98	20.00	15	10	C	
BH106	3.50 (37.17)	Dry (3.50)	3.50	ATH04	59	75	2	75	1	150	3	75	1	75	2	75	2	75	3	300	8	0.74	0.98	37.50	8	6	C	
BH106	4.50 (36.17)	Dry (4.50)	4.50	ATH04	59	75	1	75	2	150	3	75	1	75	1	75	3	75	2	300	7	0.78	0.98	42.86	7	5	C	
BH106	5.50 (35.17)	Dry (5.50)	5.50	ATH04	59	75	1	75	2	150	3	75	2	75	3	75	3	75	3	300	11	0.82	0.98	27.27	11	9	C	
BH106	7.00 (33.67)	Dry (7.00)	7.00	ATH04	59	75	1	75	4	150	5	75	2	75	3	75	4	75	3	300	12	0.88	0.98	25.00	12	10	C	
BH106	10.00 (30.67)	Dry (10.00)	10.00	ATH04	59	75	2	75	3	150	5	75	3	75	4	75	4	75	4	300	15	1.00	0.98	20.00	15	15	S	
BH106	11.00 (29.67)	Dry (10.90)	11.00	ATH04	59	19	25			19	25	37	50							37	50	1.00	0.98	0.74	-	-	C	
BH106	11.30 (29.37)	Dry (10.90)	11.30	ATH04	59	18	25			18	25	16	50							16	50	1.00	0.98	0.32	-	-	C	

NOTE: Please refer to calibration certificate for additional information and corresponding Exploratory Hole record for sampling details. Uncorrected and corrected SPTN' values are presented on the attached graphical plot relative to each Exploratory Hole.

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Northern Gateway	Far East Consortium International Limited	NW1580

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UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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STANDARD PENETRATION TEST RESULTS

(BS EN ISO 22476-3: 2005)

Exploratory Hole No.	Test Depth (Reduced Level)	Water Depth (Casing)	Rod Length	SPT Hammer Ref.	Energy Ratio E_m	SEATING DRIVE						TEST DRIVE										Rod Length Corr. C_R	Energy Ratio Corr. C_E	Pen (mm)/Blow	SPT'N' Value	SPT'N' Value (Corr.) N_{60}	Shoe or Cone	Remarks
						Pen	Blows	Pen	Blows	Total Pen	Total Blows	Pen	Blows	Pen	Blows	Pen	Blows	Pen	Blows	Total Pen	Total Blows							
	m	m	m		%	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.						S/C	
BH107	1.50 (39.79)	Dry (1.50)	1.50	ATH04	59	75	2	75	1	150	3	75	1	75	2	75	2	75	2	300	7	0.66	0.98	42.86	7	5	C	
BH107	2.50 (38.79)	Dry (2.50)	2.50	ATH04	59	75	4	75	6	150	10	75	6	75	7	75	7	75	8	300	28	0.70	0.98	10.71	28	19	C	
BH107	3.50 (37.79)	Dry (3.50)	3.50	ATH04	59	75	5	75	7	150	12	75	7	75	9	75	10	75	11	300	37	0.74	0.98	8.11	37	27	C	
BH109	1.30 (30.18)	Dry (1.20)	1.30	ATH03	56	75	3	75	5	150	8	75	4	75	7	75	4	75	5	300	20	0.65	0.93	15.00	20	12	C	
BH109	2.30 (29.18)	Dry (2.30)	2.30	ATH03	56	75	1	75	3	150	4	75	3	75	7	75	11	75	8	300	29	0.69	0.93	10.34	29	19	C	
BH109	3.10 (28.38)	Dry (3.10)	3.10	ATH03	56	75	17	20	8	95	25	75	38	20	12					95	50	0.72	0.93	1.90	-	-	S	
BH109	3.50 (27.98)	Dry (3.10)	3.50	ATH03	56	50	25			50	25	20	50							20	50	0.74	0.93	0.40	-	-	S	
BH110	1.20 (30.06)	Dry (1.20)	1.20	ATH03	56	75	4	75	10	150	14	75	13	75	24	40	13			190	50	0.65	0.93	3.80	-	-	S	
BH110	2.10 (29.16)	Dry (2.00)	2.10	ATH03	56	75	3	75	11	150	14	75	10	75	8	75	7	75	7	300	32	0.68	0.93	9.38	22	14	S	
BH110	3.10 (28.16)	Dry (2.95)	3.10	ATH03	56	75	2	75	3	150	5	75	3	75	5	75	3	75	4	300	15	0.72	0.93	20.00	15	10	S	

NOTE: Please refer to calibration certificate for additional information and corresponding Exploratory Hole record for sampling details. Uncorrected and corrected SPT'N' values are presented on the attached graphical plot relative to each Exploratory Hole.

Contract Title :-	Client :-	AEG Contract No :-
Northern Gateway	Far East Consortium International Limited	NW1580

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UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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STANDARD PENETRATION TEST RESULTS

(BS EN ISO 22476-3: 2005)

Exploratory Hole No.	Test Depth (Reduced Level)	Water Depth (Casing)	Rod Length	SPT Hammer Ref.	Energy Ratio E_m	SEATING DRIVE						TEST DRIVE										Rod Length Corr. C_R	Energy Ratio Corr. C_E	Pen (mm)/Blow	SPT'N' Value	SPT'N' Value (Corr.) N_{60}	Shoe or Cone	Remarks
						Pen	Blows	Pen	Blows	Total Pen	Total Blows	Pen	Blows	Pen	Blows	Pen	Blows	Pen	Blows	Total Pen	Total Blows							
	m	m	m		%	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.						S/C	
BH110	4.10 (27.16)	Damp (4.10)	4.10	ATH03	56	75	12	75	7	150	19	75	4	75	3	75	3	75	3	300	13	0.76	0.93	23.08	13	9	S	
BH110	5.30 (25.96)	Damp (5.30)	5.30	ATH03	56	75	3	75	2	150	5	75	3	75	3	75	3	75	3	300	12	0.81	0.93	25.00	12	9	S	
BH110	6.60 (24.66)	4.53 (6.50)	6.60	ATH03	56	75	18	20	7	95	25	40	50							40	50	0.86	0.93	0.80	-	-	S	
BH110	7.00 (24.26)	4.73 (6.70)	7.00	ATH03	56	20	25			20	25	30	50							30	50	0.88	0.93	0.60	-	-	S	
BH112	1.50 (30.75)	Dry (1.50)	1.50	ATH03	56	75	2	75	3	150	5	75	2	75	2	75	3	75	4	300	11	0.66	0.93	27.27	11	7	S	
BH112	2.50 (29.75)	Dry (2.50)	2.50	ATH03	56	75	3	75	4	150	7	75	4	75	4	75	5	75	5	300	18	0.70	0.93	16.67	18	12	C	
BH112	3.50 (28.75)	Dry (3.50)	3.50	ATH03	56	75	4	75	5	150	9	75	5	75	4	75	5	75	7	300	21	0.74	0.93	14.29	21	14	C	
BH112	4.00 (28.25)	Dry (4.00)	4.00	ATH03	56	75	18	75	25	150	43	6	25	0	25					6	50	0.76	0.93	0.12	-	-	S	
BH112	4.30 (27.95)	Dry (4.30)	4.30	ATH03	56	19	50			19	50	3	100							3	100	0.77	0.93	0.03	-	-	S	
WS101	1.20 (30.99)	Dry	1.20	DP04	81	75	1	75	1	150	2	75	2	75	2	75	5	75	2	300	11	0.65	1.35	27.27	11	10	S	

NOTE: Please refer to calibration certificate for additional information and corresponding Exploratory Hole record for sampling details. Uncorrected and corrected SPT'N' values are presented on the attached graphical plot relative to each Exploratory Hole.

Contract Title :-	Client :-	AEG Contract No :-
Northern Gateway	Far East Consortium International Limited	NW1580

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UKAS TESTING 1367

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STANDARD PENETRATION TEST RESULTS

(BS EN ISO 22476-3: 2005)

Exploratory Hole No.	Test Depth (Reduced Level)	Water Depth (Casing)	Rod Length	SPT Hammer Ref.	Energy Ratio E_{re}	SEATING DRIVE						TEST DRIVE										Rod Length Corr. C_R	Energy Ratio Corr. C_E	Pen (mm)/Blow	SPT'N' Value	SPT'N' Value (Corr.) N_{60}	Shoe or Cone	Remarks
						Pen	Blows	Pen	Blows	Total Pen	Total Blows	Pen	Blows	Pen	Blows	Pen	Blows	Pen	Blows	Total Pen	Total Blows							
	m	m	m		%	mm	No.	mm	No	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.						S/C	
WS101	2.20 (29.99)	Dry	2.20	DP04	81	75	1	75	0	150	1	75	1	75	6	75	2	75	2	300	11	0.69	1.35	27.27	11	10	S	
WS101	3.20 (28.99)	Dry	3.20	DP04	81	75	1	75	1	150	2	75	1	75	1	75	1	75	2	300	5	0.73	1.35	60.00	5	5	S	
WS101	4.20 (27.99)	3.00	4.20	DP04	81	75	1	75	2	150	3	75	2	75	2	75	3	75	3	300	10	0.77	1.35	30.00	10	10	S	
WS101	5.00 (27.19)	4.00	5.00	DP04	81	75	1	75	1	150	2	75	2	75	3	75	3	75	3	300	11	0.80	1.35	27.27	11	12	S	
WS102	1.20 (31.00)	Dry	1.20	DP04	81	75	1	75	1	150	2	75	3	75	3	75	4	75	2	300	12	0.65	1.35	25.00	12	11	S	
WS102	2.20 (30.00)	Dry	2.20	DP04	81	75	2	75	6	150	8	75	6	75	5	75	3	75	3	300	17	0.69	1.35	17.65	17	15	S	
WS102	3.20 (29.00)	Dry	3.20	DP04	81	75	1	75	1	150	2	75	1	75	1	75	2	75	2	300	6	0.73	1.35	50.00	6	6	S	
WS102	4.20 (28.00)	Dry	4.20	DP04	81	75	1	75	0	150	1	75	1	75	1	75	1	75	2	300	5	0.77	1.35	60.00	5	5	S	
WS102	5.00 (27.20)	Damp	5.00	DP04	81	75	1	75	1	150	2	75	1	75	2	75	2	75	2	300	7	0.80	1.35	42.86	7	8	S	
WS103	1.20 (31.37)	Dry	1.20	DP04	81	75	2	75	1	150	3	75	1	75	1	75	2	75	2	300	6	0.65	1.35	50.00	6	5	S	

NOTE: Please refer to calibration certificate for additional information and corresponding Exploratory Hole record for sampling details. Uncorrected and corrected SPT'N' values are presented on the attached graphical plot relative to each Exploratory Hole.

Contract Title :-	Client :-	AEG Contract No :-
Northern Gateway	Far East Consortium International Limited	NW1580

Date of Issue :-	Page No. :-	Checked By :-	Approved By :-	Certificate No. :-
12/03/2019	8 of 10	LC	NW	SPT/NW1580/8

UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS

(BS EN ISO 22476-3: 2005)

Exploratory Hole No.	Test Depth (Reduced Level)	Water Depth (Casing)	Rod Length	SPT Hammer Ref.	Energy Ratio E_m	SEATING DRIVE						TEST DRIVE										Rod Length Corr. C_R	Energy Ratio Corr. C_E	Pen (mm)/Blow	SPTN Value	SPTN' Value (Corr.) N_{60}	Shoe or Cone	Remarks
						Pen	Blows	Pen	Blows	Total Pen	Total Blows	Pen	Blows	Pen	Blows	Pen	Blows	Pen	Blows	Total Pen	Total Blows							
	m	m	m		%	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No						S/C	
WS103	2.20 (30.37)	Dry	2.20	DP04	81	75	2	75	1	150	3	75	2	75	3	75	3	75	3	300	11	0.69	1.35	27.27	11	10	S	
WS103	3.20 (29.37)	Dry	3.20	DP04	81	75	1	75	1	150	2	75	1	75	1	75	2	75	2	300	6	0.73	1.35	50.00	6	6	S	
WS103	3.90 (28.67)	Dry	3.90	DP04	81	60	50			60	50	72	100							72	100	0.76	1.35	0.72	-	-	S	
WS104	1.20 (30.29)	Dry	1.20	DP04	81	75	1	75	2	150	3	75	2	75	3	75	2	75	2	300	9	0.65	1.35	33.33	9	8	S	
WS104	2.20 (29.29)	2.00	2.20	DP04	81	75	1	75	1	150	2	75	2	75	2	75	3	75	2	300	9	0.69	1.35	33.33	9	8	S	
WS104	3.20 (28.29)	2.60	3.20	DP04	81	75	1	75	1	150	2	75	1	75	2	75	2	75	3	300	8	0.73	1.35	37.50	8	8	S	
WS104	4.20 (27.29)	3.39	4.20	DP04	81	75	1	75	1	150	2	75	2	75	3	75	3	75	3	300	11	0.77	1.35	27.27	11	11	S	
WS105	1.20 (28.25)	Dry	1.20	DP04	81	75	1	75	1	150	2	75	20	19	50					94	70	0.65	1.35	1.34	-	-	S	
WS105A	1.20 (28.25)	Dry	1.20	DP04	81	75	1	75	1	150	2	75	2	75	2	75	1	75	1	300	6	0.65	1.35	50.00	6	5	S	
WS105A	2.20 (27.25)	Dry	2.20	DP04	81	75	3	75	3	150	6	75	1	75	2	75	2	75	2	300	7	0.69	1.35	42.86	7	7	S	

NOTE: Please refer to calibration certificate for additional information and corresponding Exploratory Hole record for sampling details. Uncorrected and corrected SPTN' values are presented on the attached graphical plot relative to each Exploratory Hole.

Contract Title :- Northern Gateway		Client :- Far East Consortium International Limited	AEG Contract No :- NW1580
Date of Issue :- 12/03/2019	Page No. :- 9 of 10	Checked By :- LC	Approved By :- NW
			Certificate No. :- SPT/NW1580/9

UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn. BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS

(BS EN ISO 22476-3: 2005)

Exploratory Hole No.	Test Depth (Reduced Level)	Water Depth (Casing)	Rod Length	SPT Hammer Ref.	Energy Ratio E_m	SEATING DRIVE						TEST DRIVE										Rod Length Corr. C_R	Energy Ratio Corr. C_E	Pen (mm)/Blow	SPTN' Value	SPTN' Value (Corr.) N_{60}	Shoe or Cone	Remarks
						Pen	Blows	Pen	Blows	Total Pen	Total Blows	Pen	Blows	Pen	Blows	Pen	Blows	Pen	Blows	Total Pen	Total Blows							
	m	m	m		%	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.	mm	No.						S/C	
WS105A	3.20 (26.25)	Dry	3.20	DP04	81	75	1	75	1	150	2	75	0	75	1	75	1	75	1	300	3	0.73	1.35	100.00	3	3	S	
WS105A	4.20 (25.25)	3.90	4.20	DP04	81	75	1	75	1	150	2	75	2	75	2	75	2	75	3	300	9	0.77	1.35	33.33	9	9	S	
WS105A	5.00 (24.45)	4.50	5.00	DP04	81	75	2	75	2	150	4	75	3	75	3	75	3	75	4	300	13	0.80	1.35	23.08	13	14	S	
WS106	1.20 (30.32)	Dry	1.20	DP04	81	75	2	75	2	150	4	75	3	75	3	75	1	75	2	300	9	0.65	1.35	33.33	9	8	S	
WS106	2.20 (29.32)	1.93	2.20	DP04	81	75	1	75	2	150	3	75	6	75	6	75	3	75	3	300	18	0.69	1.35	16.67	18	17	S	
WS106	3.20 (28.32)	2.86	3.20	DP04	81	75	1	75	1	150	2	75	2	75	3	75	3	75	3	300	11	0.73	1.35	27.27	11	11	S	

NOTE: Please refer to calibration certificate for additional information and corresponding Exploratory Hole record for sampling details. Uncorrected and corrected SPTN' values are presented on the attached graphical plot relative to each Exploratory Hole.

Contract Title :-	Client :-	AEG Contract No :-
Northern Gateway	Far East Consortium International Limited	NW1580

Date of Issue :-	Page No. :-	Checked By :-	Approved By :-	Certificate No. :-
12/03/2019	10 of 10	LC	NW	SPT/NW1580/10

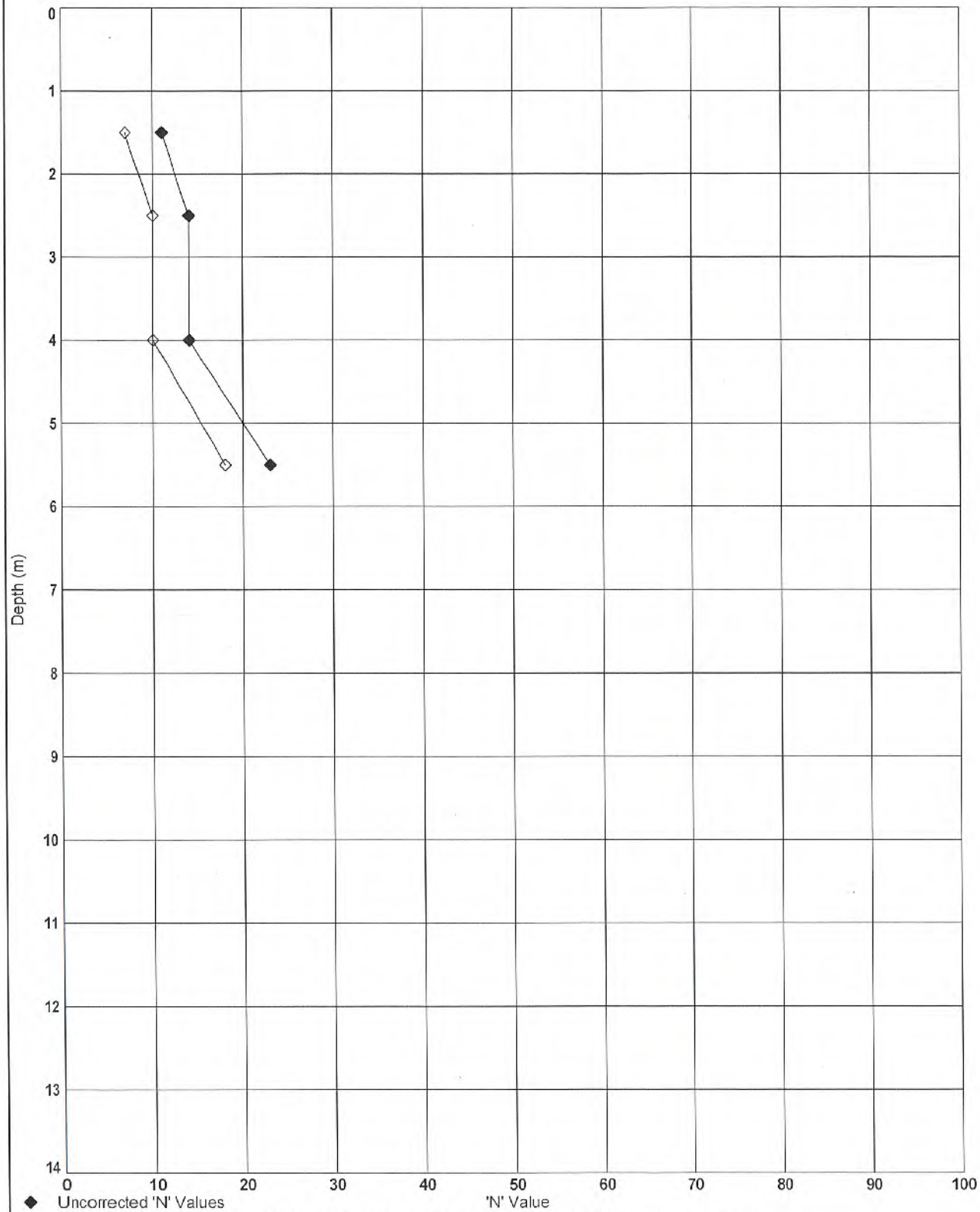
UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No
BH101



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/BH101	Operator :- M. Snaith	UKAS TESTING 1367
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	

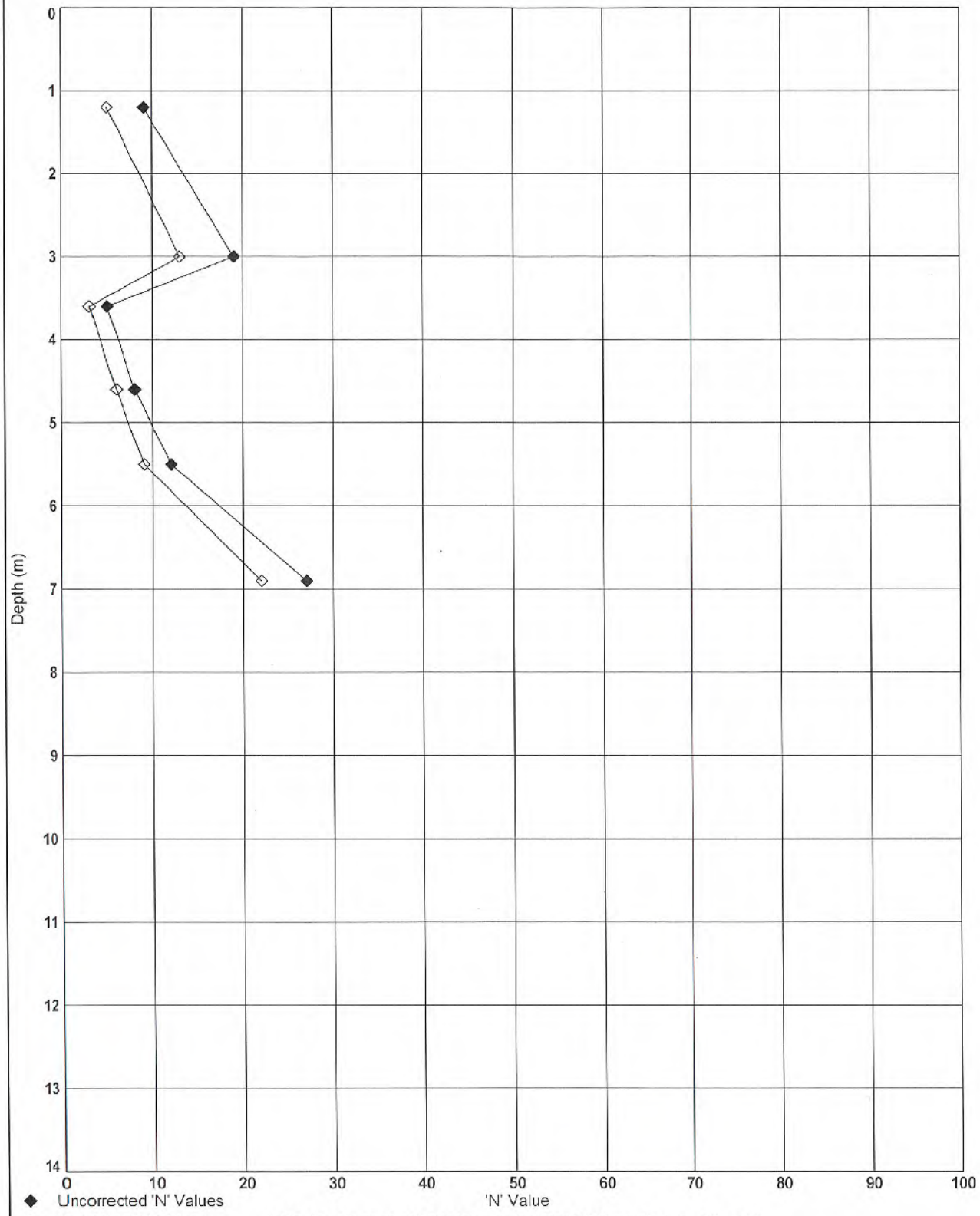
ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No

BH102



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

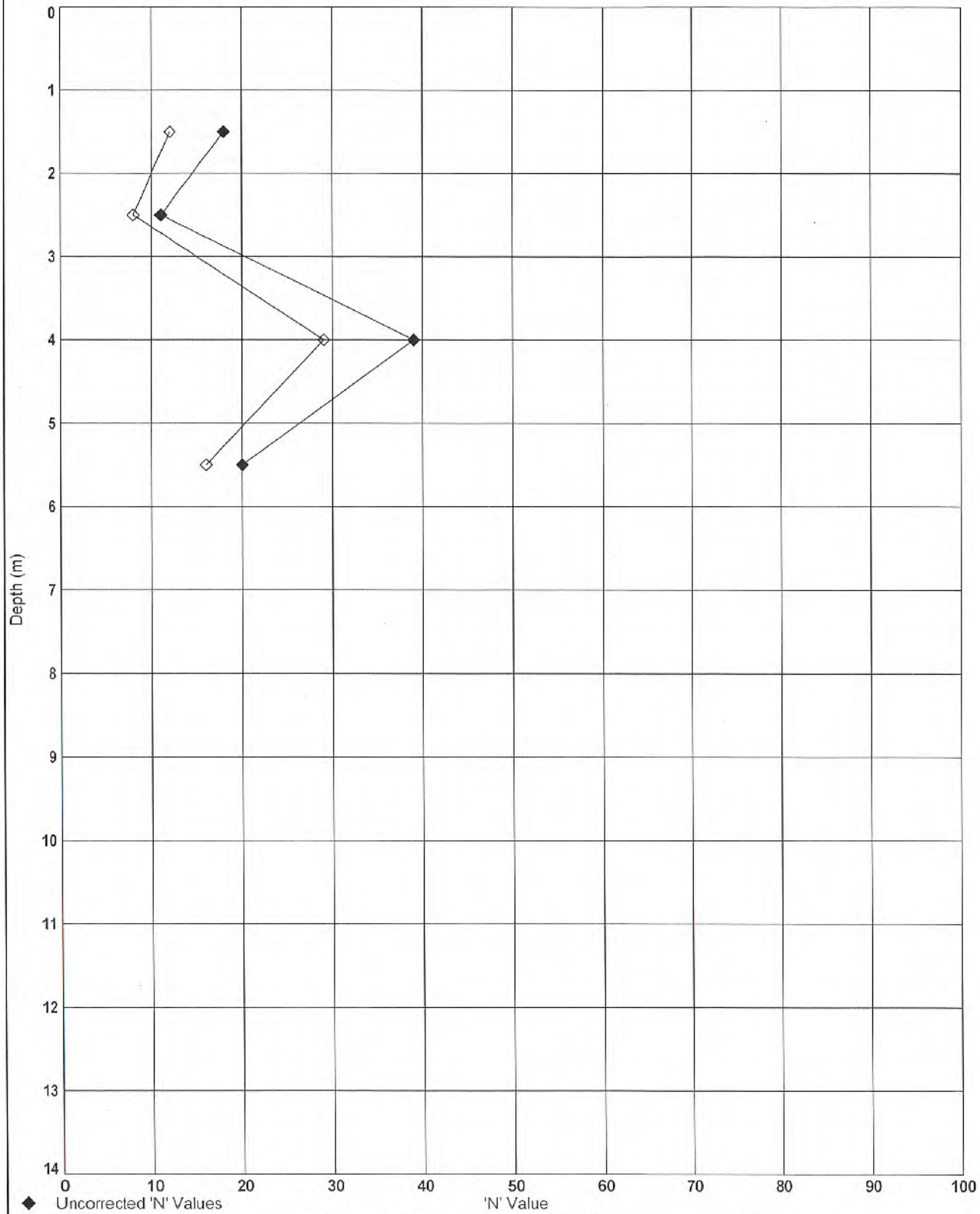
Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/BH102	Operator :- P. Butterfield	UKAS TESTING 1367
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No
BH103



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Date of issue :-	Certificate No :-	Operator :-
12/03/2019	SPT/NW1580/Graph/BH103	M. Snaith
Checked By :- LC	**Approved By :-** NW	**AEG Contract No. :-** NW1580

UKAS TESTING 1367

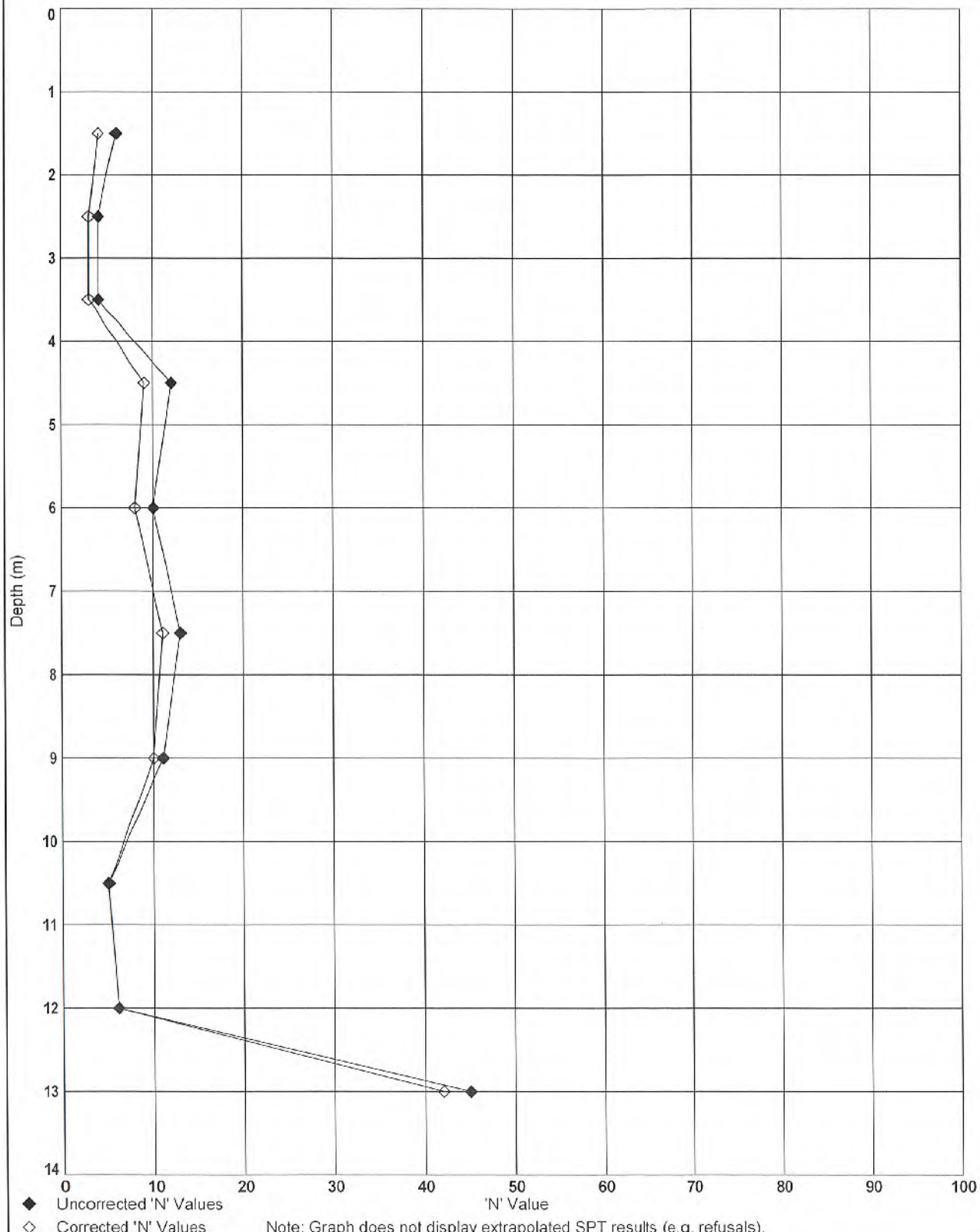
ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No

BH104



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/BH104	Operator :- P. Butterfield	UKAS TESTING 1367
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	

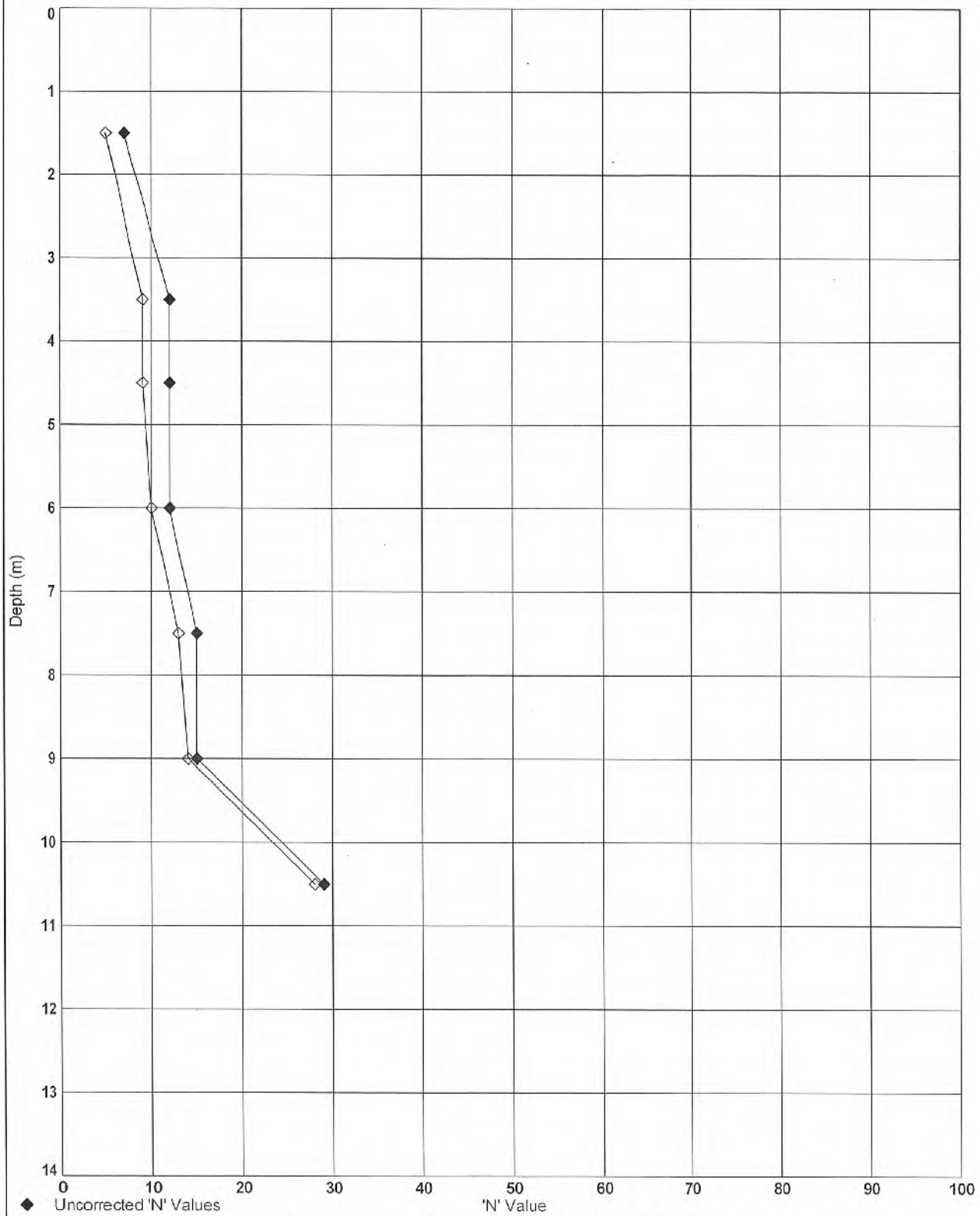
ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 899

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No

BH105



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/BH105	Operator :- P. Butterfield	
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	UKAS TESTING 1367

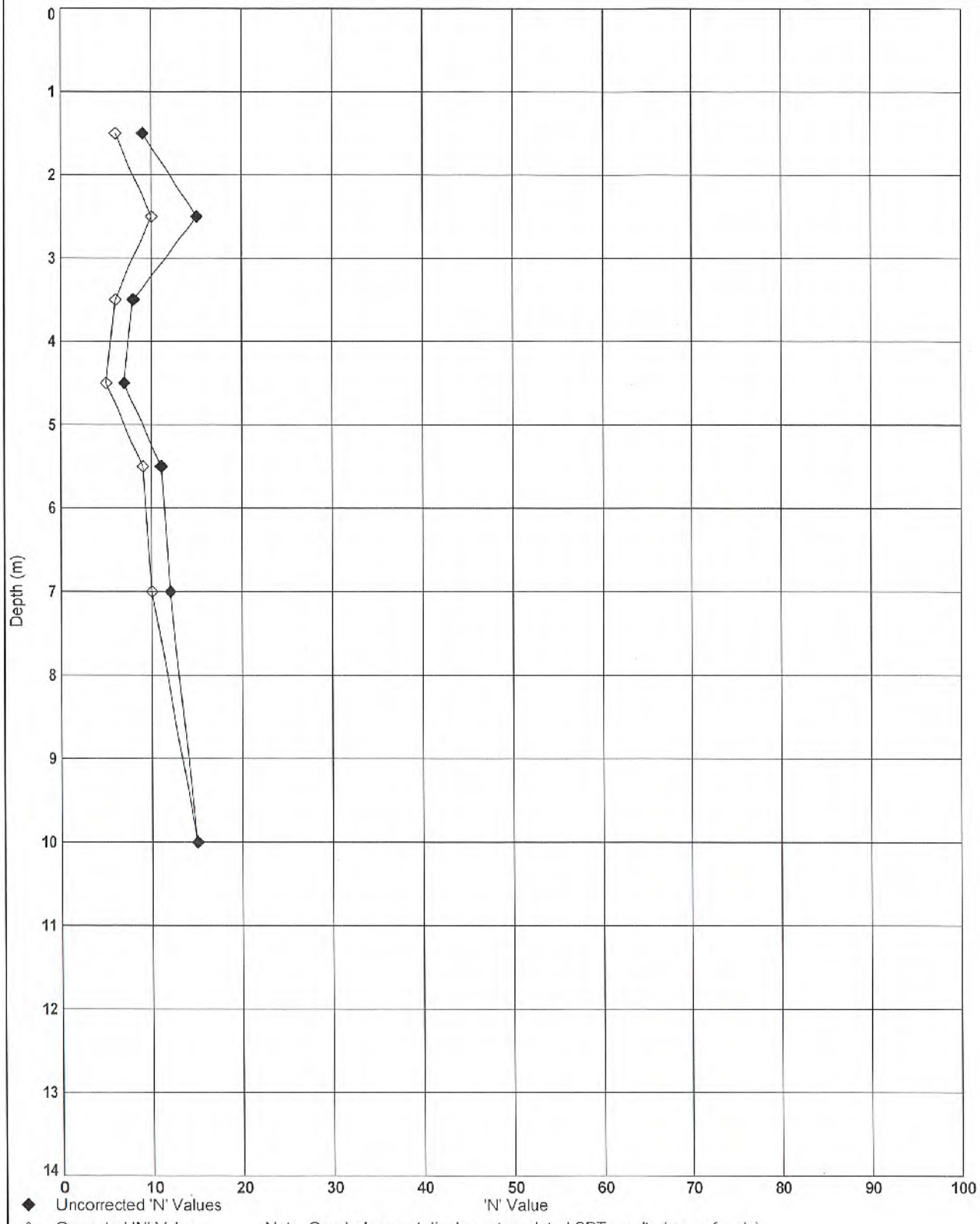
ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 9BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No

BH106



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/BH106	Operator :- L. Hayes	
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	UKAS TESTING 1367

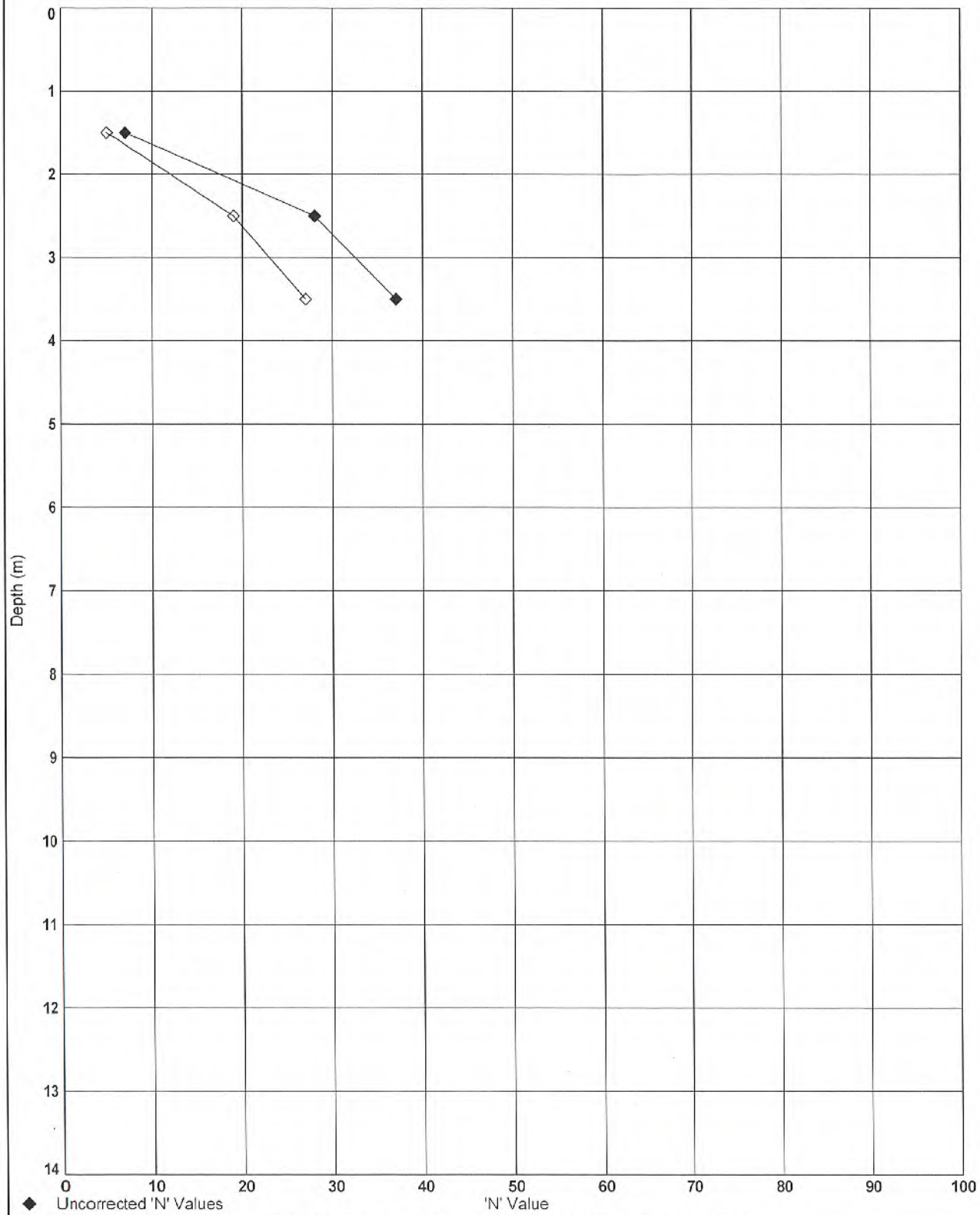
ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No

BH107



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Date of issue :-	Certificate No :-	Operator :-
12/03/2019	SPT/NW1580/Graph/BH107	P. Butterfield
Checked By :- LC	**Approved By :-** NW	**AEG Contract No. :-** NW1580

UKAS TESTING 1367

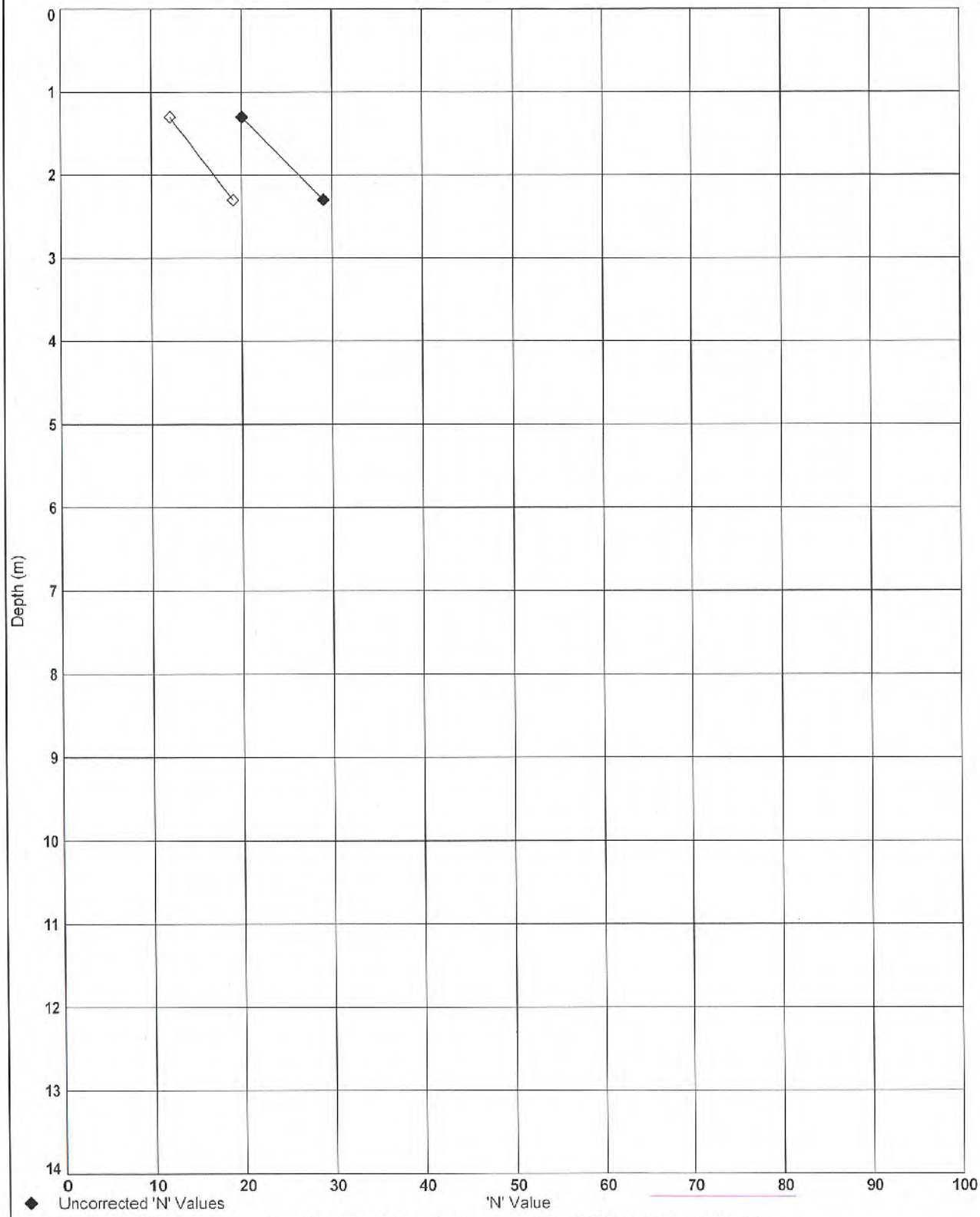
ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No

BH109



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/BH109	Operator :- P. Butterfield	UKAS TESTING 1367
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	

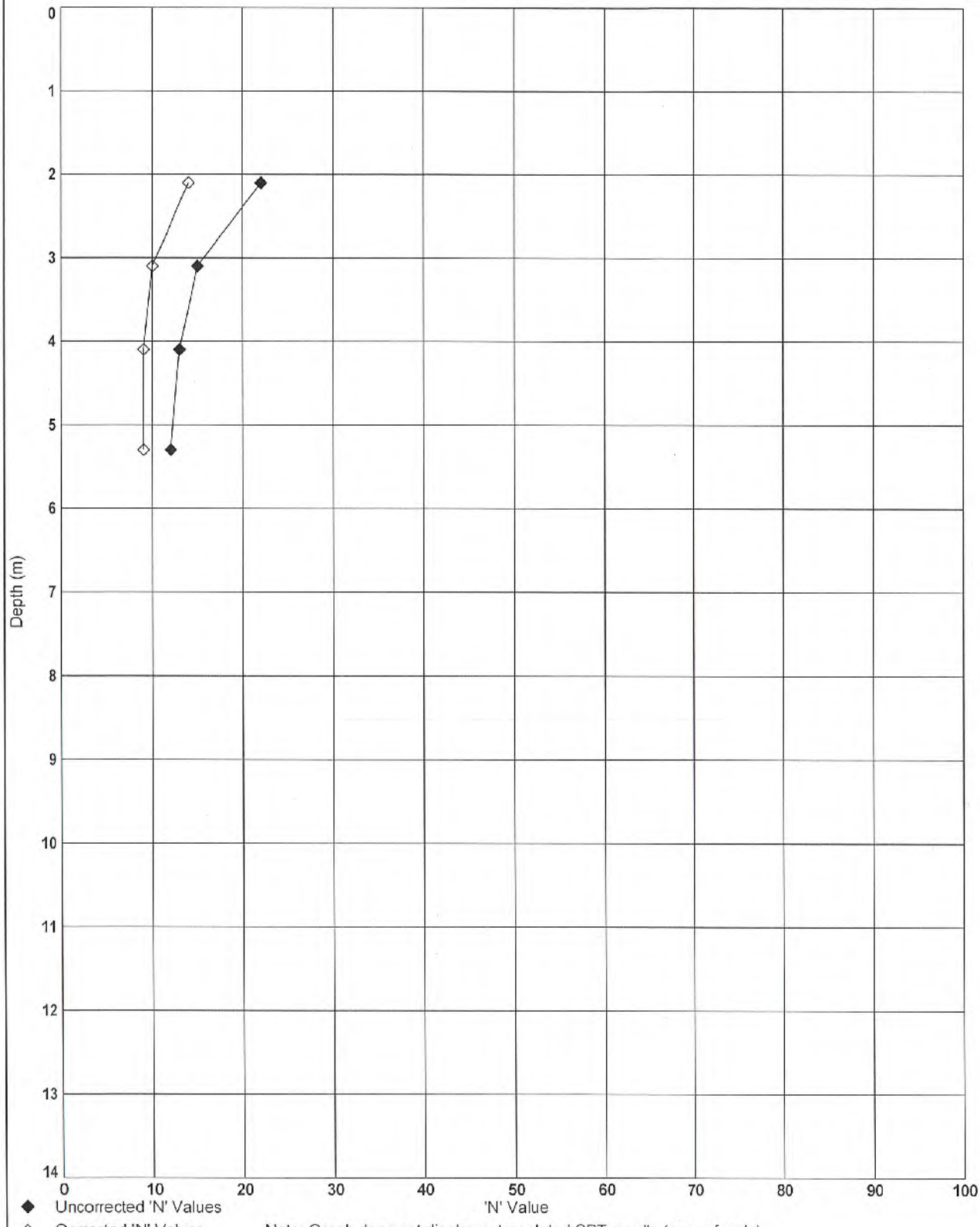
ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham. DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No

BH110



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

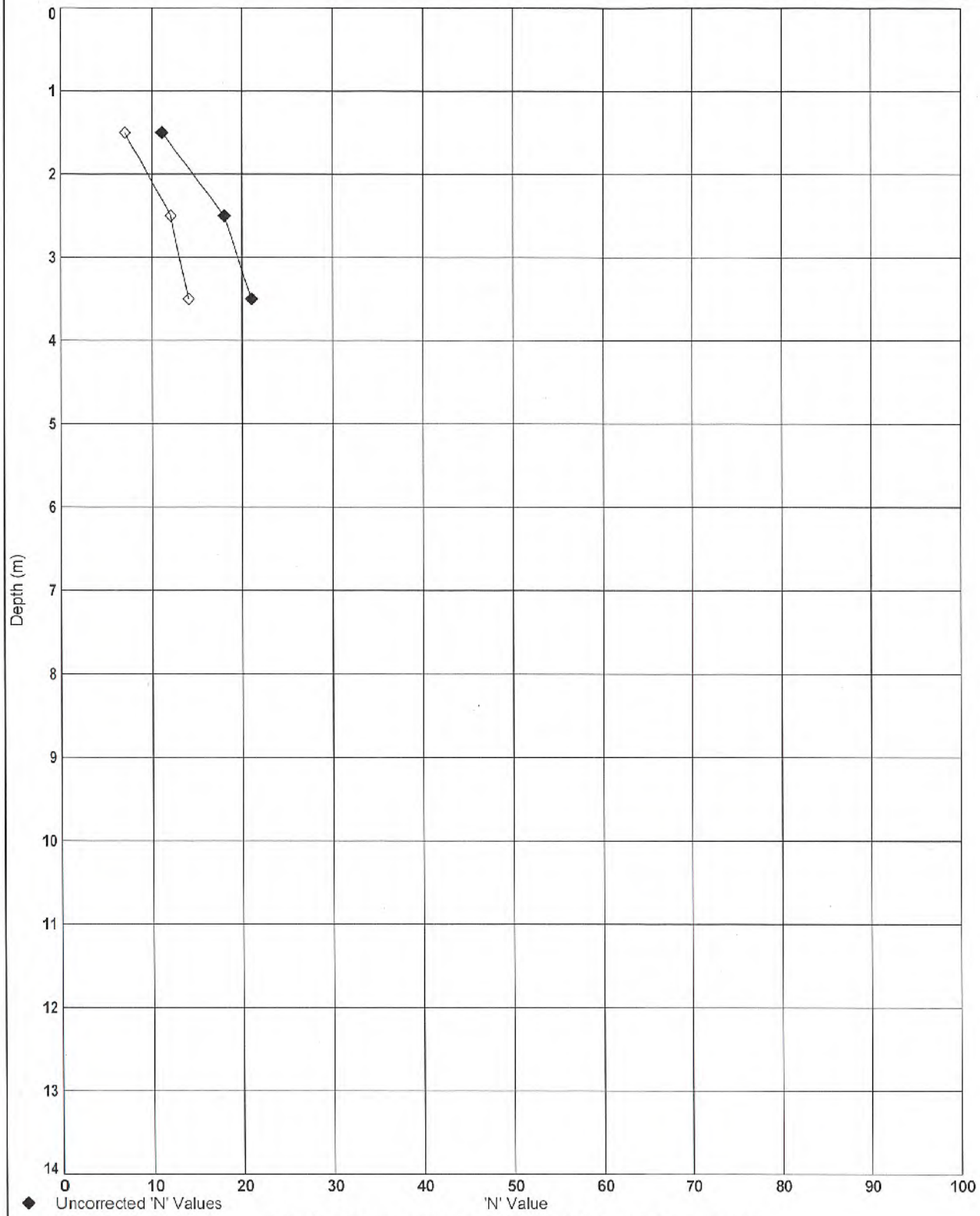
Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/BH110	Operator :- P. Butterfield	
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No
BH112



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/BH112	Operator :- P. Butterfield	UKAS TESTING 1367
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	

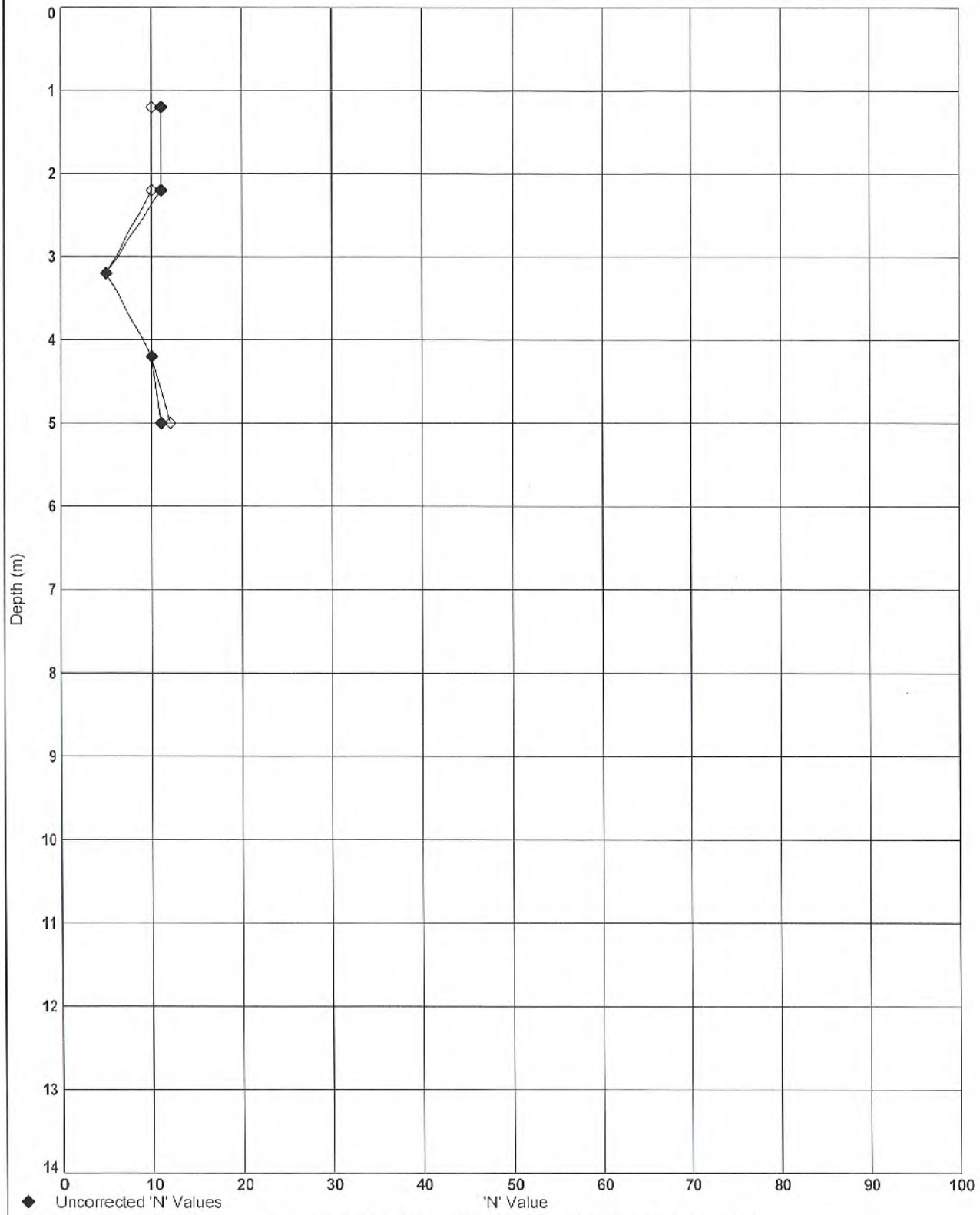
ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
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STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No

WS101



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/WS101	Operator :- R. Kennedy	
Checked By :- LC	Approved By :-	AEG Contract No. :- NW1580	UKAS TESTING 1367

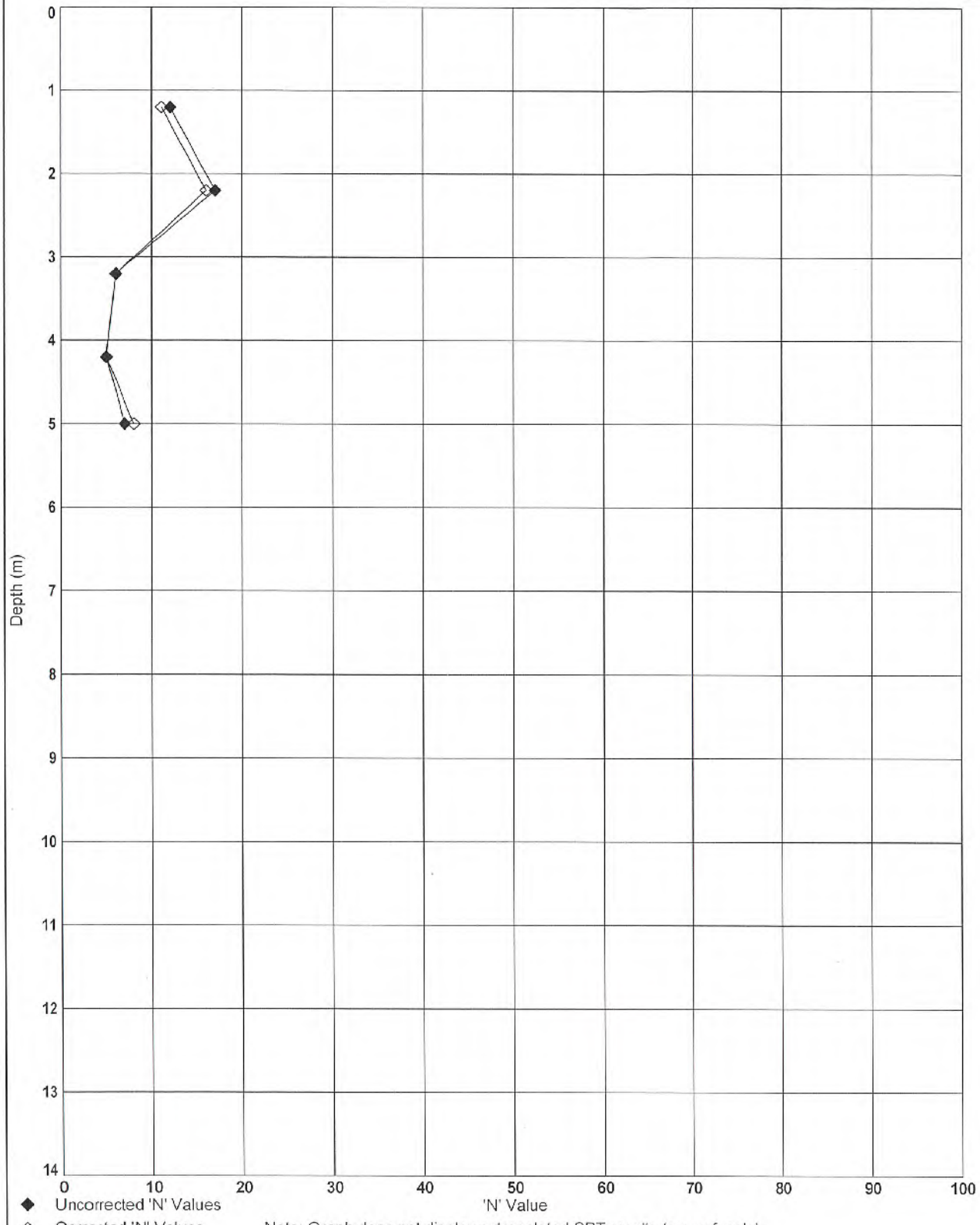
ALLIED EXPLORATION & GEOTECHNICS LIMITED

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Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No

WS102



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

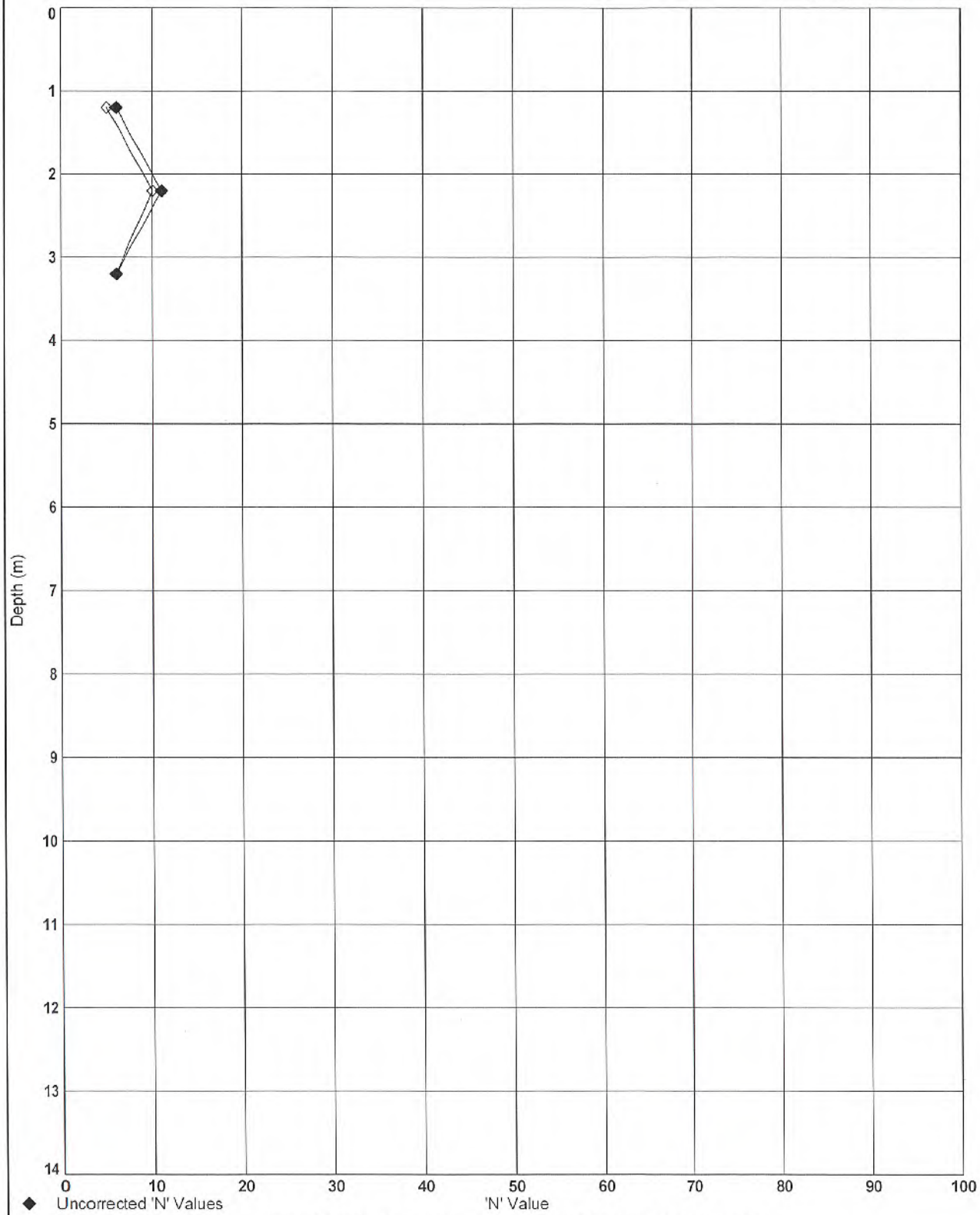
Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/WS102	Operator :- R. Kennedy	UKAS TESTING 1367
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No
WS103



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

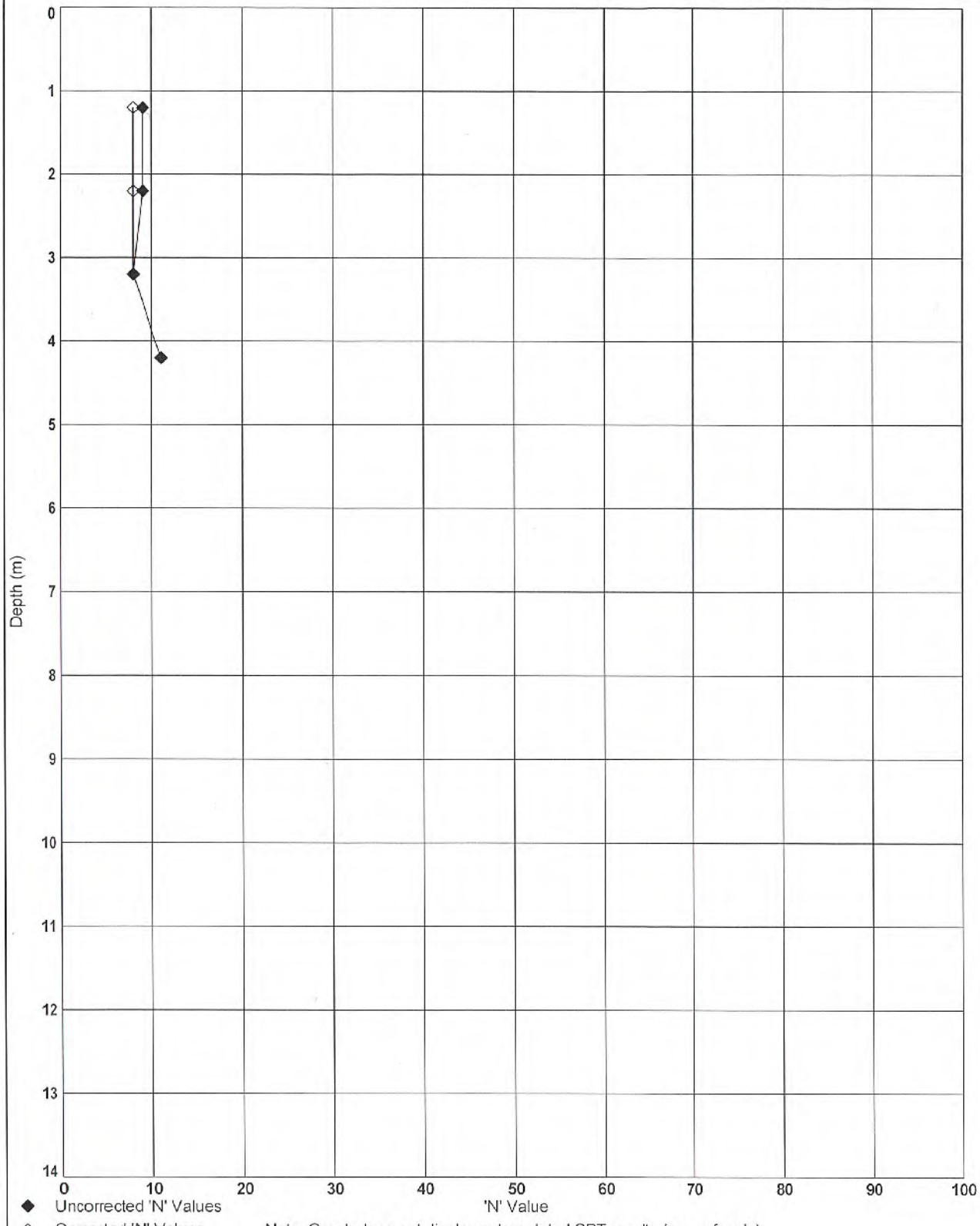
Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/WS103	Operator :- R. Kennedy	
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No
WS104



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

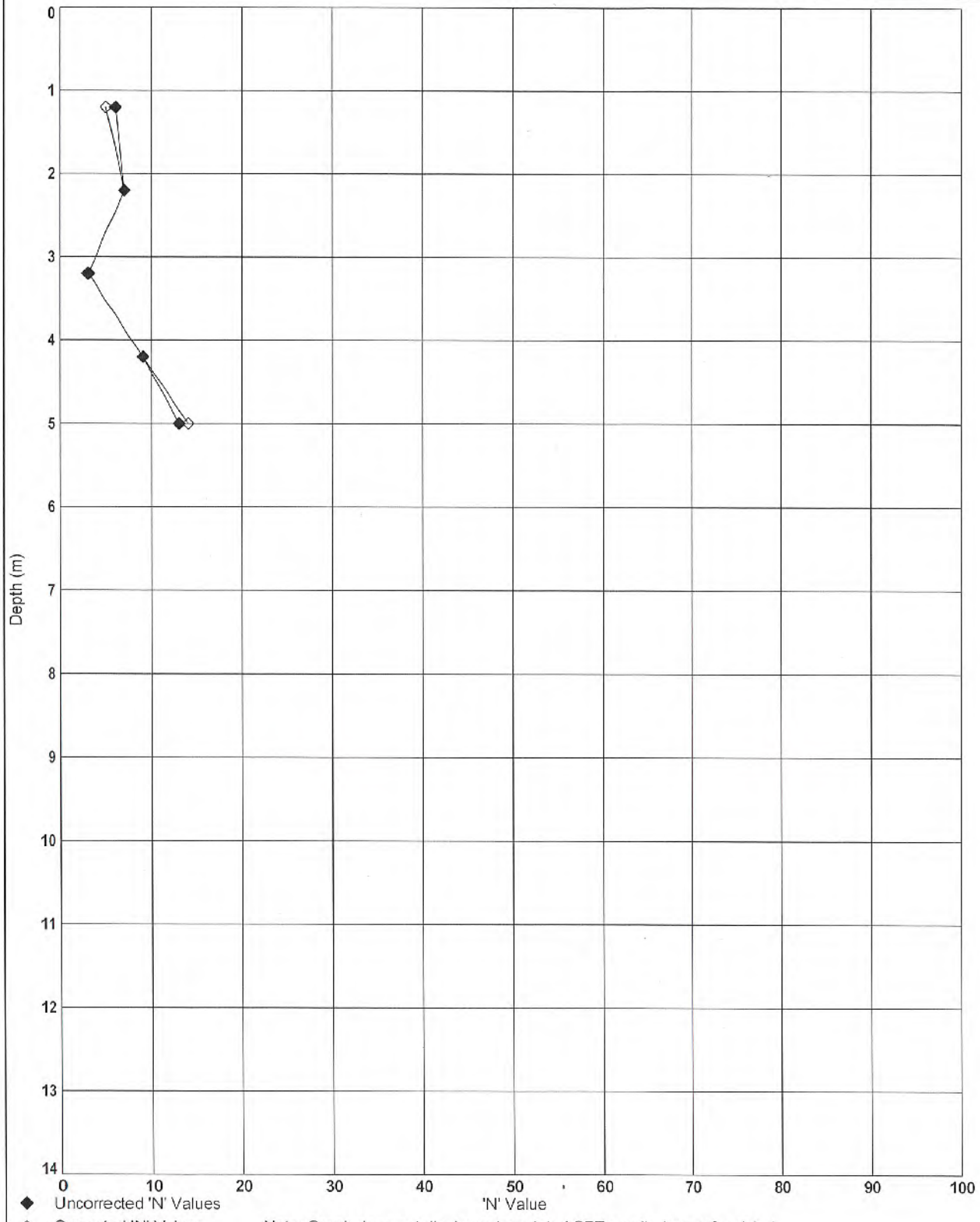
Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/WS104	Operator :- R. Kennedy	
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No
WS105A



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/WS105A	Operator :- R. Kennedy	
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	UKAS TESTING 1367

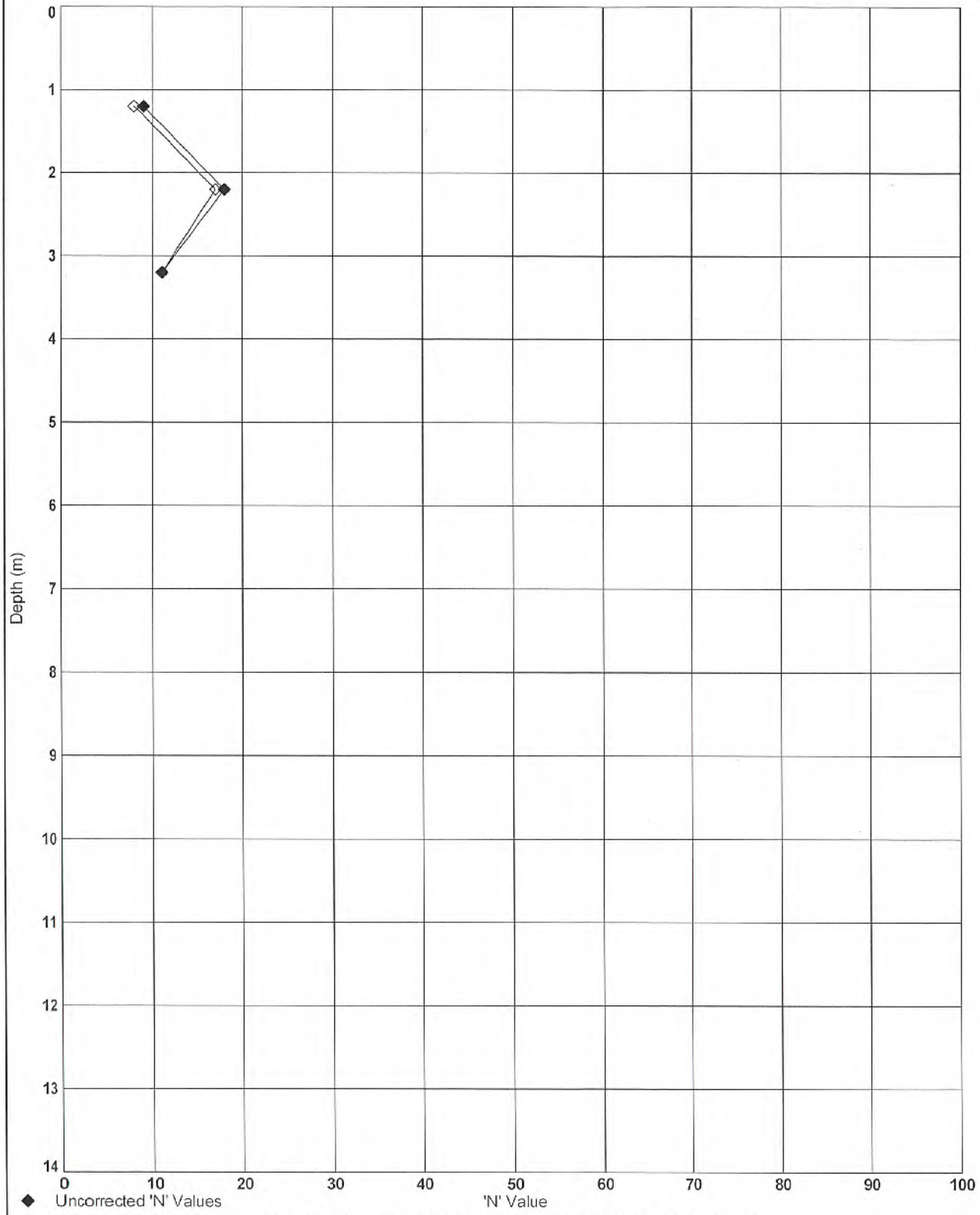
ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL Tel: 01772 735 300 Fax: 01772 735 999

STANDARD PENETRATION TEST RESULTS
(BS EN ISO 22476-3: 2005)

Exploratory Hole No

WS106



Note: Graph does not display extrapolated SPT results (e.g. refusals).

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Date of issue :- 12/03/2019	Certificate No :- SPT/NW1580/Graph/WS106	Operator :- R. Kennedy	UKAS TESTING 1367
Checked By :- LC	Approved By :- NW	AEG Contract No. :- NW1580	

Allied Exploration & Geotechnics Ltd.

Unit 25 Stella Gill Industrial Esatate
Pelton Fell
Chester-le-Street
DH2 2RG

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

SPT Hammer Ref:	ATH01
Test Date:	03/08/2018
Report Date:	03/08/2018
File Name:	ATH01.spt
Test Operator:	BP

QUALITY CONTROL CHECKED
03 AUG 2018
Signed

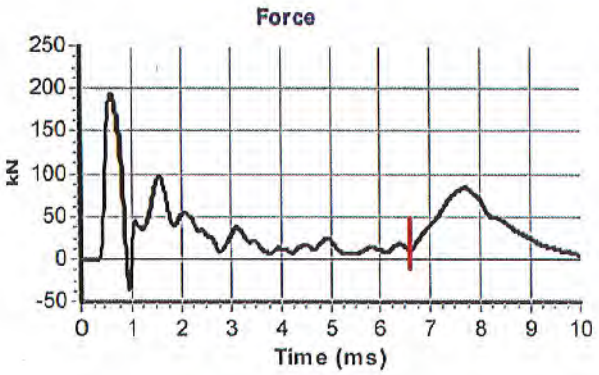
Instrumented Rod Data

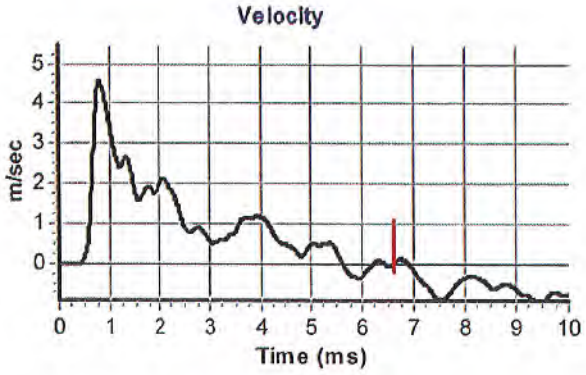
Diameter d_r (mm):	67
Wall Thickness t_r (mm):	8.5
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	6469
Accelerometer No.2:	11406

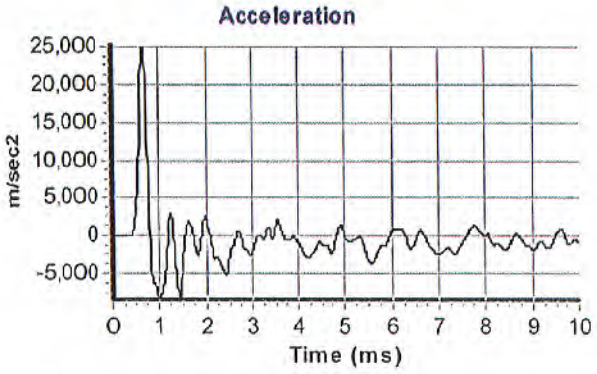
SPT Hammer Information

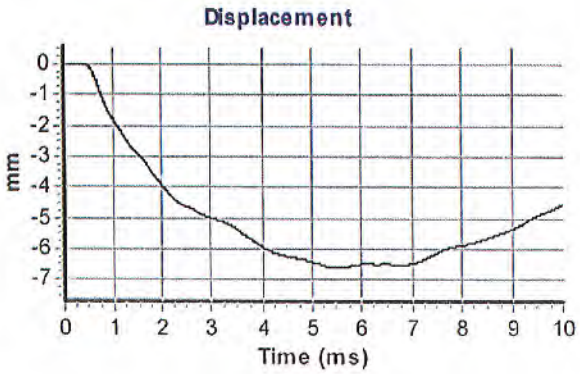
Hammer Mass m (kg):	63.8
Falling Height h (mm):	761
SPT String Length L (m):	14.1

Comments / Location









Calculations

Area of Rod A (mm2):	1562
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	278

Energy Ratio E_r (%): 59

B Proctor

Signed: Brian Proctor
Title: Technician

The recommended calibration interval is 12 months

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Unit 25 Stella Gill Industrial Esatate
Pelton Fell
Chester-le-Street
DH2 2RG

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

SPT Hammer Ref:	ATH03
Test Date:	02/07/2018
Report Date:	02/07/2018
File Name:	ATH03.spt
Test Operator:	BP

QUALITY CONTROL CHECKED
02 JUL 2018
Signed

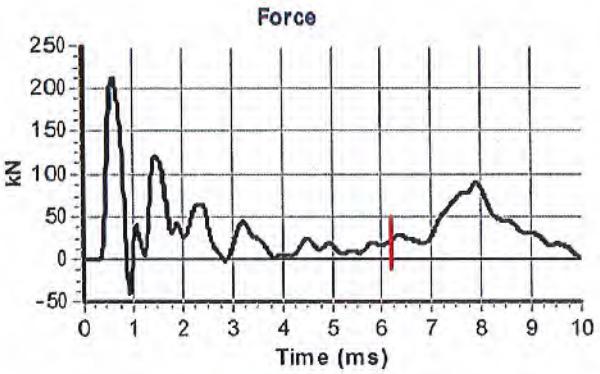
Instrumented Rod Data

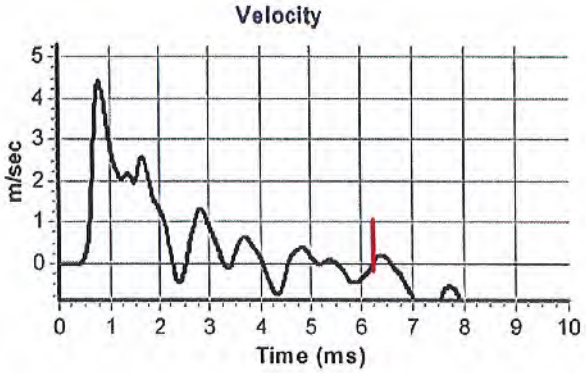
Diameter d_r (mm):	67
Wall Thickness t_r (mm):	8.5
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	6469
Accelerometer No.2:	11406

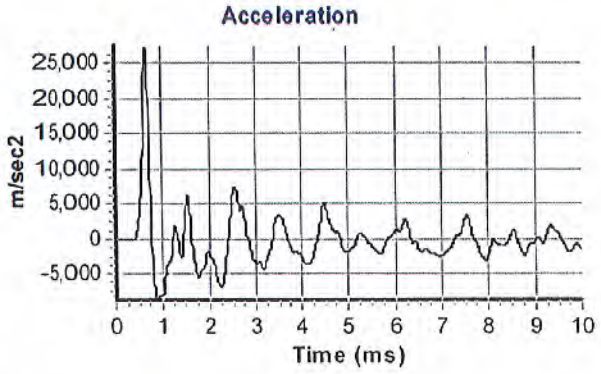
SPT Hammer Information

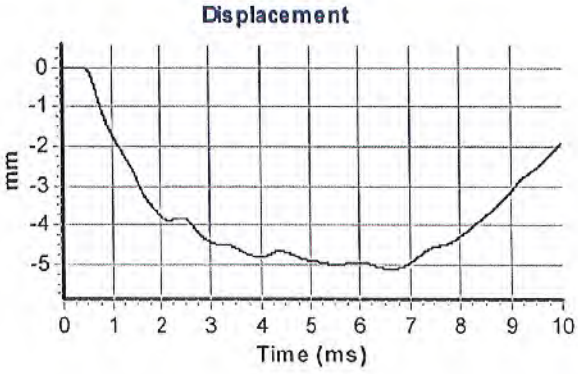
Hammer Mass m (kg):	63.24
Falling Height h (mm):	751
SPT String Length L (m):	14.1

Comments / Location









Calculations

Area of Rod A (mm2):	1562
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	263

Energy Ratio E_r (%): 56

Signed: Brian Proctor
Title: Technician

The recommended calibration interval is 12 months

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Unit 25 Stella Gill Industrial Esatate
Pelton Fell
Chester-le-Street
DH2 2RG

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

SPT Hammer Ref:	ATH04
Test Date:	17/09/2018
Report Date:	17/09/2018
File Name:	ATH04.spt
Test Operator:	BP

QUALITY CONTROL CHECKED
18 SEP 2018
Signed

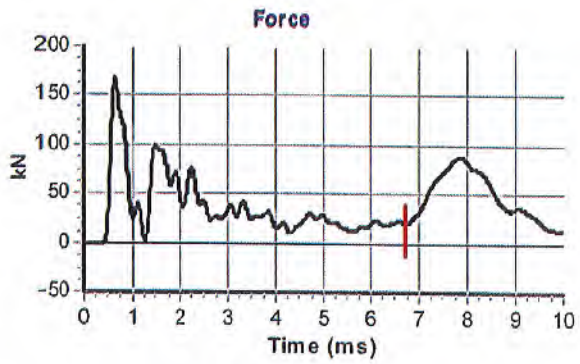
Instrumented Rod Data

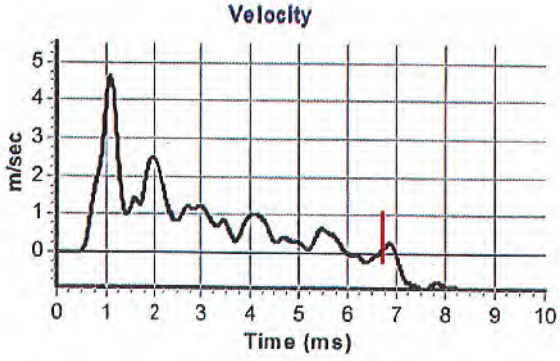
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.5
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	5991
Accelerometer No.2:	5990

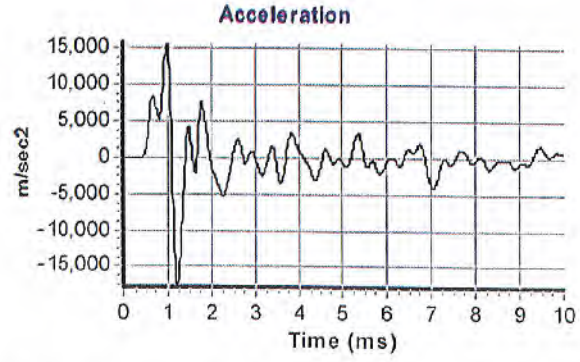
SPT Hammer Information

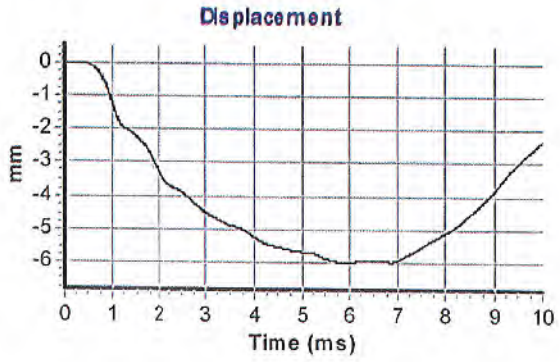
Hammer Mass m (kg):	63.70
Falling Height h (mm):	758
SPT String Length L (m):	14.1

Comments / Location









Calculations

Area of Rod A (mm2):	970
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	279

Energy Ratio E_r (%): 59

The recommended calibration interval is 12 months

B Proctor

Signed: Brian Proctor
Title: Technician

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Hand Shear Vane Test Results

IN-SITU TESTING ENCLOSURE 2

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HAND SHEAR VANE TEST RESULTS

Exploratory Hole No.	Date	Depth m	1st Result kPa	2nd Result kPa	3rd Result kPa	Average kPa	Remarks
TP120	09/01/2019	2.00	24 (33)	25	21	23 (33)	

Residual results given in brackets. Where a results is ">" the result has been ignored for the average.

Contract Title :- Northern Gateway			Client :- Far East Consortium International Limited	AEG Contract No :- NW1580
Date of Issue :- 21/02/2019	Page No. :- 1 of 1	Checked By :- LC	Approved By :- KW	Certificate No. :- HSV/NW1580/1

In-situ Water Quality Parameter Test Results

IN-SITU TESTING ENCLOSURE 3

ALLIED EXPLORATION GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

IN-SITU WATER QUALITY PARAMETER MONITORING RESULTS

Date of Test	24/01/2019	Operator	AM
Weather Condition (inc temperature)	Overcast & Foggy (4°C)		

Monitoring Point	Time	pH	Temp (°C)	Electrical Conductivity (µs)	Redox Potential (mv)	Dissolved Oxygen (%)	Total Dissolved Solids (ppm)
BH103	11:43:00	7.80	6.39	947.7	942.3	0.2	950.00
	11:45:00	7.70	7.33	942.0	995.0	2.1	923.00
	11:47:00	7.66	7.37	935.5	1013.9	2.0	917.51
	11:49:00	7.62	7.42	932.0	1030.0	1.8	911.12
	11:50:00	7.60	7.45	929.2	1040.1	1.7	907.97
BH105	12:37:00	7.94	9.61	722.4	1018.4	8.6	685.29
	12:39:00	7.83	9.47	724.6	1036.0	9.2	664.16
	12:41:00	7.75	9.85	726.2	1049.5	9.3	664.41
	12:42:00	7.67	9.94	728.1	1060.5	10.5	664.99
	12:44:00	7.60	9.99	729.0	1067.0	10.8	664.61
	12:46:00	7.55	9.99	731.4	1073.6	11.2	666.55

Remarks :	
Contract Title: Northern Gateway	Client: Far East Consortium International Limited
Checked By:	Approved By:
Date Issued: 21/02/2019	Page No. : 1 of 1
AEG Contract No. : NW1580	

Laboratory Report Certificate

LABORATORY TESTING ENCLOSURES

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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LABORATORY REPORT CERTIFICATE

UKAS TESTING
1367

Contract Title: Northern Gateway **AEG Reference:** NW1580

Client Address: Far East Consortium International Limited
Second Floor
Northern Assurance Building
Princess Street
Manchester
M2 4DN

We certify that Laboratory testing was carried out on samples from the above contract in accordance with techniques outlined in BS 1377: 1990, BS EN ISO 17892:2014 or other appropriate standards as quoted. The samples were received from January 2019 and the following results, given on the attached enclosures, were obtained.

The tests carried out are indicated in the attached table showing the enclosure number and the total number of pages.

For and on behalf of Allied Exploration & Geotechnics Limited

- ☐ Nick Vater (Technical Director)
- ☐ Kevin Warriner (HSE & Quality Director)
- ☑ Michelle Selkirk (Laboratory Manager)

Signed _____ Date: 01 March 2019

Tests marked not UKAS accredited in this certificate are not included in the UKAS accreditation schedule for our laboratory. Any opinions and interpretations expressed herein are outside the scope of the laboratory's UKAS accreditation.

Please note the material was derived from samples taken outside the control of the laboratory.

LABORATORY REPORT CERTIFICATE

ENCLOSURES

Enclosure Number	Description	UKAS Accredited	Reference	No. of Pages
0	Laboratory Report Certificate	N/A		3
1	Sample Description Sheets	N/A		5
2	Moisture Content	Yes	BS 1377 Part 2 1990 (BS EN ISO 17892-1:2014)	1
2	Plasticity Index and Moisture Content	Yes	BS 1377 Part 2 1990 (BS EN ISO 17892-1:2014)	3
-	Determination of Density by Linear Measurement	Yes	BS 1377 Part 2 1990 (BS EN ISO 17892-2:2014)	-
3	Determination of Particle Density	Yes	BS 1377 Part 2 1990	1
4	Particle Size Distribution Sieving	Yes	BS 1377 Part 2 1990	32
4	Particle Size Distribution Sedimentation	No	BS 1377 Part 2 1990	18
5	Determination of Loss on Ignition, Organic content, Total Sulphur, Sulphate and pH (Tested externally)	No	See DETS certificates	7
6	Determination of Dry Density/Moisture Content Relationship	Yes	BS 1377 Part 4 1990	3
-	Determination of Dry Density/Moisture/CBR Relationship	Yes	BS 1377 Part 4 1990	
-	Determination of Maximum and Minimum Dry Density	Yes	BS 1377 Part 4 1990	
7	Determination of MCV / Moisture Relationship	Yes	BS 1377 Part 4 1990	6
8	Determination of California Bearing Ratio	Yes	BS 1377 Part 4 1990	15
9	Determination of One Dimensional Consolidation Properties	Yes	BS 1377 Part 5 1990	8
-	Determination of Permeability (Falling Head)	Yes	*In-house* Method	-
-	Determination of Permeability in a Triaxial Cell	Yes	BS 1377 Part 6 1990	-
10	Shear Strength by Hand Vane	No		3
-	Shear Strength by Direct Shear	Yes	BS 1377 Part 7 1990	-
11	Undrained Shear Strength in Triaxial Cell without Pore Water Pressure Measurement	Yes	BS 1377 Part 7 1990	1
-	Consolidated Undrained Shear Strength in Triaxial Cell with Measurement of Pore Pressure	No	BS 1377 Part 8 1990	-

LABORATORY REPORT CERTIFICATE

ABBREVIATIONS

All the abbreviations used on the laboratory certificates are given below:

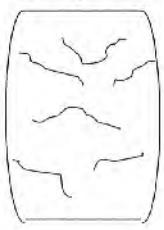
Br	Brittle	**PSD**	Particle Size Distribution by sieve analysis
C	Compound	**SB**	Shear Box
CBR	California Bearing Ratio	**SED**	Sedimentation Analysis
CDT	Consolidated Drained Triaxial	**SO4**	Sulphate (total, water extract, groundwater)
CL	Chloride content (water or soil)	**CP2**	Dry Density/Moisture Content 2.5kg rammer
US	Unsuitable sample for test	**CP4**	As above using 4.5kg rammer
UUT	Undrained Unconsolidated Triaxial	**CPV**	As above using vibrating hammer
HSV	Vane Test	**CUT**	Consolidated Undrained Triaxial
IS	Insufficient sample for test	**R**	Remoulded
LOI	Loss On Ignition	**U**	Undisturbed
M	Multi-stage testing	**MC**	Moisture Content
MCV	Moisture Content Value	**PL**	Point Load
NAT	Natural preparation method	**NMC**	Natural (or as received) moisture content
P	Plastic	**PFH**	Permeability Falling Head Method
OED	Oedometer	**PTXL**	Permeability in Triaxial Cell
OMC	Optimum Moisture Content	**ORG**	Organic content
B	Large disturbed (bulk) sample	**PD**	Particle Density (SG)
J	Small disturbed (jar) sample	**PI**	Liquid limit, plastic limit and plasticity index

Typical Mode of Failure for Triaxial Testing

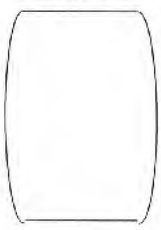
Brittle



Compound



Plastic



Sample Description Sheets

LABORATORY TESTING ENCLOSURE 1

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

LABORATORY SAMPLE DESCRIPTION SHEET

Exploratory Hole No.	Sample Depth (m)	ID	Description	Laboratory Tests/Remarks
BH101	1.00	J5	MADE GROUND (Black gravelly sand. Gravel includes ash).	MC PI(NP) ORG
BH101	1.50	J7	MADE GROUND (Brown slightly sandy slightly gravelly clay of low plasticity. Gravel includes brick fragments).	MC PI
BH101	1.50	B8	MADE GROUND (Brown slightly sandy slightly gravelly clay with occasional rootlets. Gravel includes brick fragments).	PSD SED Combined with B12.
BH101	3.50	B15	MADE GROUND (Brown slightly sandy slightly gravelly clay. Gravel includes brick fragments).	RUUT ROED
BH101	4.00	J16	MADE GROUND (Brown slightly sandy slightly gravelly clay of low plasticity).	MC PI
BH101	4.00	B17	MADE GROUND (Brown sandy slightly gravelly clay. Gravel includes wood,sandstone and coal).	BRE
BH102	0.30	J1	MADE GROUND (Black slightly sandy gravelly clay of low plasticity/very clayey slightly sandy gravel).	MC PI
BH102	0.50	B3	MADE GROUND (Brown clayey very sandy gravel with a high cobble content. Gravel includes wood, plastic, ceramic and brick fragments).	PSD
BH102	1.20	B5	MADE GROUND (Brown slightly sandy slightly gravelly clay. Gravel includes metal and brick fragments).	PSD SED
BH102	2.00	J6	MADE GROUND (Brown slightly gravelly clay).	BRE ORG
BH102	2.50	B8	MADE GROUND (Brown slightly sandy slightly gravelly clay. Gravel includes brick and coal fragments).	OED
BH102	3.00	B9	MADE GROUND (Brown slightly sandy slightly gravelly clay of low plasticity. Gravel includes brick fragments).	MC PI
BH102	6.10	B17	MADE GROUND (Red brown sandy slightly gravelly clay. Gravel is fine to coarse angular to subangular and includes sandstone and mudstone).	MC US for UUT Engineers Description.
BH102	6.80	J18	MADE GROUND (Red brown slightly sandy slightly gravelly clay of intermediate plasticity. Gravel includes brick fragments).	MC PI
BH103	0.50	B3	MADE GROUND (Brown slightly sandy gravelly clay. Gravel includes plastic, ceramic and brick fragments).	BRE LOI
BH103	1.50	J5	MADE GROUND (Brown slightly sandy slightly gravelly clay of intermediate plasticity).	MC PI
BH103	2.50	B10	MADE GROUND (Brown slightly sandy slightly gravelly clay. Gravel includes metal, glass and ceramic fragments).	PSD SED
BH103	5.50	J18	Red brown CLAY of intermediate plasticity.	MC PI
BH103	5.50	B19	Red brown silty slightly sandy CLAY.	SED
BH103	8.00	J23	Red brown slightly gravelly CLAY.	BRE
BH104	1.50	B8	MADE GROUND (Black clayey sandy gravel including ash, coal and brick fragments).	BRE

Contract Title :- Northern Gateway

Client :- Far East Consortium International Limited

Signed :- M Selkirk

Name :- M. SELKIRK

Date of issue :- 27/02/2019

Certificate No :- SD/NW1580/1

AEG Contract No. :- NW1580

UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

LABORATORY SAMPLE DESCRIPTION SHEET

Exploratory Hole No.	Sample Depth (m)	ID	Description	Laboratory Tests/Remarks
BH104	2.50	B11	MADE GROUND (Brown slightly sandy slightly gravelly clay. Gravel includes brick fragments).	PSD SED Combined with B16.
BH104	4.50	B16	MADE GROUND (Brown slightly sandy slightly gravelly clay).	BRE
BH104	5.30	B17	MADE GROUND (Brown slightly sandy clay).	RUUT ROED
BH104	7.50	B24	MADE GROUND (Dark brown very clayey sand and gravel).	PSD
BH104	10.50	B32	MADE GROUND (Brown sandy slightly gravelly clay of low plasticity. Gravel includes brick fragments).	MC PI PSD SED
BH105	0.60	B6	MADE GROUND (Brown sandy gravelly clay. Gravel includes brick fragments).	BRE
BH105	1.50	J7	Brown slightly sandy CLAY.	MC
BH105	3.50	B16	Brown sandy slightly gravelly SILT.	PSD Combined with B24.
BH105	4.50	J19	Brown SAND.	MC
BH106	1.50	B4	Dark brown COBBLES with much clayey gravelly SAND.	PSD
BH106	8.00	J18	Brown slightly sandy CLAY of low plasticity.	MC PI
BH106	8.50	U20	Low strength black brown with grey mottling silty sandy CLAY.	UUT
BH107	0.20	B3	MADE GROUND (Black brown clayey very sandy gravel with occasional rootlets. Gravel includes ceramic and brick fragments).	PSD BRE
BH107	1.50	B7	MADE GROUND (Brown grey mottling slightly sandy slightly gravelly clay of intermediate plasticity. Gravel includes brick fragments).	MC PI ORG
BH107	2.50	B11	Red slightly sandy CLAY of low plasticity.	MC PI
BH107	3.10	B13	Red sandy CLAY.	SED BRE
BH109	0.40	B3	MADE GROUND (Brown clayey very sandy gravel with a medium cobble content. Gravel includes concrete, slag and brick fragments).	PSD BRE ORG
BH109	2.00	ES6	MADE GROUND (Brown slightly sandy gravelly clay of low plasticity. Gravel includes nail and brick fragments).	MC PI
BH110	1.60	J4	MADE GROUND (Brown sandy gravelly clay. Gravel includes ash and brick fragments).	ORG
BH110	3.10	B9	Brown silty gravelly SAND. (Silt of intermediate plasticity).	MC PI PSD SED BRE
BH110	4.80	B13	Brown slightly sandy slightly gravelly CLAY.	RUUT ROED

Contract Title :- Northern Gateway

Client :- Far East Consortium International Limited

Signed :- M Selkirk

Name :- M. SELKIRK

Date of issue :- 27/02/2019

Certificate No :- SD/NW1580/2

AEG Contract No. :- NW1580

UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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Regional Office: Unit 20 Business Development Centre Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

LABORATORY SAMPLE DESCRIPTION SHEET

Exploratory Hole No.	Sample Depth (m)	ID	Description	Laboratory Tests/Remarks
BH112	0.60	B3	Brown clayey gravelly SAND.	MC BRE PSD Combined with B7 for PSD.
TP101	0.80	LB3	MADE GROUND (Black slightly clayey sandy gravel).	PSD
TP101	1.20	J4	Brown slightly sandy slightly gravelly CLAY/SILT of low plasticity.	MC PI
TP101	1.80	LB6	Brown sandy slightly gravelly CLAY.	PSD
TP102	0.50	LB3	MADE GROUND (Black sandy gravel).	BRE
TP102	1.40	J7	Red slightly gravelly SAND.	ORG
TP102	1.80	LB8	Brown SAND.	BRE
TP103	1.20	J9	Brown CLAY of low plasticity.	MC PI
TP103	1.50	B10	Brown slightly sandy slightly gravelly CLAY.	HSV CP2 CBR MCV
TP103	3.20	J14	Red brown CLAY of intermediate plasticity.	MC PI
TP104	0.80	LB3	MADE GROUND (Brown clayey very sandy gravel including slag and brick fragments).	PSD
TP104	1.20	J4	Red gravelly SAND.	MC
TP104	1.80	LB6	Red brown clayey very gravelly SAND. Gravel includes weathered sandstone.	PSD
TP104	2.20	J7	Brown slightly sandy slightly gravelly CLAY of low plasticity.	MC PI ORG
TP106	2.50	J9	Red gravelly SAND.	MC
TP106	4.00	J13	Brown slightly sandy CLAY.	MC
TP108	1.00	J4	Red clayey slightly gravelly SAND.	MC
TP108	1.60	LB6	Brown sandy slightly gravelly CLAY.	PSD SED
TP109	1.10	J4	MADE GROUND (Black slightly clayey sandy gravel with low cobble content and with brick,glass. wood and metal fragments).	BRE IS for MC
TP109	1.60	B6	MADE GROUND (Black brown clayey very sandy gravel including mudstone,slag and brick fragments).	PSD
TP111	0.80	LB3	MADE GROUND (Brown clayey very gravelly sand. Gravel includes broken clay pipe fragments).	HSV CPV CBR MCV US for Max and Min Density Combined with TP112 LB3.

Contract Title :- Northern Gateway

Client :- Far East Consortium International Limited

Signed :- M Selkirk

Name :- M. SELKIRK

Date of issue :- 27/02/2019

Certificate No :- SD/NW1580/3

AEG Contract No. :- NW1580

UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

LABORATORY SAMPLE DESCRIPTION SHEET

Exploratory Hole No.	Sample Depth (m)	ID	Description	Laboratory Tests/Remarks
TP111	1.20	J4	Brown slightly gravelly CLAY.	ORG
TP112	0.80	LB3	MADE GROUND (Brown clayey very gravelly sand. Gravel includes ceramic fragments).	PSD HSV CBR MCV US for Max and Min Density Combined with TP111 LB3.
TP112	1.10	J4	Black clayey slightly gravelly SAND.	MC BRE
TP112	2.10	J7	Black slightly clayey gravelly sand. Gravel includes wood.	ORG
TP115	0.80	LB3	MADE GROUND (Black clayey gravel and sand. Gravel includes charcoal, glass and ceramic fragments).	PSD SED
TP115	1.10	J4	MADE GROUND (Black gravelly sand. Gravel includes ash and brick fragments).	BRE ORG
TP119	0.40	B3	MADE GROUND (Grey slightly clayey sandy gravel including brick fragments).	PSD
TP119	1.50	B6	Grey slightly clayey gravelly SAND.	BRE
TP120	2.00	B9	Brown mottled sandy CLAY.	MC
TP121	0.80	LB3	MADE GROUND (Brown clayey very gravelly sand. Gravel includes brick fragments).	PSD HSV CPV CBR MCV US for Max and Min Density Combined with TP122 LB3.
TP121	1.10	J4	Brown slightly sandy slightly gravelly CLAY.	MC
TP124	0.80	LB4	MADE GROUND (Brown clayey very sandy gravel including coal, glass and ceramic fragments).	MC PSD
TP124	2.40	LB9	Brown slightly sandy slightly gravelly CLAY of low plasticity.	MC PI
WS101	0.50	B4	MADE GROUND (Brown slightly sandy gravelly clay with a low cobble content and occasional rootlets. Gravel includes brick fragments).	MC BRE ORG
WS101	1.20	J6	MADE GROUND (Brown slightly clayey slightly gravelly sand).	MC PI(NP) ORG
WS101	1.20	U7	MADE GROUND (Brown gravelly sand becoming at 1.50m soft brown sandy gravelly clay. Becoming at 1.90m soft black sandy gravelly clay).	US for UUT
WS101	2.20	U9	MADE GROUND (Brown sandy gravel including ash, glass and brick fragments. Becoming at 2.80m brown slightly gravelly sand becoming at 3.00m soft brown sandy clay/very clayey sand).	PD
WS101	3.20	J10	Red brown SAND.	MC
WS102	1.20	U7	MADE GROUND (Red brown sandy gravelly clay. Gravel includes concrete, glass and brick fragments).	PSD BRE Combined with WS103 U6.
WS102	3.20	J10	Brown slightly sandy CLAY.	MC PI(IS for LL)
WS103	1.20	J5	MADE GROUND (Brown sandy gravel including brick fragments).	ORG

Contract Title :- Northern Gateway

Client :- Far East Consortium International Limited

Signed :- msrp

Name :- M SELKIRK

Date of issue :- 27/02/2019

Certificate No :- SD/NW1580/4

AEG Contract No. :- NW1580

UKAS TESTING 1367

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LABORATORY SAMPLE DESCRIPTION SHEET

Exploratory Hole No.	Sample Depth (m)	ID	Description	Laboratory Tests/Remarks
WS103	1.20	U6	MADE GROUND (Red brown clayey very sandy gravel including chalk, wood, concrete and brick fragments).	PSD BRE Combined with WS102 U7.
WS103	3.20	J9	Brown clayey SAND.	ORG
WS104	1.20	U8	Brown clayey very sandy GRAVEL.	MC PI PSD BRE ORG Combined with U10 and U12.
WS104	2.20	U10	Brown clayey very sandy GRAVEL with bands of soft grey sandy gravelly CLAY of low plasticity from 2.90 to 3.20m.	MC PI PSD BRE ORG Combined with U8 and U12.
WS104	3.20	U12	Brown clayey very sandy GRAVEL with bands of soft grey sandy gravelly CLAY from 4.00 to 4.20m.	MC PI PSD BRE ORG Combined with U8 and U10.
WS105	0.50	B5	Grey brown COBBLES with much clayey sandy GRAVEL.	PSD BRE
WS105A	1.20	U9	MADE GROUND (Black brown slightly clayey gravelly sand. Gravel includes concrete, ash and brick fragments. Becoming at 1.70m soft brown black sandy gravelly clay. Gravel includes concrete and brick fragments).	BRE ORG
WS105A	2.20	J10	MADE GROUND (Black brown sandy gravelly clay of low plasticity/clayey gravelly sand. Gravel includes brick fragments).	MC PI
WS105A	2.20	U11	MADE GROUND (Brown clayey very gravelly sand. Gravel includes ash, clinker, glass and brick fragments. Becoming at 2.80m soft brown sandy gravelly clay. Gravel includes brick fragments).	PSD
WS105A	4.20	U15	Brown clayey SAND.	PSD
WS106	1.20	U7	MADE GROUND (Brown very sandy gravel including ash and brick fragments. becoming at 1.90m soft brown sandy gravelly clay of intermediate plasticity).	MC PI PSD PD BRE ORG LOI Combined with U9.
WS106	2.20	U9	MADE GROUND (Brown sandy gravel including brick fragments. Becoming at 2.70m brown clayey gravelly sand becoming at 2.80m soft grey sandy gravelly clay. Gravel includes brick fragments).	MC PI PSD PD BRE ORG LOI Combined with U7.

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Signed :- MSorp	Name :- M. SELKIRK	Page 5 of 5	
Date of issue :- 27/02/2019	Certificate No :- SD/NW1580/5	AEG Contract No. :- NW1580	UKAS TESTING 1367

Moisture Content/Plasticity Index and Moisture Content

LABORATORY TESTING ENCLOSURE 2

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MOISTURE CONTENT CERTIFICATE

BS 1377 : Part 2 : Clause 3.2

Exploratory Hole No.	Sample Depth (m)	Sample ID	Specific Depth (m)	Moisture Content (%)	Date Tested	Remarks
BH102	6.10	B17	6.10	31.6	08/02/2019	
BH105	1.50	J7	1.50	19.2	30/01/2019	
BH105	4.50	J19	4.50	21.6	30/01/2019	
BH112	0.60	B3	0.60	14.5	29/01/2019	
TP104	1.20	J4	1.20	18.2	30/01/2019	
TP106	2.50	J9	2.50	14.1	30/01/2019	
TP106	4.00	J13	4.00	21.1	30/01/2019	
TP108	1.00	J4	1.00	12.8	30/01/2019	
TP112	1.10	J4	1.10	16.4	30/01/2019	
TP120	2.00	B9	2.00	30.9	30/01/2019	
TP121	1.10	J4	1.10	23.5	30/01/2019	
TP124	0.80	LB4	0.80	30.2	29/01/2019	
WS101	0.50	B4	0.50	15.2	29/01/2019	
WS101	3.20	J10	3.20	21.0	30/01/2019	

For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway

Client :- Far East Consortium International Limited

Signed :- MSeo

Name :- M [illegible] CLARK

Page 1 of 1

Date of issue :- 14/02/2019

Certificate No :- MC/NW1580/1

AEG Contract No. :- NW1580

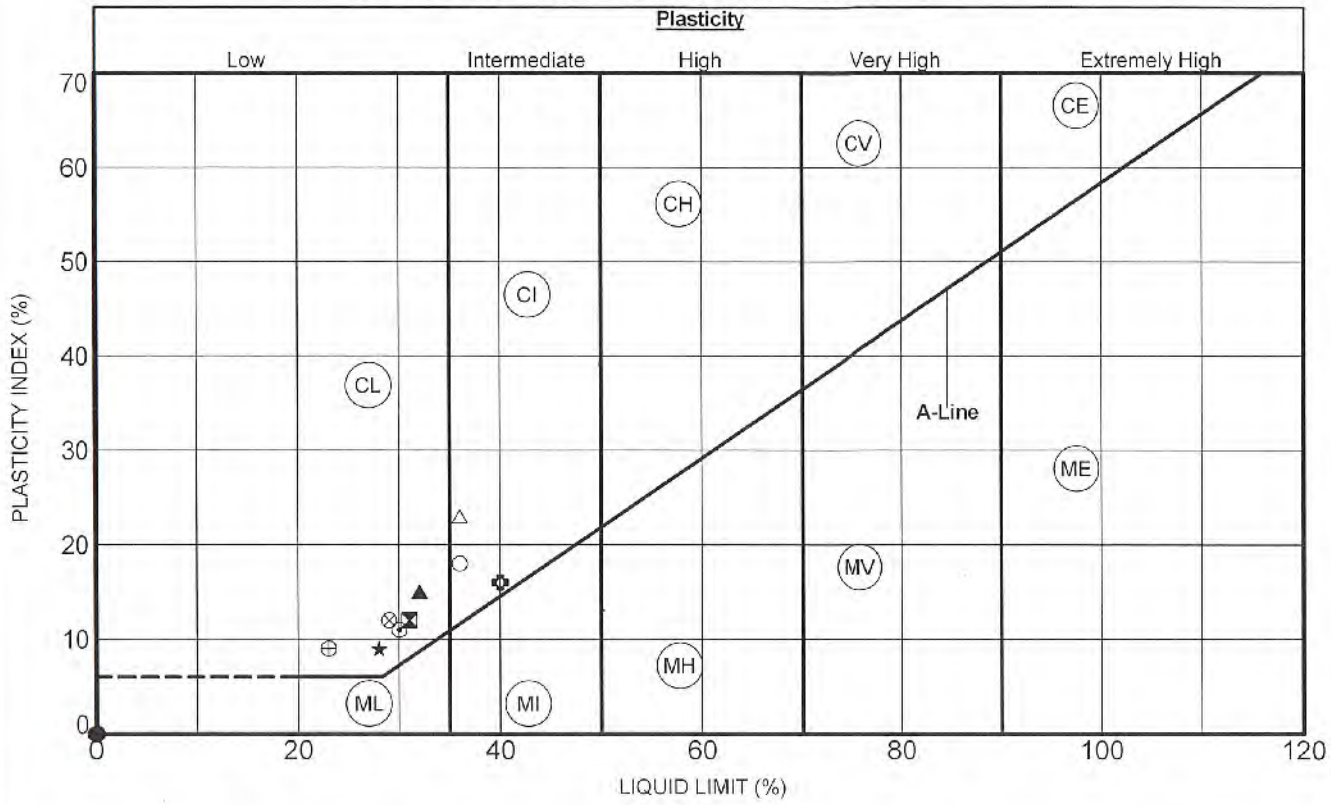
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ATTERBERG LIMITS & NATURAL MOISTURE CONTENT

Test Method :- BS 1377 : Part 2 : Clause 3.2, 4.1 to 4.4 & 5 : 1990



Exploratory Hole No.	Depth (m)	Sample Type/Ref.	Specific Depth (m)	LL	PL	PI	I_c	Preparation Method	<0.425mm (%)	m/c (%)	Date Tested	
● BH101	1.00	J5	1.00	NP	NP	NP		Natural		7.3	30/01/2019	
⧗ BH101	1.50	J7	1.50	31	19	12	0.82	Natural		21.2	30/01/2019	
▲ BH101	4.00	J16	4.00	32	17	15	0.83	Natural		19.5	30/01/2019	
★ BH102	0.30	J1	0.30	28	19	9	1.26	Natural		16.7	30/01/2019	#
⊙ BH102	3.00	B9	3.00	30	19	11	0.85	Natural		20.7	29/01/2019	
✿ BH102	6.80	J18	6.80	40	24	16	1.16	Natural		21.5	30/01/2019	
○ BH103	1.50	J5	1.50	36	18	18	0.81	Natural		21.4	30/01/2019	
△ BH103	5.50	J18	5.50	36	13	23	0.82	Natural		17.2	30/01/2019	
⊗ BH104	10.50	B32	10.50	29	17	12	0.48	Natural	74.0	23.3	29/01/2019	
⊖ BH106	8.00	J18	8.00	23	14	9	0.44	Natural		19.0	30/01/2019	

For description of sample please refer to the Laboratory Sample Description Sheet. # = Insufficient for 4 point PI
If sample is prepared in the natural state we are unable to determine % retained on the 0.425mm test sieve.

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

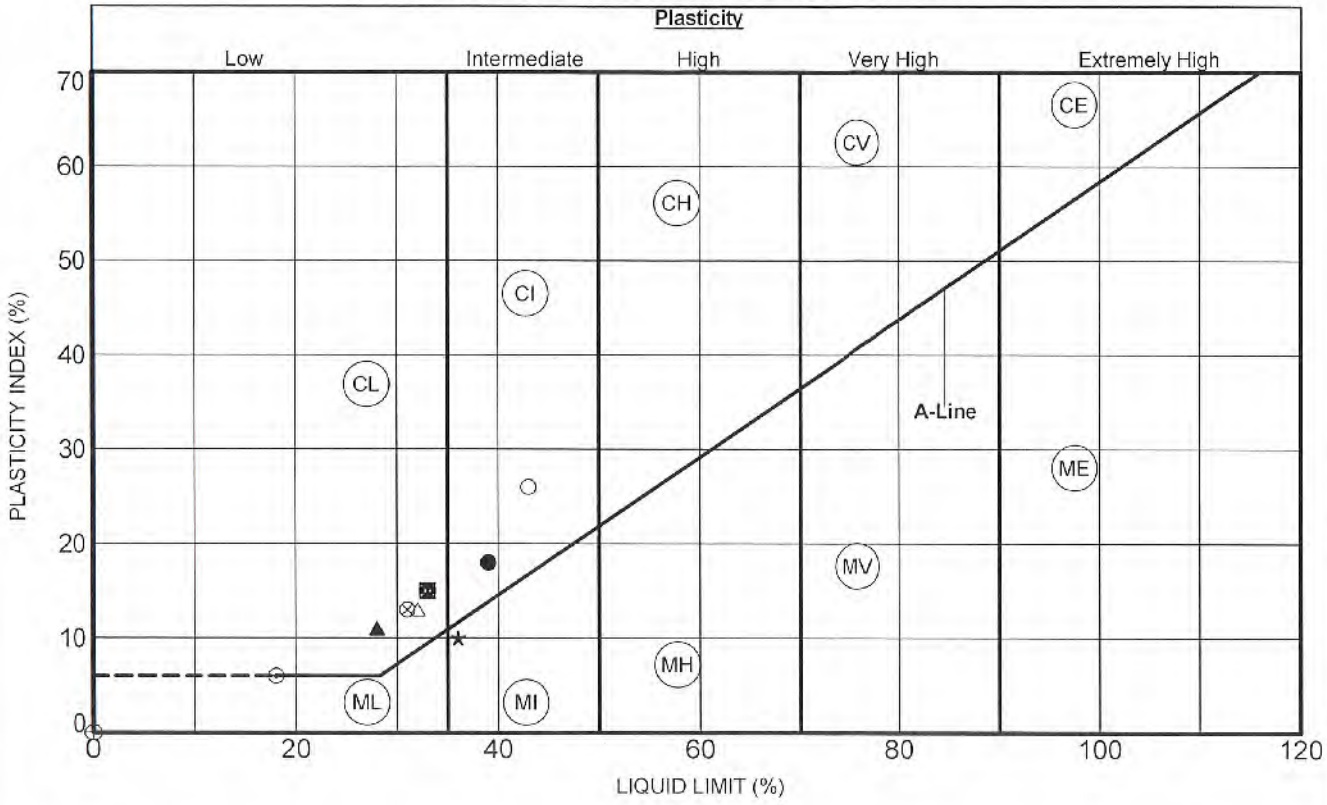
Signed :- MSelk	Name :- M. SELKIRK	Page 1 of 3	UKAS TESTING 1367
Date of issue :- 13/02/2019	Certificate No :- PI/NW1580/1	AEG Contract No. :- NW1580	

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ATTERBERG LIMITS & NATURAL MOISTURE CONTENT

Test Method :- BS 1377 : Part 2 : Clause 3.2, 4.1 to 4.4 & 5 : 1990



Exploratory Hole No.	Depth (m)	Sample Type/Ref.	Specific Depth (m)	LL	PL	PI	I_c	Preparation Method	<0.425mm (%)	m/c (%)	Date Tested	
● BH107	1.50	B7	1.50	39	21	18	0.61	Natural		28.0	29/01/2019	
⊠ BH107	2.50	B11	2.50	33	18	15	0.88	Natural		19.8	29/01/2019	
▲ BH109	2.00	ES6	2.00	28	17	11	0.75	Natural		19.8	30/01/2019	
★ BH110	3.10	B9	3.10	36	26	10	0.06	Natural	70.0	35.4	29/01/2019	
⊙ TP101	1.20	J4	1.20	18	12	6	1.67	Natural		8.0	30/01/2019	
✿ TP103	1.20	J9	1.20	33	18	15	0.81	Natural		20.9	30/01/2019	
○ TP103	3.20	J14	3.20	43	17	26	0.95	Natural		18.2	30/01/2019	
△ TP104	2.20	J7	2.20	32	19	13	0.58	Natural		24.4	30/01/2019	#
⊗ TP124	2.40	LB9	2.40	31	18	13	0.70	Natural		21.9	29/01/2019	
⊕ WS101	1.20	J6	1.20	NP	NP	NP		Natural		11.6	30/01/2019	

For description of sample please refer to the Laboratory Sample Description Sheet. # = Insufficient for 4 point PI
If sample is prepared in the natural state we are unable to determine % retained on the 0.425mm test sieve.

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

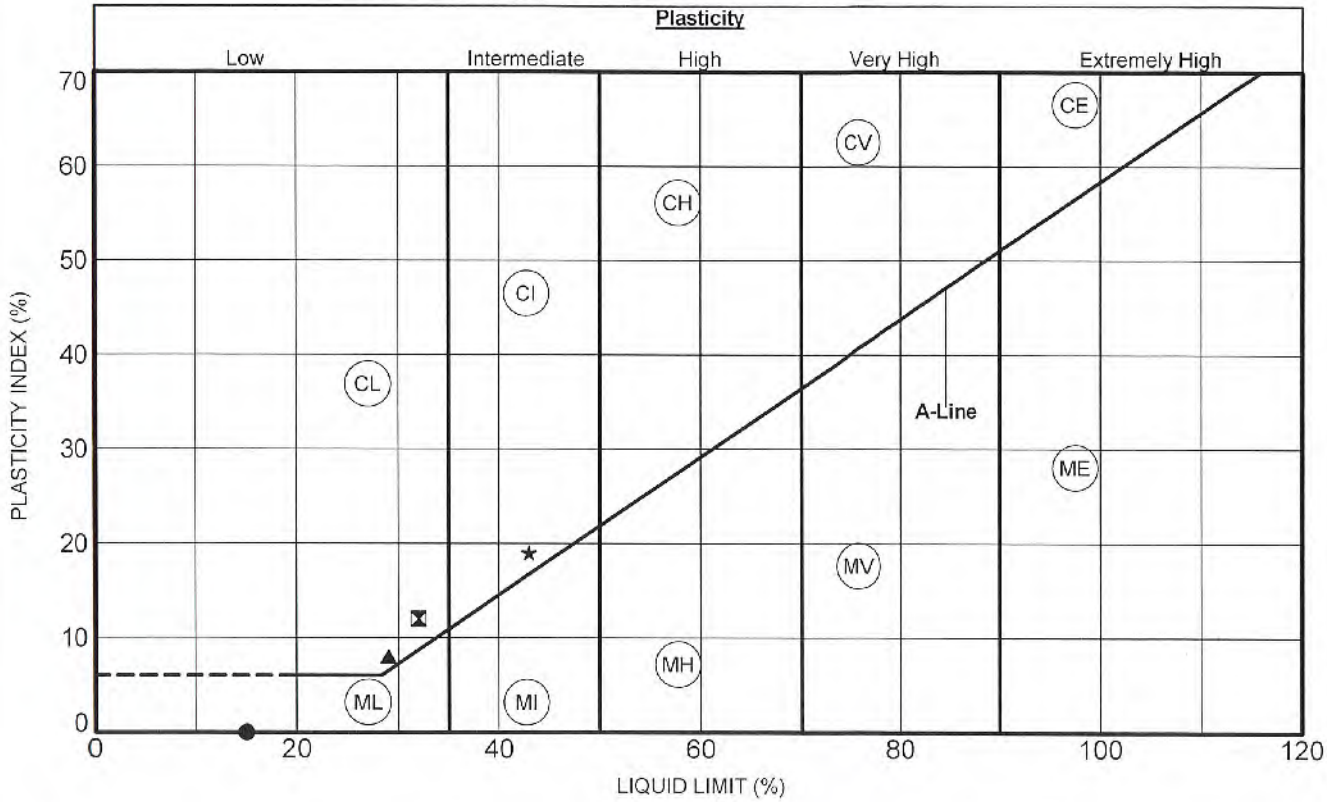
Signed :-	Name :-	Page 2 of 3	
Date of issue :- 13/02/2019	Certificate No :- PI/NW1580/2	AEG Contract No. :- NW1580	UKAS TESTING 1367

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ATTERBERG LIMITS & NATURAL MOISTURE CONTENT

Test Method :- BS 1377 : Part 2 : Clause 3.2, 4.1 to 4.4 & 5 : 1990



Exploratory Hole No.	Depth (m)	Sample Type/Ref.	Specific Depth (m)	LL	PL	PI	I_c	Preparation Method	<0.425mm (%)	m/c (%)	Date Tested	
● WS102	3.20	J10	3.20		15			Natural		18.6	30/01/2019	
⧗ WS104	2.20	U10	3.00	32	20	12	0.95	Natural	30.0	20.6	30/01/2019	#
▲ WS105A	2.20	J10	2.20	29	21	8	1.30	Natural		18.6	30/11/2019	
★ WS106	1.20	U7	1.20	43	24	19	0.15	Natural	14.0	40.1	30/01/2019	

For description of sample please refer to the Laboratory Sample Description Sheet. # = Insufficient for 4 point PI
If sample is prepared in the natural state we are unable to determine % retained on the 0.425mm test sieve.

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Signed :-	Name :-	Page 3 of 3	
Date of issue :- 14/02/2019	Certificate No :- PI/NW1580/3	AEG Contract No. :- NW1580	UKAS TESTING 1367

Determination of Particle Density

LABORATORY TESTING ENCLOSURE 3

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DETERMINATION OF PARTICLE DENSITY

BS1377 : Part 2 : Clause 8.2 : 1990

Exploratory Hole No.	Depth (m)	Sample Type & No.	Specific Depth (m)	Particle Density (Mg/m^3)	Date Tested
WS101	2.20	U9	2.20	2.45	31/01/2019
WS106	1.20	U7	1.20	2.46	31/01/2019

For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Signed :- MSone	Name :- M. PEARK	Page 1 of 1	UKAS TESTING 1367
Date of issue :- 13/02/2019	Certificate No :- PD/NW1580/1	AEG Contract No. :- NW1580	

Particle Size Distribution Sieving and Sedimentation

LABORATORY TESTING ENCLOSURE 4

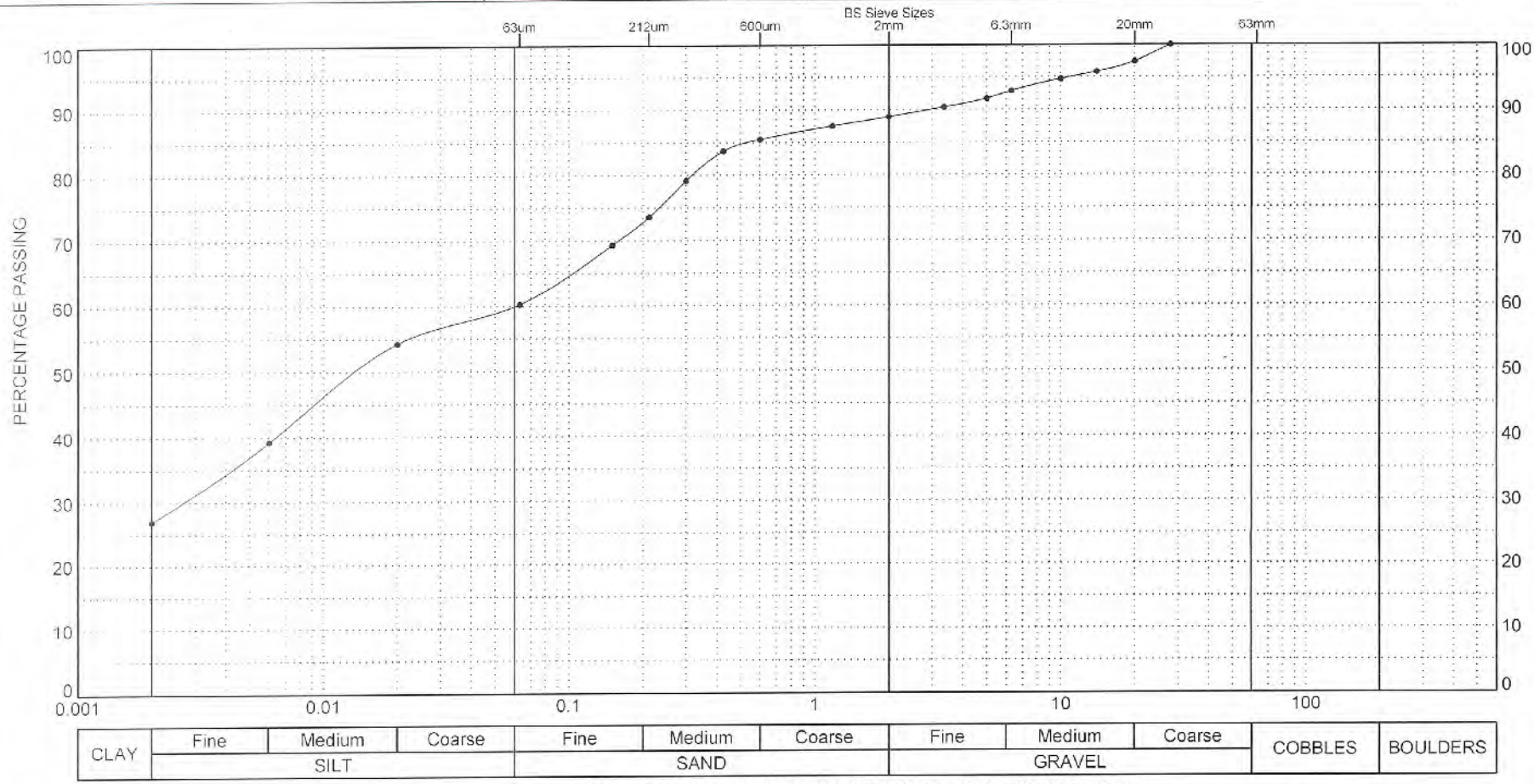
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **BH101**	Depth (m) :- **1.50**	Sample Type & No :- **B8**	Specific Depth (m) :- **1.50**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
28	100.0
20	97.4
14	95.8
10	94.7
6.3	92.9
5	91.7
3.35	90.4
2	88.9
1.18	87.5
0.6	85.5
0.425	83.7
0.3	79.2
0.212	73.6
0.15	69.3
0.063	60.3
0.02	54.3
0.006	39.3
0.002	27.0

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH101/B8/1.50			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

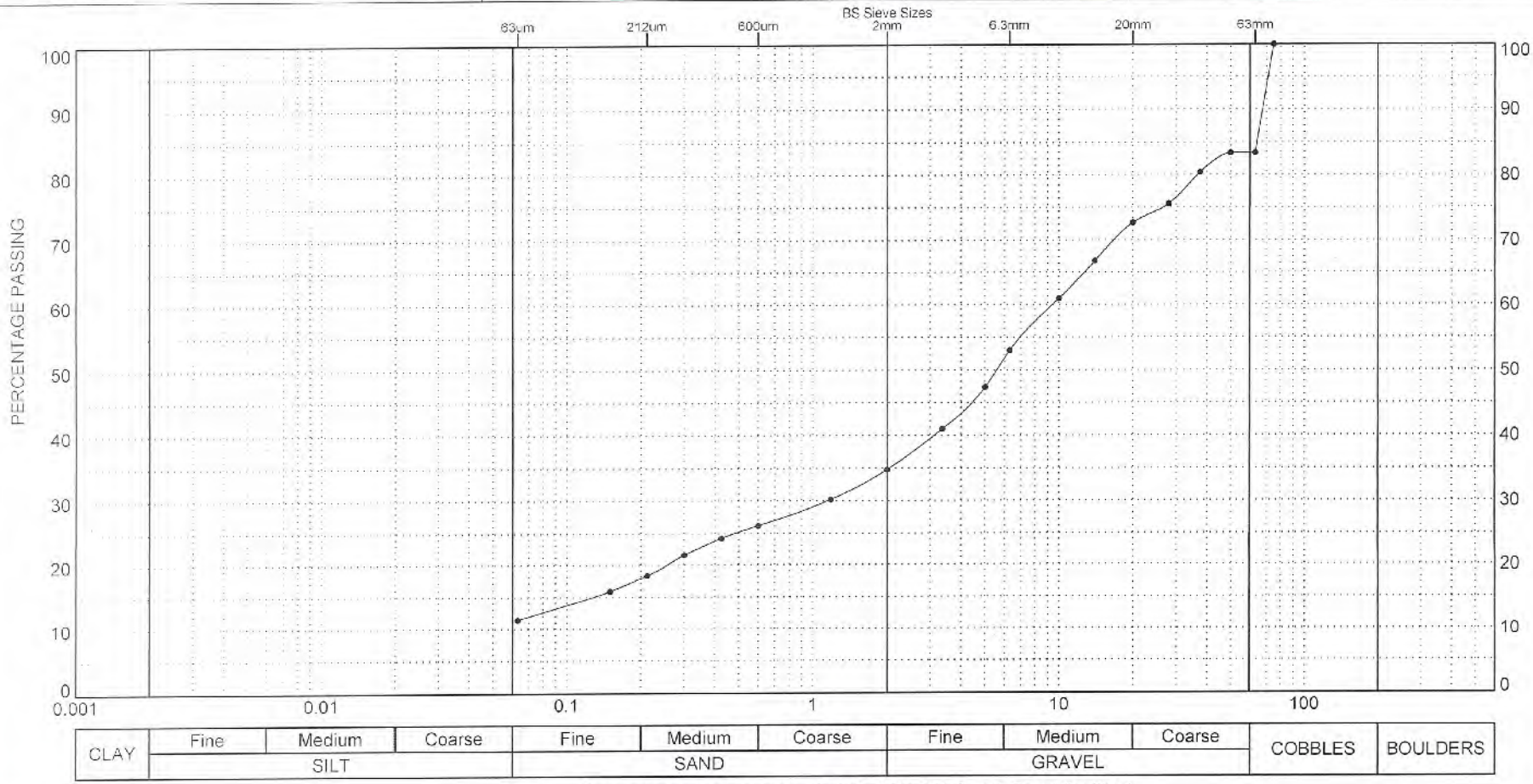
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990
(Test deviated from standard due to insufficient sample mass)

Exploratory Hole No :- BH102	Depth (m) :- 0.50	Sample Type & No :- B3	Specific Depth (m) :- 0.50	Date Tested :- 29/01/2019



Sieve Size (mm)	Passing (%)
75	100.0
63	83.4
50	83.4
37.5	80.4
28	75.6
20	72.7
14	66.8
10	61.0
6.3	53.0
5	47.4
3.35	41.0
2	34.8
1.18	30.2
0.6	26.2
0.425	24.3
0.3	21.5
0.212	18.3
0.15	15.9
0.063	11.5

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :- 13/02/2019	Certificate No :- PSD/NW1580/BH102/B3/0.50	Signed :-	Name :-	Page 1 of 1
Client :- Far East Consortium International Limited	Contract Title :- Northern Gateway			AEG Contract No :- NW1580

UKAS TESTING 1367

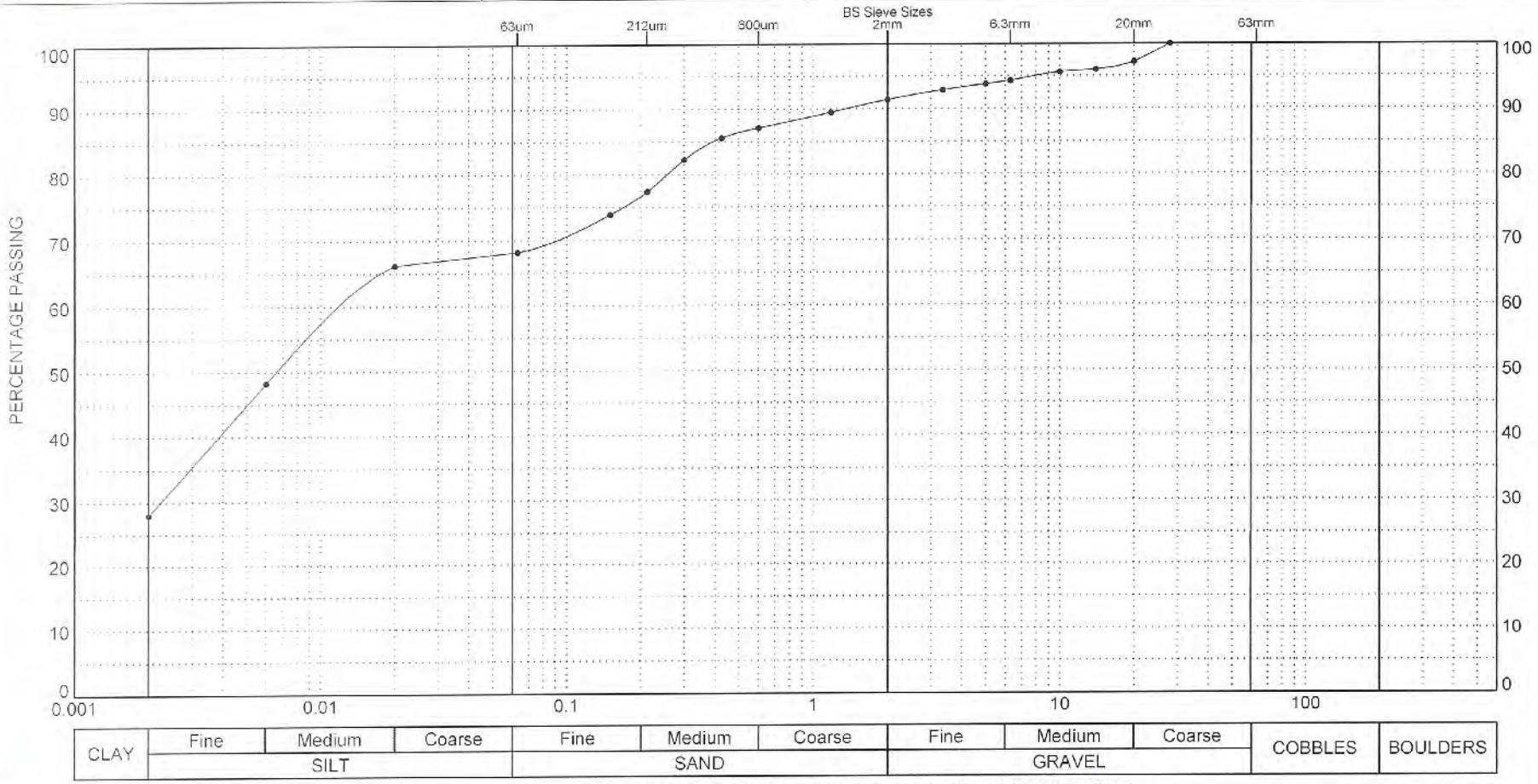
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **BH102**	Depth (m) :- **1.20**	Sample Type & No :- **B5**	Specific Depth (m) :- **1.20**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
28	100.0
20	97.2
14	96.0
10	95.6
6.3	94.3
5	93.8
3.35	92.9
2	91.4
1.18	89.5
0.6	87.1
0.425	85.6
0.3	82.3
0.212	77.4
0.15	73.9
0.063	68.2
0.02	66.2
0.006	48.3
0.002	28.0

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH102/B5/1.20	MSnp	M. CLARK	

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

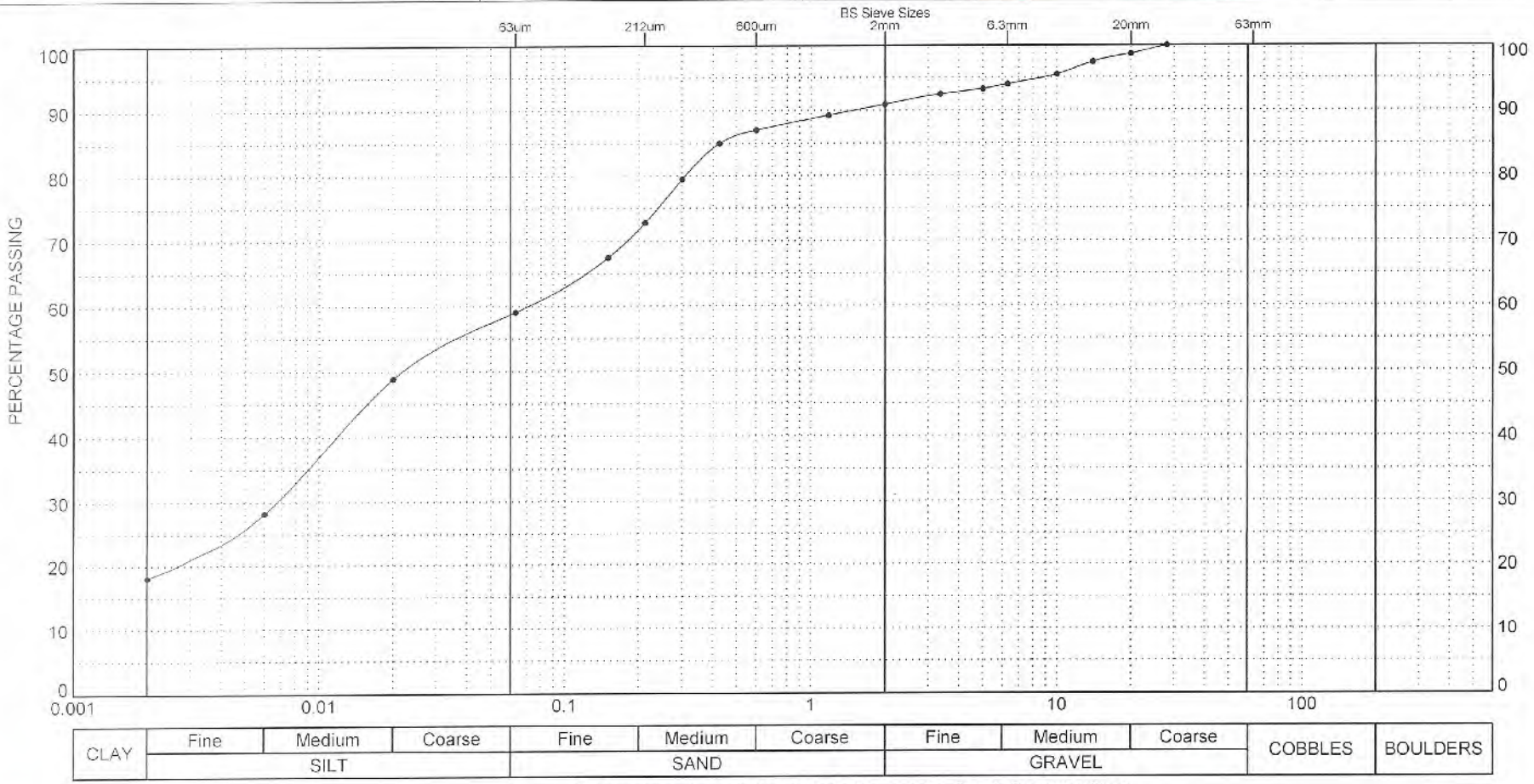
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- BH103	Depth (m) :- **2.50**	Sample Type & No :- **B10**	Specific Depth (m) :- **2.50**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
28	100.0
20	98.6
14	97.4
10	95.5
6.3	94.0
5	93.3
3.35	92.5
2	90.9
1.18	89.3
0.6	87.0
0.425	85.0
0.3	79.5
0.212	72.8
0.15	67.5
0.063	59.1
0.02	48.9
0.006	28.3
0.002	18.0

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :- 13/02/2019	Certificate No :- PSD/NW1580/BH103/B10/2.50	Signed :-	Name :-	Page 1 of 1
Client :- Far East Consortium International Limited	Contract Title :- Northern Gateway			AEG Contract No :- NW1580

UKAS TESTING 1367

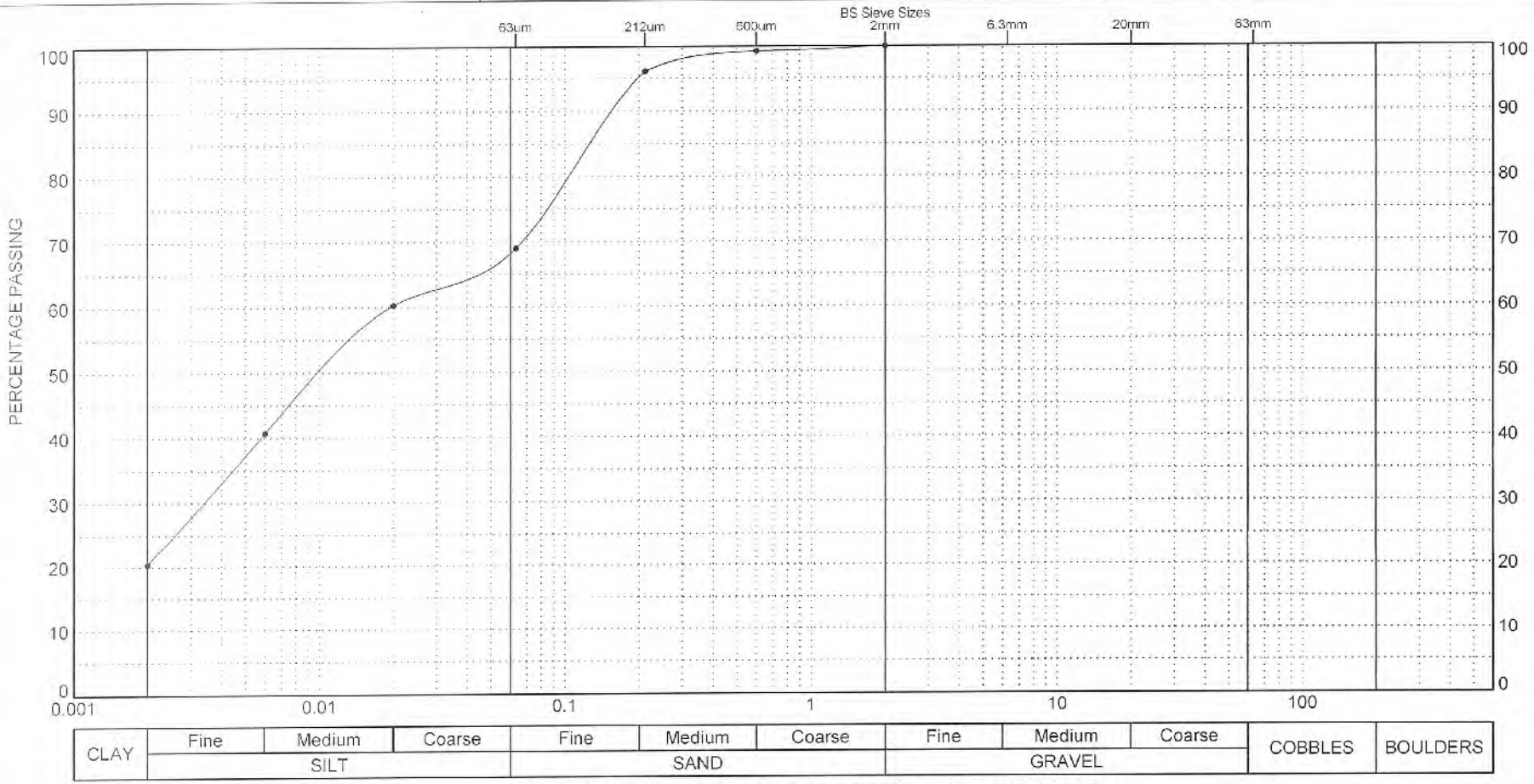
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- BH103	Depth (m) :- 5.50	Sample Type & No :- B19	Specific Depth (m) :- 5.50	Date Tested :- 29/01/2019



Sieve Size (mm)	Passing (%)
2	100.0
0.6	99.2
0.212	96.2
0.063	69.0
0.02	60.3
0.006	40.8
0.002	20.4

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH103/B19/5.50	MSnd	[illegible]	

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

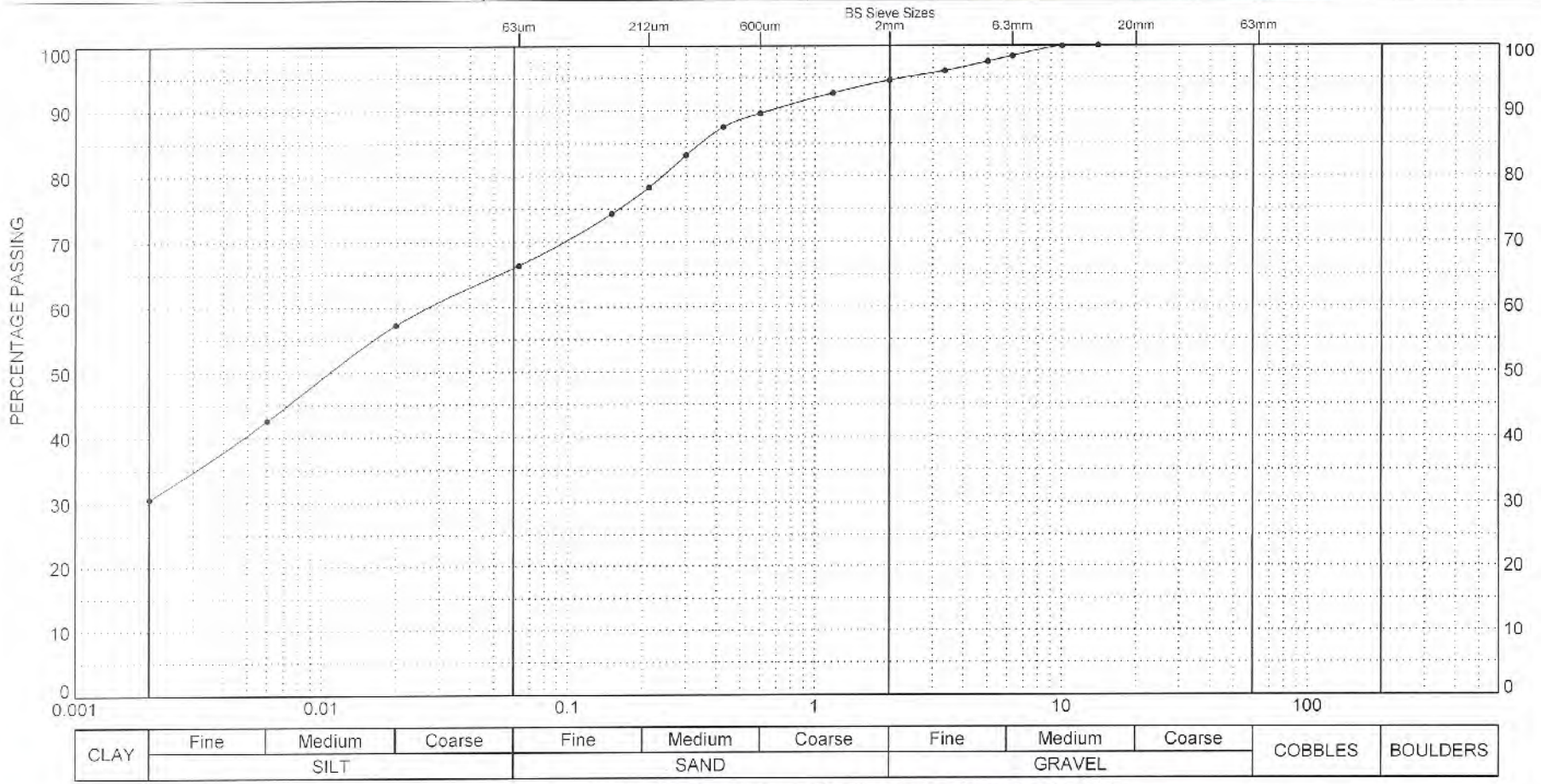
ALLIED EXPLORATION & GEOTECHNICS LIMITED

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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **BH104**	Depth (m) :- **2.50**	Sample Type & No :- **B11**	Specific Depth (m) :- **2.50**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
14	100.0
10	99.9
6.3	98.3
5	97.5
3.35	96.1
2	94.6
1.18	92.7
0.6	89.6
0.425	87.5
0.3	83.2
0.212	78.3
0.15	74.3
0.063	66.4
0.02	57.3
0.006	42.6
0.002	30.6

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH104/B11/2.50			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

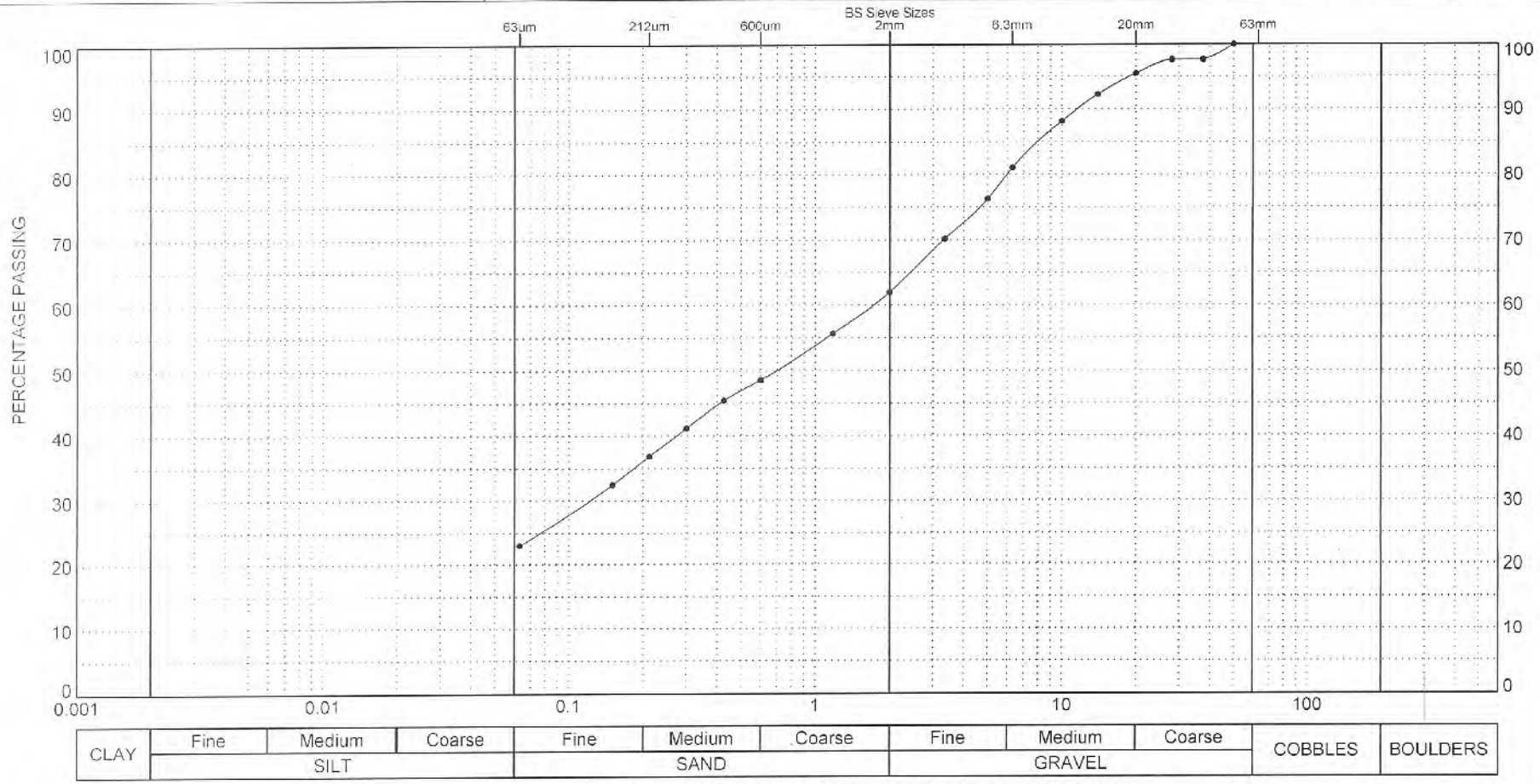
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **BH104**	Depth (m) :- **7.50**	Sample Type & No :- **B24**	Specific Depth (m) :- **7.50**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
50	100.0
37.5	97.6
28	97.6
20	95.5
14	92.3
10	88.2
6.3	81.1
5	76.3
3.35	70.2
2	62.0
1.18	55.7
0.6	48.6
0.425	45.5
0.3	41.2
0.212	36.9
0.15	32.5
0.063	23.1

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH104/B24/7.50			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

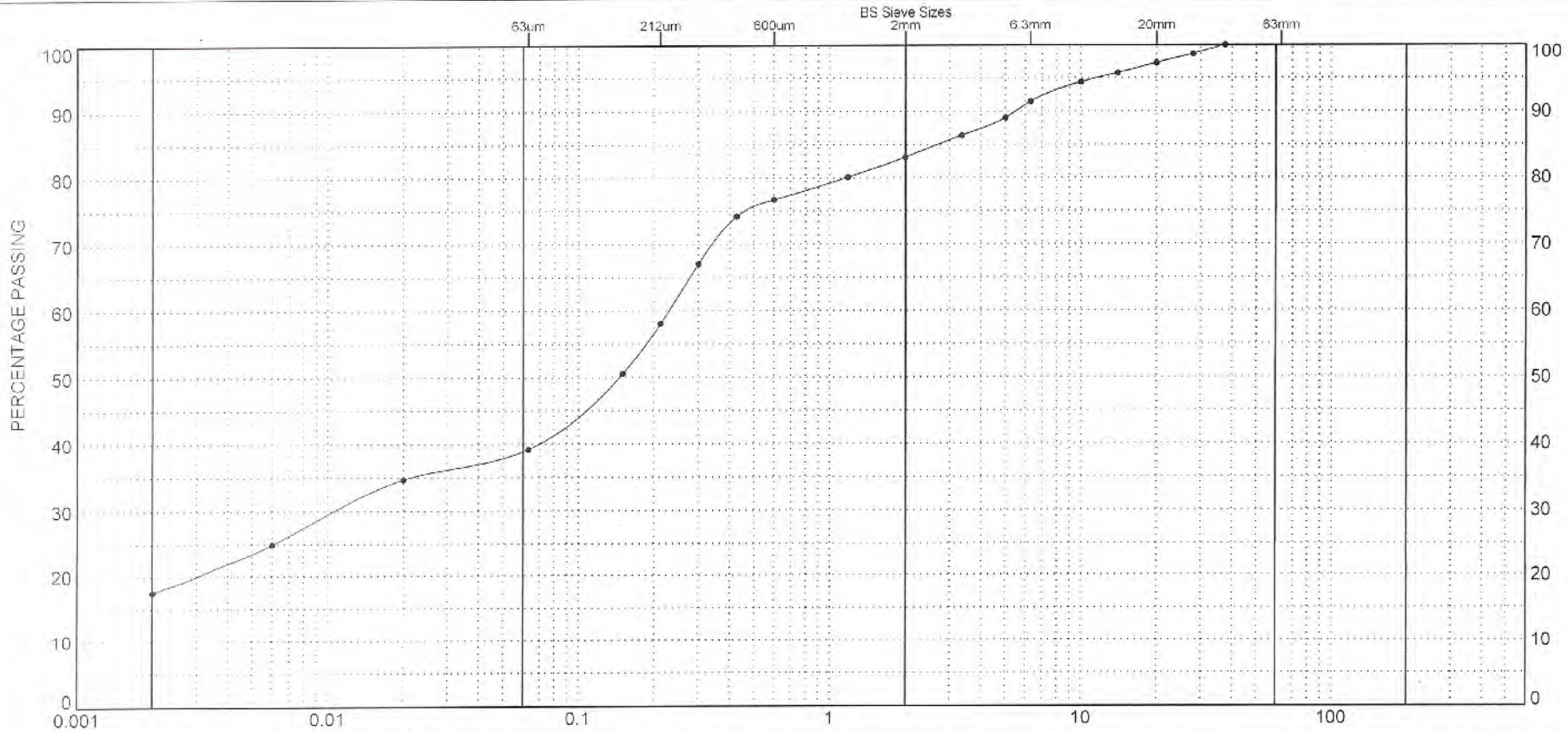
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **BH104**	Depth (m) :- **10.50**	Sample Type & No :- **B32**	Specific Depth (m) :- **10.50**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
37.5	100.0
28	98.6
20	97.3
14	95.8
10	94.4
6.3	91.5
5	89.1
3.35	86.4
2	83.1
1.18	80.1
0.6	76.7
0.425	74.2
0.3	67.1
0.212	58.1
0.15	50.6
0.063	39.2
0.02	34.7
0.006	25.0
0.002	17.4

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH104/B32/10.50			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

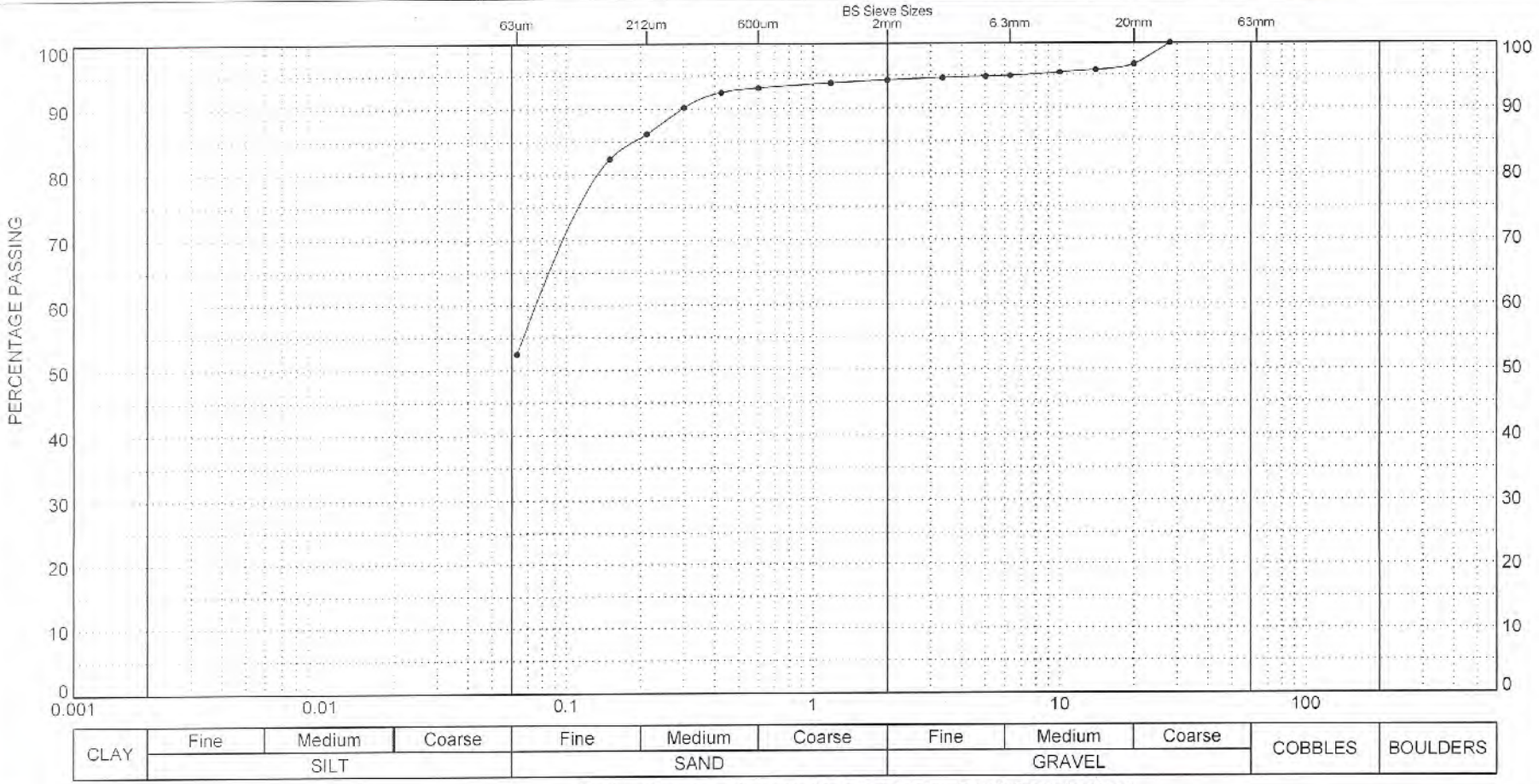
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **BH105**	Depth (m) :- **3.50**	Sample Type & No :- **B16**	Specific Depth (m) :- **3.50**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
28	100.0
20	96.7
14	95.8
10	95.4
6.3	94.9
5	94.8
3.35	94.6
2	94.3
1.18	93.9
0.6	93.2
0.425	92.5
0.3	90.2
0.212	86.2
0.15	82.4
0.063	52.5

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH105/B16/3.50			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

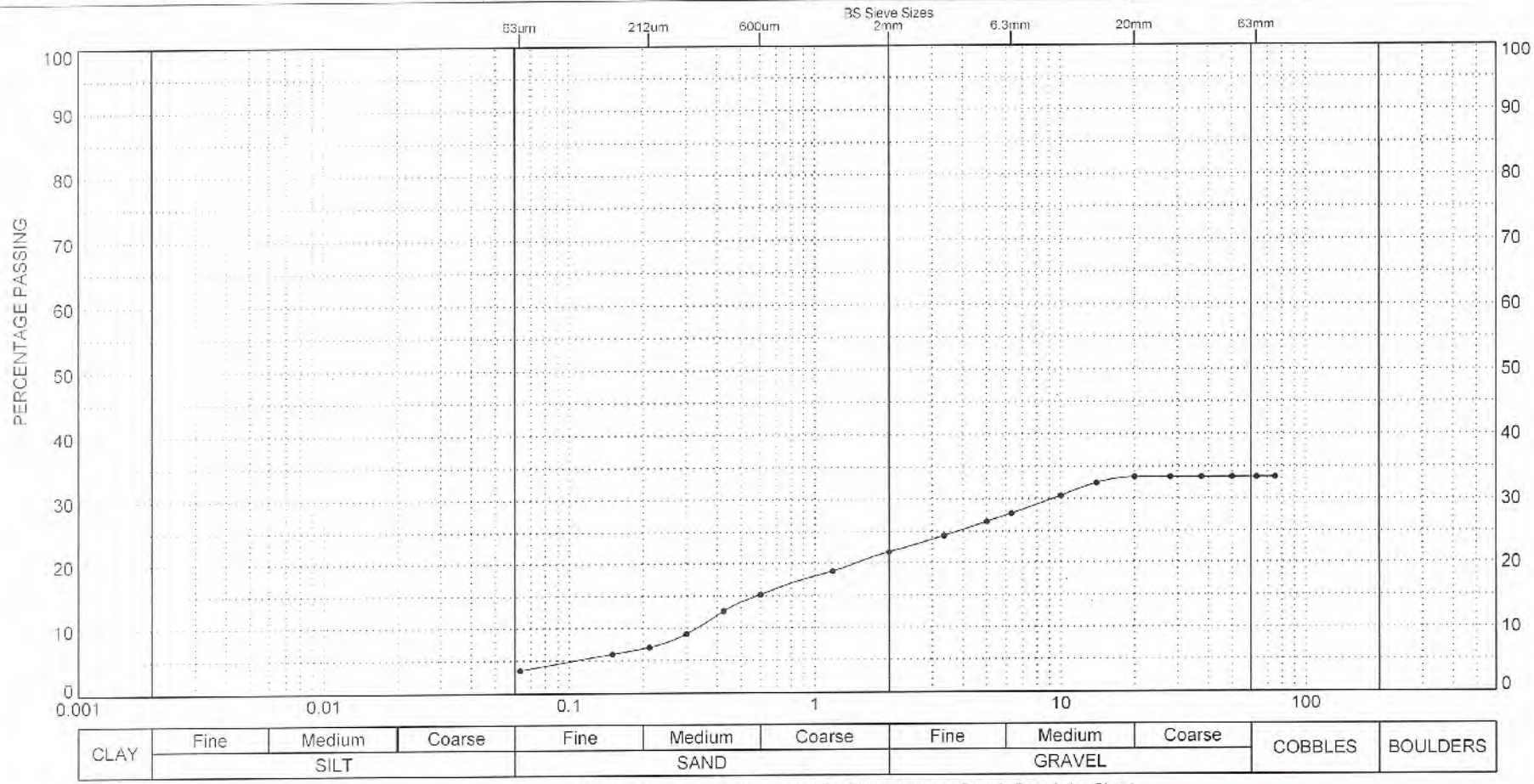
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990
(Test deviated from standard due to insufficient sample mass)

Exploratory Hole No :-	Depth (m) :-	Sample Type & No :-	Specific Depth (m) :-	Date Tested :-
BH106	1.50	B4	1.50	29/01/2019



Sieve Size (mm)	Passing (%)
75	33.4
63	33.4
50	33.4
37.5	33.4
28	33.4
20	33.4
14	32.5
10	30.5
6.3	27.8
5	26.5
3.35	24.4
2	21.7
1.18	18.8
0.6	15.2
0.425	12.6
0.3	9.1
0.212	7.1
0.15	6.0
0.063	3.6

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH106/B4/1.50	MSono	[illegible]	

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING
1367

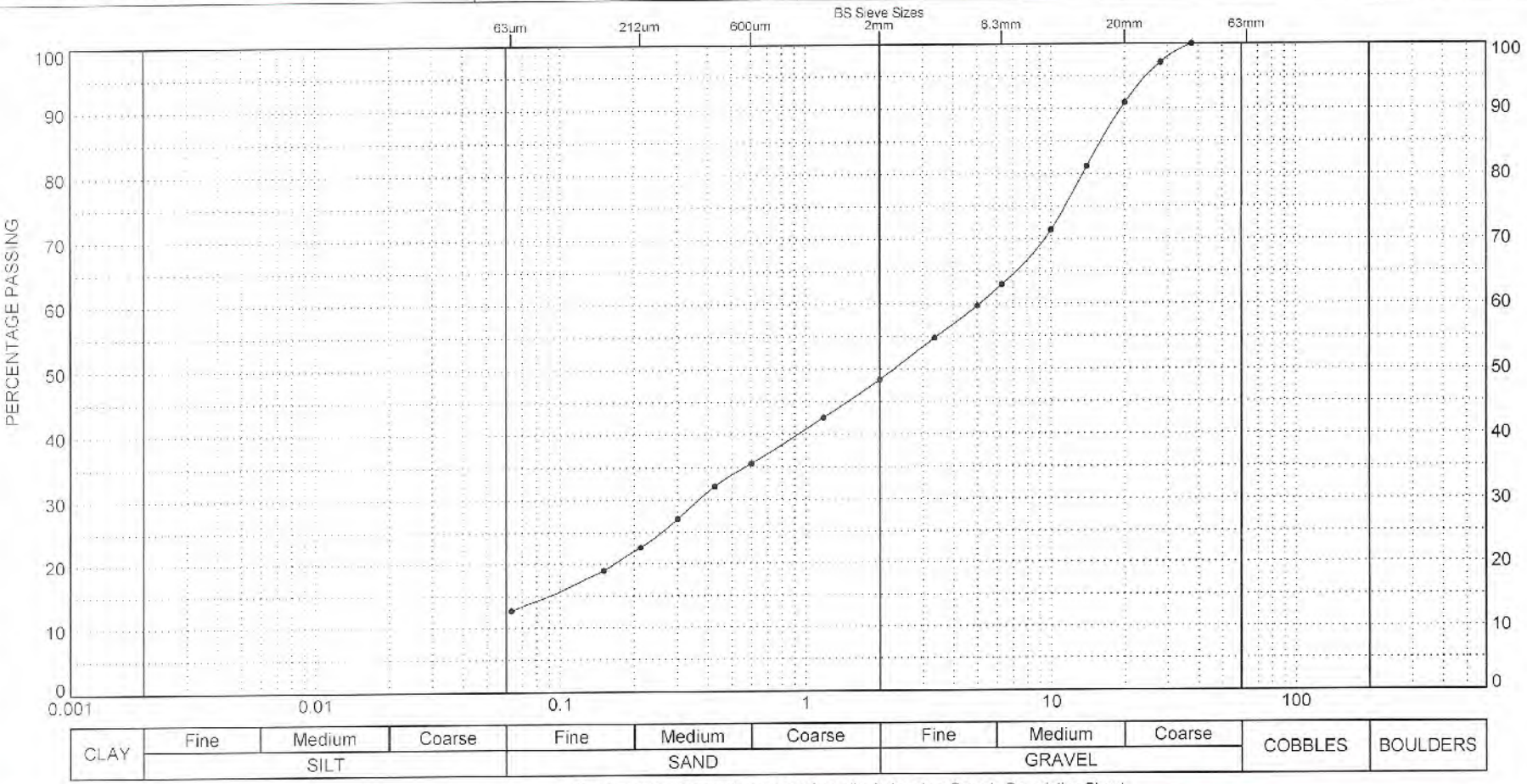
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- BH107	Depth (m) :- 0.20	Sample Type & No :- B3	Specific Depth (m) :- 0.20	Date Tested :- 29/01/2019



Sieve Size (mm)	Passing (%)
37.5	100.0
28	97.1
20	90.9
14	81.2
10	71.4
6.3	63.0
5	59.7
3.35	54.8
2	48.4
1.18	42.6
0.6	35.6
0.425	32.1
0.3	27.1
0.212	22.6
0.15	19.0
0.063	12.7

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH107/B3/0.20			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

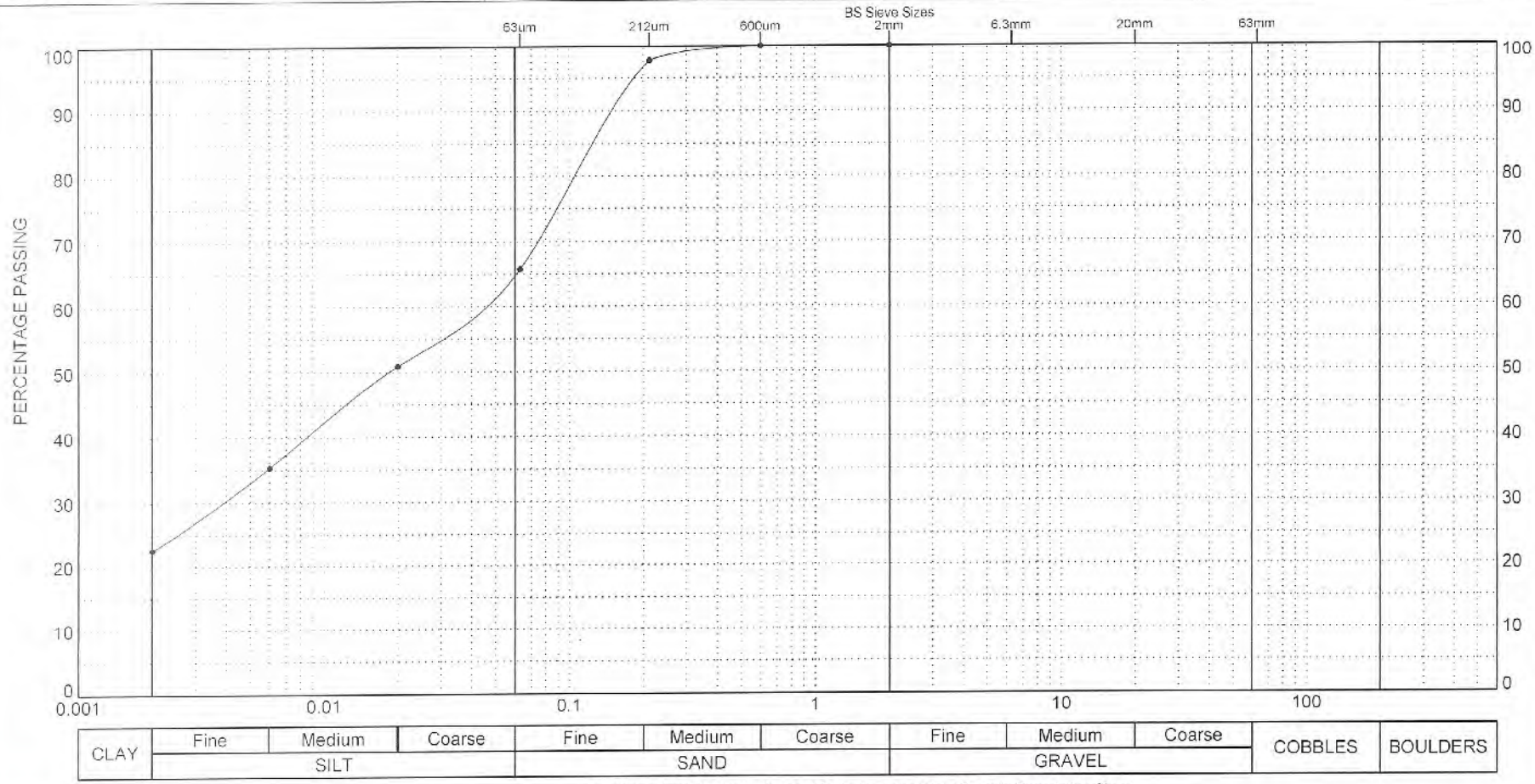
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **BH107**	Depth (m) :- **3.10**	Sample Type & No :- **B13**	Specific Depth (m) :- **3.10**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
2	100.0
0.6	100.0
0.212	97.8
0.063	65.8
0.02	50.9
0.006	35.4
0.002	22.5

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH107/B13/3.10	MSeo	[illegible]	

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

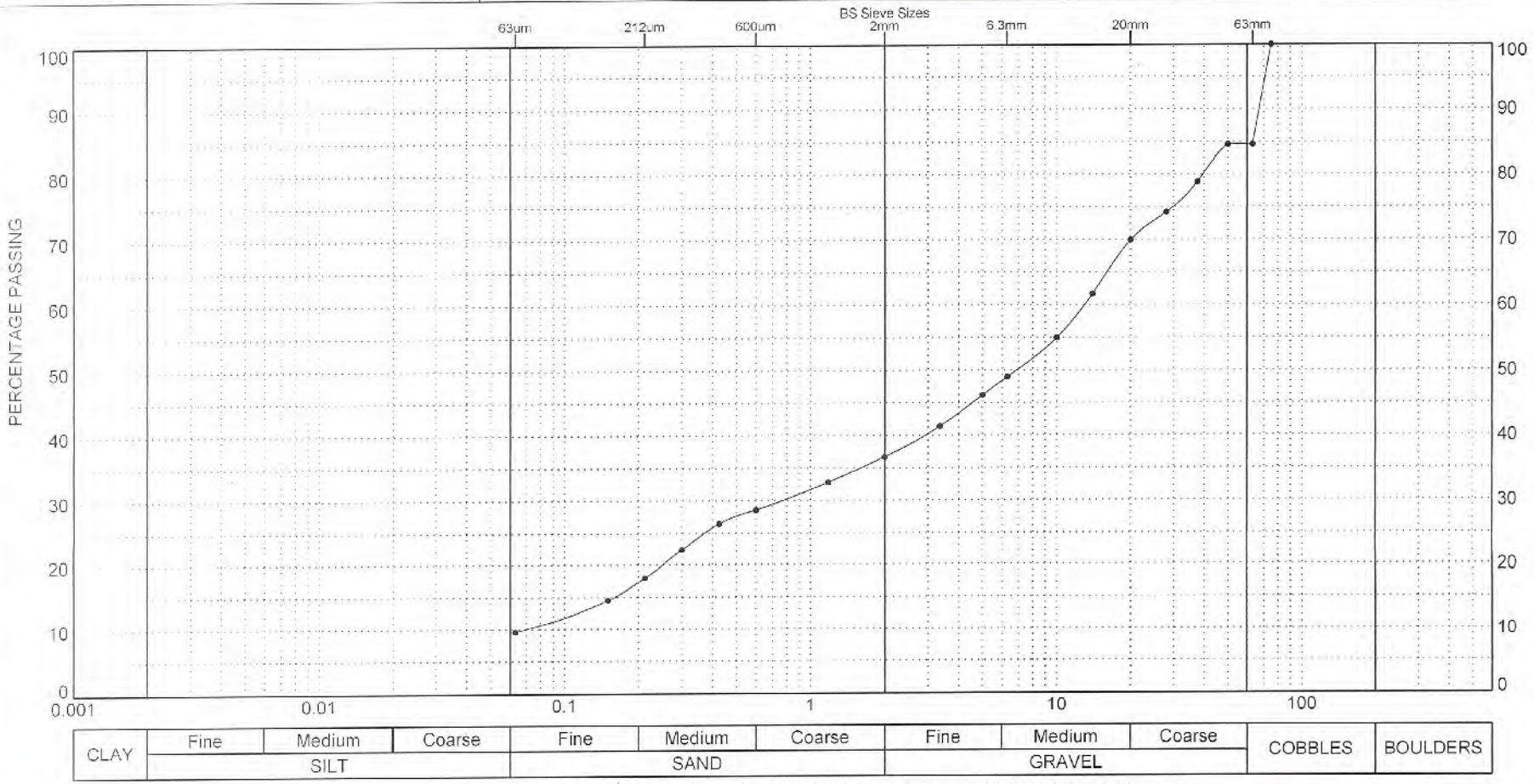
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990
(Test deviated from standard due to insufficient sample mass)

Exploratory Hole No :-	Depth (m) :-	Sample Type & No :-	Specific Depth (m) :-	Date Tested :-
BH109	0.40	B3	0.40	29/01/2019



Sieve Size (mm)	Passing (%)
75	100.0
63	84.6
50	84.6
37.5	78.8
28	74.2
20	69.9
14	61.7
10	55.0
6.3	49.0
5	46.2
3.35	41.4
2	36.7
1.18	32.8
0.6	28.6
0.425	26.5
0.3	22.4
0.212	17.9
0.15	14.5
0.063	9.6

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH109/B3/0.40			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING
1367

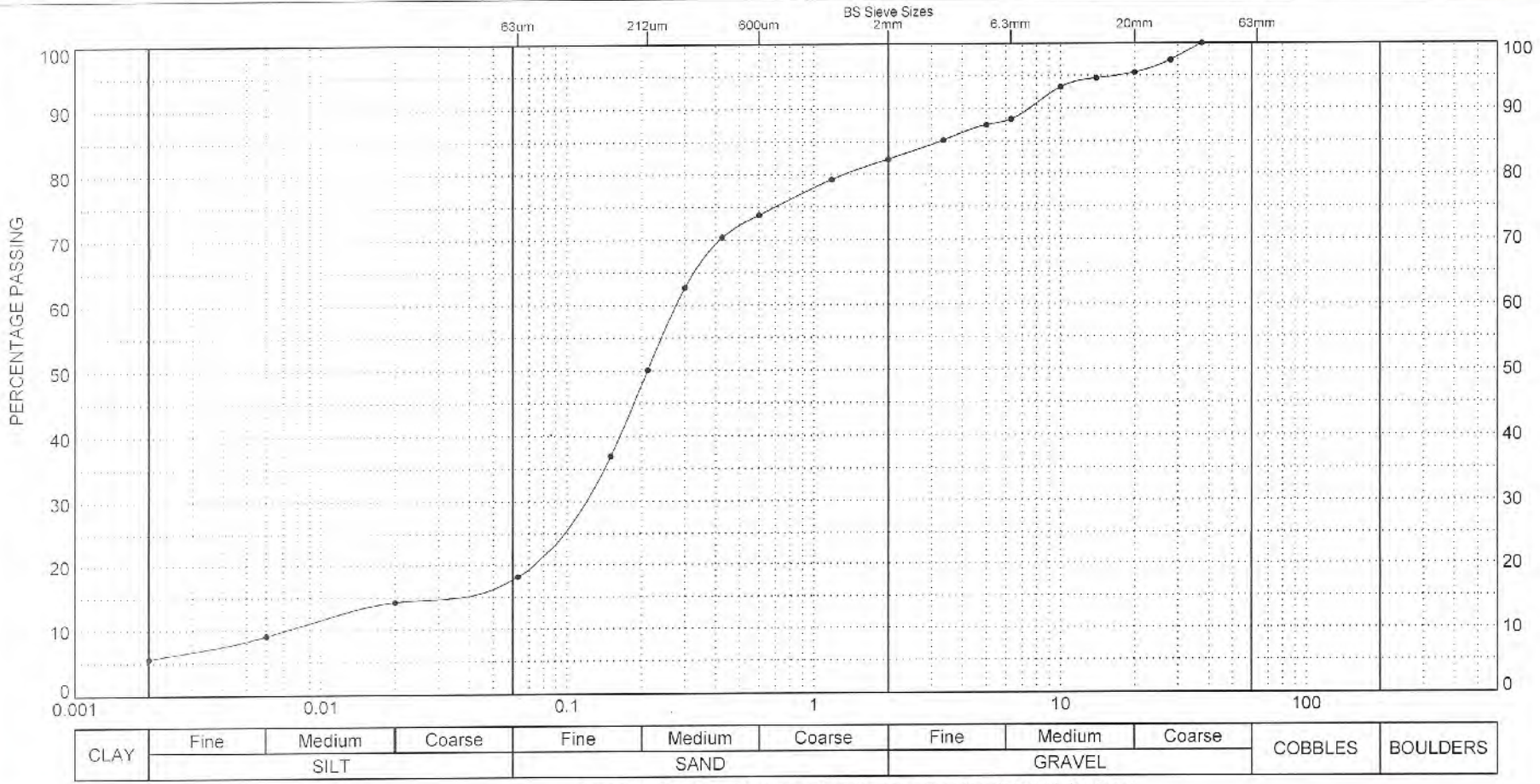
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **BH110**	Depth (m) :- **3.10**	Sample Type & No :- **B9**	Specific Depth (m) :- **3.10**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
37.5	100.0
28	97.4
20	95.5
14	94.6
10	93.3
6.3	88.4
5	87.5
3.35	85.2
2	82.3
1.18	79.2
0.6	73.8
0.425	70.4
0.3	62.7
0.212	50.1
0.15	37.0
0.063	18.1
0.02	14.2
0.006	9.1
0.002	5.6

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH110/B9/3.10			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

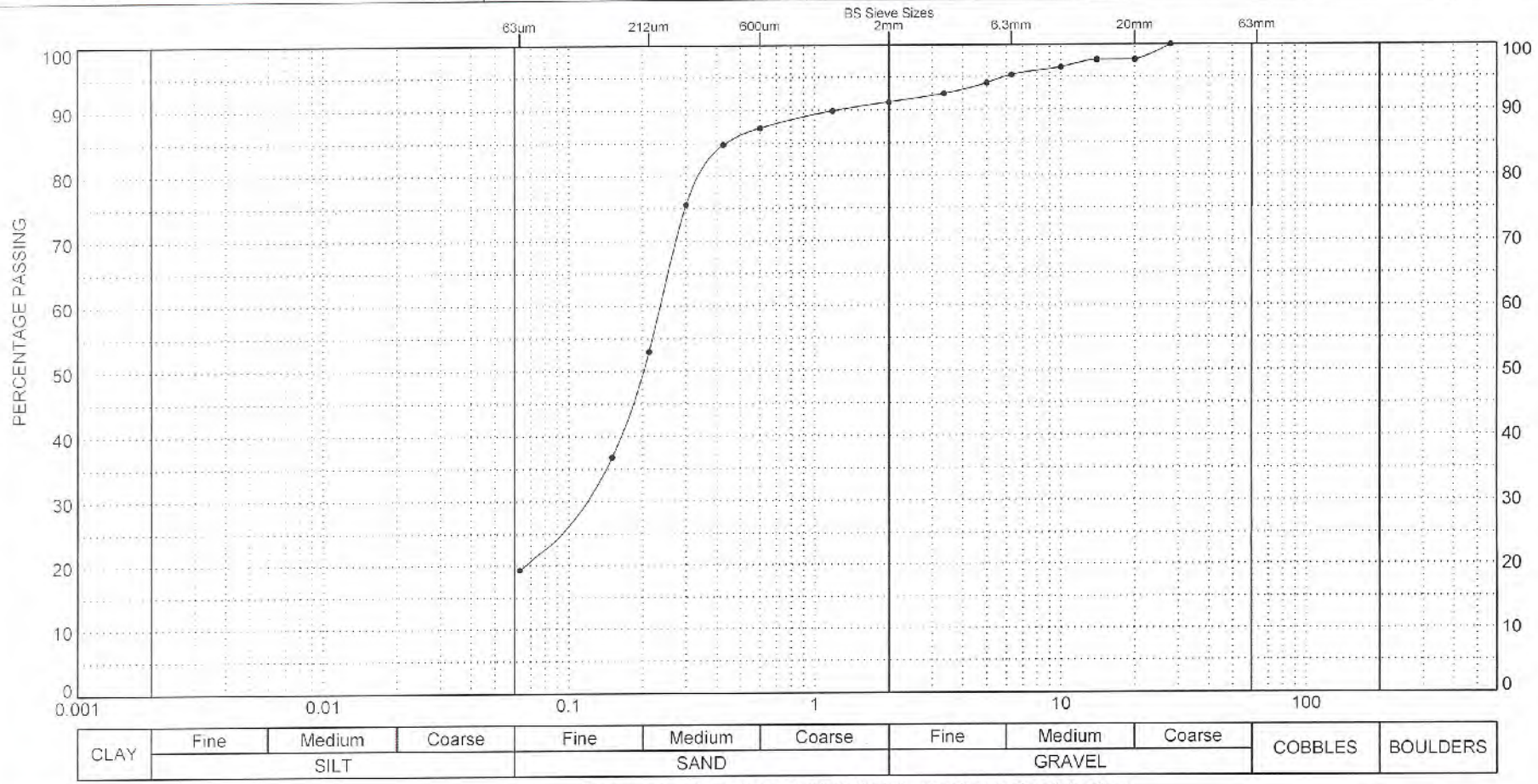
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- BH112	Depth (m) :- **0.60**	Sample Type & No :- B3	Specific Depth (m) :- **0.60**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
28	100.0
20	97.6
14	97.6
10	96.5
6.3	95.3
5	94.1
3.35	92.5
2	91.2
1.18	89.9
0.6	87.3
0.425	84.8
0.3	75.6
0.212	53.0
0.15	36.8
0.063	19.3

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/BH112/B3/0.60	MSND	[illegible]	

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

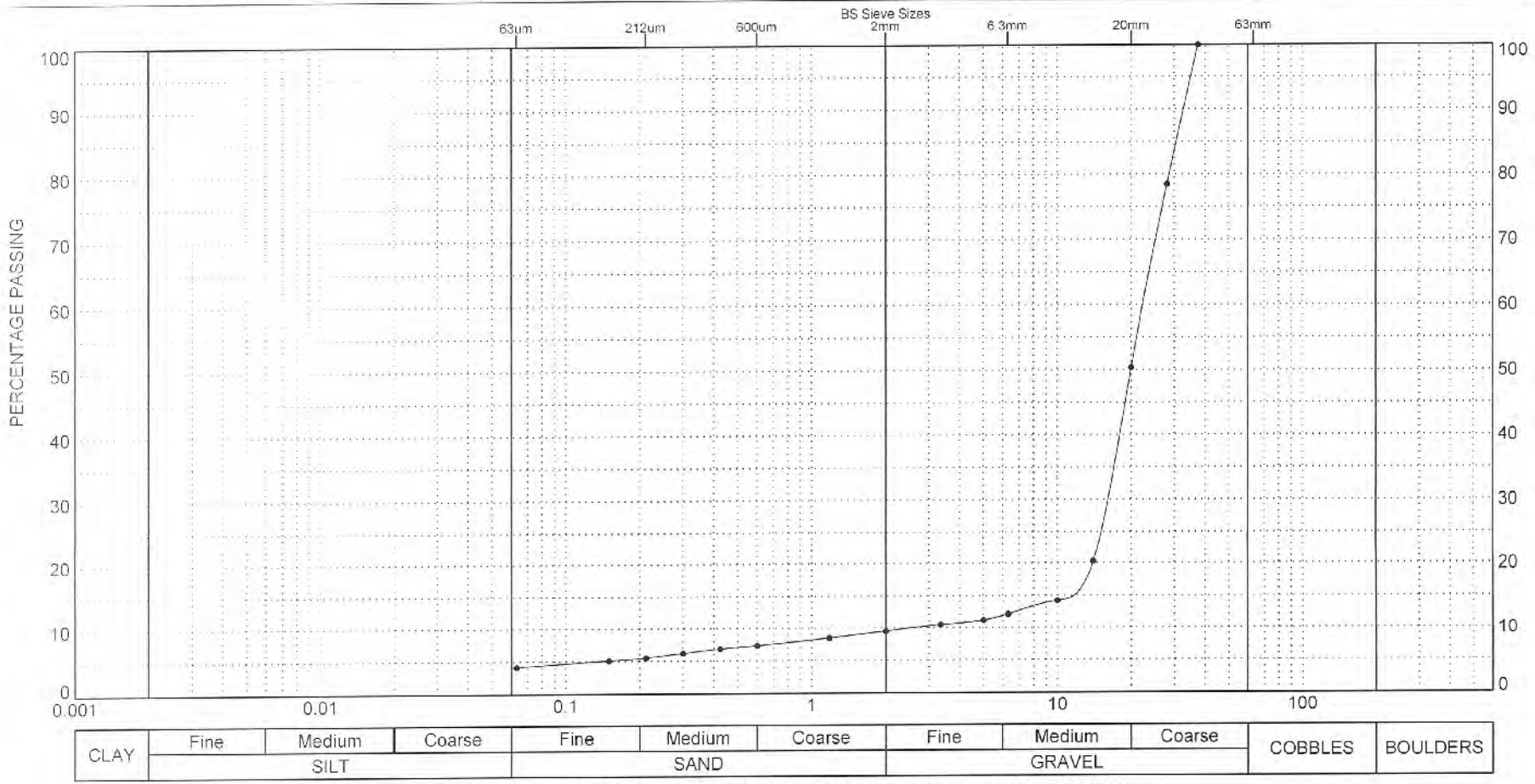
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990
(Test deviated from standard due to insufficient sample mass)

Exploratory Hole No :-	Depth (m) :-	Sample Type & No :-	Specific Depth (m) :-	Date Tested :-
TP101	0.80	LB3	0.80	30/01/2019



Sieve Size (mm)	Passing (%)
37.5	100.0
28	78.5
20	50.4
14	20.3
10	14.2
6.3	12.1
5	11.2
3.35	10.5
2	9.5
1.18	8.5
0.6	7.4
0.425	6.9
0.3	6.2
0.212	5.5
0.15	5.1
0.063	4.2

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/TP101/LB3/0.80			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

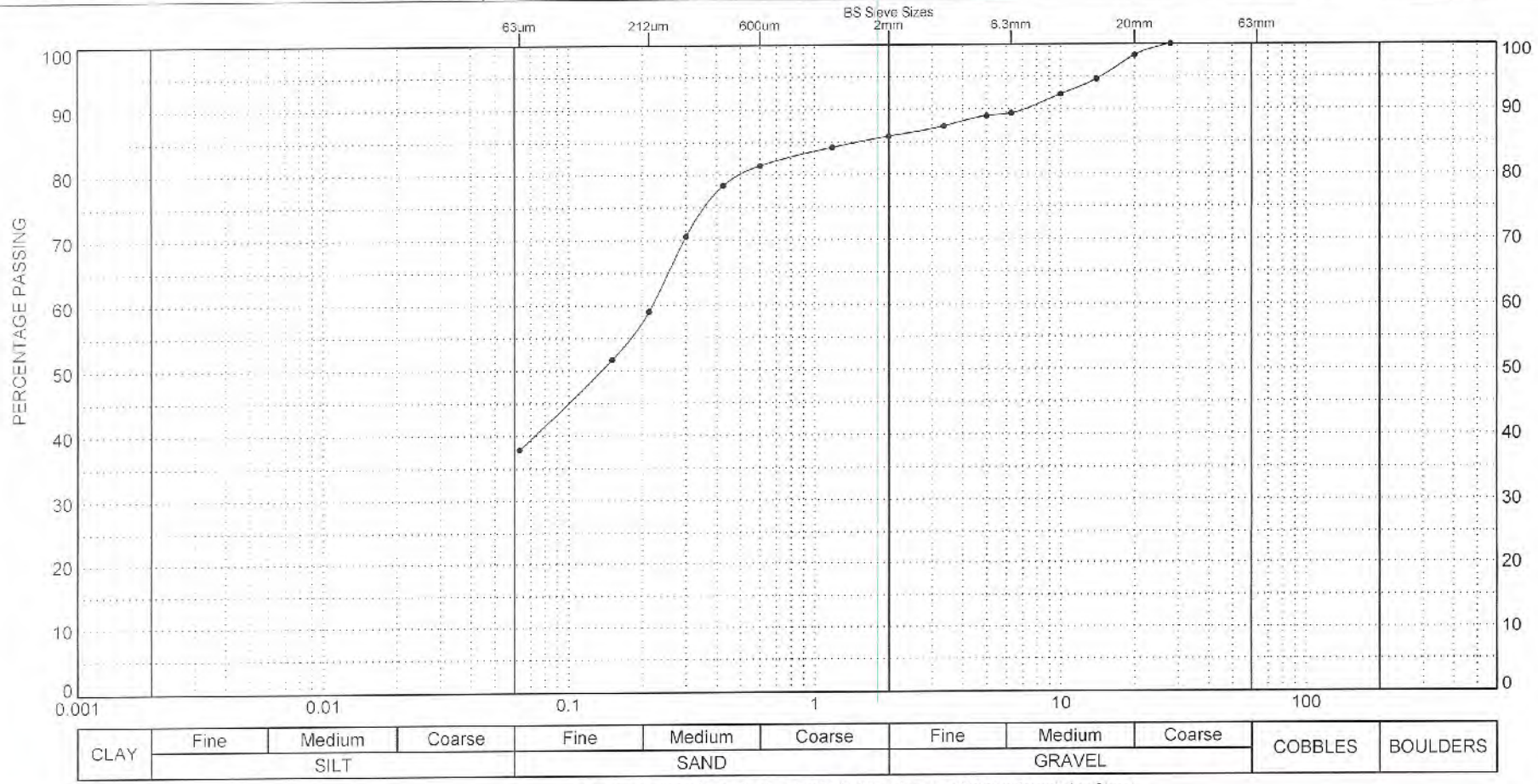
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- TP101	Depth (m) :- 1.80	Sample Type & No :- LB6	Specific Depth (m) :- 1.80	Date Tested :- 29/01/2019



Sieve Size (mm)	Passing (%)
28	100.0
20	98.2
14	94.6
10	92.3
6.3	89.4
5	89.0
3.35	87.4
2	85.9
1.18	84.2
0.6	81.4
0.425	78.4
0.3	70.6
0.212	59.1
0.15	51.7
0.063	37.9

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/TP101/LB6/1.80			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

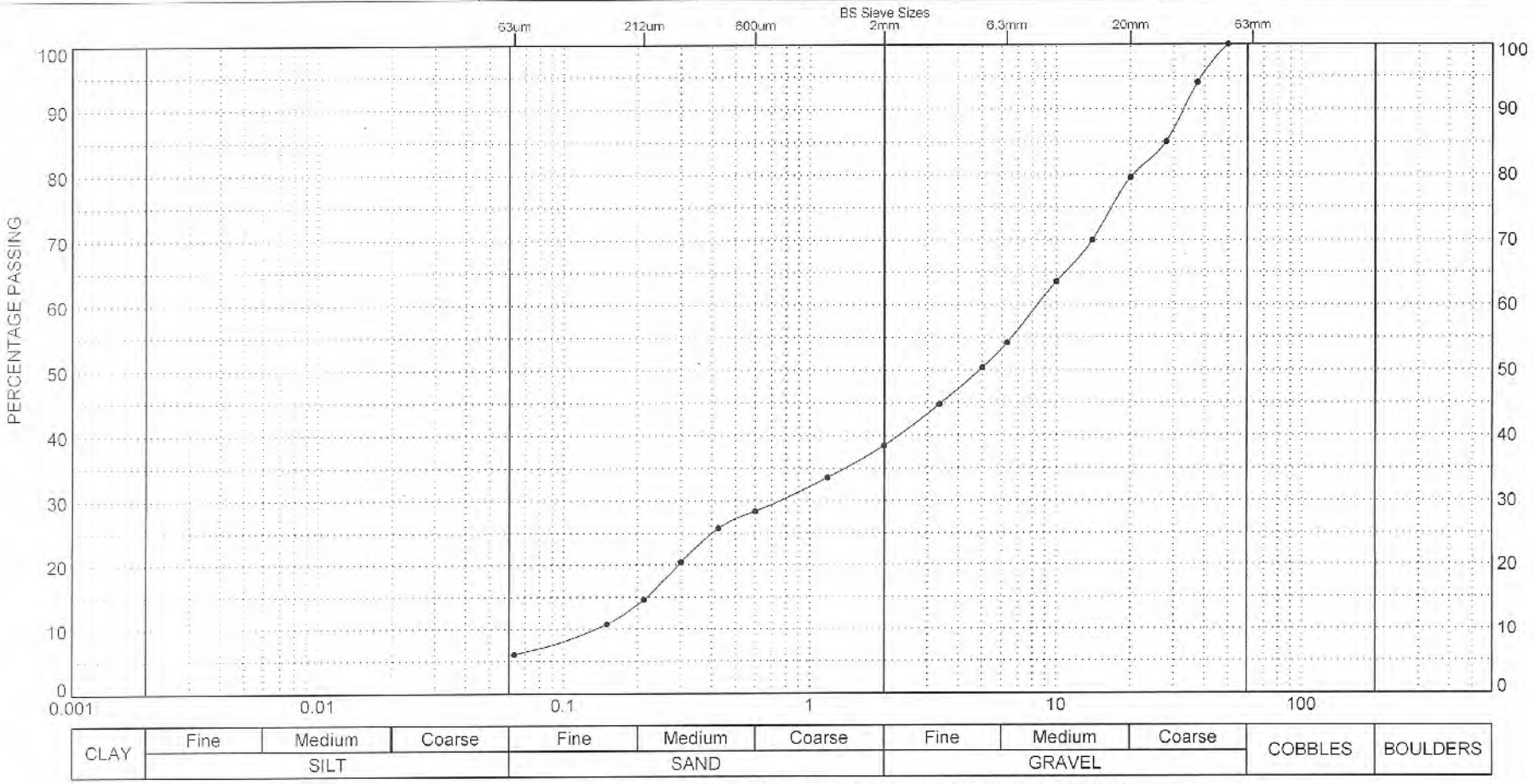
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- TP104	Depth (m) :- 0.80	Sample Type & No :- LB3	Specific Depth (m) :- 0.80	Date Tested :- 29/01/2019



Sieve Size (mm)	Passing (%)
50	100.0
37.5	94.1
28	85.1
20	79.6
14	70.0
10	63.6
6.3	54.2
5	50.4
3.35	44.8
2	38.5
1.18	33.6
0.6	28.4
0.425	25.8
0.3	20.4
0.212	14.6
0.15	10.8
0.063	6.1

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :- 13/02/2019	Certificate No :- PSD/NW1580/TP104/LB3/0.80	Signed :-	Name :-	Page 1 of 1
Client :- Far East Consortium International Limited	Contract Title :- Northern Gateway			AEG Contract No :- NW1580

UKAS TESTING 1367

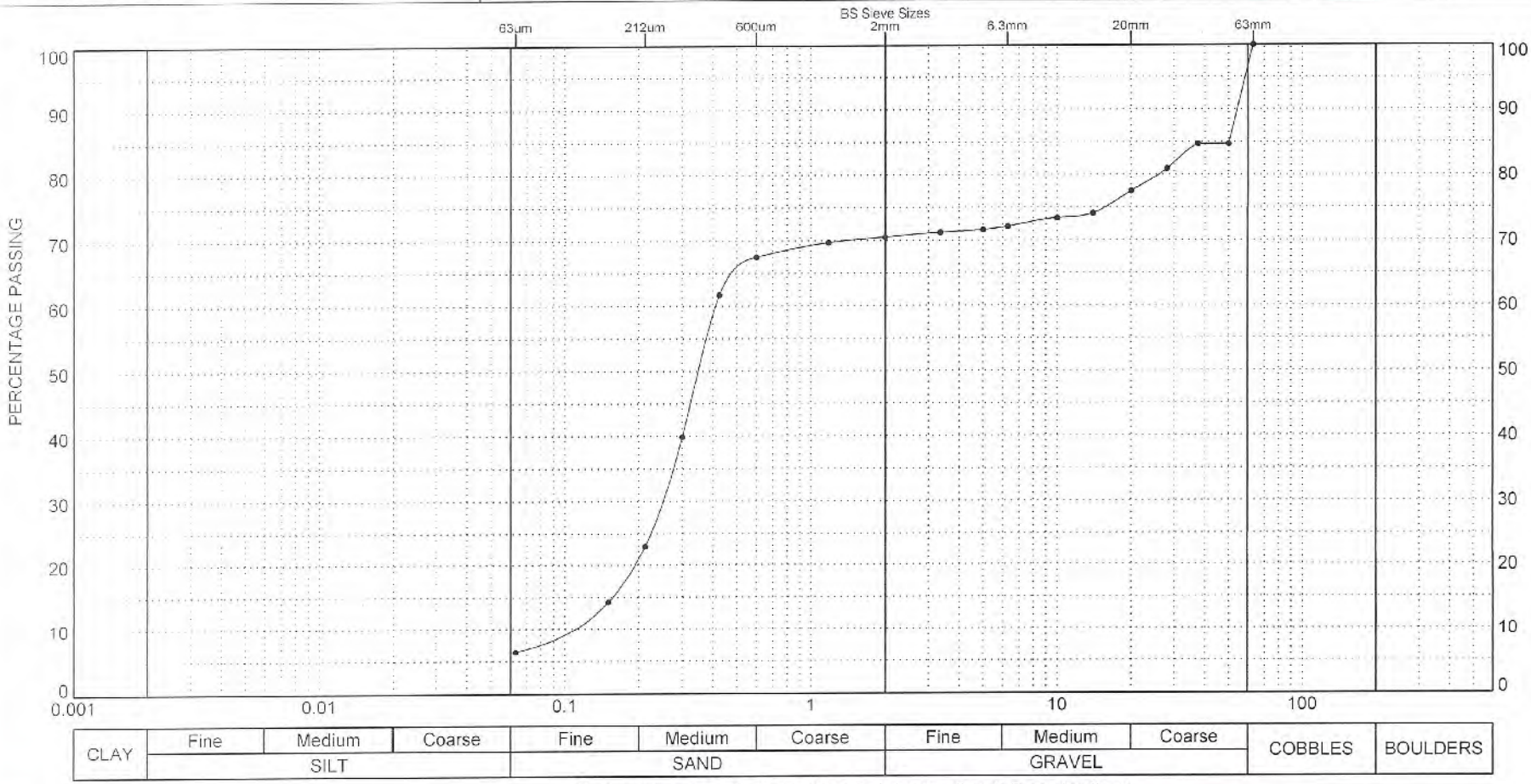
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **TP104**	Depth (m) :- **1.80**	Sample Type & No :- **LB6**	Specific Depth (m) :- **1.80**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
63	100.0
50	84.7
37.5	84.7
28	80.9
20	77.5
14	74.1
10	73.4
6.3	72.1
5	71.6
3.35	71.2
2	70.5
1.18	69.7
0.6	67.5
0.425	61.7
0.3	39.9
0.212	23.0
0.15	14.2
0.063	6.5

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of **1**
13/02/2019	PSD/NW1580/TP104/LB6/1.80			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

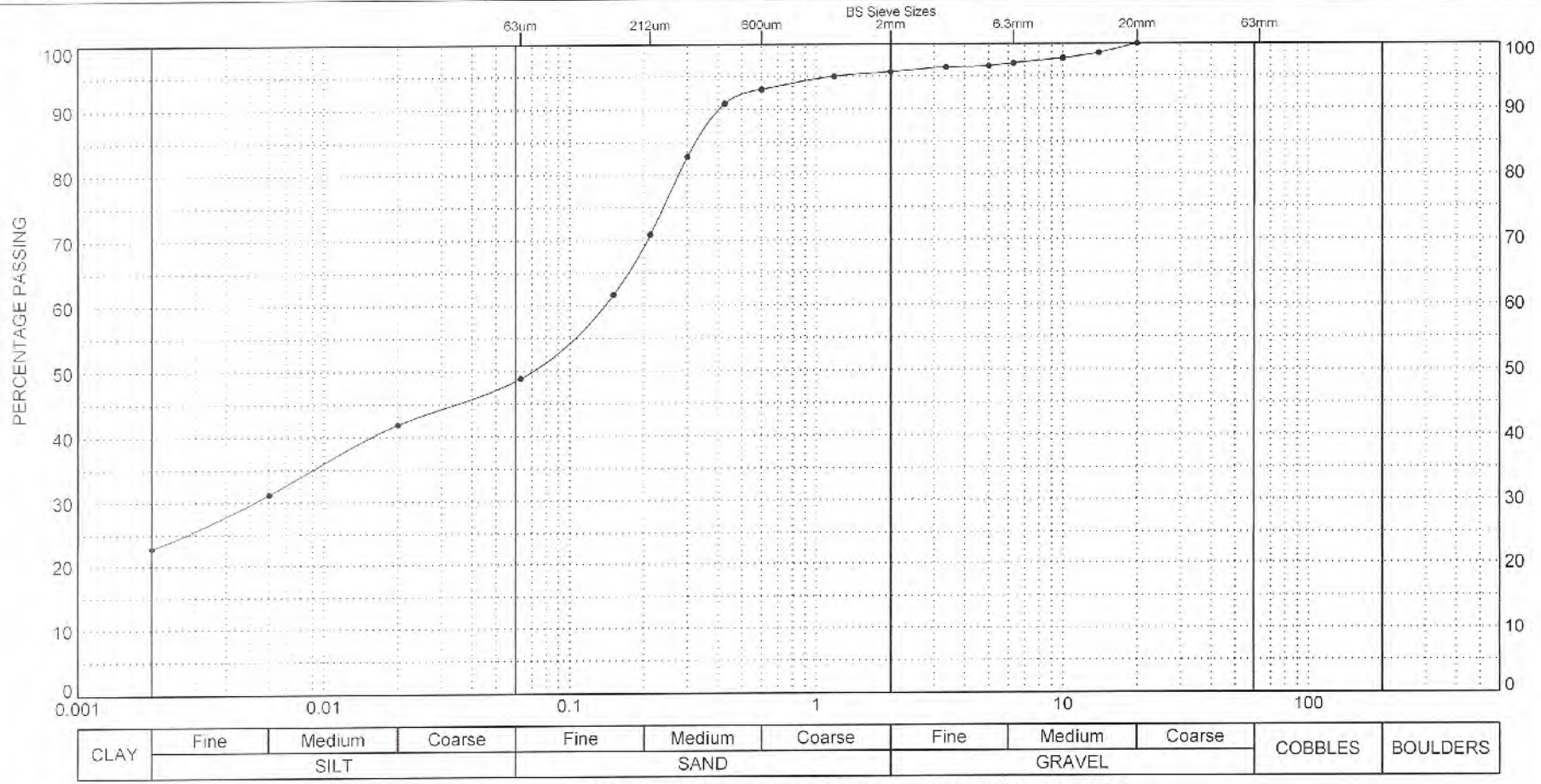
ALLIED EXPLORATION & GEOTECHNICS LIMITED

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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- TP108	Depth (m) :- **1.60**	Sample Type & No :- **LB6**	Specific Depth (m) :- **1.60**	Date Tested :- **30/01/2019**



Sieve Size (mm)	Passing (%)
20	100.0
14	98.5
10	97.7
6.3	97.0
5	96.6
3.35	96.4
2	95.7
1.18	95.0
0.6	93.1
0.425	90.9
0.3	82.8
0.212	70.9
0.15	61.7
0.063	48.9
0.02	41.9
0.006	31.2
0.002	22.7

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/TP108/LB6/1.60	MSone		

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

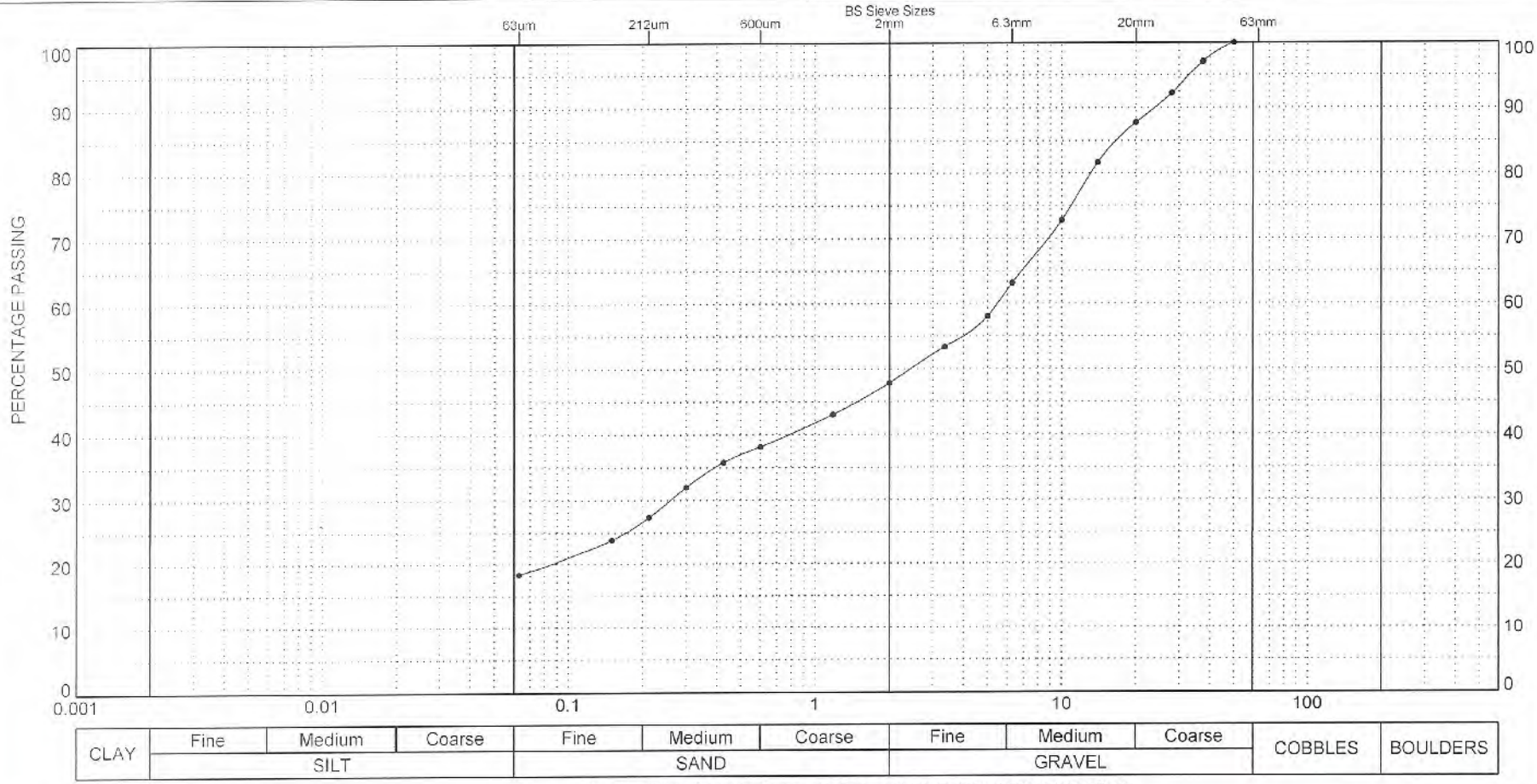
ALLIED EXPLORATION & GEOTECHNICS LIMITED

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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- TP109	Depth (m) :- 1.60	Sample Type & No :- B6	Specific Depth (m) :- 1.60	Date Tested :- 01/02/2019



Sieve Size (mm)	Passing (%)
50	100.0
37.5	97.1
28	92.3
20	87.8
14	81.7
10	72.8
6.3	63.2
5	58.1
3.35	53.4
2	47.9
1.18	43.1
0.6	38.2
0.425	35.8
0.3	32.0
0.212	27.4
0.15	23.9
0.063	18.3

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/TP109/B6/1.60			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

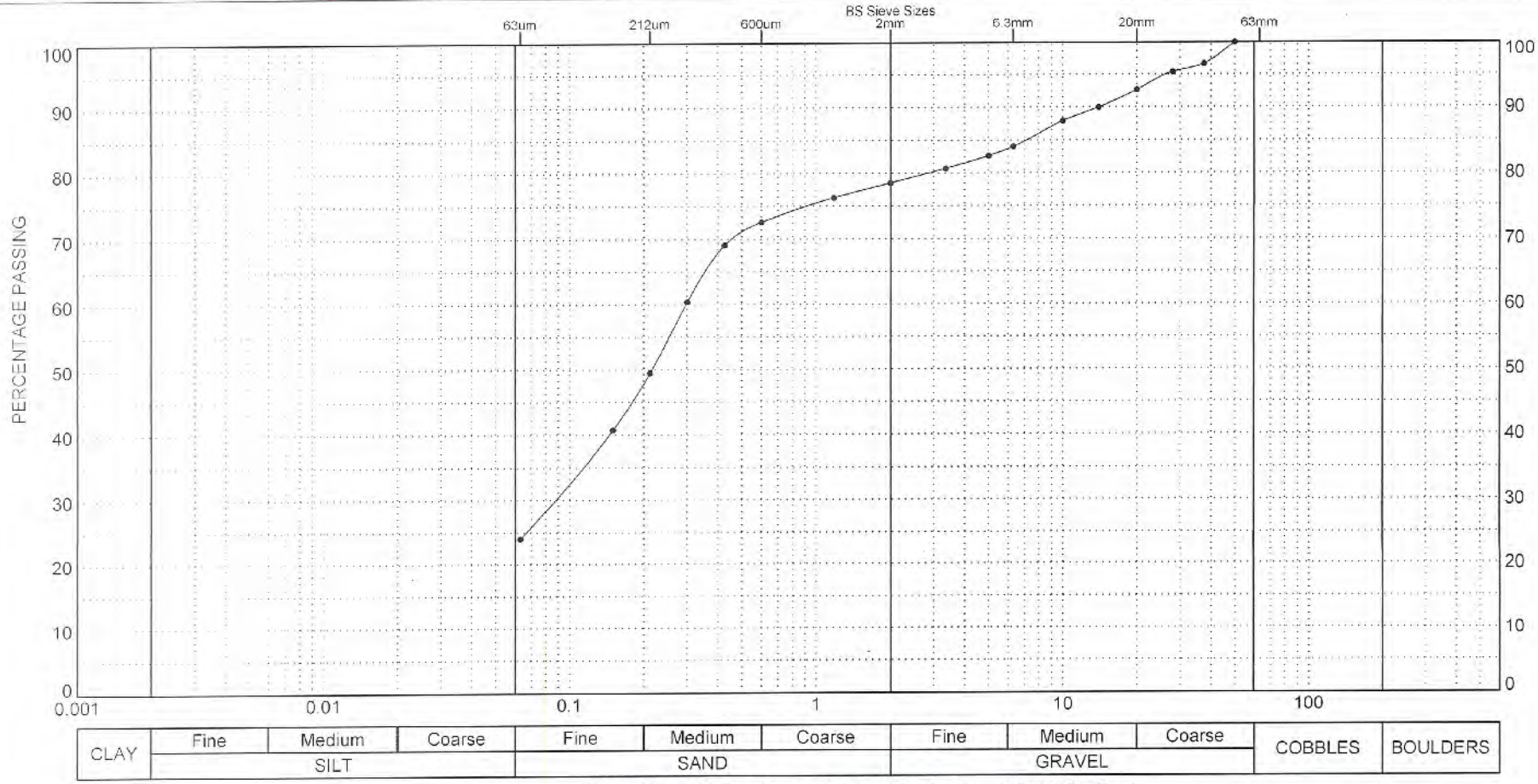
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- TP112	Depth (m) :- **0.80**	Sample Type & No :- **LB3**	Specific Depth (m) :- **0.80**	Date Tested :- **30/01/2019**



Sieve Size (mm)	Passing (%)
50	100.0
37.5	96.7
28	95.4
20	92.7
14	90.0
10	87.9
6.3	84.0
5	82.6
3.35	80.7
2	78.5
1.18	76.3
0.6	72.6
0.425	69.1
0.3	60.4
0.212	49.5
0.15	40.8
0.063	24.1

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/TP112/LB3/0.80	mseng		

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

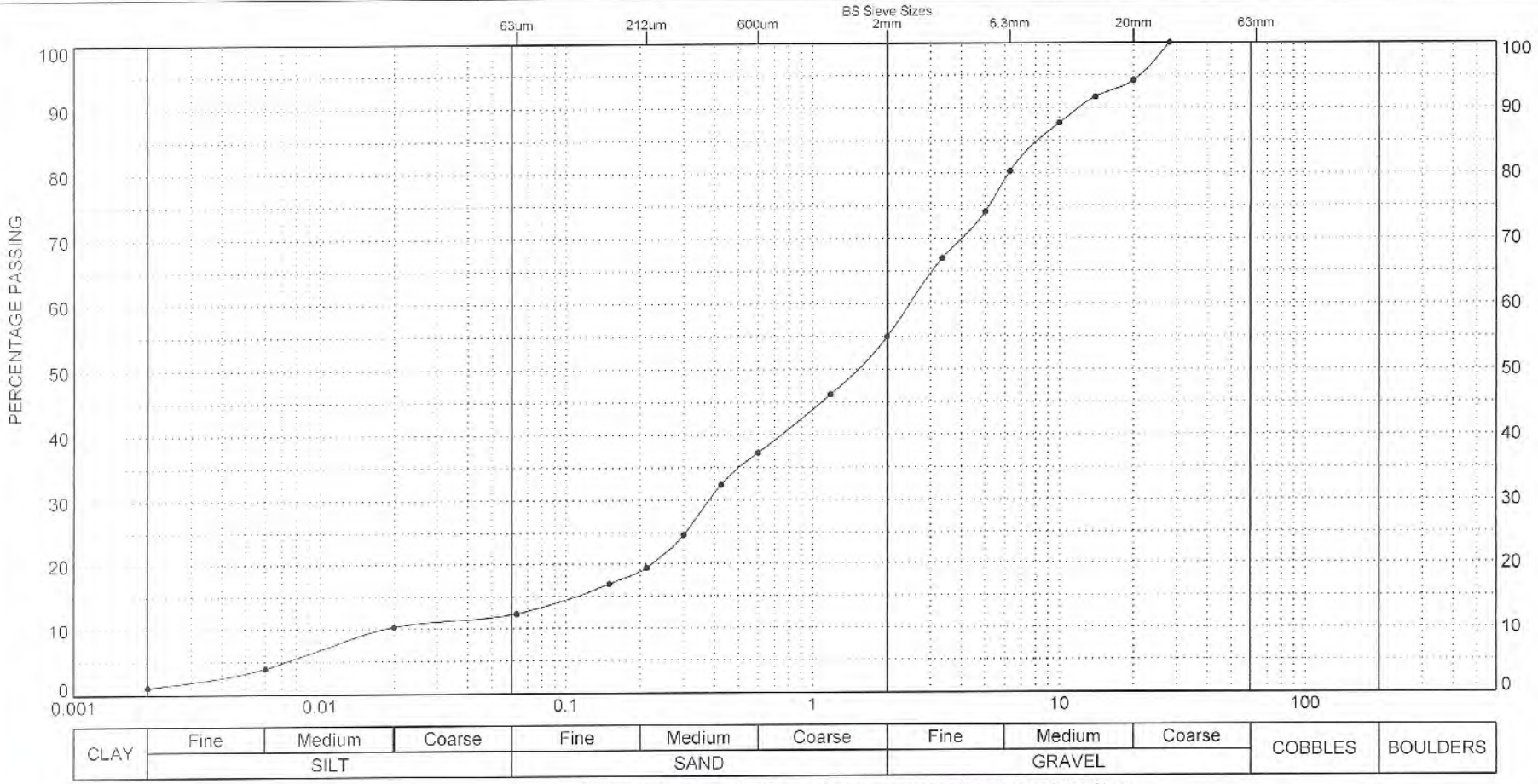
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Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **TP115**	Depth (m) :- **0.80**	Sample Type & No :- **LB3**	Specific Depth (m) :- **0.80**	Date Tested :- **30/01/2019**



Sieve Size (mm)	Passing (%)
28	100.0
20	94.2
14	91.7
10	87.7
6.3	80.3
5	74.1
3.35	67.0
2	55.0
1.18	46.2
0.6	37.3
0.425	32.4
0.3	24.7
0.212	19.4
0.15	16.8
0.063	12.3
0.02	10.3
0.006	4.0
0.002	1.1

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of **1**
13/02/2019	PSD/NW1580/TP115/LB3/0.80			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

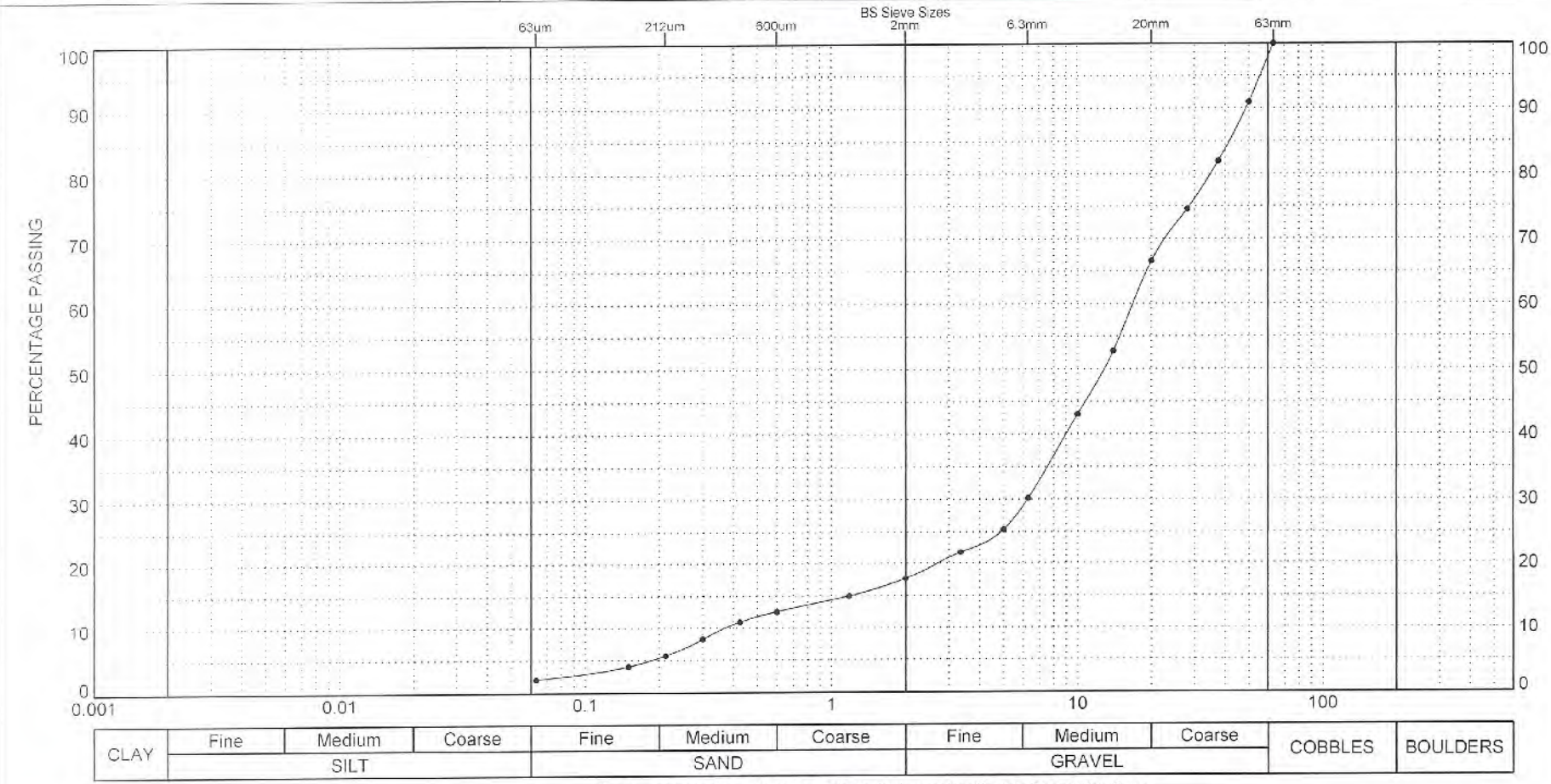
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990
(Test deviated from standard due to insufficient sample mass)

Exploratory Hole No :-	Depth (m) :-	Sample Type & No :-	Specific Depth (m) :-	Date Tested :-
TP119	0.40	B3	0.40	30/01/2019



Sieve Size (mm)	Passing (%)
63	100.0
50	91.0
37.5	82.0
28	74.6
20	66.6
14	52.8
10	43.1
6.3	30.2
5	25.4
3.35	21.7
2	17.6
1.18	15.0
0.6	12.5
0.425	11.0
0.3	8.3
0.212	5.7
0.15	4.1
0.063	2.1

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/TP119/B3/0.40			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING
1367

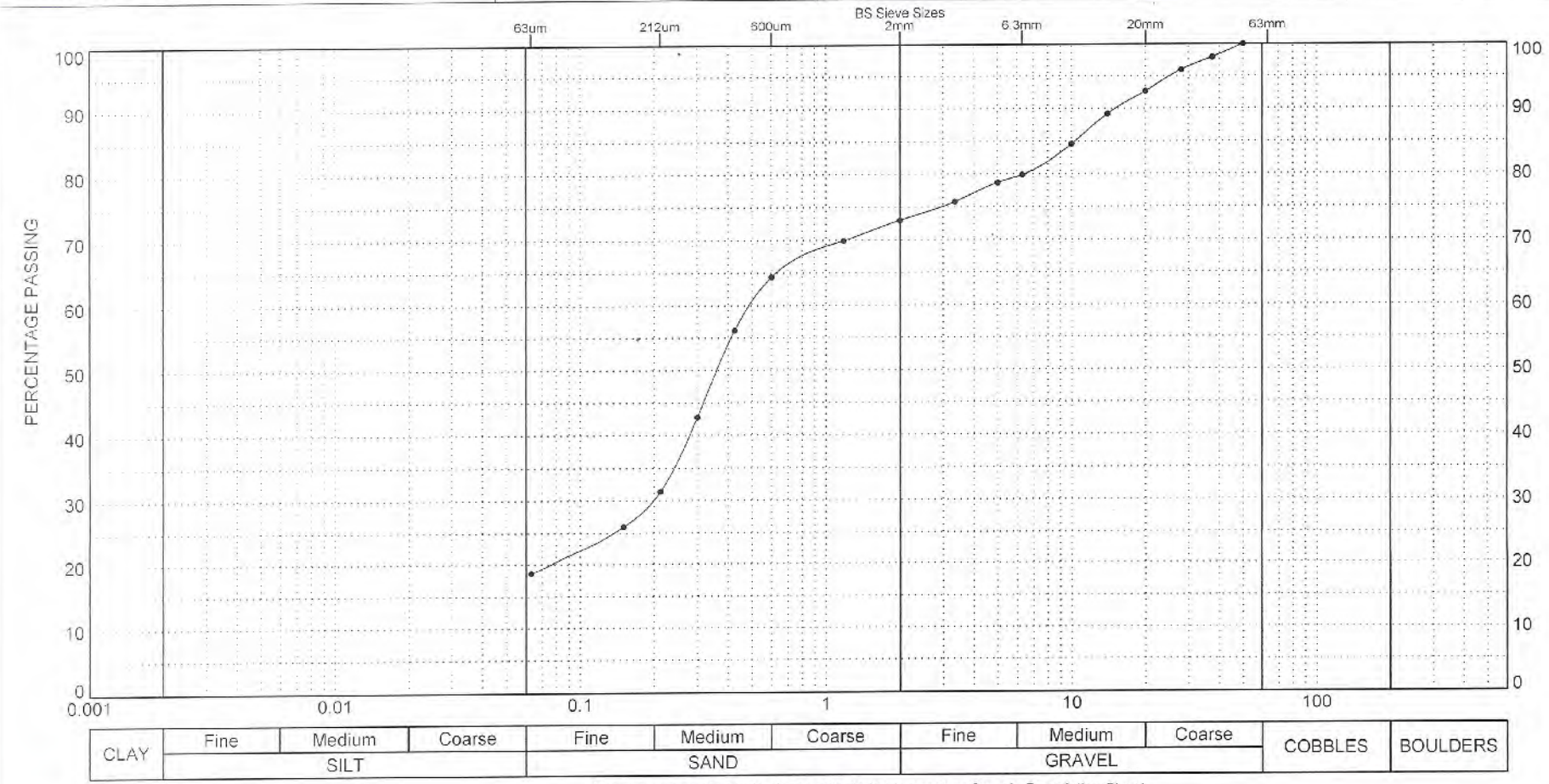
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Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- TP121	Depth (m) :- **0.80**	Sample Type & No :- **LB3**	Specific Depth (m) :- **0.80**	Date Tested :- **31/01/2019**



Sieve Size (mm)	Passing (%)
50	100.0
37.5	97.9
28	96.0
20	92.7
14	89.2
10	84.6
6.3	79.9
5	78.7
3.35	75.8
2	73.0
1.18	69.9
0.6	64.4
0.425	56.2
0.3	42.8
0.212	31.4
0.15	26.0
0.063	18.6

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :- 13/02/2019	Certificate No :- PSD/NW1580/TP121/LB3/0.80	Signed :-	Name :-	Page 1 of 1
Client :- Far East Consortium International Limited	Contract Title :- Northern Gateway			AEG Contract No :- NW1580

UKAS TESTING 1367

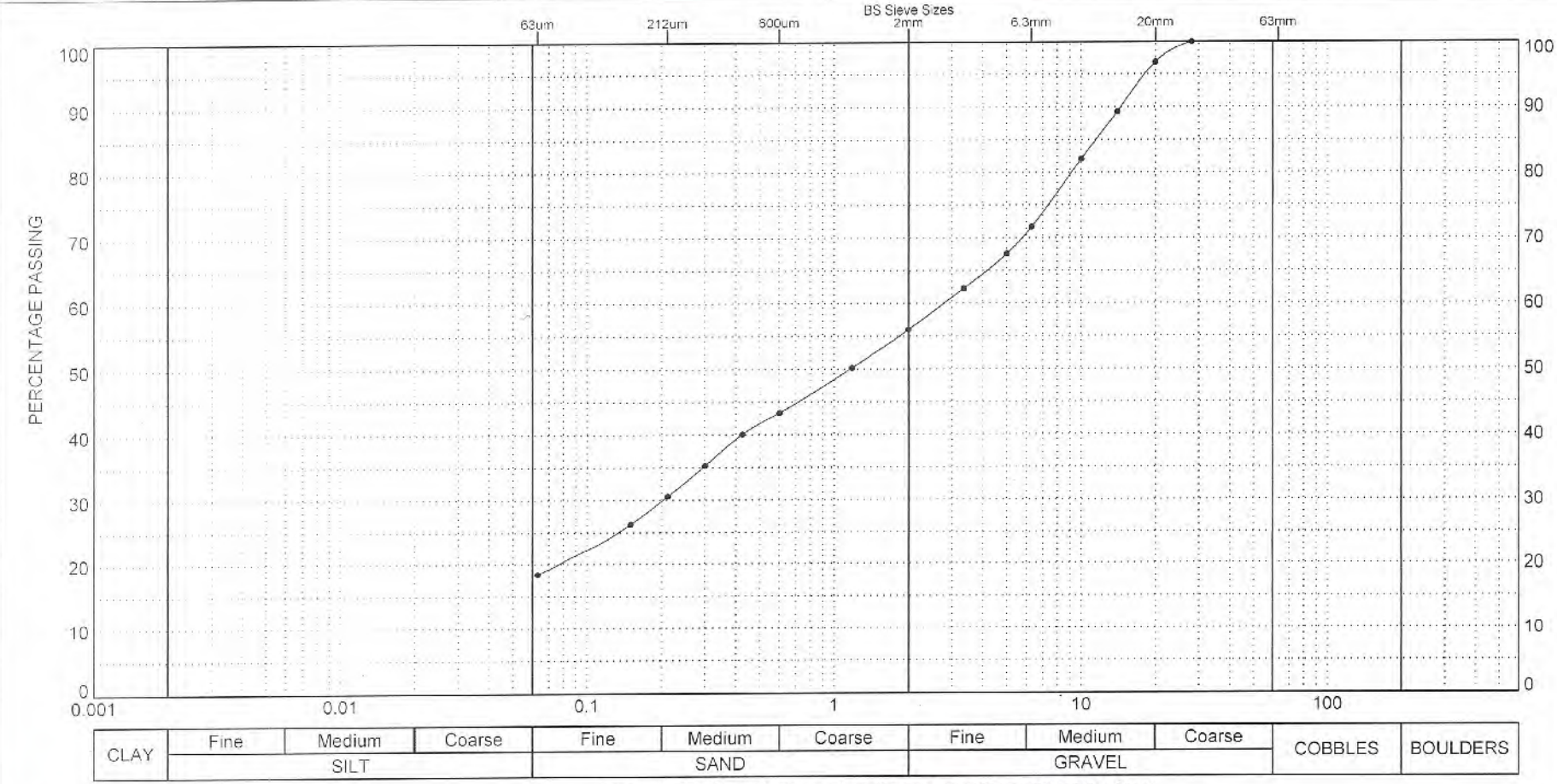
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **TP124**	Depth (m) :- **0.80**	Sample Type & No :- **LB4**	Specific Depth (m) :- **0.80**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
28	100.0
20	96.9
14	89.3
10	82.1
6.3	71.7
5	67.6
3.35	62.3
2	56.0
1.18	50.2
0.6	43.4
0.425	40.1
0.3	35.3
0.212	30.6
0.15	26.3
0.063	18.4

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/TP124/LB4/0.80			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

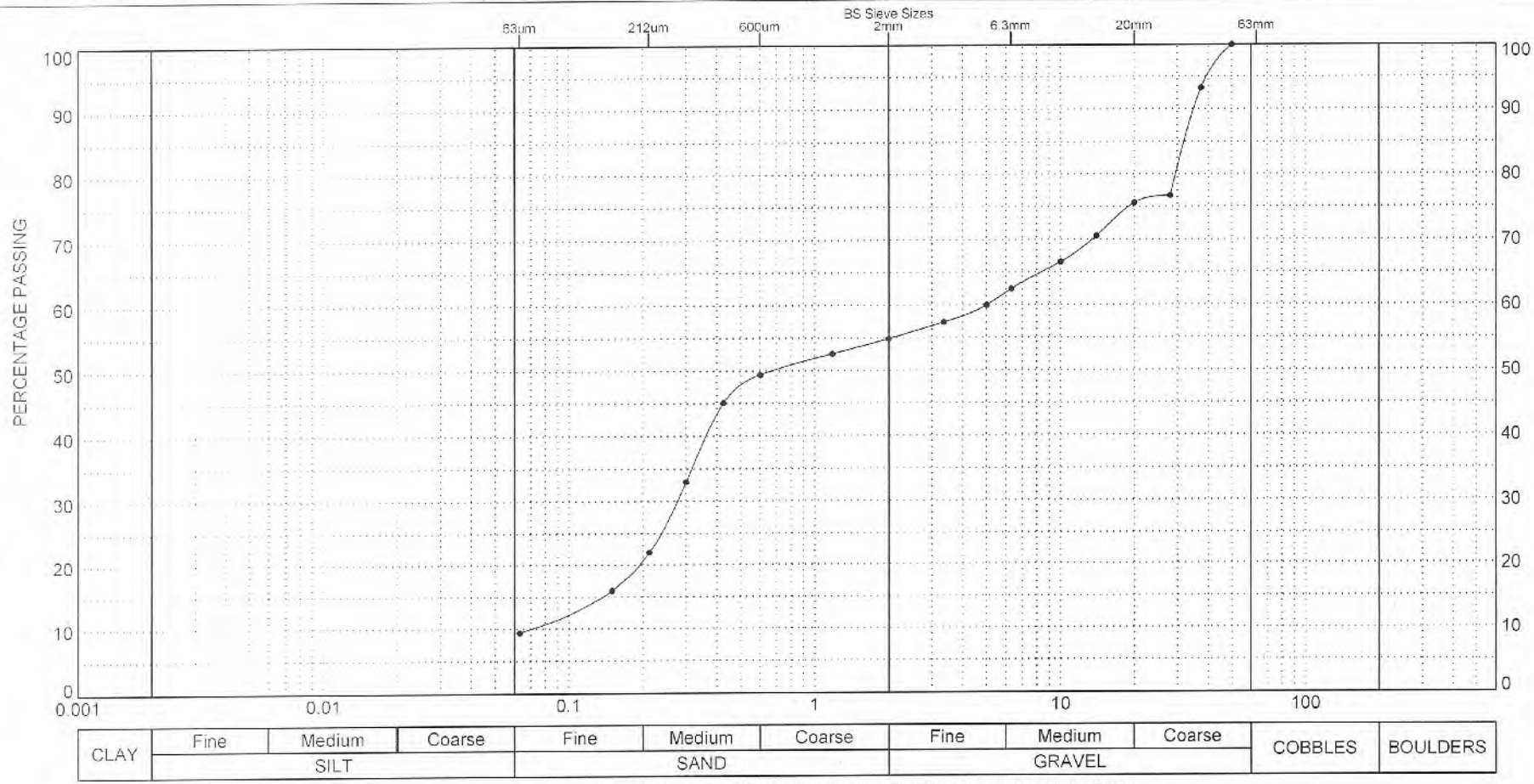
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Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990
(Test deviated from standard due to insufficient sample mass)

Exploratory Hole No :- **WS102**	Depth (m) :- **1.20**	Sample Type & No :- **U7**	Specific Depth (m) :- **1.20**	Date Tested :- **30/01/2019**



Sieve Size (mm)	Passing (%)
50	100.0
37.5	93.3
28	76.7
20	75.6
14	70.6
10	66.6
6.3	62.5
5	60.0
3.35	57.4
2	54.9
1.18	52.6
0.6	49.4
0.425	45.1
0.3	33.0
0.212	21.9
0.15	16.0
0.063	9.4

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/WS102/U7/1.20	MSore		

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING
1367

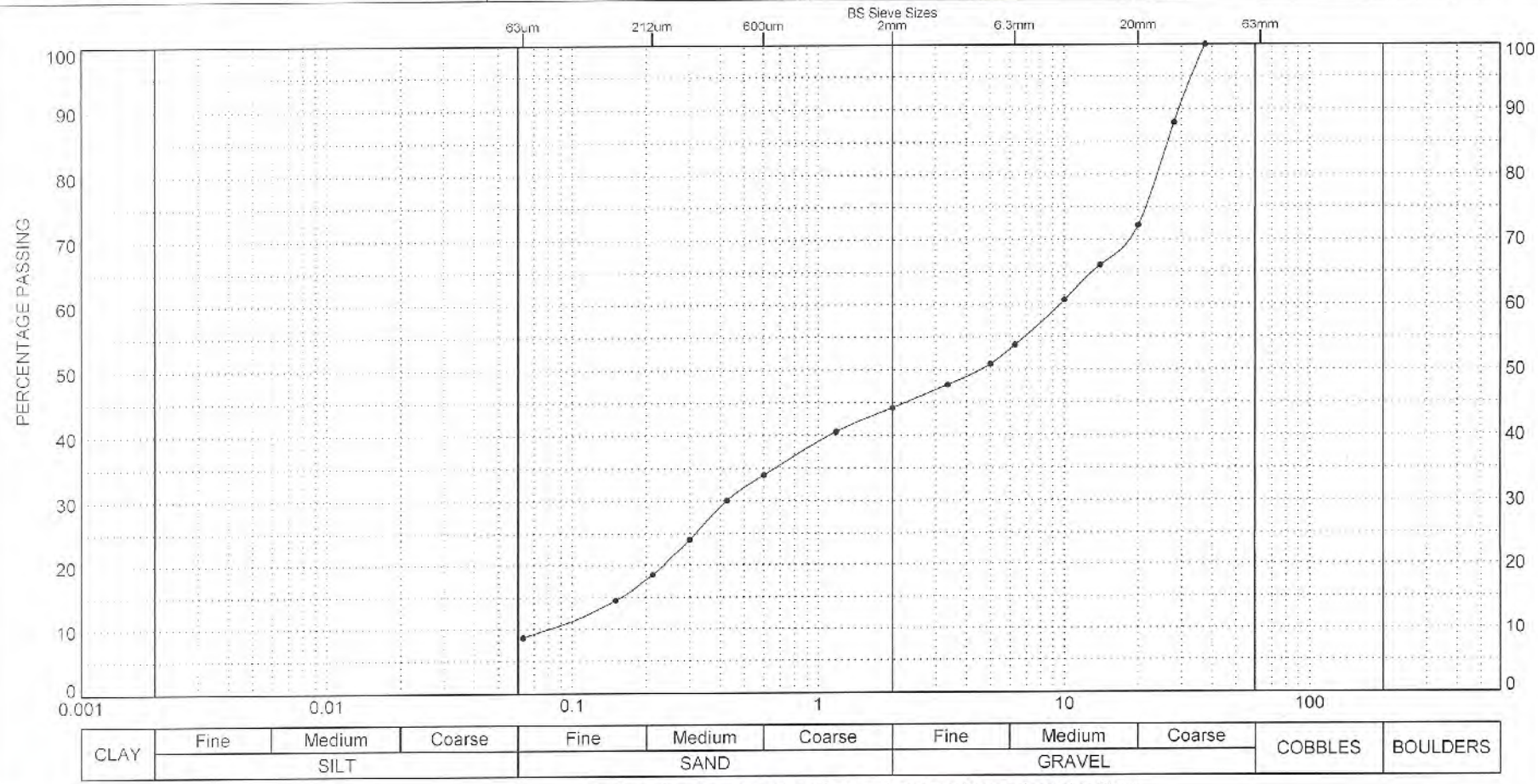
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **WS104**	Depth (m) :- **1.20**	Sample Type & No :- **U8**	Specific Depth (m) :- **1.20**	Date Tested :- **30/01/2019**



Sieve Size (mm)	Passing (%)
37.5	100.0
28	88.0
20	72.2
14	66.1
10	60.7
6.3	53.8
5	50.9
3.35	47.7
2	44.2
1.18	40.6
0.6	34.0
0.425	30.1
0.3	24.1
0.212	18.5
0.15	14.5
0.063	8.7

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/WS104/U8/1.20	MSone	[illegible]	

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

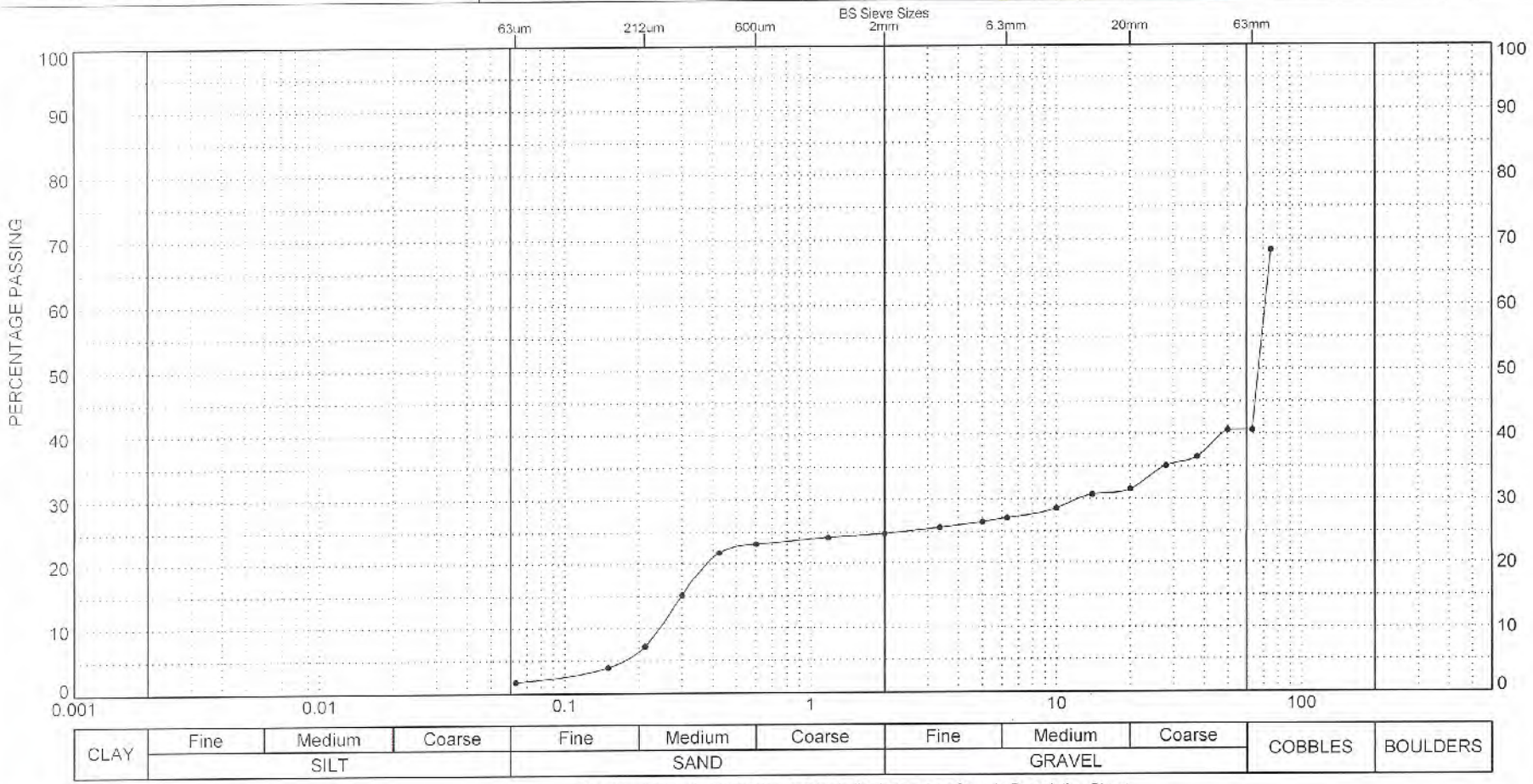
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Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **WS105**	Depth (m) :- **0.50**	Sample Type & No :- **B5**	Specific Depth (m) :- **0.50**	Date Tested :- **29/01/2019**



Sieve Size (mm)	Passing (%)
75	68.3
63	40.6
50	40.6
37.5	36.5
28	35.1
20	31.5
14	30.7
10	28.6
6.3	27.1
5	26.5
3.35	25.7
2	24.8
1.18	24.2
0.6	23.2
0.425	21.7
0.3	15.2
0.212	7.3
0.15	4.0
0.063	1.7

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/WS105/B5/0.50			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

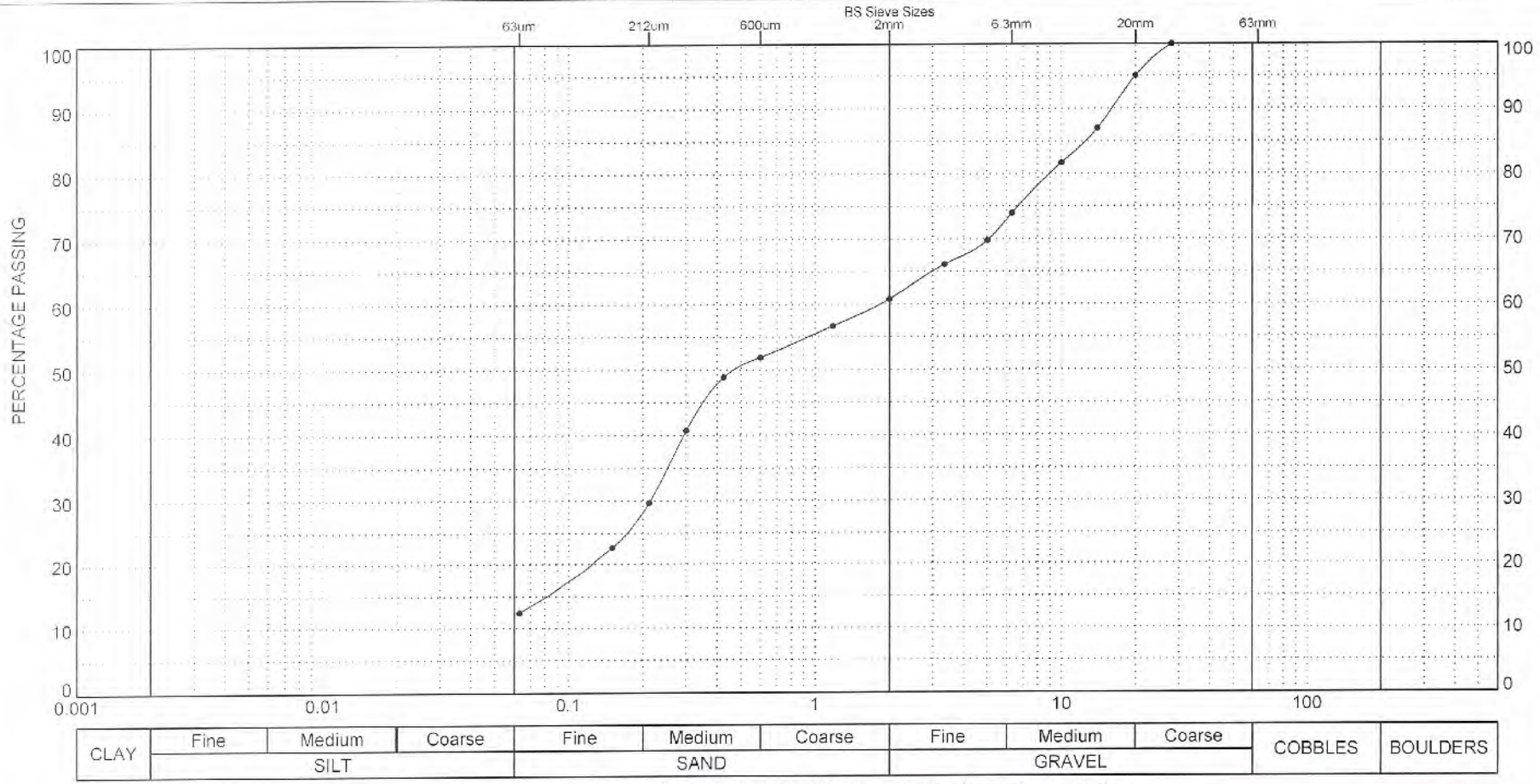
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No - **WS105A**	Depth (m) :- **2.20**	Sample Type & No :- **U11**	Specific Depth (m) :- **2.20**	Date Tested :- **30/01/2019**



Sieve Size (mm)	Passing (%)
28	100.0
20	95.1
14	87.0
10	81.7
6.3	74.0
5	69.8
3.35	66.1
2	60.8
1.18	56.7
0.6	51.9
0.425	48.9
0.3	40.8
0.212	29.7
0.15	22.7
0.063	12.4

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/WS105A/U11/2.20			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

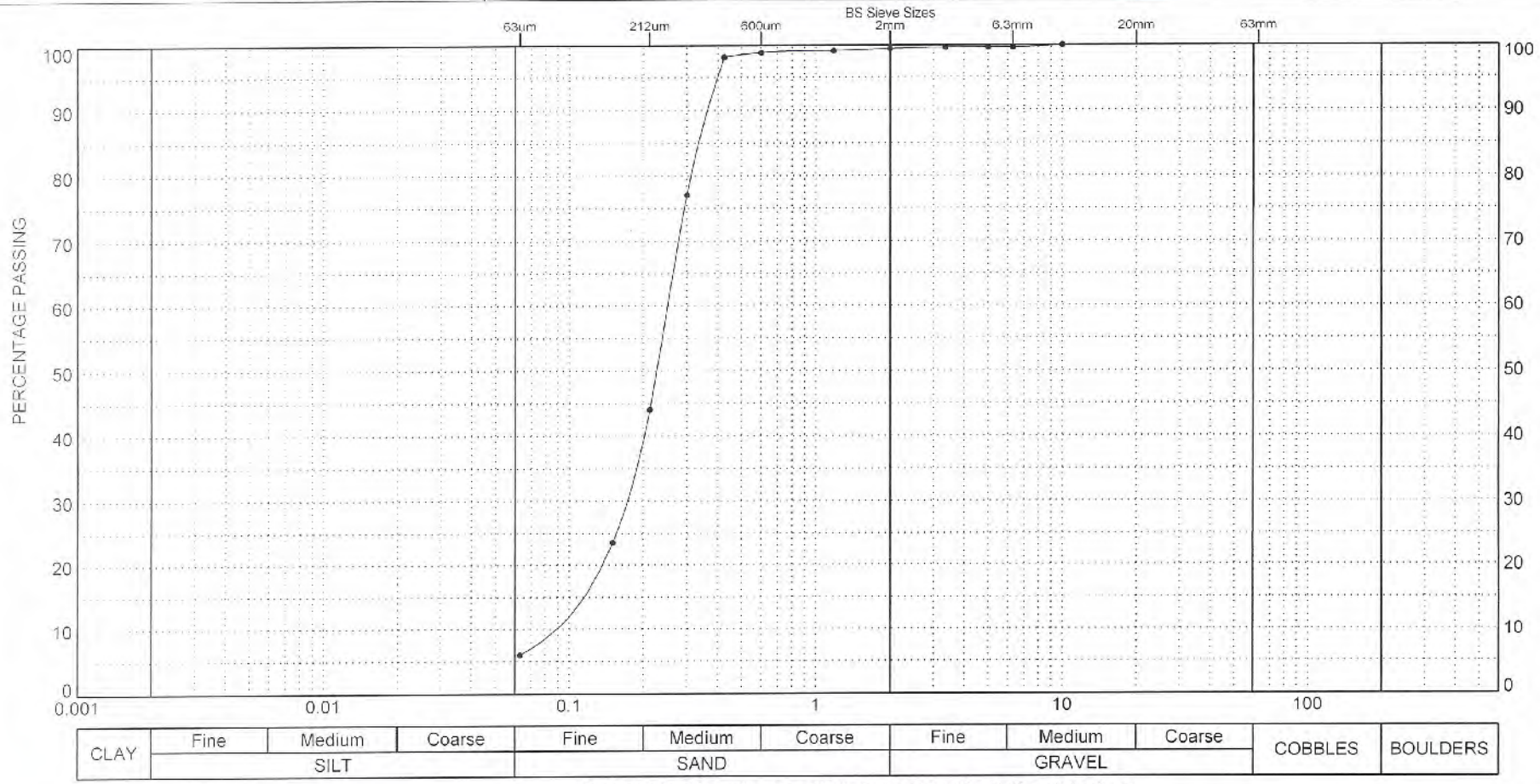
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PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **WS105A**	Depth (m) :- **4.20**	Sample Type & No :- **U15**	Specific Depth (m) :- **4.20**	Date Tested :- **30/01/2019**



Sieve Size (mm)	Passing (%)
10	100.0
6.3	99.6
5	99.6
3.35	99.6
2	99.4
1.18	99.1
0.6	98.8
0.425	98.1
0.3	77.1
0.212	44.1
0.15	23.6
0.063	6.0

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/WS105A/U15/4.20			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

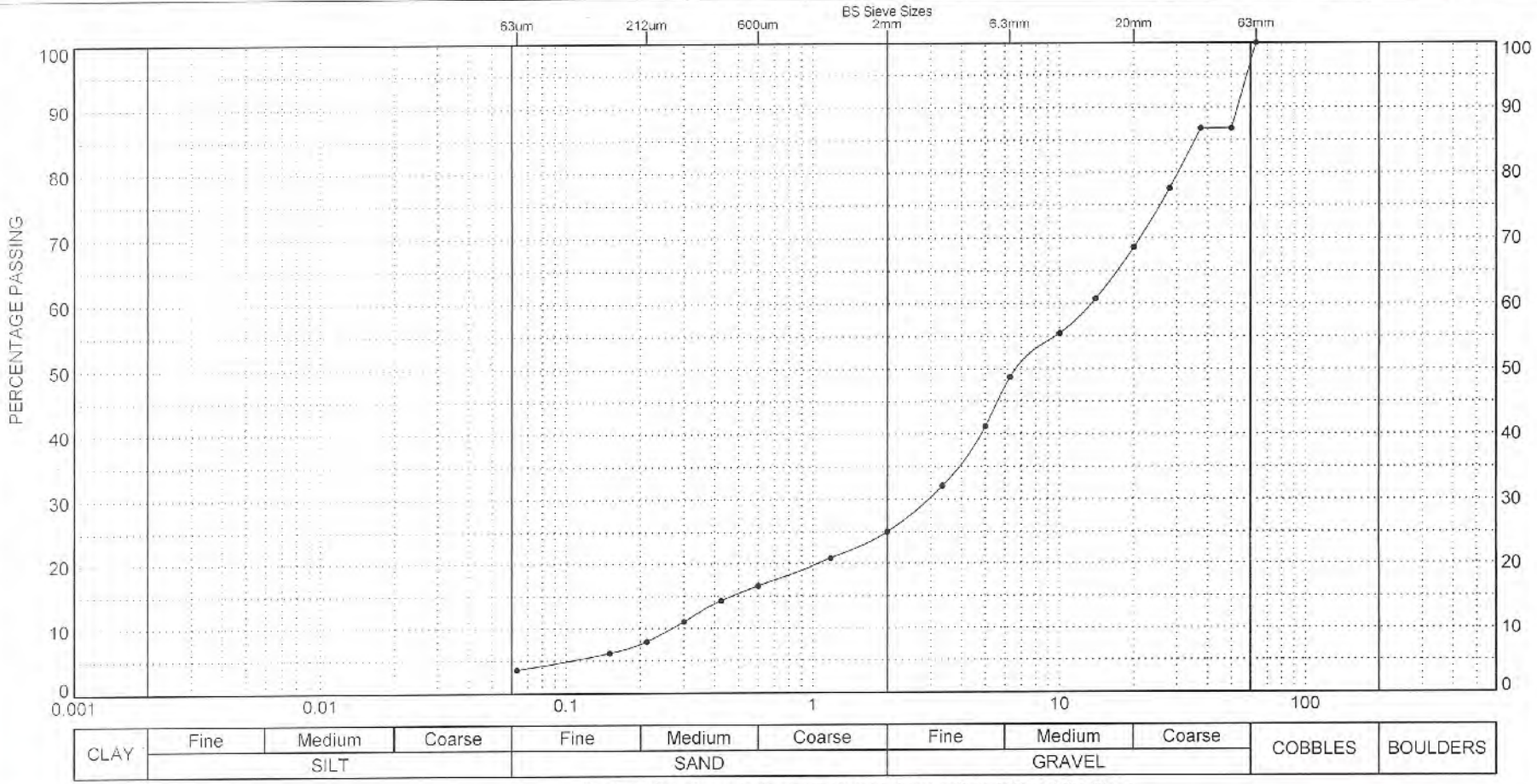
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Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

PARTICLE SIZE DISTRIBUTION

BS1377 : Part 2 : Clause 9.2 & 9.4 : 1990

Exploratory Hole No :- **WS106**	Depth (m) :- **1.20**	Sample Type & No :- **U7**	Specific Depth (m) :- **1.20**	Date Tested :- **30/01/2019**



Sieve Size (mm)	Passing (%)
63	100.0
50	86.8
37.5	86.8
28	77.6
20	68.6
14	60.8
10	55.5
6.3	48.8
5	41.2
3.35	32.1
2	25.1
1.18	20.8
0.6	16.5
0.425	14.3
0.3	11.1
0.212	8.0
0.15	6.2
0.063	3.7

For description of sample please refer to the Laboratory Sample Description Sheet

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	PSD/NW1580/WS106/U7/1.20			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

LABORATORY TESTING ENCLOSURE 5

Determination of Loss on Ignition, Organic Content, Total Sulphur, Total Sulphur, Sulphate and pH (Tested Externally)

DETS

Certificate of Analysis

Certificate Number 19-01940

11-Feb-19

Client Allied Exploration & Geotechnics Limited
Unit 25
Stella Gill Industrial Estate
Pelton Fell
DH2 2RG

Our Reference 19-01940

Client Reference NW1580

Order No LA2130

Contract Title Northern Gateway

Description 38 Soil samples.

Date Received 01-Feb-19

Date Started 01-Feb-19

Date Completed 11-Feb-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

Adam Fenwick
Contracts Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 19-01940
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1454160	1454161	1454162	1454163	1454164	1454165	1454166	1454167	1454168	1454169	1454170
			Sample ID	BH101	BH101	BH102	BH103	BH103	BH104	BH104	BH105	BH107	BH107	BH107
			Depth	1.00	4.00	2.00	0.50	8.00	1.50	4.50	0.60	0.20	1.50	3.10
			Other ID	5	17	6	3	23	8	16	6	3	7	13
			Sample Type	J	B	J	B	J	B	B	B	B	B	B
			Sampling Date	03/01/19	03/01/19	03/01/19	04/01/19	07/01/19	04/01/19	04/01/19	04/01/19	04/01/19	09/01/19	09/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**											
Inorganics														
Loss on Ignition at 440oC	DETSC 2003#	0.01	%				5.0							
pH	DETSC 2008#				8.3	8.2	7.9	8.4	7.2	8.2	8.3	7.9		8.6
Organic matter	DETSC 2002#	0.1	%	8.3		1.5							2.6	
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l		22	47	530	38	590	72	86	210		36
Sulphur as S, Total	DETSC 2320	0.01	%					< 0.01						< 0.01
Sulphate as SO4, Total	DETSC 2321#	0.01	%					0.02						0.02

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

Summary of Chemical Analysis
Soil Samples

Our Ref 19-01940
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1454171	1454172	1454173	1454174	1454175	1454176	1454177	1454178	1454179	1454180	1454181
			Sample ID	BH109	BH110	BH110	BH112	TP102	TP102	TP102	TP104	TP105	TP109	TP111
			Depth	0.40	1.60	3.10	0.60	0.50	1.40	1.80	2.20	1.10	1.10	1.20
			Other ID	3	4	9	3	3	7	8	7	4	4	4
			Sample Type	B	J	B	B	LB	J	LB	J	J	J	J
			Sampling Date	09/01/19	10/01/19	10/01/19	10/01/19	03/01/19	03/01/19	03/01/19	03/01/19	03/01/19	04/01/19	07/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**											
Inorganics														
Loss on Ignition at 440oC	DETSC 2003#	0.01	%											
pH	DETSC 2008#			11.1		8.9	8.4	8.5		8.4		8.0	11.7	
Organic matter	DETSC 2002#	0.1	%	2.9	3.9				0.6		1.7			6.3
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	240		150	40	31		20		54	51	
Sulphur as S, Total	DETSC 2320	0.01	%											
Sulphate as SO4, Total	DETSC 2321#	0.01	%											

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

Summary of Chemical Analysis
Soil Samples

Our Ref 19-01940
Client Ref NW1580
Contract Title Northern Gateway

	Lab No	Sample ID	Depth	Other ID	Sample Type	Sampling Date	Sampling Time	LOD	Units
	1454182	TP112	1.10	4	J	07/01/19	n/s		
	1454183	TP112	2.10	7	J	07/01/19	n/s		
	1454184	TP115	1.10	4	J	07/01/19	n/s		
	1454185	TP119	1.50	6	B	09/01/19	n/s		
	1454186	TP120	1.20	6	B	09/01/19	n/s		
	1454187	TP125	0.50	3	B	10/01/19	n/s		
	1454188	WS101	0.50	4	B	08/01/19	n/s		
	1454189	WS101	1.20	6	J	08/01/19	n/s		
	1454190	WS102	1.20	7	U	07/01/19	n/s		
	1454191	WS103	1.20	5	J	07/01/19	n/s		
	1454192	WS103	3.20	9	J	07/01/19	n/s		
Test	**Method**							**LOD**	**Units**
Inorganics									
Loss on Ignition at 440oC	DETSC 2003#						14	0.01	%
pH	DETSC 2008#	6.6		7.4	10.1		10.6	7.9		8.7				
Organic matter	DETSC 2002#		7.9	10		9.8		2.4	1.4		1.3	0.8	0.1	%
Sulphate Aqueous Extract as SO4	DETSC 2076#	520		180	1700		1600	42		670			10	mg/l
Sulphur as S, Total	DETSC 2320												0.01	%
Sulphate as SO4, Total	DETSC 2321#												0.01	%

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

Summary of Chemical Analysis
Soil Samples

Our Ref 19-01940
Client Ref NW1580
Contract Title Northern Gateway

	Lab No	1454193	1454194	1454195	1454196	1454197
	Sample ID	WS104	WS104	WS105	WS105A	WS106
	Depth	0.20	1.20	0.50	1.20	2.20
	Other ID	2	8	5	9	9
	Sample Type	B	U	B	U	U
	Sampling Date	08/01/19	08/01/19	10/01/19	10/01/19	08/01/19
	Sampling Time	n/s	n/s	n/s	n/s	n/s
Test	Method	LOD	Units					
Inorganics								
Loss on Ignition at 440oC	DETSC 2003#	0.01	%					3.9
pH	DETSC 2008#			8.5	8.4	11.2	7.0	8.9
Organic matter	DETSC 2002#	0.1	%		2.0		2.3	4.3
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	82	120	65	450	85
Sulphur as S, Total	DETSC 2320	0.01	%					
Sulphate as SO4, Total	DETSC 2321#	0.01	%					

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

Information in Support of the Analytical Results

Our Ref 19-01940
Client Ref NW1580
Contract Northern Gateway

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1454160	BH101 1.00 SOIL	03/01/19	PT 500ml	Organic Matter (Manual) (28 days)	
1454161	BH101 4.00 SOIL	03/01/19	PT 500ml	pH + Conductivity (7 days)	
1454162	BH102 2.00 SOIL	03/01/19	PT 500ml	Organic Matter (Manual) (28 days), pH + Conductivity (7 days)	
1454163	BH103 0.50 SOIL	04/01/19	PT 500ml	pH + Conductivity (7 days)	
1454164	BH103 8.00 SOIL	07/01/19	PT 500ml	pH + Conductivity (7 days)	
1454165	BH104 1.50 SOIL	04/01/19	PT 1L	pH + Conductivity (7 days)	
1454166	BH104 4.50 SOIL	04/01/19	PT 500ml	pH + Conductivity (7 days)	
1454167	BH105 0.60 SOIL	04/01/19	PT 1L	pH + Conductivity (7 days)	
1454168	BH107 0.20 SOIL	04/01/19	PT 500ml	pH + Conductivity (7 days)	
1454169	BH107 1.50 SOIL	09/01/19	PT 1L		
1454170	BH107 3.10 SOIL	09/01/19	PT 500ml	pH + Conductivity (7 days)	
1454171	BH109 0.40 SOIL	09/01/19	PT 500ml	pH + Conductivity (7 days)	
1454172	BH110 1.60 SOIL	10/01/19	PT 500ml		
1454173	BH110 3.10 SOIL	10/01/19	PT 1L	pH + Conductivity (7 days)	
1454174	BH112 0.60 SOIL	10/01/19	PT 1L	pH + Conductivity (7 days)	
1454175	TP102 0.50 SOIL	03/01/19	PT 1L	pH + Conductivity (7 days)	
1454176	TP102 1.40 SOIL	03/01/19	PT 500ml	Organic Matter (Manual) (28 days)	
1454177	TP102 1.80 SOIL	03/01/19	PT 1L	pH + Conductivity (7 days)	
1454178	TP104 2.20 SOIL	03/01/19	PT 500ml	Organic Matter (Manual) (28 days)	
1454179	TP105 1.10 SOIL	03/01/19	PT 500ml	pH + Conductivity (7 days)	
1454180	TP109 1.10 SOIL	04/01/19	PT 500ml	pH + Conductivity (7 days)	
1454181	TP111 1.20 SOIL	07/01/19	PT 500ml		
1454182	TP112 1.10 SOIL	07/01/19	PT 500ml	pH + Conductivity (7 days)	
1454183	TP112 2.10 SOIL	07/01/19	PT 500ml		
1454184	TP115 1.10 SOIL	07/01/19	PT 500ml	pH + Conductivity (7 days)	
1454185	TP119 1.50 SOIL	09/01/19	PT 500ml	pH + Conductivity (7 days)	
1454186	TP120 1.20 SOIL	09/01/19	PG		
1454187	TP125 0.50 SOIL	10/01/19	PG	pH + Conductivity (7 days)	
1454188	WS101 0.50 SOIL	08/01/19	PT 500ml	pH + Conductivity (7 days)	
1454189	WS101 1.20 SOIL	08/01/19	PT 500ml		
1454190	WS102 1.20 SOIL	07/01/19	PT 500ml	pH + Conductivity (7 days)	
1454191	WS103 1.20 SOIL	07/01/19	PT 500ml		
1454192	WS103 3.20 SOIL	07/01/19	PT 500ml		
1454193	WS104 0.20 SOIL	08/01/19	PG	pH + Conductivity (7 days)	
1454194	WS104 1.20 SOIL	08/01/19	PT 500ml	pH + Conductivity (7 days)	
1454195	WS105 0.50 SOIL	10/01/19	PT 1L	pH + Conductivity (7 days)	
1454196	WS105A 1.20 SOIL	10/01/19	PT 500ml	pH + Conductivity (7 days)	
1454197	WS106 2.20 SOIL	08/01/19	PT 1L	pH + Conductivity (7 days)	

Key: P-Plastic T-Tub G-Bag

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.

Information in Support of the Analytical Results

Our Ref 19-01940
Client Ref NW1580
Contract Northern Gateway

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

Determination of Dry Density/Moisture Relationship

LABORATORY TESTING ENCLOSURE 6

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

MOISTURE CONTENT/DRY DENSITY RELATIONSHIP

BS 1377 : Part 4 : 1990

Specimen Identification

Exploratory Hole No :- **TP103** Depth (m) :- **1.50** Sample Type & No :- **B10**

Test Method 2.5kg Compaction Single Sample

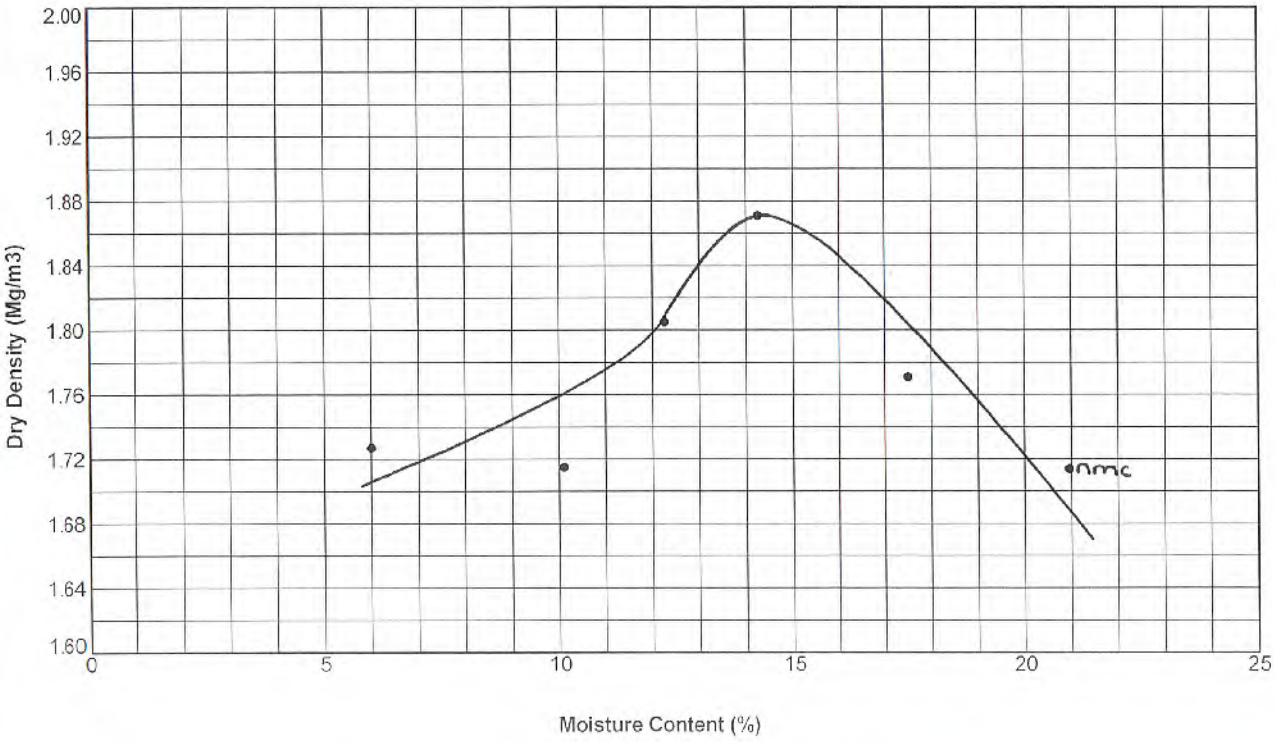
Test Results

Optimum Moisture Content (%) = **14.3** Particle Density (Assumed) = **2.70**

Maximum Dry Density (Mg/m3) = **1.87** Retained on 20mm Sieve (%) = **0.8**

Date Tested = **25/02/2019** Retained on 37.5mm Sieve (%) = **0.0**

Remarks :



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Signed :-	Name :- M. SOLIAR	Page 1 of 1	
Date of issue :- 27/02/2019	Certificate No :- COMP/NW1580/1	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - **Tel:** 01772 735 300 **Fax:** 01772 735 999

MOISTURE CONTENT/DRY DENSITY RELATIONSHIP

BS 1377 : Part 4 : 1990

Specimen Identification

Exploratory Hole No :- **TP111** Depth (m) :- **0.80** Sample Type & No :- **LB3**

Test Method Vibro Hammer Compaction Separate Samples

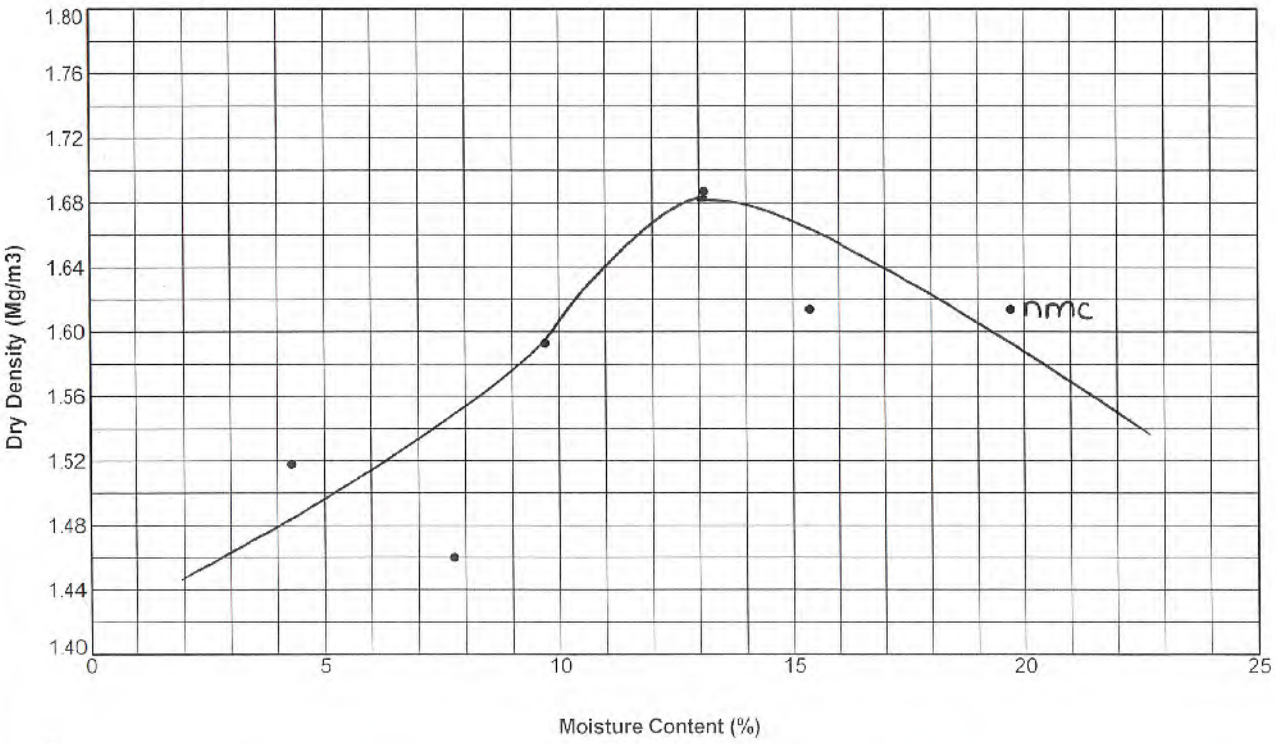
Test Results

Optimum Moisture Content (%) = **14.0** Particle Density (Assumed) = **2.50**

Maximum Dry Density (Mg/m3) = **1.69** Retained on 20mm Sieve (%) = **17.0**

Date Tested = **28/02/2019** Retained on 37.5mm Sieve (%) = **7.2**

Remarks :



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Signed :- msene	Name :- M. SELKIRK		Page 1 of 1
Date of issue :- 01/03/2019	Certificate No :- COMP/NW1580/1	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

MOISTURE CONTENT/DRY DENSITY RELATIONSHIP

BS 1377 : Part 4 : 1990

Specimen Identification

Exploratory Hole No :- **TP121** Depth (m) :- **0.80** Sample Type & No :- **LB3**

Test Method 2.5kg Compaction Single Sample

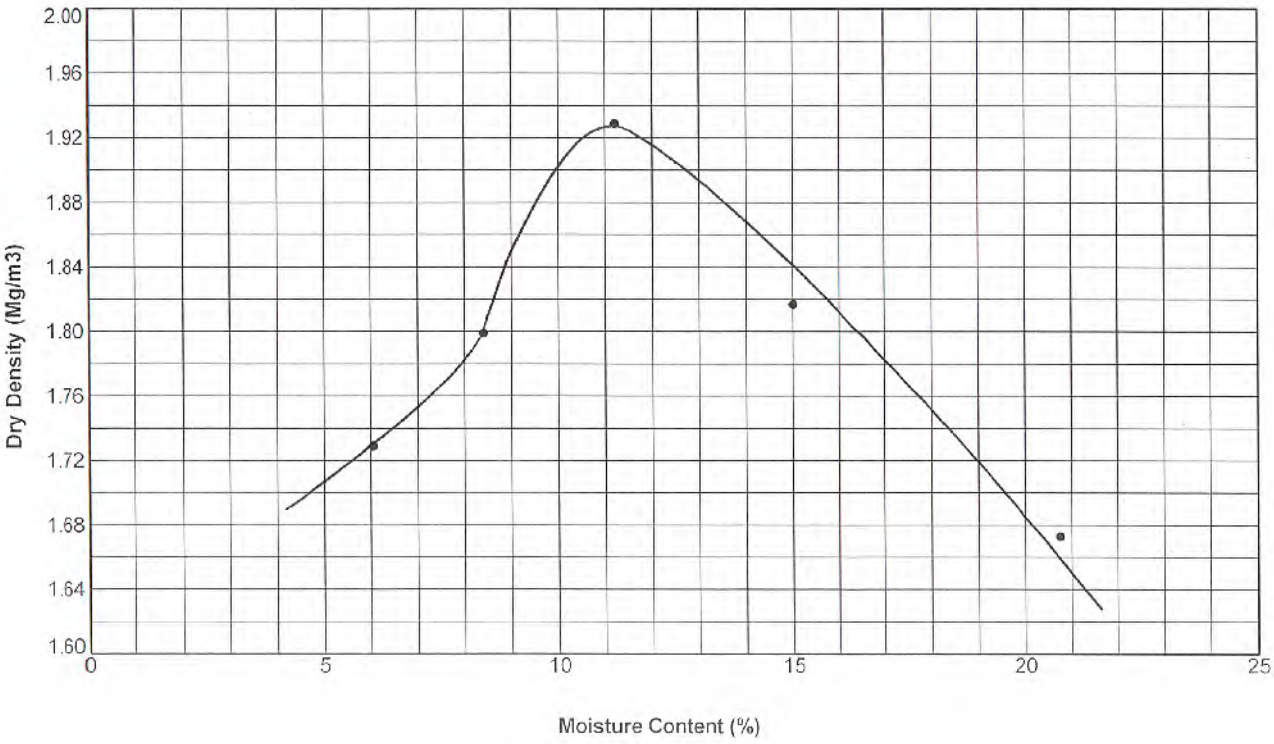
Test Results

Optimum Moisture Content (%) = **11.2** Particle Density (Assumed) = **2.65**

Maximum Dry Density (Mg/m3) = **1.93** Retained on 20mm Sieve (%) = **7.0**

Date Tested = **25/02/2019** Retained on 37.5mm Sieve (%) = **2.0**

Remarks :



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Signed :- MSelk	Name :- M. SELKIRK	Page 1 of 1	
Date of issue :- 27/02/2019	Certificate No :- COMP/NW1580/1	AEG Contract No. :- NW1580	UKAS TESTING 1367

LABORATORY TESTING ENCLOSURE 7

Determination of MCV/Moisture Relationship

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Unit 25 Stella Gill Industrial Estate , Pelton Fell
Chester-le-Street , Co Durham DH2 2RG
a UKAS Testing Laboratory No.1367

MOISTURE CONDITION VALUE (BS 1377:PART4:1990 CLAUSE 5)

UKAS TESTING No. 1367

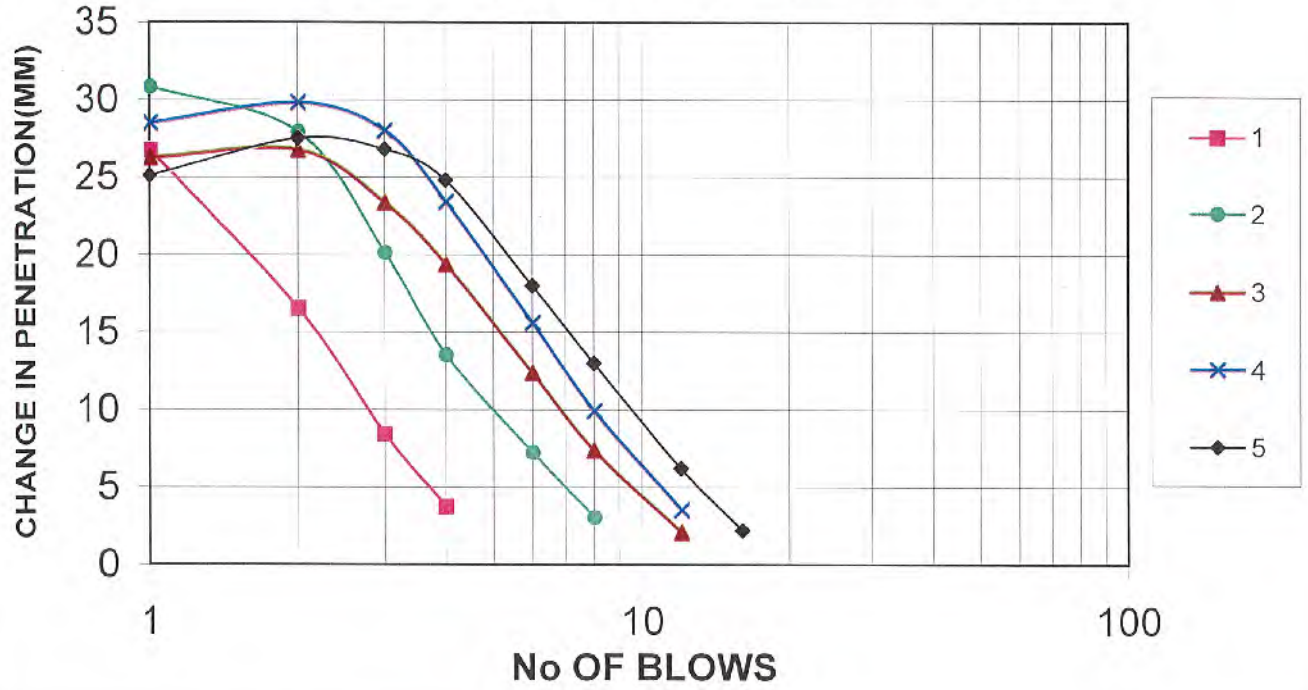
SITE: Northern Gateway **JOB No:** NW1580

CLIENT: Far East Consortium International Limited **Depth:** 1.50m

Sample No: TP103 B10 **Specific Depth:** N/A

For sample description please refer to sample description sheet.

CHANGE IN PENETRATION PLOT



Sample	1	2 (NAT)	3	4	5
MCV	5.7	8.4	9.8	10.4	11.2
M.C.(%)	22.5	21.0	18.6	17.6	16.8
MCV = 10 Log No. OF BLOWS @ 5MM PENETRATION					

Remarks: 0.8% Retained on 20mm sieve.

DATE TESTED: 31/01/2019 **DATE OF ISSUE:** 12/02/2019

APPROVED BY: MSelk **NAME:** Michelle Selkirk

Certificate No:	NW1580 TP103 B10 1.50m	Sheet 2 of 2

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Unit 25 Stella Gill Industrial Estate , Pelton Fell
Chester-le-Street , Co Durham DH2 2RJ
a UKAS Testing Laboratory No.1367

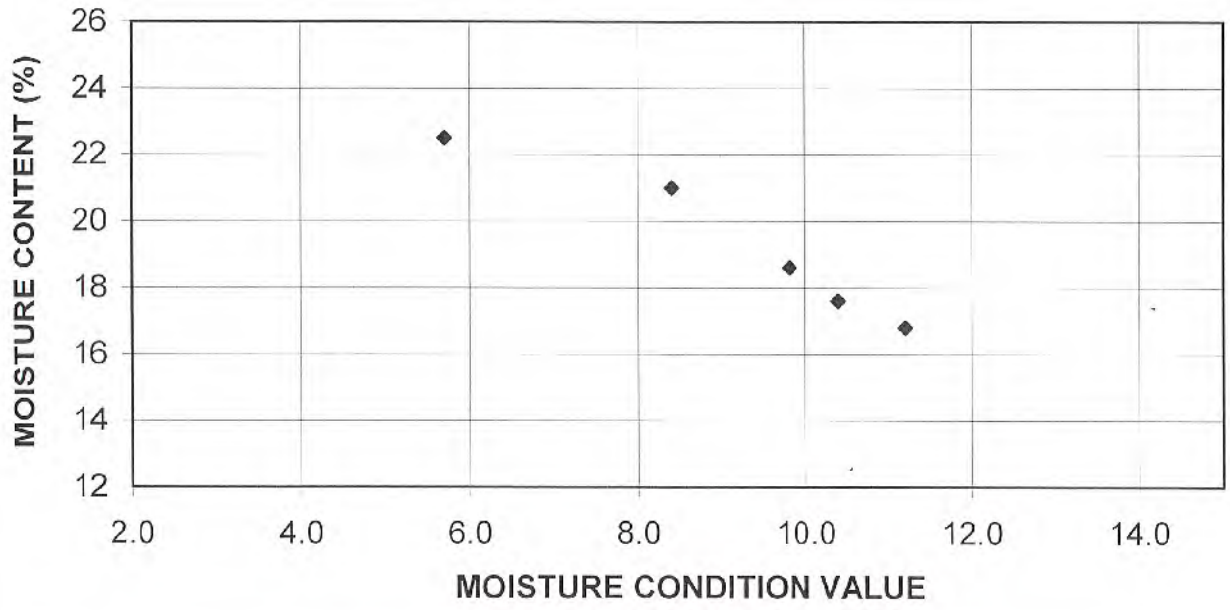
UKAS TESTING
No. 1367

MOISTURE CONDITION VALUE (BS 1377:PART4:1990 CLAUSE 5)

SITE:	Northern Gateway	**JOB No:**	NW1580
CLIENT:	Far East Consortium International Limited	**Depth:**	1.50m
Sample No:	TP103 B10	**Specific Depth:**	N/A

For sample description please refer to sample description sheet.

CALIBRATION LINE



Sample	1	2 (NAT)	3	4	5
MCV	5.7	8.4	9.8	10.4	11.2
M.C.(%)	22.5	21	18.6	17.6	16.8

MCV = 10 Log No. OF BLOWS @ 5MM PENETRATION		
INTERCEPT (MC% AXIS)	28.9	REMARKS:
SLOPE	-1.060	
SENSITIVITY (1/SLOPE)	-0.661	

DATE TESTED:	31/01/2019	DATE OF ISSUE:	12/02/2019
APPROVED BY:	MSelk	NAME:	Michelle Selkirk

Certificate No:	NW1580 TP111/112 LB3 0.80m	Sheet 1 of 2

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Unit 25 Stella Gill Industrial Estate , Pelton Fell
Chester-le-Street , Co Durham DH2 2RG
a UKAS Testing Laboratory No.1367

UKAS TESTING
No. 1367

MOISTURE CONDITION VALUE (BS 1377:PART4:1990 CLAUSE 5)

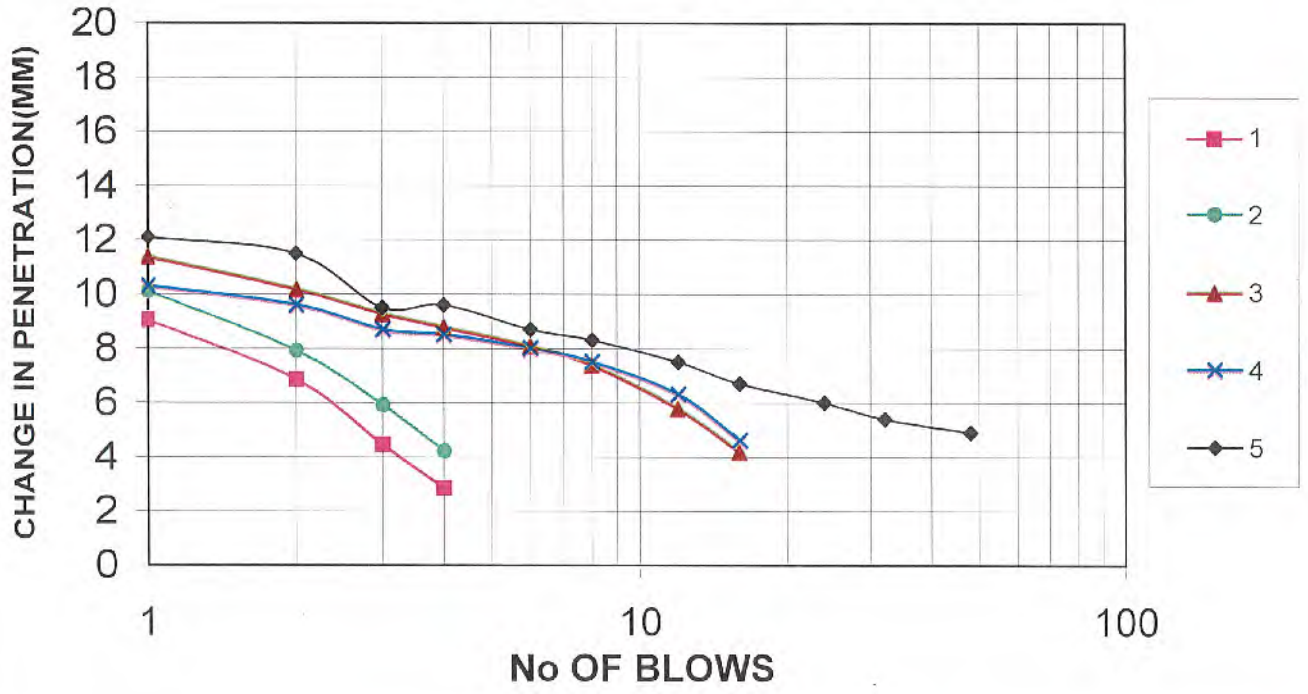
SITE: Northern Gateway **JOB No:** NW1580

CLIENT: Far East Consortium International Limited **Depth:** 0.80m

Sample No: TP111/112 LB3 **Specific Depth:** N/A

For sample description please refer to sample description sheet.

CHANGE IN PENETRATION PLOT



Sample	1	2	3	4	5 (NAT)
MCV	4.4	5.4	11.4	11.8	16.2
M.C.(%)	14.4	13.8	11.8	11.5	9.9
MCV = 10 Log No. OF BLOWS @ 5MM PENETRATION					

Remarks: 8.5% Retained on 20mm sieve.

DATE TESTED: 06/02/2019 DATE OF ISSUE: 19/02/2019

APPROVED BY: MSelk NAME: Michelle Selkirk

Certificate No:	NW1580 TP111/112 LB3 0.80m	Sheet 2 of 2

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Unit 25 Stella Gill Industrial Estate , Pelton Fell
Chester-le-Street , Co Durham DH2 2RJ
a UKAS Testing Laboratory No.1367

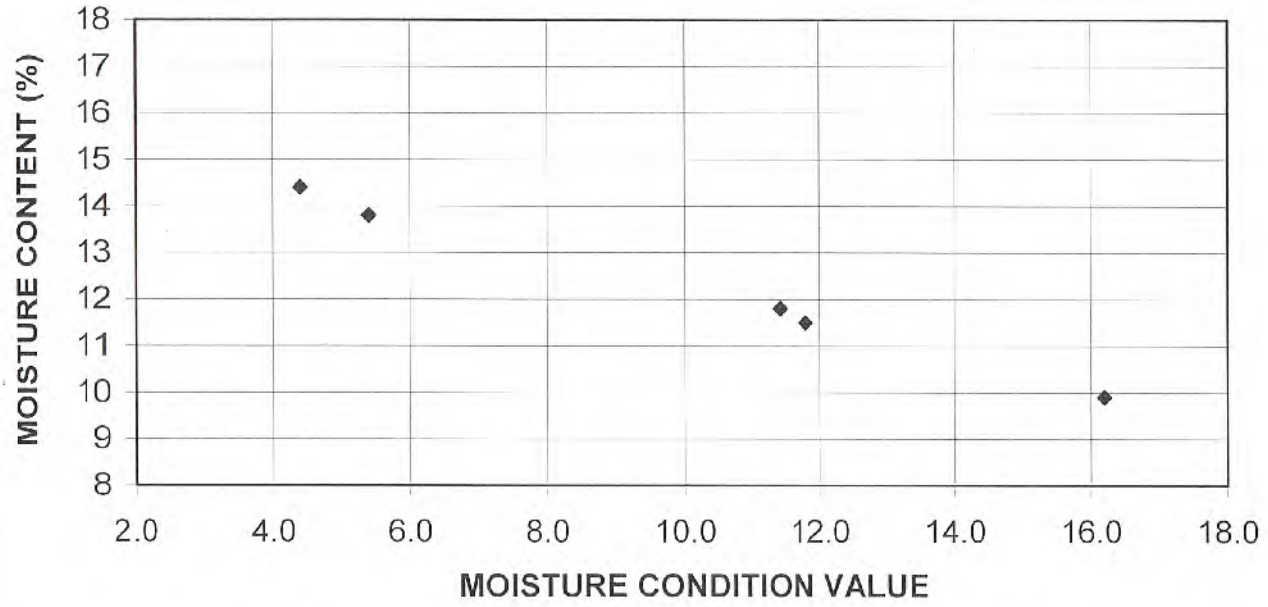
UKAS TESTING
No. 1367

MOISTURE CONDITION VALUE (BS 1377:PART4:1990 CLAUSE 5)

SITE:	Northern Gateway	**JOB No:**	NW1580
CLIENT:	Far East Consortium International Limited	**Depth:**	0.80m
Sample No:	TP111/112 LB3	**Specific Depth:**	N/A

For sample description please refer to sample description sheet.

CALIBRATION LINE



Sample	1	2	3	4	5 (NAT)
MCV	4.4	5.4	11.4	11.8	16.2
M.C.(%)	14.4	13.8	11.8	11.5	9.9

MCV = 10 Log No. OF BLOWS @ 5MM PENETRATION		
INTERCEPT (MC% AXIS)	15.94	REMARKS:
SLOPE	-0.372	
SENSITIVITY (1/SLOPE)	-2.688	

DATE TESTED: 06/02/2019 DATE OF ISSUE: 13/02/2019

APPROVED BY: MSelk NAME: Michelle Selkirk

Certificate No:	NW1580 TP121/122 LB3 0.80m	Sheet 1 of 2

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Unit 25 Stella Gill Industrial Estate , Pelton Fell
Chester-le-Street , Co Durham DH2 2RG
a UKAS Testing Laboratory No.1367

UKAS TESTING
No. 1367

MOISTURE CONDITION VALUE (BS 1377:PART4:1990 CLAUSE 5)

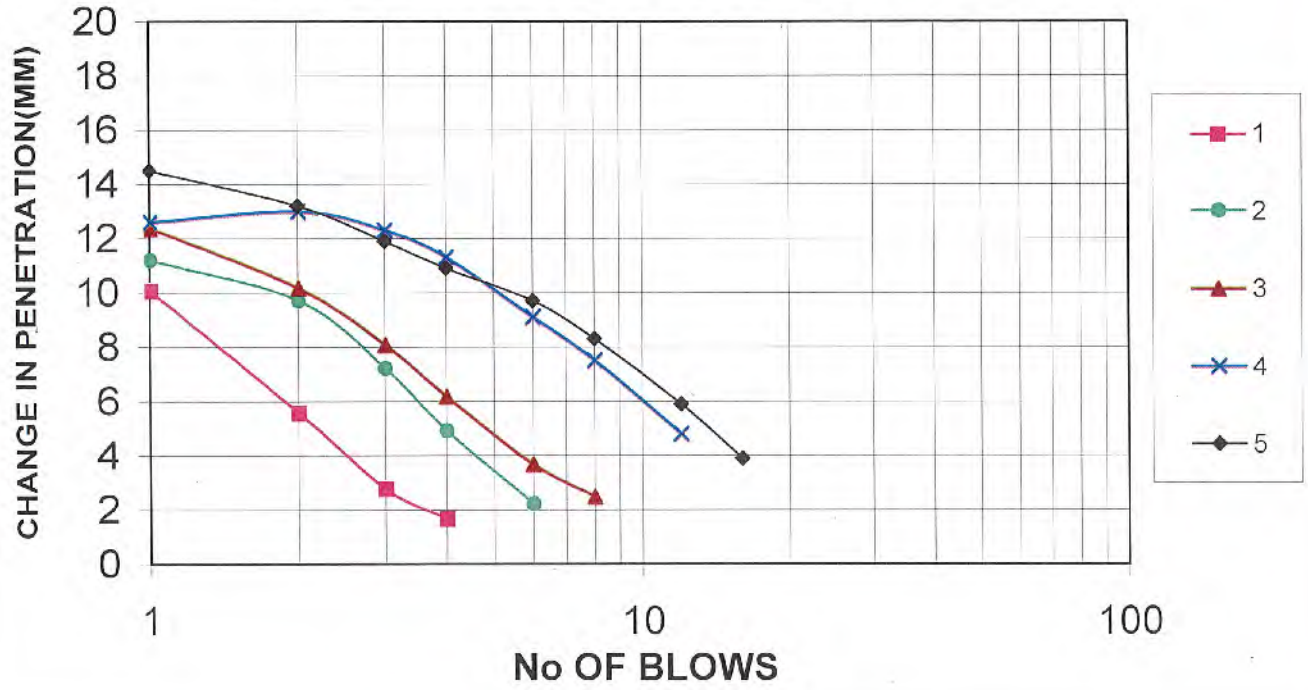
SITE: Northern Gateway **JOB No:** NW1580

CLIENT: Far East Consortium International Limited **Depth:** 0.80m

Sample No: TP121/122 LB3 **Specific Depth:** N/A

For sample description please refer to sample description sheet.

CHANGE IN PENETRATION PLOT



Sample	1	2 (NAT)	3	4	5
MCV	3.5	5.9	6.8	10.7	11.1
M.C.(%)	21.6	20.1	17.0	16.0	15.7
MCV = 10 Log No. OF BLOWS @ 5MM PENETRATION					

Remarks: 13.0% Retained on 20mm sieve.

DATE TESTED: 01/02/2019 **DATE OF ISSUE:** 13/02/2019

APPROVED BY: MSelk **NAME:** Michelle Selkirk

Certificate No:	NW1580 TP121/122 LB3 0.80m	Sheet 2 of 2

ALLIED EXPLORATION & GEOTECHNICS LIMITED

Unit 25 Stella Gill Industrial Estate , Pelton Fell
Chester-le-Street , Co Durham DH2 2RJ
a UKAS Testing Laboratory No.1367

UKAS TESTING
No. 1367

MOISTURE CONDITION VALUE (BS 1377:PART4:1990 CLAUSE 5)

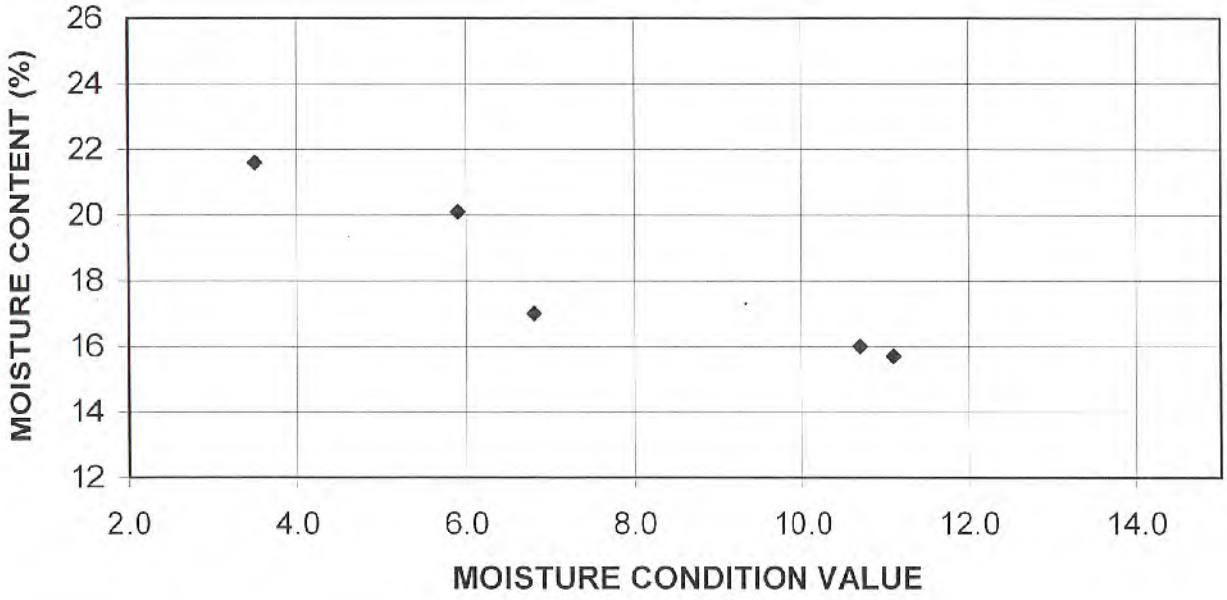
SITE: Northern Gateway **JOB No:** NW1580

CLIENT: Far East Consortium International Limited **Depth:** 0.80m

Sample No: TP121/122 LB3 **Specific Depth:** N/A

For sample description please refer to sample description sheet.

CALIBRATION LINE



Sample	1	2 (NAT)	3	4	5
MCV	3.5	5.9	6.8	10.7	11.1
M.C.(%)	21.6	20.1	17.0	16.0	15.7
MCV = 10 Log No. OF BLOWS @ 5MM PENETRATION					
INTERCEPT (MC% AXIS)			23.80	REMARKS:	
SLOPE			-0.753		
SENSITIVITY (1/SLOPE)			-1.328		

DATE TESTED: 01/02/2019 DATE OF ISSUE: 13/02/2019

APPROVED BY: NAME: Michelle Selkirk

LABORATORY TESTING ENCLOSURE 8

Determination of California Bearing Ratio

ALLIED EXPLORATION & GEOTECHNICS LIMITED

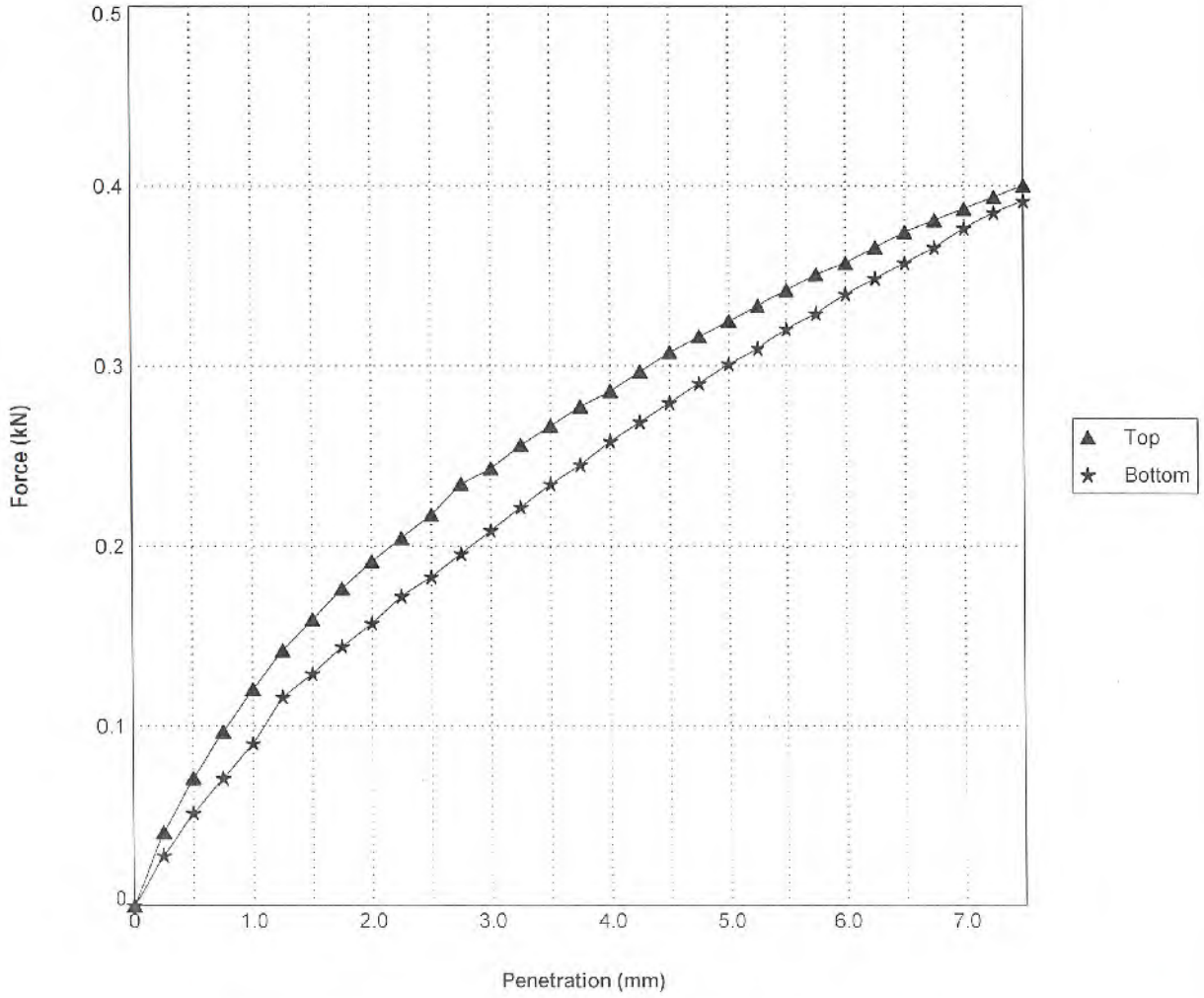
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 9BL - **Tel:** 01772 735 300 **Fax:** 01772 735 999

DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP103** Sample No.- **B10** Depth (m)- **1.50**

"As Received" Moisture Content (%) :	21.0	Surcharge (Kg) :	6
Retained on 20mm (%) :	0.8	Seating Load (N) :	Top 10 / Bottom 10
Correction Needed :	No	Test Moisture Content (%) :	Top 21.2 / Bottom 20.7
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	2.08
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.72
Date Tested :	30/01/2019	CBR Value (%) :	Top 1.6 / Bottom 1.5
Preparation Method :	2.5kg Compaction		
Remarks :	Tested at "As Received" Moisture Content		



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :-	Name :-	Page 1 of 1	UKAS TESTING 1367
Date of issue :- 28/02/2019	Certificate No :- CBR/NW1580/TP103/B10/1.50/1	AEG Contract No. :- NW1580	

ALLIED EXPLORATION & GEOTECHNICS LIMITED

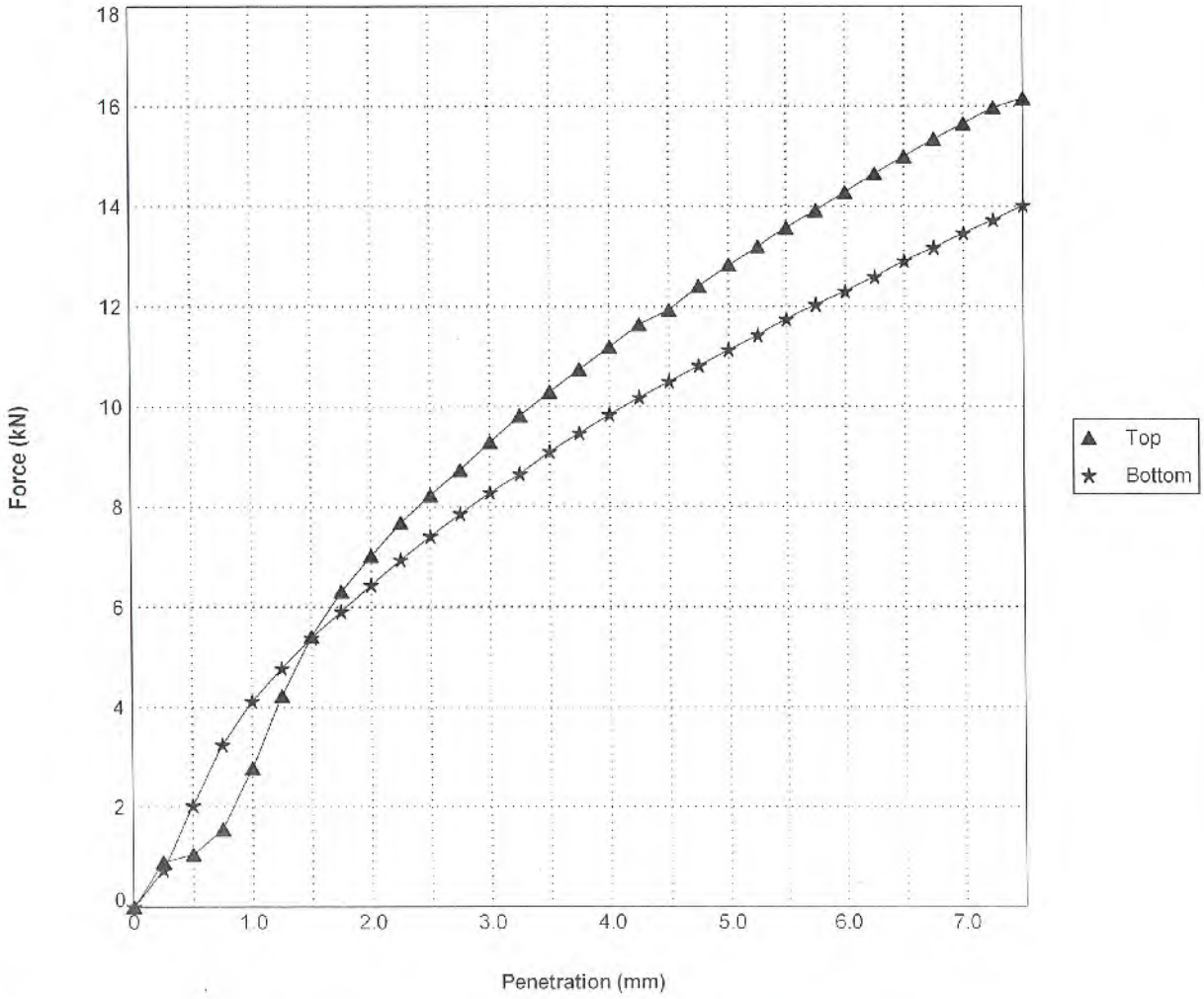
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP103** Sample No.- **B10** Depth (m)- **1.50**

"As Received" Moisture Content (%) :	21.0	Surcharge (Kg) :	6
Retained on 20mm (%) :	0.8	Seating Load (N) :	Top 250 / Bottom 250
Correction Needed :	No	Test Moisture Content (%) :	Top 5.5 / Bottom 5.8
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	1.91
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.81
Date Tested :	14/02/2019	CBR Value (%) :	Top 64.3 / Bottom 56.0
Preparation Method :	2.5kg Compaction		
Remarks :			



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :-	Name :-	Page 1 of 1	
Date of issue :- 28/02/2019	Certificate No :- CBR/NW1580/TP103/B10/1.50/2	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

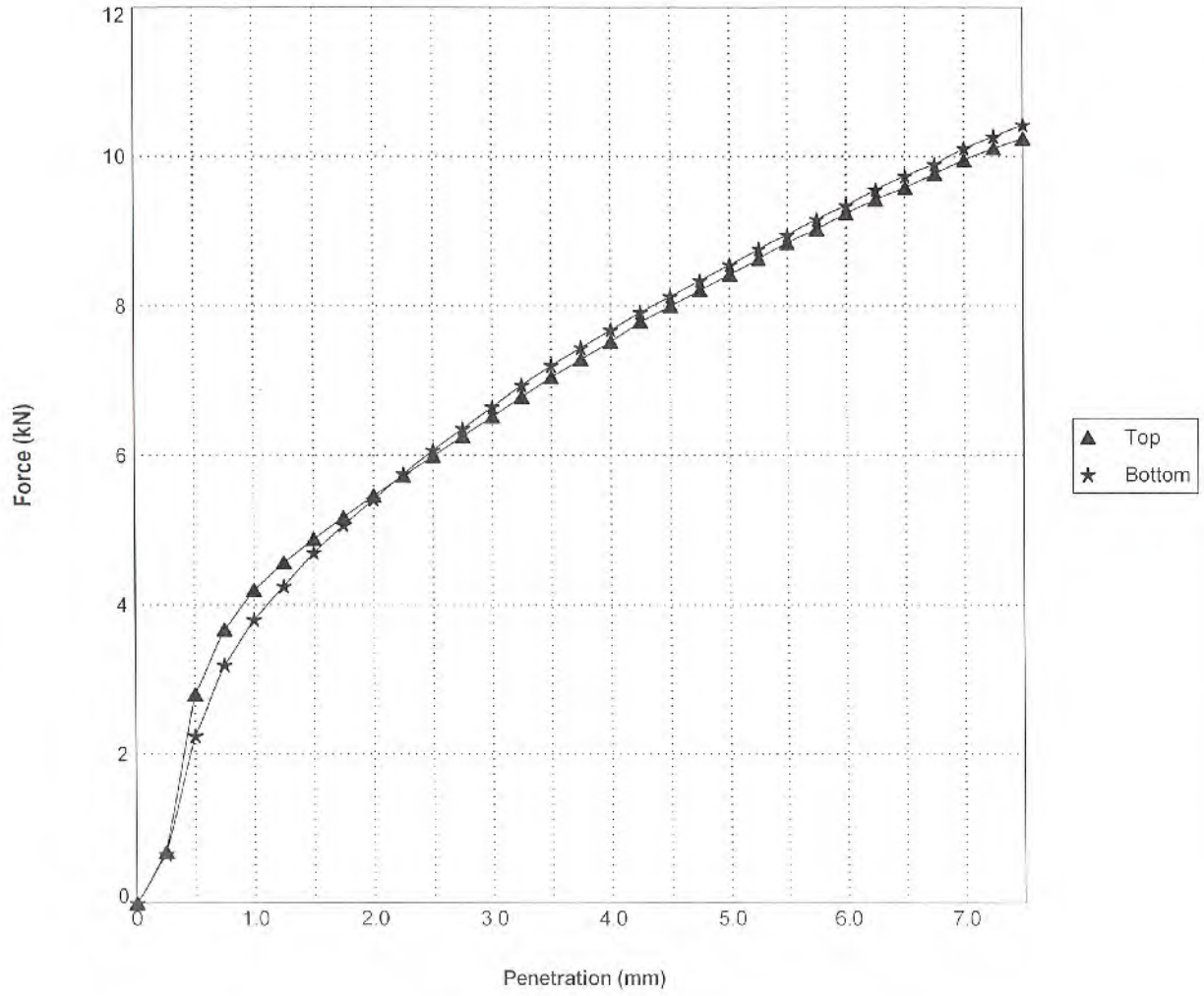
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - **Tel:** 01772 735 300 **Fax:** 01772 735 999

DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP103** Sample No.- **B10** Depth (m)- **1.50**

"As Received" Moisture Content (%) :	21.0	Surcharge (Kg) :	6
Retained on 20mm (%) :	0.8	Seating Load (N) :	Top 250 / Bottom 250
Correction Needed :	No	Test Moisture Content (%) :	Top 8.7 / Bottom 8.7
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	1.95
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.79
Date Tested :	14/02/2019	CBR Value (%) :	Top 45.3 / Bottom 45.9
Preparation Method :	2.5kg Compaction		
Remarks :			



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :-	Name :-		Page 1 of 1
Date of issue :- 28/02/2019	Certificate No :- CBR/NW1580/TP103/B10/1.50/3	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

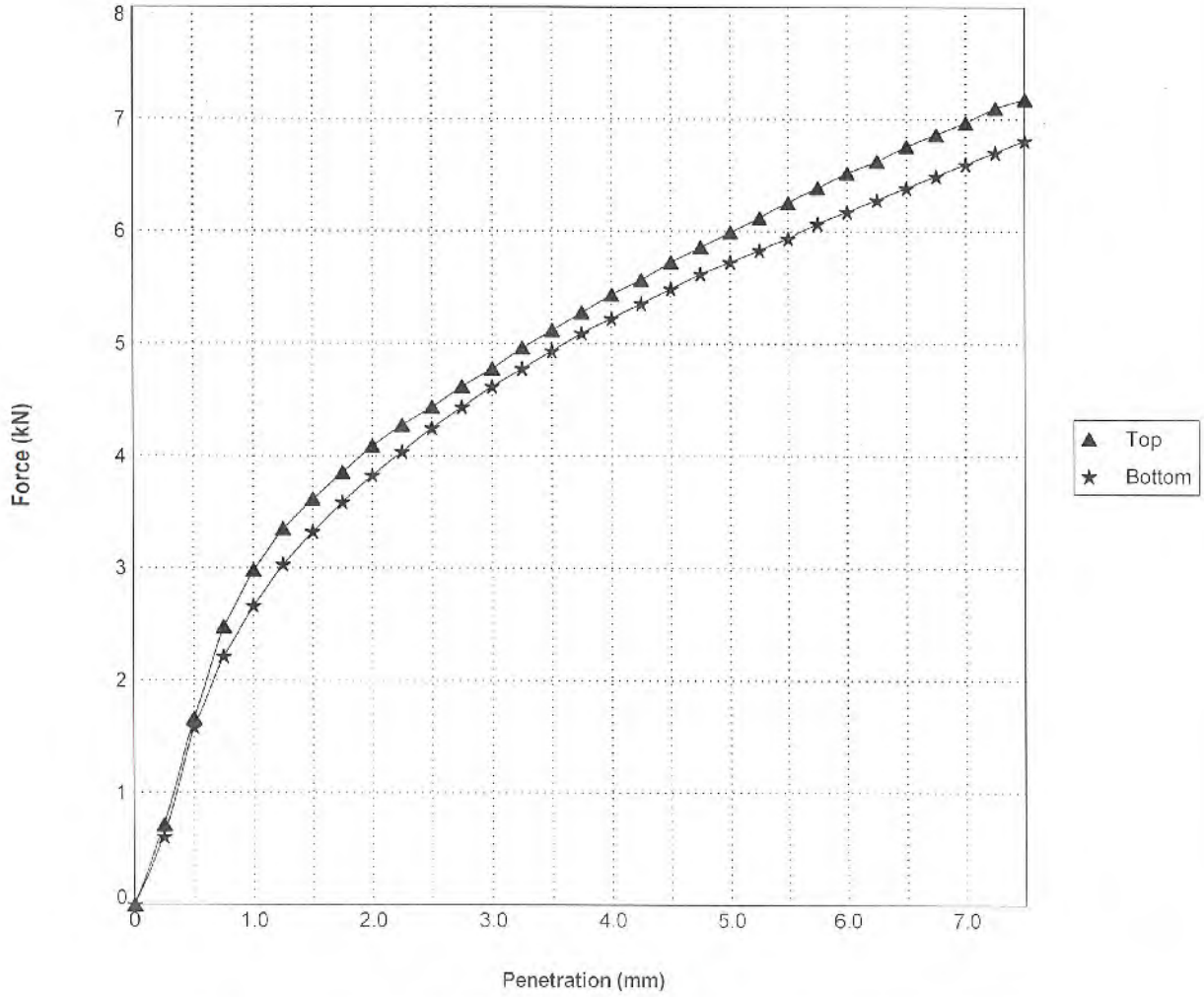
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - Tel: 0191 387 4700 Fax: 0191 387 4710
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DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP103** Sample No.- **B10** Depth (m)- **1.50**

"As Received" Moisture Content (%) :	21.0	Surcharge (Kg) :	6
Retained on 20mm (%) :	0.8	Seating Load (N) :	Top 250 / Bottom 250
Correction Needed :	No	Test Moisture Content (%) :	Top 11.6 / Bottom 12.0
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	2.08
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.86
Date Tested :	19/02/2019	CBR Value (%) :	Top 33.5 / Bottom 32.1
Preparation Method :	2.5kg Compaction		
Remarks :			



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :- msene Name :- M PEARSON Page 1 of 1

Date of issue :- 28/02/2019 Certificate No :- CBR/NW1580/TP103/B10/1.50/4 AEG Contract No. :- NW1580

UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

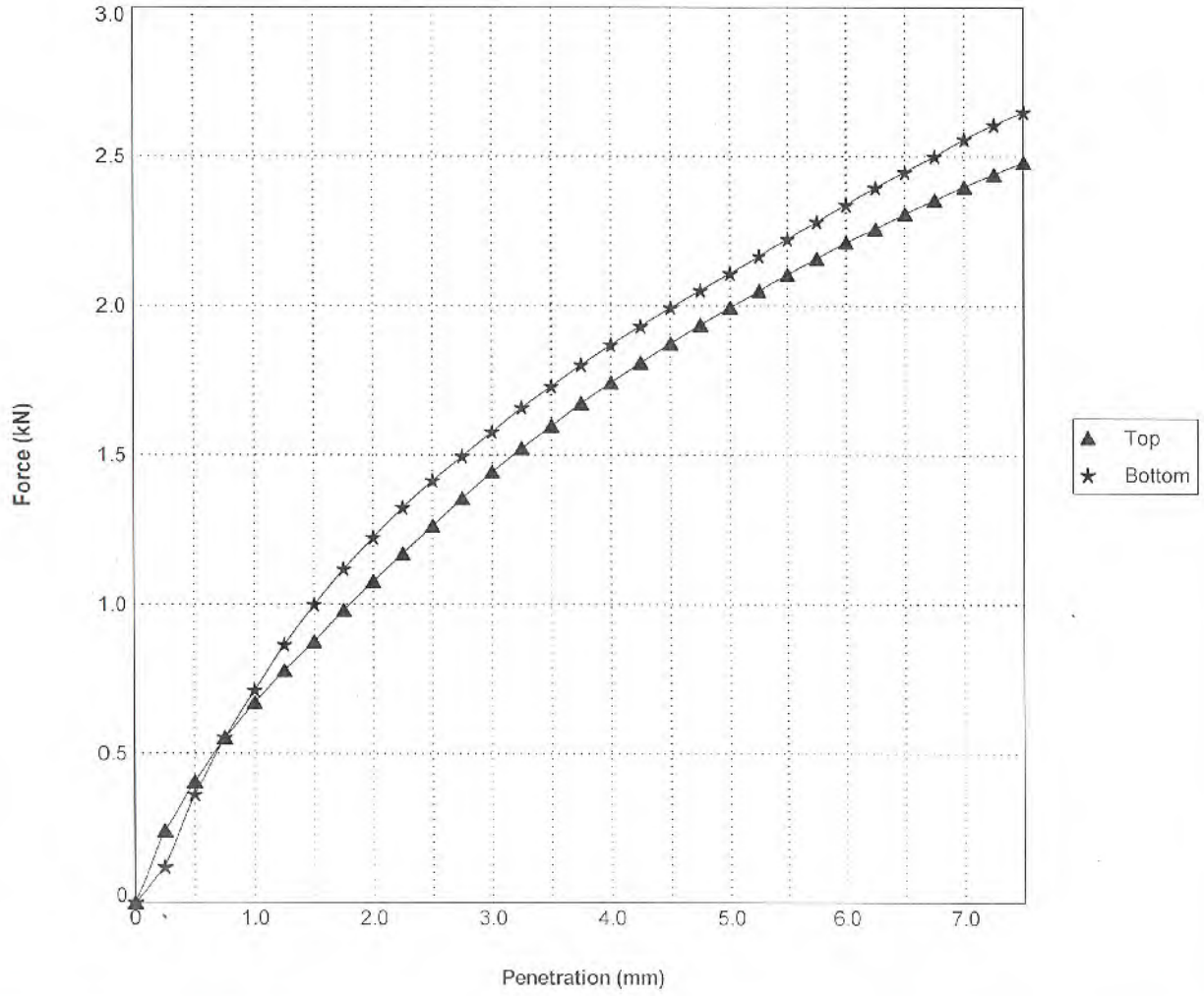
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20 Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - **Tel:** 01772 735 300 **Fax:** 01772 735 999

DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP103** Sample No.- **B10** Depth (m)- **1.50**

"As Received" Moisture Content (%) :	21.0	Surcharge (Kg) :	6
Retained on 20mm (%) :	0.8	Seating Load (N) :	Top 10 / Bottom 50
Correction Needed :	No	Test Moisture Content (%) :	Top 14.6 / Bottom 22.9
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	2.12
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.78
Date Tested :	21/02/2019	CBR Value (%) :	Top 10.0 / Bottom 10.7
Preparation Method :	2.5kg Compaction		
Remarks :			



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :- MSeq	Name :-		Page 1 of 1
Date of issue :- 28/02/2019	Certificate No :- CBR/NW1580/TP103/B10/1.50/5	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

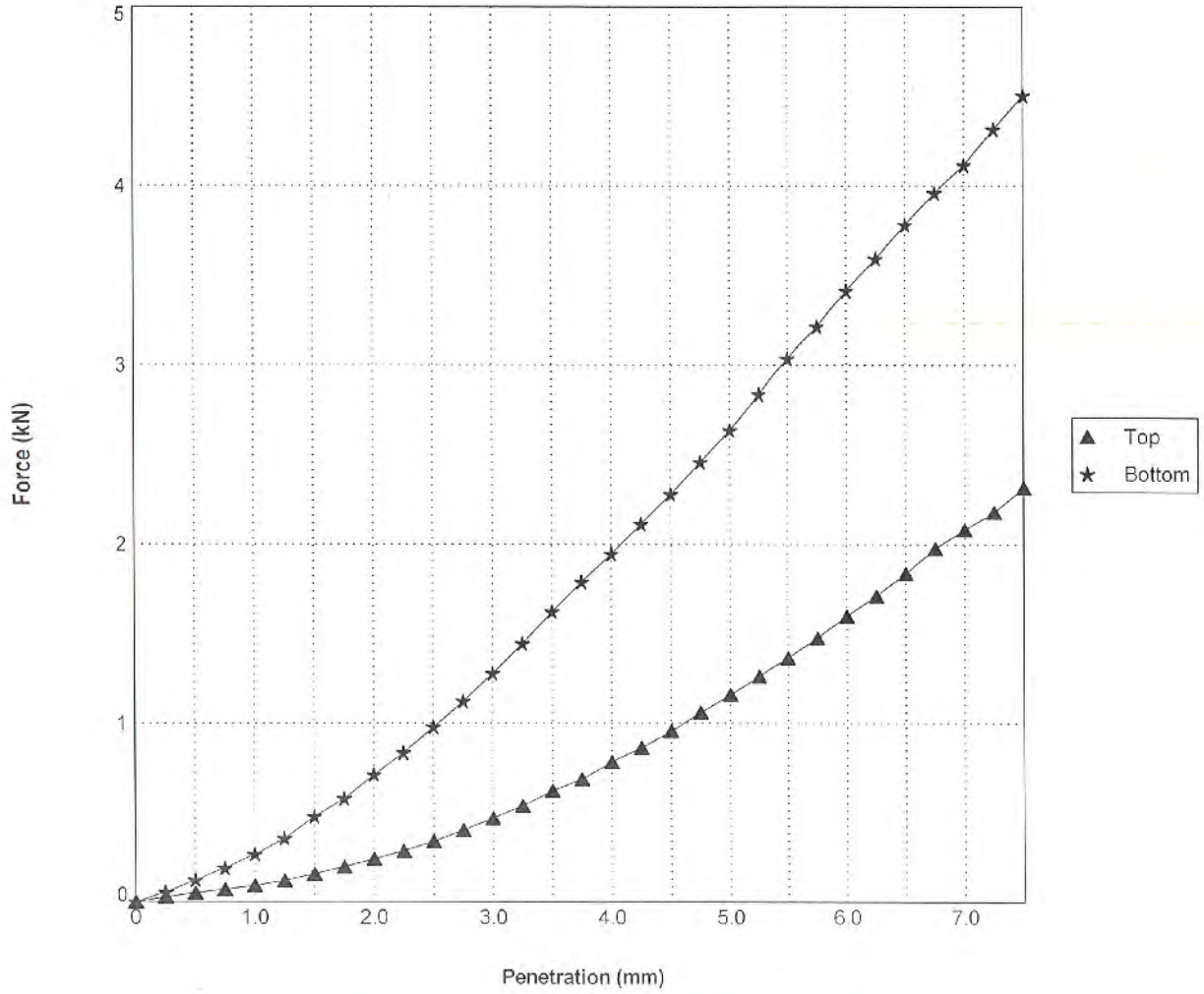
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 899

DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP111** Sample No.- **LB3** Depth (m)- **0.80**

"As Received" Moisture Content (%) :	19.7	Surcharge (Kg) :	6
Retained on 20mm (%) :	17.0	Seating Load (N) :	Top 50 / Bottom 10
Correction Needed :	No	Test Moisture Content (%) :	Top 19.7 / Bottom 19.7
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	1.91
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.60
Date Tested :	21/02/2019	CBR Value (%) :	Top 5.8 / Bottom 13.2
Preparation Method :	Vibrating Hammer Compaction		
Remarks :	Tested at "As Received" Moisture Content		



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :-	Name :-		Page 1 of 1
Date of issue :- 28/02/2019	Certificate No :- CBR/NW1580/TP111/LB3/0.80/1	AEG Contract No. :- NW1580	

UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

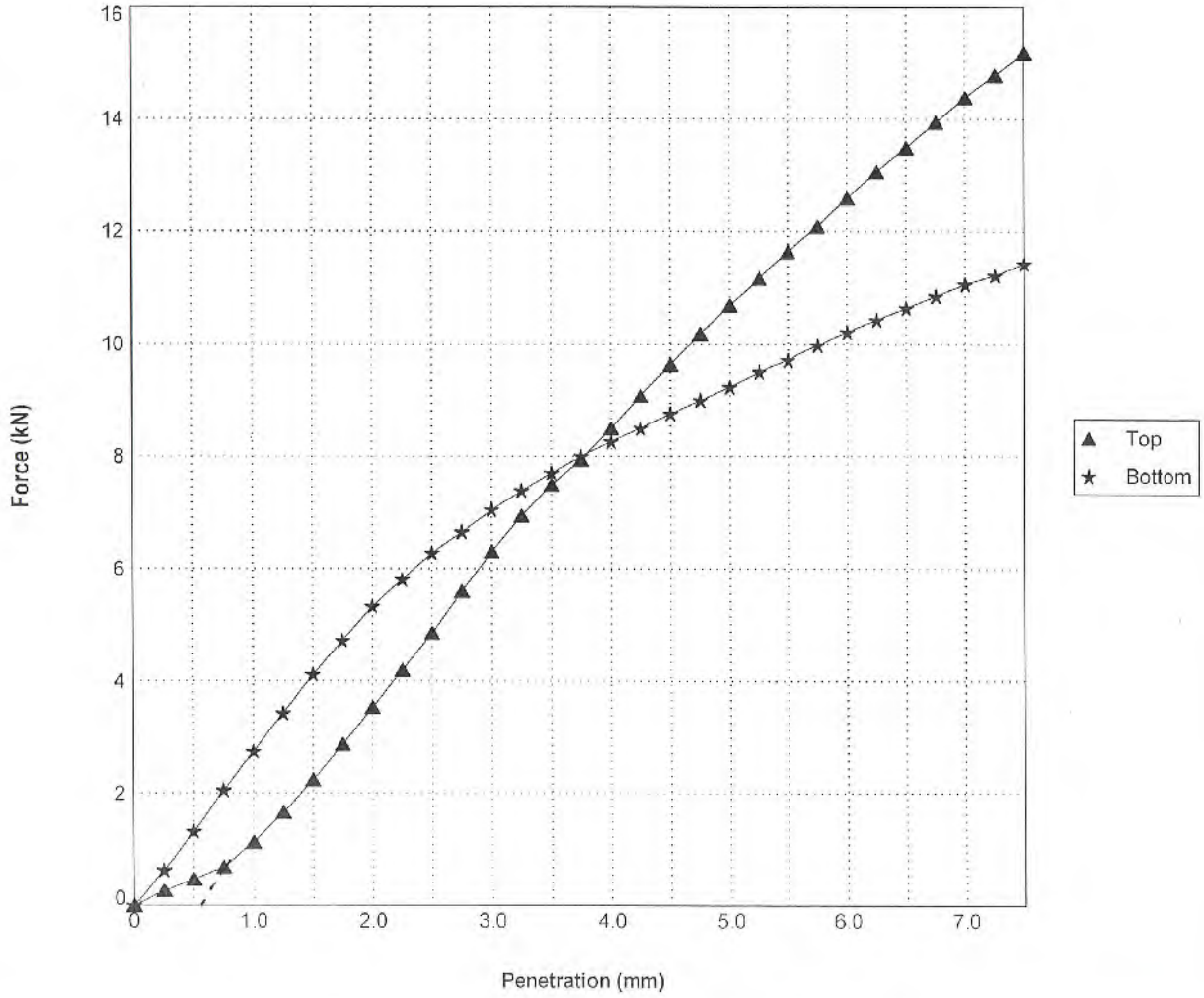
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham. DH2 2RG - Tel: 0191 387 4700 Fax: 0191 387 4710
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DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP111** Sample No.- **LB3** Depth (m)- **0.80**

"As Received" Moisture Content (%) :	19.7	Surcharge (Kg) :	6
Retained on 20mm (%) :	17.0	Seating Load (N) :	Top 250 / Bottom 250
Correction Needed :	Yes	Test Moisture Content (%) :	Top 4.6 / Bottom 4.0
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	1.57
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.50
Date Tested :	26/02/2019	CBR Value (%) :	Top 60.5 / Bottom 47.5
Preparation Method :	Vibrating Hammer Compaction		
Remarks :			



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :- MSene	Name :- M SELKIRK	Page 1 of 1	
Date of issue :- 01/03/2019	Certificate No :- CBR/NW1580/TP111/LB3/0.80/2	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

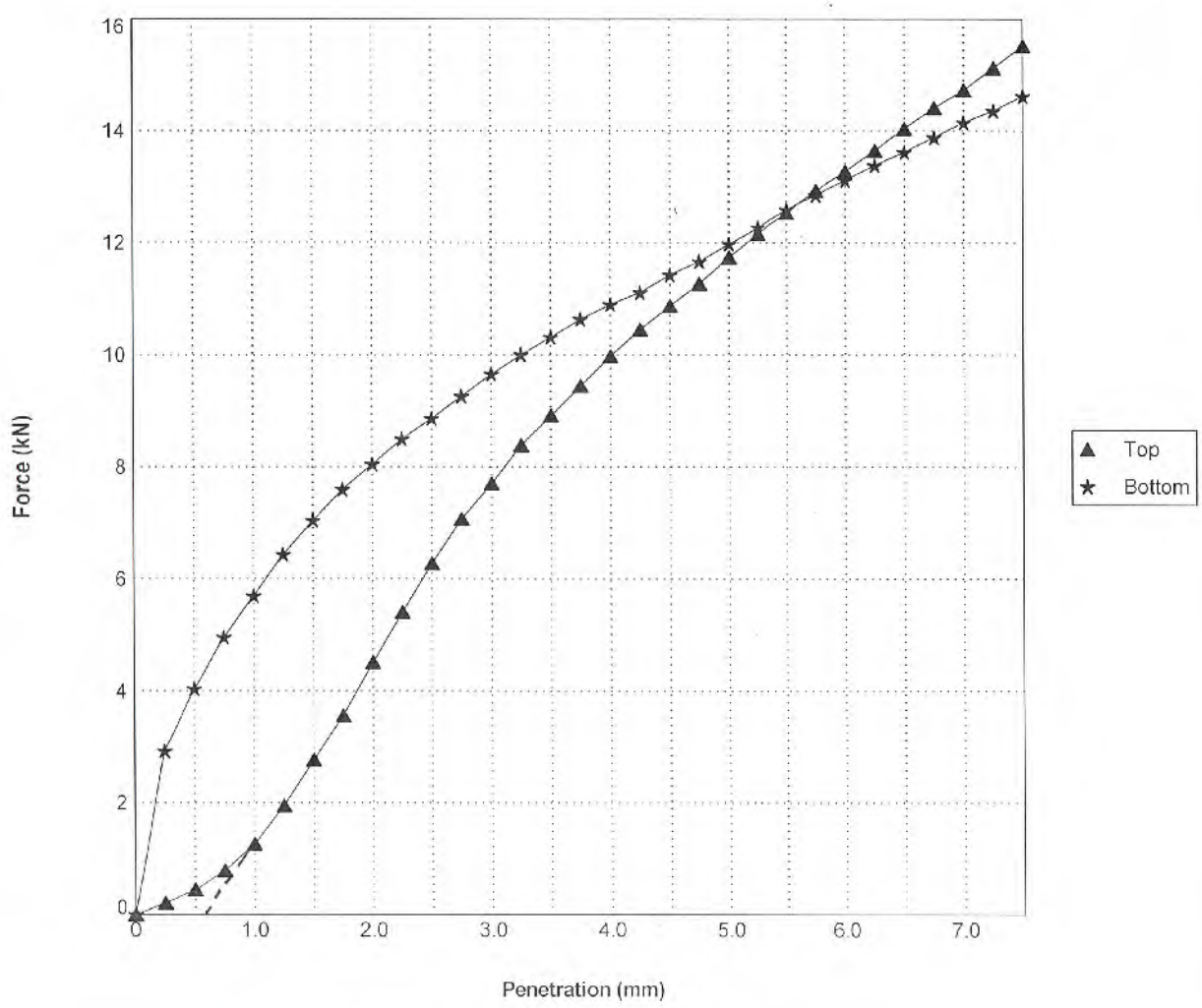
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - **Tel:** 01772 735 300 **Fax:** 01772 735 999

DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP111** Sample No.- **LB3** Depth (m)- **0.80**

"As Received" Moisture Content (%) :	19.7	Surcharge (Kg) :	6
Retained on 20mm (%) :	17.0	Seating Load (N) :	Top 250 / Bottom 250
Correction Needed :	No	Test Moisture Content (%) :	Top 7.7 / Bottom 7.8
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	1.56
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.45
Date Tested :	26/02/2019	CBR Value (%) :	Top 64.7 / Bottom 67.0
Preparation Method :	Vibrating Hammer Compaction		
Remarks :			



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :-	Name :-		Page 1 of 1
Date of issue :- 01/03/2019	Certificate No :- CBR/NW1580/TP111/LB3/0.80/3	AEG Contract No. :- **NW1580**	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

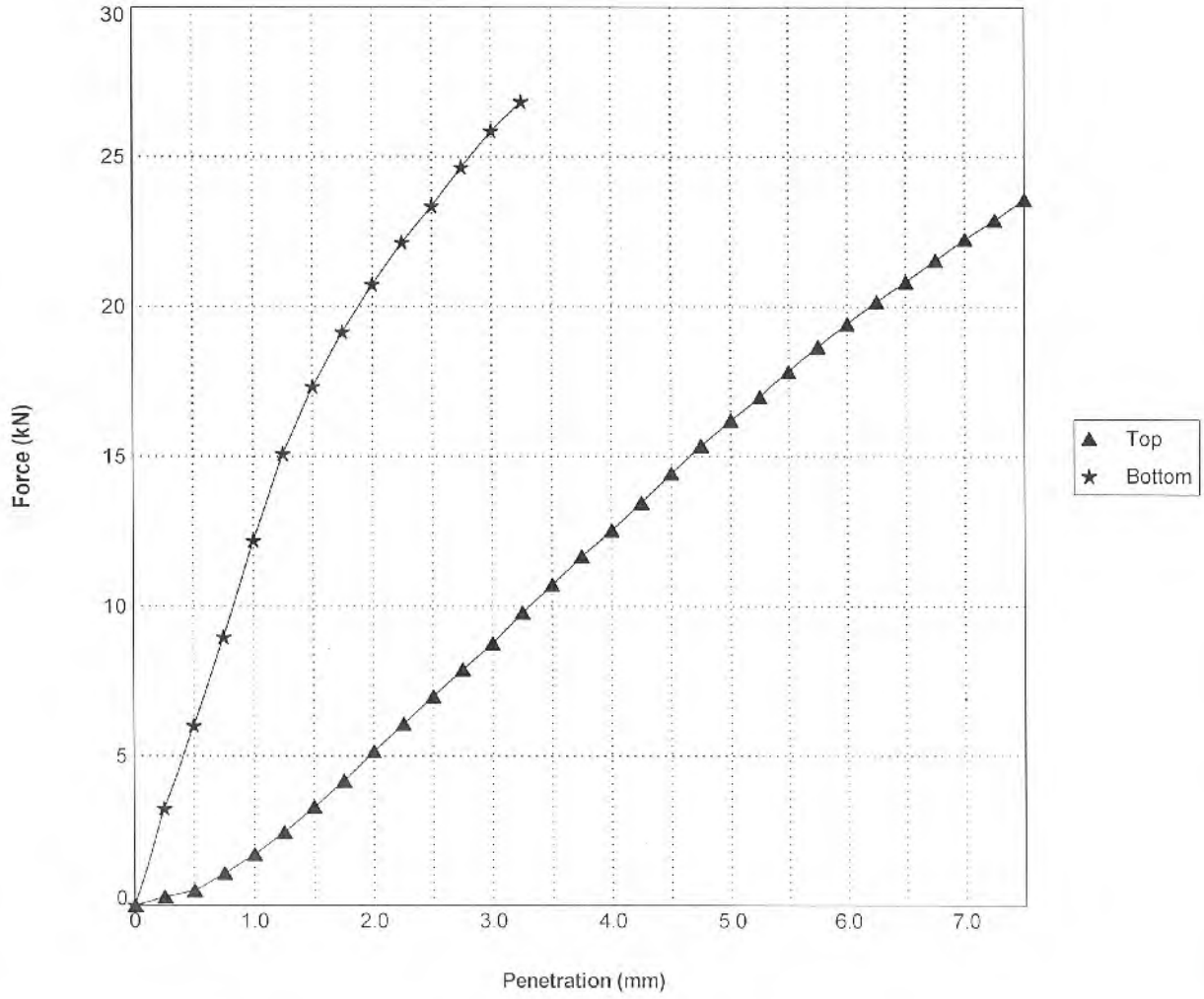
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham DH2 2RG - **Tel:** 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Lanam Wharf, Blackburn, BB1 5BL - **Tel:** 01772 735 300 Fax: 01772 735 999

DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP111** Sample No.- **LB3** Depth (m)- **0.80**

"As Received" Moisture Content (%) :	19.7	Surcharge (Kg) :	6
Retained on 20mm (%) :	17.0	Seating Load (N) :	Top 250 / Bottom 250
Correction Needed :	No	Test Moisture Content (%) :	Top 10.5 / Bottom 8.8
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	1.74
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.58
Date Tested :	26/02/2019	CBR Value (%) :	Top 81.2 / Bottom 176.5
Preparation Method :	Vibrating Hammer Compaction		
Remarks :	Test was stopped due to maximum load ring capacity being reached.		



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :- MSerq	Name :- M. ELKIRK	Page 1 of 1	
Date of issue :- 01/03/2019	Certificate No :- CBR/NW1580/TP111/LB3/0.80/4	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

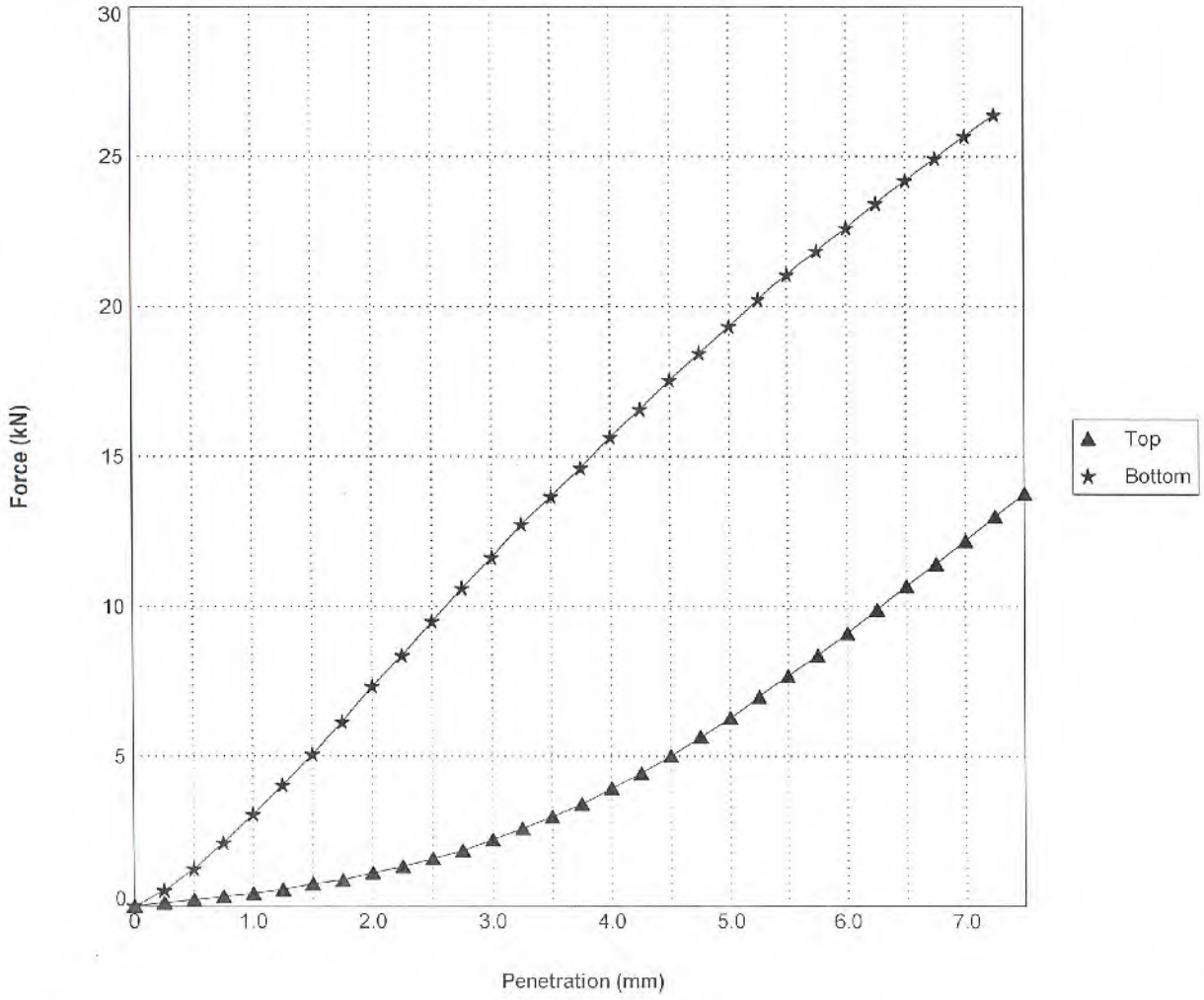
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
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DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP111** Sample No.- **LB3** Depth (m)- **0.80**

"As Received" Moisture Content (%) :	19.7	Surcharge (Kg) :	6
Retained on 20mm (%) :	17.0	Seating Load (N) :	Top 250 / Bottom 250
Correction Needed :	No	Test Moisture Content (%) :	Top 13.5 / Bottom 12.7
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	1.87
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.65
Date Tested :	26/02/2019	CBR Value (%) :	Top 31.5 / Bottom 97.0
Preparation Method :	Vibrating Hammer Compaction		
Remarks :	Test was stopped due to maximum load ring capacity being reached.		



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :-	Name :-		Page 1 of 1
Date of issue :- 01/03/2019	Certificate No :- CBR/NW1580/TP111/LB3/0.80/5	AEG Contract No. :- NW1580	

UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

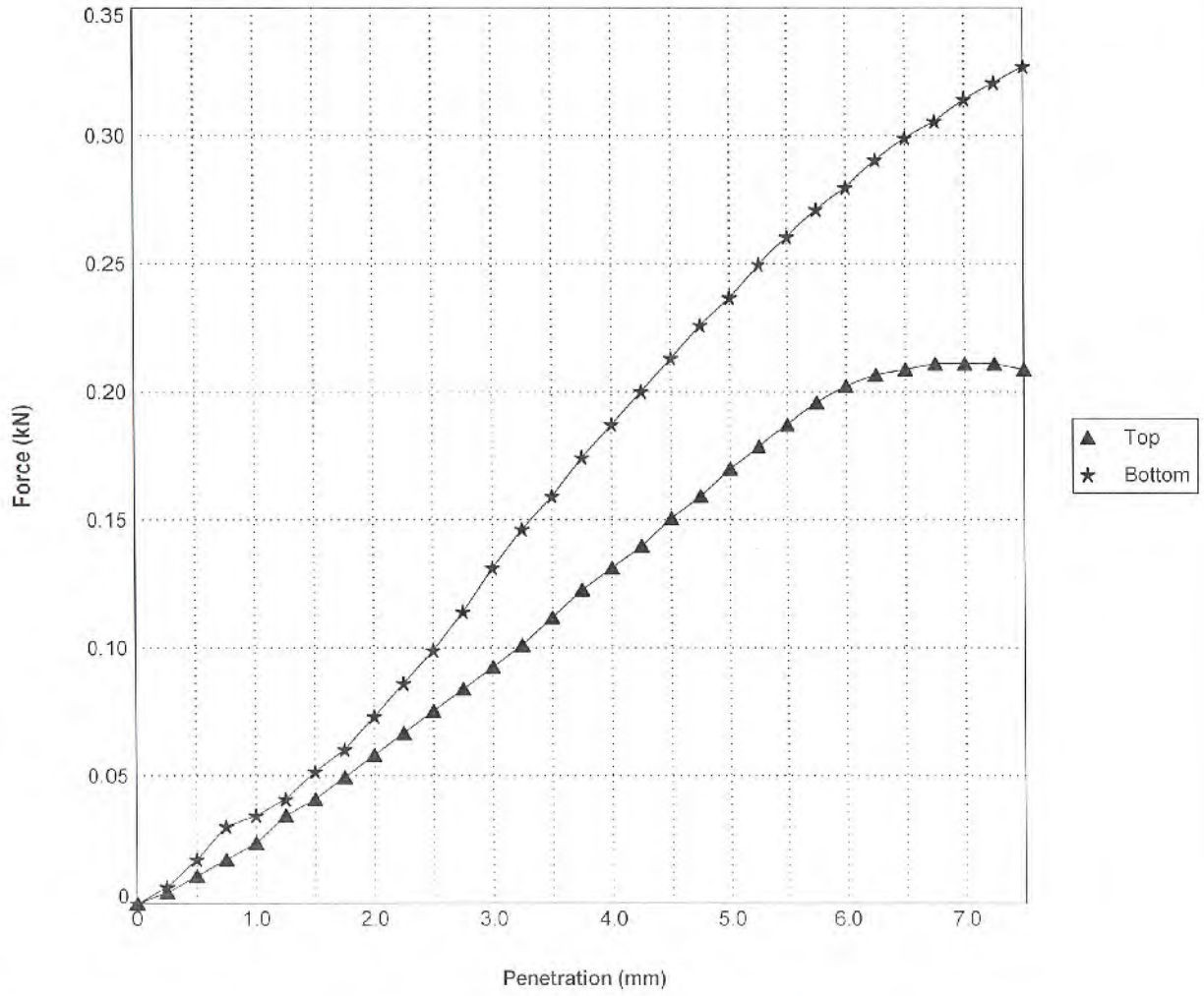
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - Tel: 0191 387 4700 Fax: 0191 387 4710
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DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP121** Sample No.- **LB3** Depth (m)- **0.80**

"As Received" Moisture Content (%) :	20.8	Surcharge (Kg) :	6
Retained on 20mm (%) :	7.0	Seating Load (N) :	Top 50 / Bottom 10
Correction Needed :	No	Test Moisture Content (%) :	Top 20.7 / Bottom 20.8
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	2.01
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.67
Date Tested :	31/01/2019	CBR Value (%) :	Top 0.9 / Bottom 1.2
Preparation Method :	Vibrating Hammer Compaction		
Remarks :	Tested at "As Received" Moisture Content		



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :-	Client :-
Northern Gateway	Far East Consortium International Limited

Signed :-	Name :-	Page 1 of 1	
Date of issue :- 28/02/2019	Certificate No :- CBR/NW1580/TP121/LB3/0.80/1	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

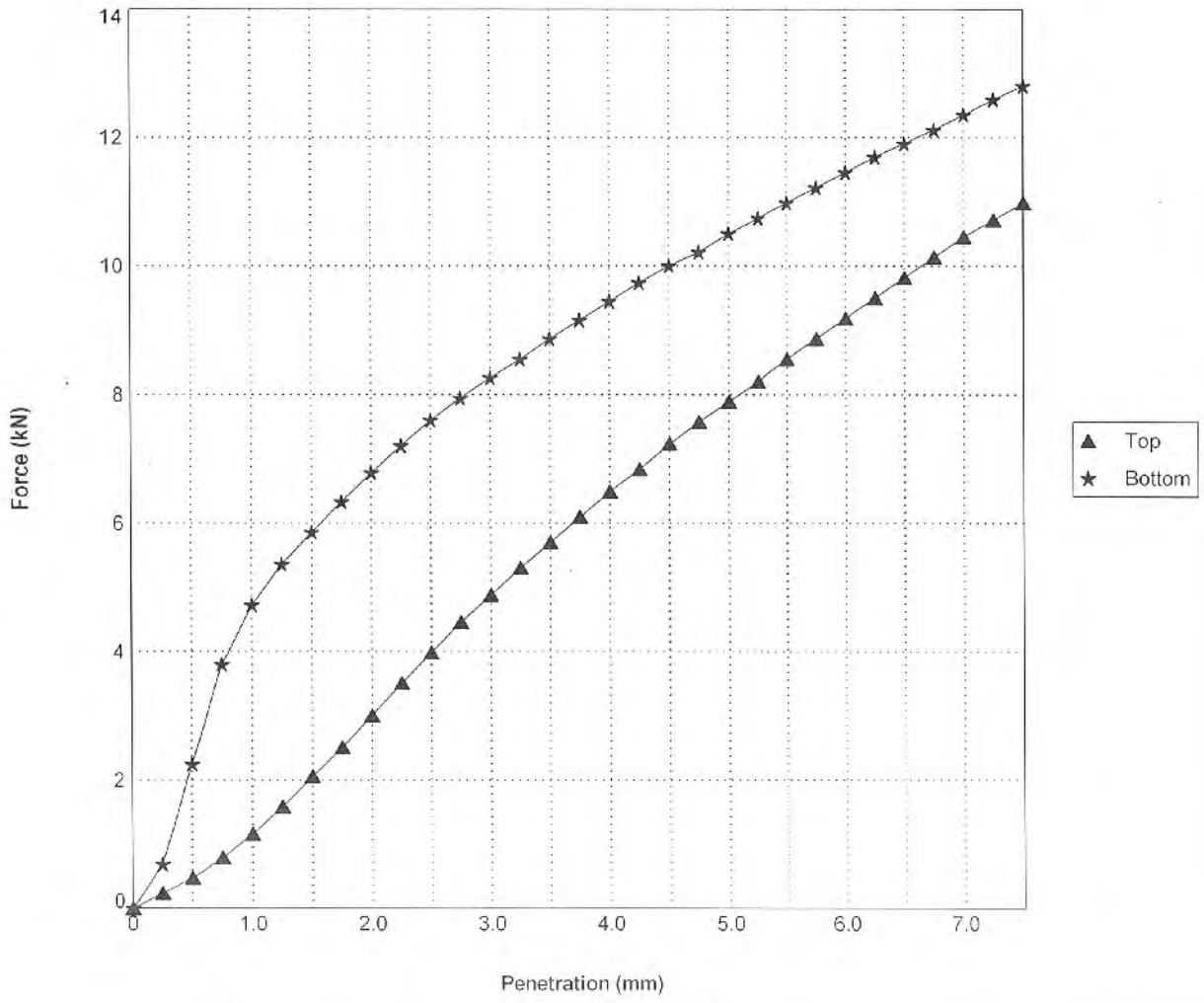
Head Office: Unit 25 Stella Gill Industrial Estate, Pelton Fell, Chester-le-Street, Co. Durham, DH2 2RG - Tel: 0191 387 4700 Fax: 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP121** Sample No.- **LB3** Depth (m)- **0.80**

"As Received" Moisture Content (%) :	20.8	Surcharge (Kg) :	6
Retained on 20mm (%) :	7.0	Seating Load (N) :	Top 250 / Bottom 250
Correction Needed :	No	Test Moisture Content (%) :	Top 6.5 / Bottom 5.6
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	1.81
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.71
Date Tested :	19/02/2019	CBR Value (%) :	Top 39.6 / Bottom 57.4
Preparation Method :	Vibrating Hammer Compaction		
Remarks :			



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :-	Name :-		Page 1 of 1
Date of issue :- 28/02/2019	Certificate No :- CBR/NW1580/TP121/LB3/0.80/2	AEG Contract No. :- NW1580	UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

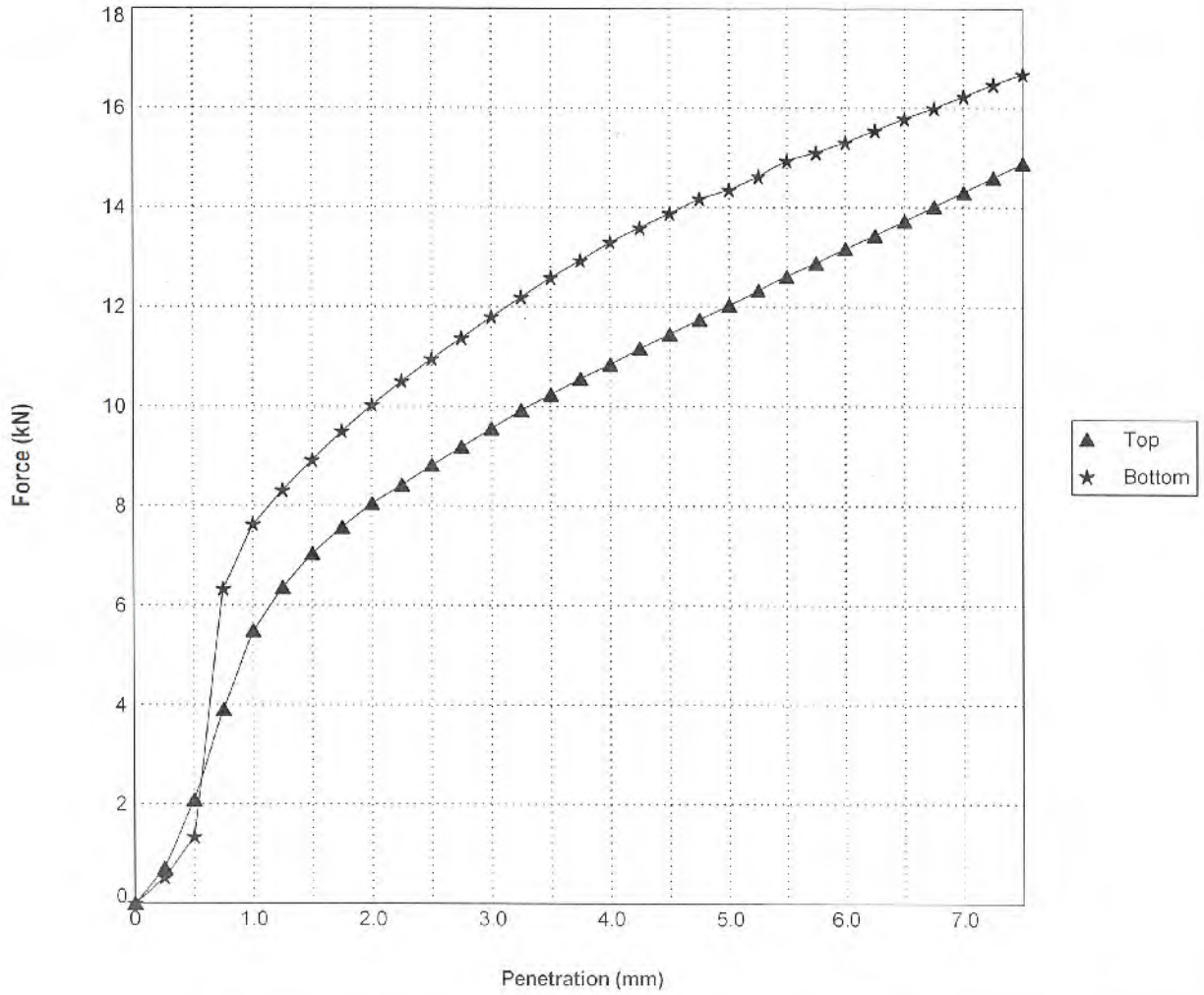
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Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP121** Sample No.- **LB3** Depth (m)- **0.80**

"As Received" Moisture Content (%) :	20.8	Surcharge (Kg) :	6
Retained on 20mm (%) :	7.0	Seating Load (N) :	Top 250 / Bottom 250
Correction Needed :	Yes	Test Moisture Content (%) :	Top 8.1 / Bottom 8.7
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	1.94
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.79
Date Tested :	19/02/2019	CBR Value (%) :	Top 66.6 / Bottom 89.4
Preparation Method :	Vibrating Hammer Compaction		
Remarks :			



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited
Signed :- msorp	Name :-
Date of issue :- 28/02/2019	Certificate No :- CBR/NW1580/TP121/LB3/0.80/3
AEG Contract No. :- NW1580	Page 1 of 1

UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

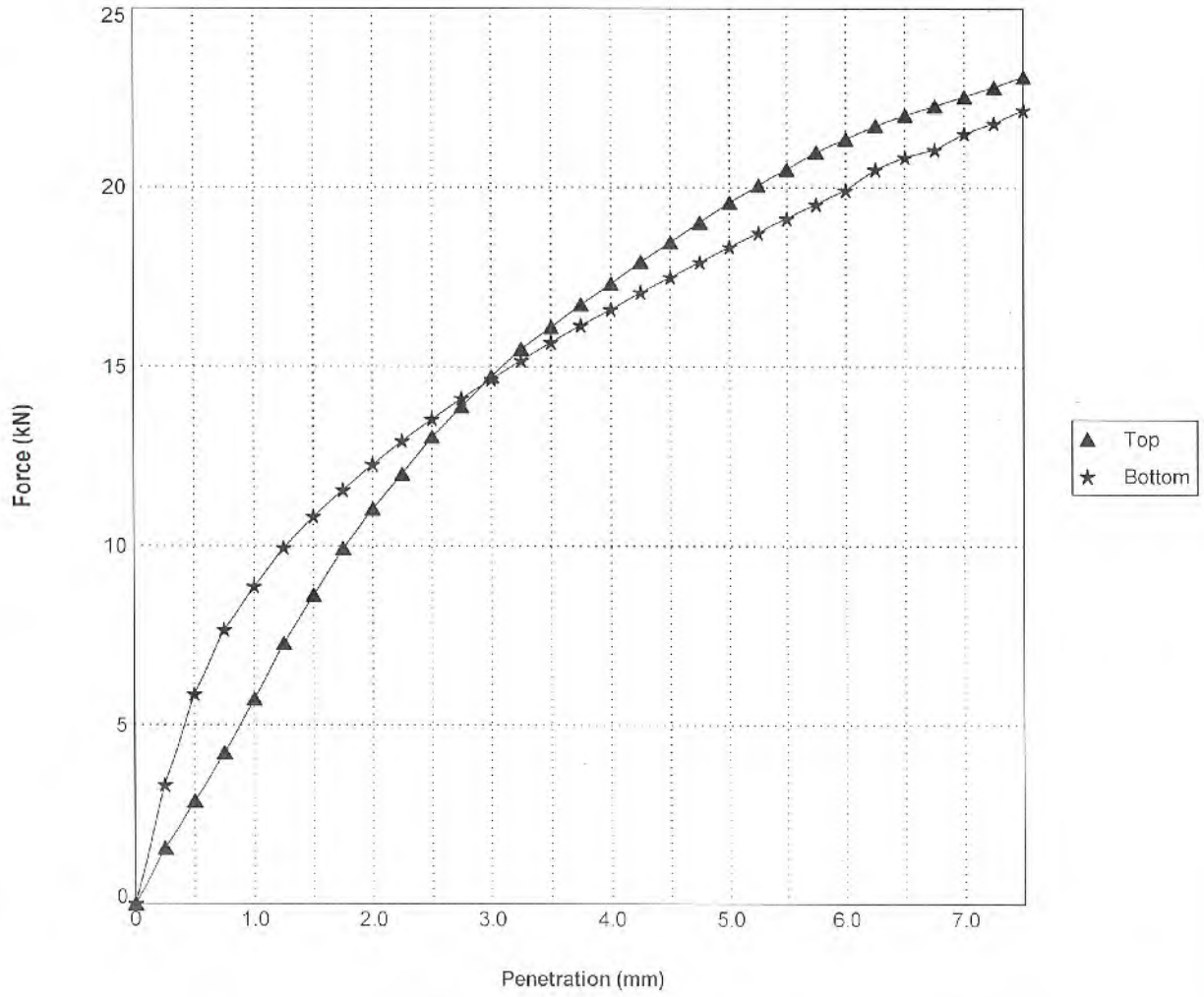
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Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - Tel: 01772 735 300 Fax: 01772 735 999

DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP121** Sample No.- **LB3** Depth (m)- **0.80**

"As Received" Moisture Content (%) :	20.8	Surcharge (Kg) :	6
Retained on 20mm (%) :	7.0	Seating Load (N) :	Top 250 / Bottom 250
Correction Needed :	No	Test Moisture Content (%) :	Top 11.2 / Bottom 11.2
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	2.09
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.88
Date Tested :	20/02/2019	CBR Value (%) :	Top 98.5 / Bottom 102.3
Preparation Method :	Vibrating Hammer Compaction		
Remarks :			



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :-	Name :-		Page 1 of 1
Date of issue :- 28/02/2019	Certificate No :- CBR/NW1580/TP121/LB3/0.80/4	AEG Contract No. :- NW1580	

UKAS TESTING 1367

ALLIED EXPLORATION & GEOTECHNICS LIMITED

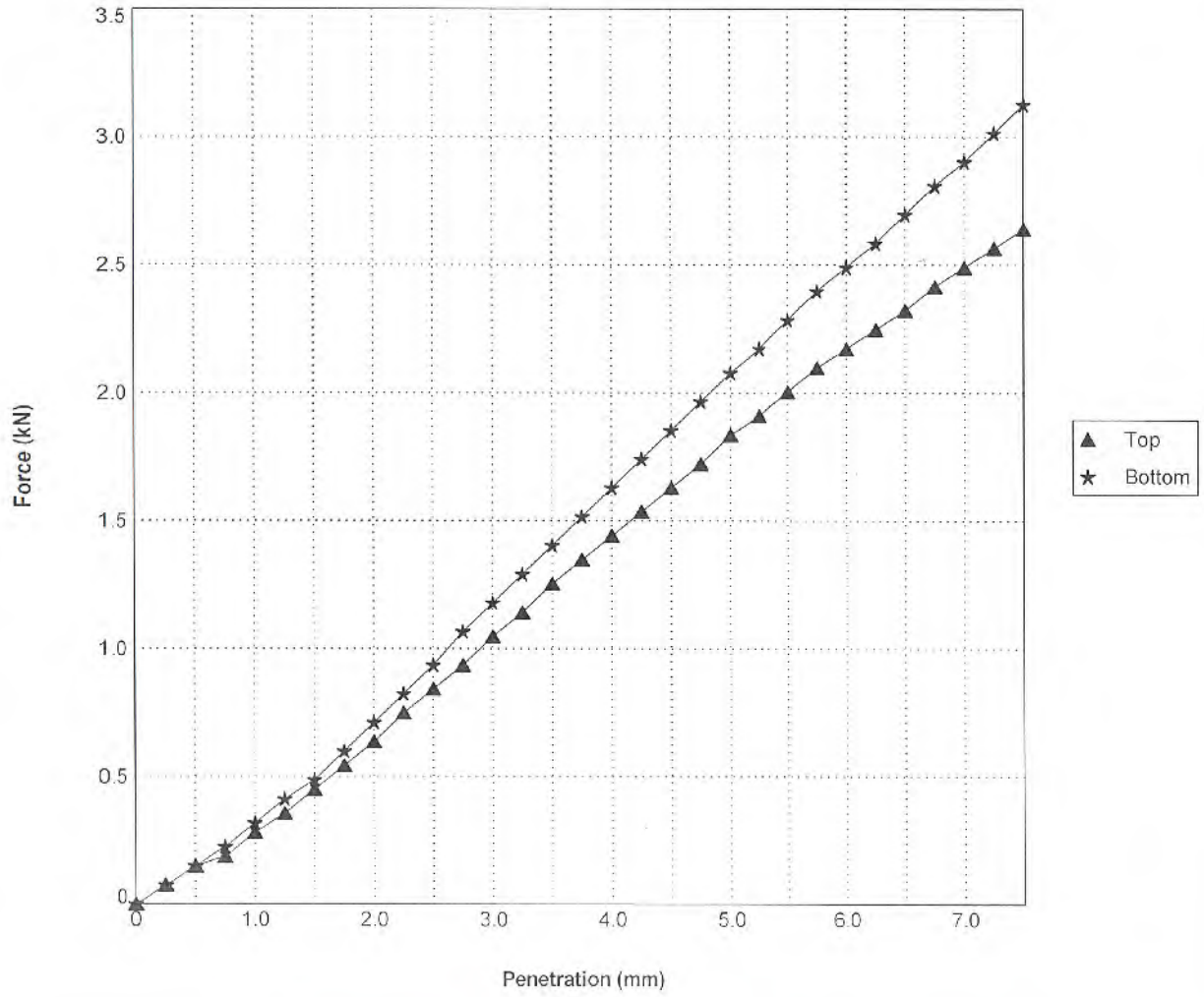
Head Office: Unit 25 Stella Oil Industrial Estate, Pelton Fell, Chester-le Street, Co. Durham, DH2 2RG - **Tel:** 0191 387 4700 **Fax:** 0191 387 4710
Regional Office: Unit 20, Business Development Centre, Eanam Wharf, Blackburn, BB1 5BL - **Tel:** 01772 735 300 **Fax:** 01772 735 999

DETERMINATION OF THE CALIFORNIA BEARING RATIO

BS 1377 : Part 4 : 1990 and Part 2 : Clause 3.2 : 1990

Exploratory Hole No.- **TP121** Sample No.- **LB3** Depth (m)- **0.80**

"As Received" Moisture Content (%) :	20.8	Surcharge (Kg) :	6
Retained on 20mm (%) :	7.0	Seating Load (N) :	Top 250 / Bottom 250
Correction Needed :	No	Test Moisture Content (%) :	Top 15.3 / Bottom 14.6
Soaking Time (Days) :	N/A	Bulk Density (Mg/m^3) :	2.10
Swelling (mm) :	N/A	Dry Density (Mg/m^3) :	1.83
Date Tested :	21/02/2019	CBR Value (%) :	Top 9.2 / Bottom 10.4
Preparation Method :	Vibrating Hammer Compaction		
Remarks :			



For description of sample please refer to the Laboratory Sample Description Sheet

Contract Title :- Northern Gateway	Client :- Far East Consortium International Limited

Signed :-	Name :-		Page 1 of 1
Date of issue :- 28/02/2019	Certificate No :- CBR/NW1580/TP121/LB3/0.80/5	AEG Contract No. :- **NW1580**	

UKAS TESTING 1367

LABORATORY TESTING ENCLOSURE 9

Determination of One Dimensional Consolidation Properties

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES

BS 1377 : PART 5 : 1990 : CLAUSE 3

Exploratory Hole No	**BH101**	**Sample**	**B15**	**Depth**	**3.50m**
Specimen Type	**Compacted**	**Orientation**	**N/A**	**Specific Depth**	**N/A**

	INITIAL	FINAL			
Height	18.7	17.1	mm	Particle Density (Assumed)	2.70
Diameter	74.4	74.4	mm		
Moisture Content	21.0	17.6	%	Degree of Saturation (%)	98.8
Wet Density	2.08	2.20	Mg/m^3		
Dry Density	1.72	1.87	Mg/m^3	Test Duration (Days)	6
				Date Tested	30/01/2019

Square Root of Time Fitting Method

Pressure Range kN/m2	Mv m2/MN	Cv m2/yr	Temp C	Voids Ratio
Initial				0.574
0 - 50	0.660	.	18	0.522
50 - 100	0.259	3.38	17	0.502
100 - 200	0.192	4.50	17	0.473
200 - 400	0.113	2.96	17	0.440
400 - 100	0.018	Swelling	18	0.448
100 - 400	0.026	6.60	18	0.437

For sample description please refer to the Laboratory Sample Description Sheet.

Contract Title:	Client:
Northern Gateway	Far East Consortium International Limited

AEG	Signed: MSelk	Name: M. SELKIRK	Page 1 of 2	UKAS TESTING 1367
	Date of Issue: 08/02/2019	Certificate No: NW1580/A	AEG Contract No: NW1580	

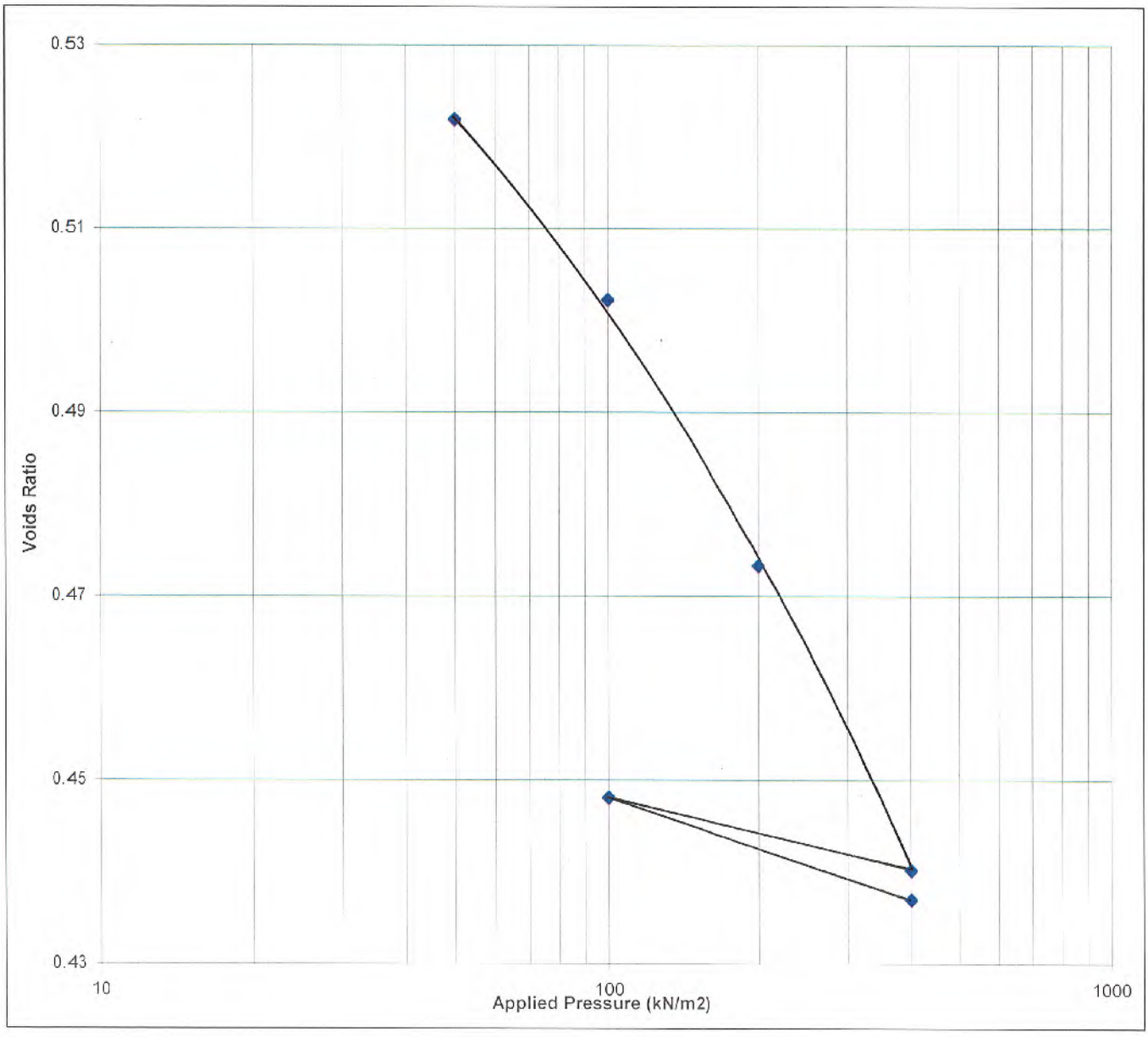
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ONE DIMENSIONAL CONSOLIDATION PROPERTIES

BS 1377 : PART 5 : 1990 : CLAUSE 3

Exploratory Hole No	BH101	Sample	B15	Depth	3.50m
Specimen Type	Compacted	Orientation	N/A	Specific Depth	N/A



Contract Title:	Client:
Northern Gateway	Far East Consortium International Limited

Signed: MSelk	Name: M. SELKIRK	Page 2 of 2	
Date of Issue: 08/02/2019	Certificate No: NW1580/A	AEG Contract No: NW1580	UKAS TESTING 1367

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES

BS 1377 : PART 5 : 1990 : CLAUSE 3

Exploratory Hole No	**BH102**	**Sample**	**B8**	**Depth**	**2.50m**
Specimen Type	**Compacted**	**Orientation**	**N/A**	**Specific Depth**	**N/A**

	INITIAL	FINAL			
Height	18.7	17.3	mm	Particle Density (Assumed)	2.70
Diameter	74.4	74.4	mm		
Moisture Content	21.5	19.5	%	Degree of Saturation (%)	96.2
Wet Density	2.05	2.17	Mg/m^3		
Dry Density	1.68	1.82	Mg/m^3	Test Duration (Days)	6
				Date Tested	30/01/2019

Square Root of Time Fitting Method

Pressure Range kN/m2	Mv m2/MN	Cv m2/yr	Temp C	Voids Ratio
Initial				0.603
0 - 25	1.065	.	18	0.561
25 - 50	0.409	3.64	17	0.545
50 - 100	0.330	7.30	17	0.519
100 - 200	0.211	7.68	17	0.487
200 - 50	0.024	Swelling	18	0.493
50 - 200	0.037	11.05	18	0.484

For sample description please refer to the Laboratory Sample Description Sheet.

Contract Title:	Client:
Northern Gateway	Far East Consortium International Limited

	Signed:	Name:		
AEG	MSelk	M. SELKIRK	Page 1 of 2	UKAS TESTING 1367
	Date of Issue: 08/02/2019	Certificate No: NW1580/C	AEG Contract No: NW1580	

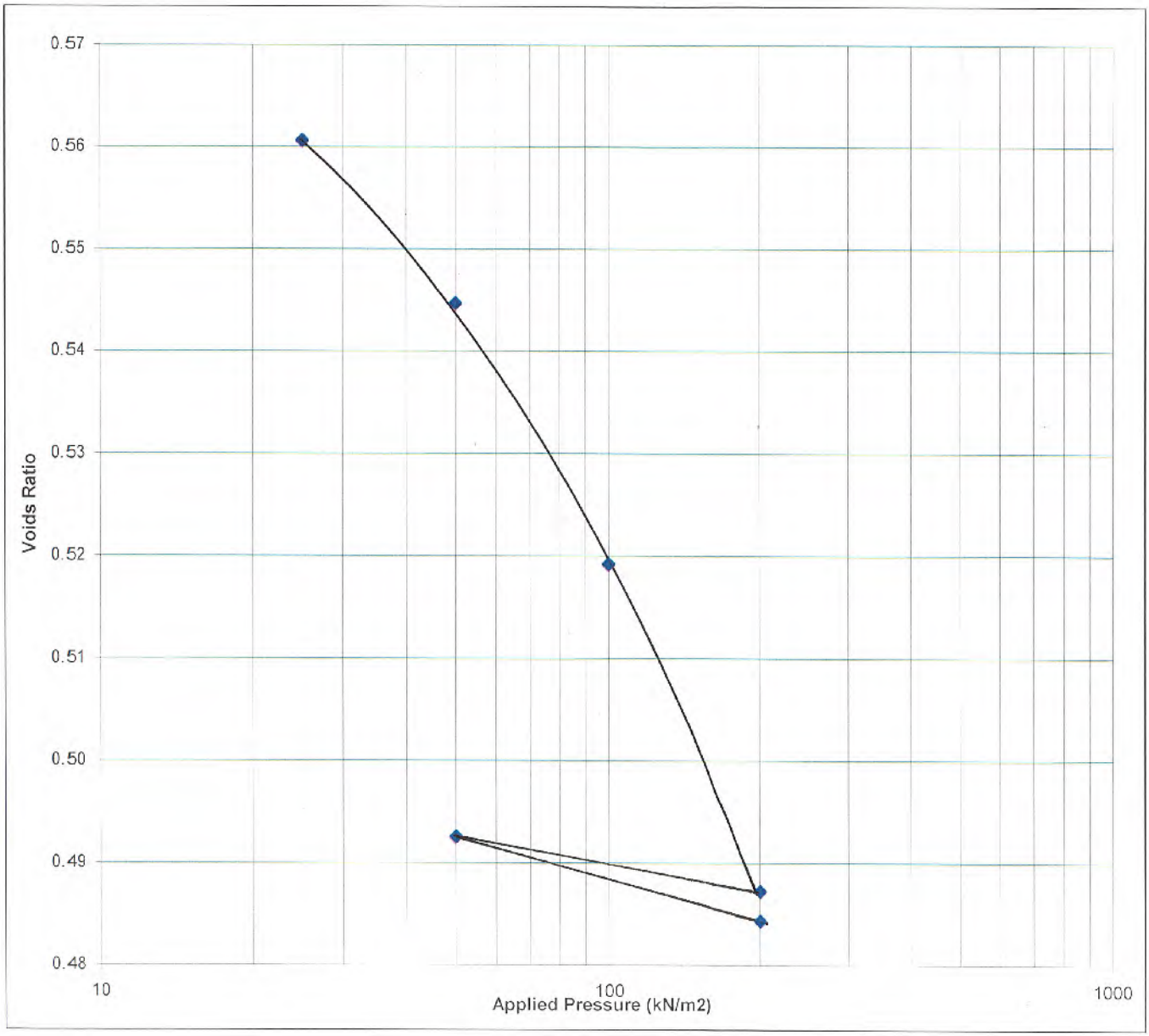
ALLIED EXPLORATION & GEOTECHNICS LIMITED

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES

BS 1377 : PART 5 : 1990 : CLAUSE 3

Exploratory Hole No	BH102	Sample	B8	Depth	2.50m
Specimen Type	Compacted	Orientation	N/A	Specific Depth	N/A



Contract Title:	Client:
Northern Gateway	Far East Consortium International Limited

Signed: MSelk	Name: M. SELKIRK	Page 2 of 2	
Date of Issue: 08/02/2019	Certificate No: NW1580/C	AEG Contract No: NW1580	UKAS TESTING 1367

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES

BS 1377 : PART 5 : 1990 : CLAUSE 3

Exploratory Hole No	**BH104**	**Sample**	**B17**	**Depth**	**5.30m**
Specimen Type	**Compacted**	**Orientation**	**N/A**	**Specific Depth**	**N/A**

	INITIAL	FINAL			
Height	18.9	17.3	mm	Particle Density (Assumed)	2.70
Diameter	74.4	74.4	mm		
Moisture Content	28.1	24.6	%	Degree of Saturation (%)	99.0
Wet Density	1.96	2.08	Mg/m^3		
Dry Density	1.53	1.67	Mg/m^3	Test Duration (Days)	6
				Date Tested	30/01/2019

Square Root of Time Fitting Method

Pressure Range kN/m2	Mv m2/MN	Cv m2/yr	Temp C	Voids Ratio
Initial				0.766
0 - 25	0.984	.	18	0.723
25 - 50	0.579	2.66	17	0.698
50 - 100	0.429	2.02	17	0.662
100 - 200	0.253	1.28	17	0.620
200 - 50	0.060	Swelling	18	0.634
50 - 200	0.077	2.93	18	0.615

For sample description please refer to the Laboratory Sample Description Sheet.

Contract Title:	Client:
Northern Gateway	Far East Consortium International Limited

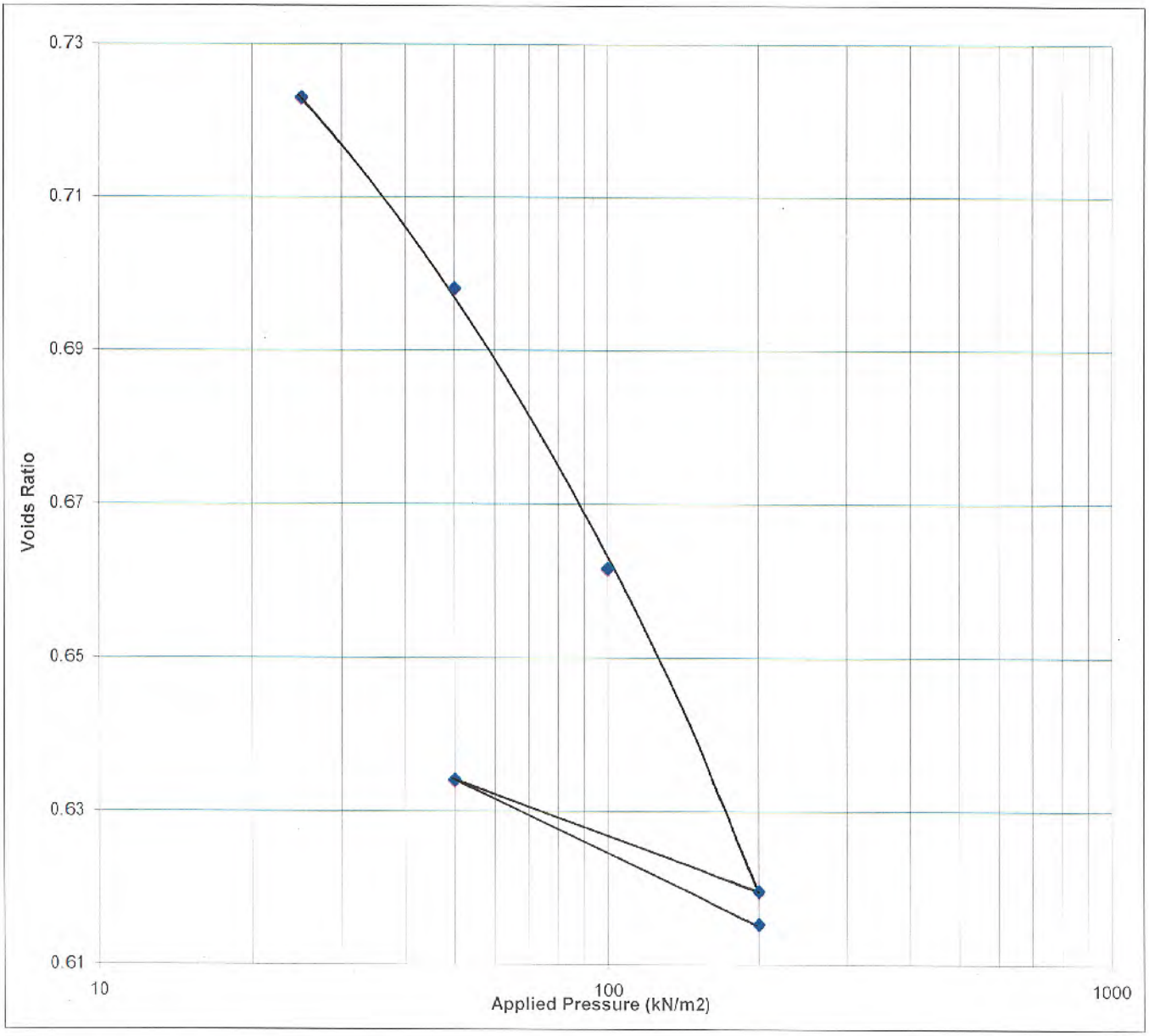
	Signed:	Name:		
AEG	MSelkirk	M. SELKIRK	Page 1 of 2	UKAS TESTING 1367
	Date of Issue: 08/02/2019	Certificate No: NW1580/D	AEG Contract No: NW1580	

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES

BS 1377 : PART 5 : 1990 : CLAUSE 3

Exploratory Hole No	BH104	Sample	B17	Depth	5.30m
Specimen Type	Compacted	Orientation	N/A	Specific Depth	N/A



Contract Title:	Client:
Northern Gateway	Far East Consortium International Limited

Signed: MSelkirk	Name: M. SELKIRK	Page 2 of 2	
Date of Issue: 08/02/2019	Certificate No: NW1580/D	AEG Contract No: NW1580	UKAS TESTING 1367

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ONE DIMENSIONAL CONSOLIDATION PROPERTIES

BS 1377 : PART 5 : 1990 : CLAUSE 3

Exploratory Hole No	**BH110**	**Sample**	**B13**	**Depth**	**4.80m**
Specimen Type	**Compacted**	**Orientation**	**N/A**	**Specific Depth**	**N/A**

	INITIAL	FINAL			
Height	19.0	17.4	mm	Particle Density (Assumed)	2.70
Diameter	74.4	74.4	mm		
Moisture Content	18.0	14.3	%	Degree of Saturation (%)	95.6
Wet Density	2.11	2.24	Mg/m^3		
Dry Density	1.79	1.96	Mg/m^3	Test Duration (Days)	6
				Date Tested	30/01/2019

Square Root of Time Fitting Method

Pressure Range kN/m2	Mv m2/MN	Cv m2/yr	Temp C	Voids Ratio
Initial				0.509
0 - 50	1.064	.	18	0.428
50 - 100	0.159	9.71	17	0.417
100 - 200	0.117	9.52	17	0.400
200 - 400	0.063	12.86	17	0.383
400 - 100	0.001	Swelling	18	0.383
100 - 400	0.002	36.01	18	0.382

For sample description please refer to the Laboratory Sample Description Sheet.

Contract Title:	Client:
Northern Gateway	Far East Consortium International Limited

	Signed:	Name:		
AEG	MSelk	M. SELKIRK	Page 1 of 2	UKAS TESTING 1367
	Date of Issue: 08/02/2019	Certificate No: NW1580/B	AEG Contract No: NW1580	

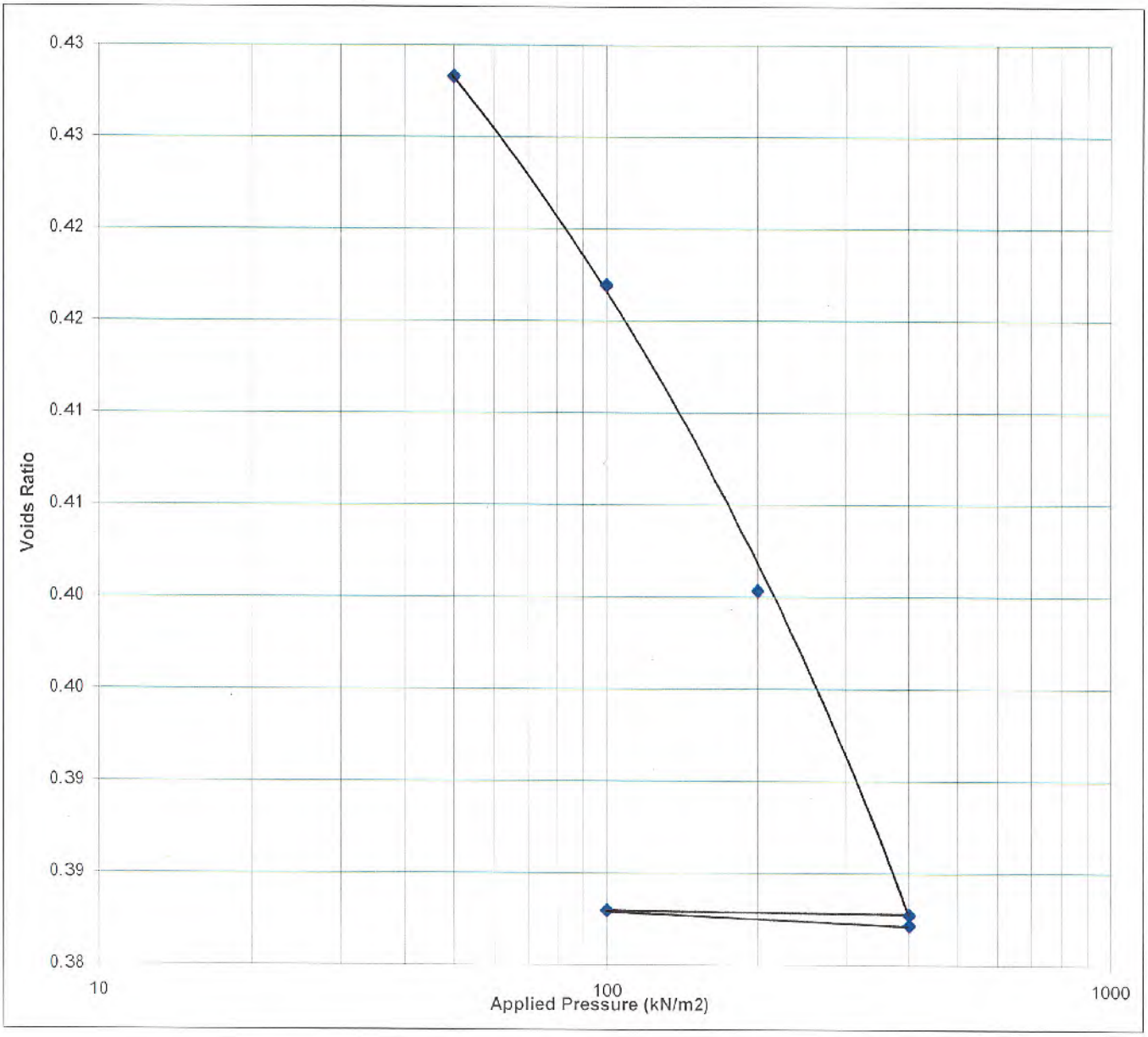
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ONE DIMENSIONAL CONSOLIDATION PROPERTIES

BS 1377 : PART 5 : 1990 : CLAUSE 3

Exploratory Hole No	**BH110**	**Sample**	**B13**	**Depth**	**4.80m**
Specimen Type	**Compacted**	**Orientation**	**N/A**	**Specific Depth**	**N/A**



Contract Title:	Client:
Northern Gateway	Far East Consortium International Limited

Signed:	Name: M. SELKIRK	Page 2 of 2	
Date of Issue: 08/02/2019	Certificate No: NW1580/B	AEG Contract No: NW1580	UKAS TESTING 1367

Shear Strength by Hand Vane

LABORATORY TESTING ENCLOSURE 10

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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DETERMINATION OF SHEAR STRENGTH BY HAND VANE

For sample description please refer to Sample Description Sheet.

Exploratory Hole No.	Depth (m BGL)	Sample Type & No.	Vane Shear Strength	Remarks*
TP103	1.50	B10	34kPa	MCV Nat Point
			31kPa	Point 1
			74kPa	Point 2
			96kPa	Point 3
			25kPa	Point 4
			68kPa	Point 5

* All specific depths are approximate within the sample.

Contract Title: Northern Gateway	Client: Far East Consortium International Limited

Signed:	Name: M. SELKIRK	Page 1 of 1	
Date of Issue: 13/02/2019	Certificate No. : Certificate No.NW1580/HV01	AEG Contract No. : NW1580	

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DETERMINATION OF SHEAR STRENGTH BY HAND VANE

For sample description please refer to Sample Description Sheet.

Exploratory Hole No.	Depth (m BGL)	Sample Type & No.	Vane Shear Strength	Remarks*
TP111/112	0.80	LB3	21kPa	MCV Point 1
			29kPa	MCV Point 2
			46kPa	MCV Point 3
			54kPa	MCV Point 4
			>130kPa	MCV Point 5 (NMC)

* All specific depths are approximate within the sample.

Contract Title:	Client:
Northern Gateway	Far East Consortium International Limited

Signed:	Name:	Page 1 of 1	
Date of Issue: 27/02/2019	Certificate No. : Certificate No.NW1580/HV01	AEG Contract No. : NW1580	

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DETERMINATION OF SHEAR STRENGTH BY HAND VANE

For sample description please refer to Sample Description Sheet.

Exploratory Hole No.	Depth (m BGL)	Sample Type & No.	Vane Shear Strength	Remarks*
TP121/122	0.80	LB3	20kPa	MCV Point 1
			35kPa	MCV Point 2 (NAT)
			38kPa	MCV Point 3
			43kPa	MCV Point 4
			51kPa	MCV Point 5

* All specific depths are approximate within the sample.

Contract Title:	Client:
Northern Gateway	Far East Consortium International Limited

Signed: MSone	Name: M. SELVAR	Page 1 of 1	
Date of Issue: 14/02/2019	Certificate No. : Certificate No.nw1580/HV01	AEG Contract No. : NW1580	

Undrained Shear Strength in Triaxial Cell without Pore Water Pressure Measurement

LABORATORY TESTING ENCLOSURE 11

ALLIED EXPLORATION & GEOTECHNICS LIMITED

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UNDRAINED SHEAR STRENGTH IN TRIAXIAL COMPRESSION WITHOUT MEASUREMENT OF PORE PRESSURE

BS 1377 : Part 7 : Clauses 8 & 9 : 1990 Part 2 Clause 3.2

Exploratory Hole	Sample ID Depth (m)	Sample ID Type	Specific Depth (m)	Diameter (mm)	Length (mm)	Prep. Method	Stage No.	Initial Moisture Content (%)	Bulk Density (Mg/m3)	Dry Density (Mg/m3)	Membrane Thickness (mm)	Membrane Correction (kPa)	Cell Pressure (kPa)	Corrected Deviator Stress (kPa)	Failure Strain (%)	Mode of Failure	cu (kPa)	Date Tested
BH101	3.50	B15	3.50	104.7	192.4	REMOULDED	1	21.0	2.05	1.69	0.4	1.45	65	63	20.0	C	31	29/01/2019
BH104	5.30	B17	5.30	102.0	208.7	REMOULDED	1	25.7	2.08	1.65	0.4	1.49	100	54	20.0	C	27	30/01/2019
BH106	8.50	U20	8.50	103.0	205.9	UNDISTURBED	1	22.8	2.12	1.73	0.4	1.45	160	48	19.5	P	24	30/01/2019
BH110	4.80	B13	4.80	104.3	199.2	REMOULDED	1	17.5	2.22	1.89	0.5	1.82	100	23	20.0	P	12	30/01/2019

For description of sample please refer to the Laboratory Sample Description Sheet. Please note the rate of strain was 2% per minute and the orientation of the test specimen was vertical. Latex membrane used.

Date of issue :-	Certificate No :-	Signed :-	Name :-	Page 1 of 1
13/02/2019	TXL/NW1580/1			

Client :-	Contract Title :-	AEG Contract No :-
Far East Consortium International Limited	Northern Gateway	NW1580

UKAS TESTING 1367

APPENDIX I

Specialist Chemical Testing

(Tested Externally)

Certificate of Analysis

Certificate Number 19-01510

01-Feb-19

Client Allied Exploration & Geotechnics Limited
Unit 25
Stella Gill Industrial Estate
Pelton Fell
DH2 2RG

Our Reference 19-01510

Client Reference NW1580

Order No CH1500

Contract Title Northern Gateway

Description 1 Soil sample, 2 Water samples.

Date Received 28-Jan-19

Date Started 28-Jan-19

Date Completed 01-Feb-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

Adam Fenwick
Contracts Manager

UKAS TESTING
2139

Summary of Chemical Analysis
Soil Samples

Our Ref 19-01510
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1450940
			Sample ID	BH102
			Depth	0.30
			Other ID	2
			Sample Type	ES
			Sampling Date	24/01/19
			Sampling Time	n/s
Test	**Method**	**LOD**	**Units**	
Metals				
Antimony	DETSC 2301*	1	mg/kg	7.6
Arsenic	DETSC 2301#	0.2	mg/kg	16
Beryllium	DETSC 2301#	0.2	mg/kg	1.1
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	0.7
Cadmium	DETSC 2301#	0.1	mg/kg	1.0
Chromium	DETSC 2301#	0.15	mg/kg	23
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	140
Lead	DETSC 2301#	0.3	mg/kg	530
Mercury	DETSC 2325#	0.05	mg/kg	0.44
Nickel	DETSC 2301#	1	mg/kg	26
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	36
Zinc	DETSC 2301#	1	mg/kg	500
Inorganics				
pH	DETSC 2008#			10.6
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1
Total Organic Carbon	DETSC 2084#	0.5	%	7.1
Petroleum Hydrocarbons				
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	2.4
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	9.3
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	22
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	120
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	160
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	11
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	52
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	250
Aromatic C5-C35	DETSC 3072*	10	mg/kg	320
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	470
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01

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

Summary of Chemical Analysis
Soil Samples

Our Ref 19-01510
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1450940
			Sample ID	BH102
			Depth	0.30
			Other ID	2
			Sample Type	ES
			Sampling Date	24/01/19
			Sampling Time	n/s
Test	**Method**	**LOD**	**Units**	
PAHs				
Naphthalene	DETSC 3303#	0.03	mg/kg	0.22
Acenaphthylene	DETSC 3303#	0.03	mg/kg	0.06
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.65
Fluorene	DETSC 3303	0.03	mg/kg	0.43
Phenanthrene	DETSC 3303#	0.03	mg/kg	2.3
Anthracene	DETSC 3303	0.03	mg/kg	0.96
Fluoranthene	DETSC 3303#	0.03	mg/kg	6.4
Pyrene	DETSC 3303#	0.03	mg/kg	5.6
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	2.1
Chrysene	DETSC 3303	0.03	mg/kg	2.0
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	2.4
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	1.0
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	2.4
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.78
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.11
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.94
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	28
Phenols				
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3

Summary of Chemical Analysis
Water Samples

Our Ref 19-01510
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1450941	1450942
			Sample ID	BH103	BH105
			Depth	0.90-3.50	4.52-9.00
			Other ID	1	1
			Sample Type	EW	EW
			Sampling Date	24/01/19	24/01/19
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Metals					
Antimony, Dissolved	DETSC 2306	0.17	ug/l	11	8.4
Arsenic, Dissolved	DETSC 2306	0.16	ug/l	2.8	0.57
Beryllium, Dissolved	DETSC 2306*	0.1	ug/l	0.1	< 0.1
Cadmium, Dissolved	DETSC 2306	0.03	ug/l	0.10	0.13
Calcium, Dissolved	DETSC 2306	0.09	mg/l	110	120
Chromium, Dissolved	DETSC 2306	0.25	ug/l	7.8	< 0.25
Copper, Dissolved	DETSC 2306	0.4	ug/l	3.0	2.7
Lead, Dissolved	DETSC 2306	0.09	ug/l	1.9	0.20
Manganese, Dissolved	DETSC 2306	0.22	ug/l	2800	820
Mercury, Dissolved	DETSC 2306	0.01	ug/l	< 0.01	< 0.01
Nickel, Dissolved	DETSC 2306	0.5	ug/l	6.4	3.4
Selenium, Dissolved	DETSC 2306	0.25	ug/l	5.0	1.2
Vanadium, Dissolved	DETSC 2306	0.6	ug/l	3.5	1.1
Zinc, Dissolved	DETSC 2306	1.3	ug/l	13	19
Inorganics					
pH	DETSC 2008			7.4	7.3
Cyanide, Total	DETSC 2130	40	ug/l	< 40	< 40
Dissolved Organic Carbon	*	2	mg/l	17	2.5
Hardness	DETSC 2303	0.1	mg/l	359	369
Ammoniacal Nitrogen as N	DETSC 2207	0.015	mg/l	3.8	1.3
Chloride	DETSC 2055	0.1	mg/l	29	29
Petroleum Hydrocarbons					
Aliphatic C5-C6	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C6-C8	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C8-C10	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aliphatic C10-C12	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C12-C16	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C16-C21	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C21-C35	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aliphatic C5-C35	DETSC 3072*	10	ug/l	< 10	< 10
Aromatic C5-C7	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aromatic C7-C8	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aromatic C8-C10	DETSC 3322	0.1	ug/l	< 0.1	< 0.1
Aromatic C10-C12	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C12-C16	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C16-C21	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C21-C35	DETSC 3072*	1	ug/l	< 1.0	< 1.0
Aromatic C5-C35	DETSC 3072*	10	ug/l	< 10	< 10
TPH Ali/Aro Total	DETSC 3072*	10	ug/l	< 10	< 10
Benzene	DETSC 3322	1	ug/l	< 1.0	< 1.0
Toluene	DETSC 3322	1	ug/l	< 1.0	< 1.0

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Water Samples

Our Ref 19-01510
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1450941	1450942
			Sample ID	BH103	BH105
			Depth	0.90-3.50	4.52-9.00
			Other ID	1	1
			Sample Type	EW	EW
			Sampling Date	24/01/19	24/01/19
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Ethylbenzene	DETSC 3322	1	ug/l	< 1.0	< 1.0
Xylene	DETSC 3322	1	ug/l	< 1.0	< 1.0
PAHs					
Naphthalene	DETSC 3304	0.05	ug/l	0.81	< 0.05
Acenaphthylene	DETSC 3304	0.01	ug/l	0.01	< 0.01
Acenaphthene	DETSC 3304	0.01	ug/l	0.41	< 0.01
Fluorene	DETSC 3304	0.01	ug/l	0.18	< 0.01
Phenanthrene	DETSC 3304	0.01	ug/l	0.17	< 0.01
Anthracene	DETSC 3304	0.01	ug/l	0.11	< 0.01
Fluoranthene	DETSC 3304	0.01	ug/l	0.06	< 0.01
Pyrene	DETSC 3304	0.01	ug/l	0.05	< 0.01
Benzo(a)anthracene	DETSC 3304	0.01	ug/l	0.01	< 0.01
Chrysene	DETSC 3304	0.01	ug/l	0.05	< 0.01
Benzo(b)fluoranthene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(k)fluoranthene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(a)pyrene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Indeno(1,2,3-c,d)pyrene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Dibenzo(a,h)anthracene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
Benzo(g,h,i)perylene	DETSC 3304	0.01	ug/l	< 0.01	< 0.01
PAH Total	DETSC 3304	0.2	ug/l	1.9	< 0.20
Phenols					
Phenol - Monohydric	DETSC 2130	100	ug/l	< 100	< 100

Key: * -not accredited. n/s -not supplied.

Summary of Asbestos Analysis
Soil Samples

Our Ref 19-01510
Client Ref NW1580
Contract Title Northern Gateway

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1450940	BH102 2 0.30	SOIL	NAD	none	Michael Kay

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 19-01510
Client Ref NW1580
Contract Northern Gateway

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1450940	BH102 0.30 SOIL	24/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L		
1450941	BH103 0.90-3.50 WATER	24/01/19	GB 1L x2, PB 1L, PU		
1450942	BH105 4.52-9.00 WATER	24/01/19	GB 1L x2, PB 1L, PU		

Key: G-Glass P-Plastic J-Jar T-Tub B-Bottle U-Tube

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

Certificate of Analysis

Certificate Number	19-00676-1	21-Feb-19
Client	Allied Exploration & Geotechnics Limited Unit 25 Stella Gill Industrial Estate Pelton Fell DH2 2RG	

Our Reference	19-00676-1
Client Reference	NW1580
Order No	CH1500
Contract Title	Northern Gateway
Description	15 Soil samples.
Date Received	15-Jan-19
Date Started	15-Jan-19
Date Completed	21-Feb-19
Test Procedures	Identified by prefix DETSn (details on request).
Notes	**This report supersedes 19-00676, amendments.** 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

Adam Fenwick
Contracts Manager

mCERTS
THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING
2139

Summary of Chemical Analysis
Matrix Descriptions

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

Sample ID	Other ID	Depth	Lab No	Completed	Matrix Description
BH107	8	2	1444842	21/02/2019	Brown sandy CLAY
BH109	4	1.2	1444843	21/02/2019	Dark brown gravelly, sandy CLAY (Made ground - brick)
BH110	2	0.3	1444844	21/02/2019	Very dark brown gravelly SAND (Possible made ground - brick)
BH110	7	3	1444845	21/02/2019	Brown gravelly, sandy CLAY
BH112	2	0.3	1444846	21/02/2019	Brown sandy GRAVEL (Made ground - brick) (sample matrix outside MCERTS scope of accreditation)
BH112	12	3.3	1444847	21/02/2019	Brown sandy CLAY
TP119	1	0.2	1444848	21/02/2019	Light brown gravelly, clayey SAND (Possible made ground - brick)
TP119	10	3	1444849	21/02/2019	Brown gravelly, clayey SAND
TP120	1	0.3	1444850	21/02/2019	Brown gravelly, sandy CLAY
TP120	5	1	1444851	21/02/2019	Very dark brown gravelly,, clayey SAND
TP125	1	0.3	1444852	21/02/2019	Brown gravelly, sandy CLAY
TP126	1	0.3	1444853	21/02/2019	Dark brown sandy CLAY
TP126	10	2.2	1444854	21/02/2019	Dark brown gravelly, sandy CLAY
TP127	1	0.3	1444855	21/02/2019	Dark brown gravelly, sandy CLAY
WS105	3	0.3	1444856	21/02/2019	Very dark brown sandy GRAVEL (sample matrix outside MCERTS scope of accreditation)

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444842	1444843	1444844	1444845	1444846	1444847
			Sample ID	BH107	BH109	BH110	BH110	BH112	BH112
			Depth	2.00	1.20	0.30	3.00	0.30	3.30
			Other ID	8	4	2	7	2	12
			Sample Type	ES	ES	ES	ES	ES	ES
			Sampling Date	09/01/19	09/01/19	11/01/19	11/01/19	11/01/19	11/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Asbestos Quantification	DETSC 1102	0				Y		Y	
Metals									
Antimony	DETSC 2301*	1	mg/kg	1.2	1.4	2.1	< 1.0	5.1	< 1.0
Arsenic	DETSC 2301#	0.2	mg/kg	9.0	6.7	6.2	7.1	8.5	4.5
Beryllium	DETSC 2301#	0.2	mg/kg	0.8	0.4	0.4	0.5	0.4	0.4
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	1.1	1.5	1.2	1.2	1.1	0.7
Cadmium	DETSC 2301#	0.1	mg/kg	0.2	0.5	0.3	0.2	0.3	0.1
Chromium	DETSC 2301#	0.15	mg/kg	24	17	22	13	15	11
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	25	19	46	22	40	8.9
Lead	DETSC 2301#	0.3	mg/kg	18	77	37	1900	300	66
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	0.15	< 0.05	0.10	0.16	< 0.05
Nickel	DETSC 2301#	1	mg/kg	28	11	25	11	12	12
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	30	21	38	20	22	19
Zinc	DETSC 2301#	1	mg/kg	57	74	91	74	95	36
Inorganics									
pH	DETSC 2008#			8.3	11.4	10.5	11.7	8.5	9.3
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1	0.1	< 0.1	< 0.1	< 0.1
Cyanide, Free	DETSC 2130#	0.1	mg/kg						
Cyanide, Complex	DETSC 2130*	0.2	mg/kg						
Thiocyanate	DETSC 2130#	0.6	mg/kg						
Total Organic Carbon	DETSC 2084#	0.5	%	1.1	1.6	3.3	1.7	1.8	0.5
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	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	2.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	5.8	4.1	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	8.3	14	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	35	120	< 3.4	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	52	140	< 10	< 10	< 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	2.9	< 0.5	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	5.5	27	< 0.6	< 0.6	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	71	350	< 1.4	< 1.4	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	76	380	< 10	< 10	< 10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	< 10	130	520	< 10	< 10	< 10
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 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.

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444842	1444843	1444844	1444845	1444846	1444847
			Sample ID	BH107	BH109	BH110	BH110	BH112	BH112
			Depth	2.00	1.20	0.30	3.00	0.30	3.30
			Other ID	8	4	2	7	2	12
			Sample Type	ES	ES	ES	ES	ES	ES
			Sampling Date	09/01/19	09/01/19	11/01/19	11/01/19	11/01/19	11/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
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
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	0.23	0.17	0.43	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.24	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.16	0.48	0.48	0.04	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	0.12	0.37	0.28	0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	1.0	3.1	1.6	0.41	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	0.23	1.1	0.37	0.10	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.94	6.7	1.5	0.89	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.92	6.1	1.2	0.89	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.30	2.8	0.42	0.35	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	0.38	3.0	0.47	0.41	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.29	4.5	0.50	0.54	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.13	1.5	0.16	0.17	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.24	3.9	0.36	0.44	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.10	2.2	0.15	0.25	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.54	0.04	0.05	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.13	2.7	0.18	0.30	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	5.2	39	8.1	4.8	< 0.10
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444848	1444849	1444850	1444851	1444852	1444853
			Sample ID	TP119	TP119	TP120	TP120	TP125	TP126
			Depth	0.20	3.00	0.30	1.00	0.30	0.30
			Other ID	1	10	1	5	1	1
			Sample Type	ES	ES	ES	ES	ES	ES
			Sampling Date	09/01/19	09/01/19	09/01/19	09/01/19	11/01/19	09/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Asbestos Quantification	DETSC 1102	0					Y	Y	Y
Metals									
Antimony	DETSC 2301*	1	mg/kg	1.3	1.3	2.7	3.7	4.9	2.6
Arsenic	DETSC 2301#	0.2	mg/kg	4.1	12	16	19	14	9.5
Beryllium	DETSC 2301#	0.2	mg/kg	< 0.2	0.5	1.2	1.9	0.7	0.5
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	1.6	1.1	1.0	1.5	1.4	1.4
Cadmium	DETSC 2301#	0.1	mg/kg	0.6	0.1	0.9	0.6	0.7	3.0
Chromium	DETSC 2301#	0.15	mg/kg	12	15	19	22	31	18
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	59	19	110	120	41	39
Lead	DETSC 2301#	0.3	mg/kg	47	18	2100	96	830	120
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	0.14	0.13	0.43	0.72
Nickel	DETSC 2301#	1	mg/kg	7.5	16	17	28	18	18
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	10	36	23	35	39	34
Zinc	DETSC 2301#	1	mg/kg	100	67	140	140	150	520
Inorganics									
pH	DETSC 2008#			11.6	7.4	10.1	8.3	10.2	10.2
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1	0.4	0.3	0.2	0.1
Cyanide, Free	DETSC 2130#	0.1	mg/kg				< 0.1		
Cyanide, Complex	DETSC 2130*	0.2	mg/kg				0.3		
Thiocyanate	DETSC 2130#	0.6	mg/kg				0.8		
Total Organic Carbon	DETSC 2084#	0.5	%	0.9	0.7	4.5	16	3.1	2.2
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	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	2.8
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	3.7	< 1.2	< 1.2	< 1.2	< 1.2	8.7
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	25	< 1.5	< 1.5	< 1.5	< 1.5	19
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	91	< 3.4	< 3.4	< 3.4	< 3.4	86
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	120	< 10	< 10	< 10	< 10	120
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	< 0.5	< 0.5	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	< 0.6	< 0.6	< 0.6	< 0.6	9.2
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	< 1.4	< 1.4	< 1.4	< 1.4	97
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	110
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	120	< 10	< 10	< 10	< 10	220
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444848	1444849	1444850	1444851	1444852	1444853
			Sample ID	TP119	TP119	TP120	TP120	TP125	TP126
			Depth	0.20	3.00	0.30	1.00	0.30	0.30
			Other ID	1	10	1	5	1	1
			Sample Type	ES	ES	ES	ES	ES	ES
			Sampling Date	09/01/19	09/01/19	09/01/19	09/01/19	11/01/19	09/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 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
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03		0.19	0.16
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03		< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03		0.29	0.23
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03		0.17	0.15
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.07	< 0.03	0.05		1.1	1.6
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03		0.26	0.37
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.24	< 0.03	0.08		1.3	1.9
Pyrene	DETSC 3303#	0.03	mg/kg	0.20	< 0.03	0.06		1.2	1.7
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.06	< 0.03	< 0.03		0.40	0.60
Chrysene	DETSC 3303	0.03	mg/kg	0.11	< 0.03	0.03		0.46	0.69
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.10	< 0.03	< 0.03		0.44	0.59
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.05	< 0.03	< 0.03		0.16	0.24
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.06	< 0.03	< 0.03		0.31	0.44
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.06	< 0.03	< 0.03		0.15	0.19
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03		0.04	0.05
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.09	< 0.03	< 0.03		0.17	0.21
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	1.0	< 0.10	0.20		6.6	9.1
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444854	1444855	1444856
			Sample ID	TP126	TP127	WS105
			Depth	2.20	0.30	0.30
			Other ID	10	1	3
			Sample Type	ES	ES	ES
			Sampling Date	09/01/19	11/01/19	11/01/19
			Sampling Time	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**			
Asbestos Quantification	DETSC 1102	0			Y	
Metals						
Antimony	DETSC 2301*	1	mg/kg	1.1	1.5	6.3
Arsenic	DETSC 2301#	0.2	mg/kg	6.6	17	12
Beryllium	DETSC 2301#	0.2	mg/kg	0.6	0.7	0.4
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	0.9	1.4	1.0
Cadmium	DETSC 2301#	0.1	mg/kg	0.1	0.4	4.7
Chromium	DETSC 2301#	0.15	mg/kg	19	19	38
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	16	37	190
Lead	DETSC 2301#	0.3	mg/kg	27	87	490
Mercury	DETSC 2325#	0.05	mg/kg	0.10	0.23	0.13
Nickel	DETSC 2301#	1	mg/kg	15	16	42
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	0.7
Vanadium	DETSC 2301#	0.8	mg/kg	26	26	27
Zinc	DETSC 2301#	1	mg/kg	53	100	1700
Inorganics						
pH	DETSC 2008#			8.7	9.8	8.7
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1	0.8
Cyanide, Free	DETSC 2130#	0.1	mg/kg			
Cyanide, Complex	DETSC 2130*	0.2	mg/kg			
Thiocyanate	DETSC 2130#	0.6	mg/kg			
Total Organic Carbon	DETSC 2084#	0.5	%	0.7	2.7	2.2
Petroleum Hydrocarbons						
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	4.2	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	12	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	53	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	69	< 10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	< 10	69	< 10
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444854	1444855	1444856
			Sample ID	TP126	TP127	WS105
			Depth	2.20	0.30	0.30
			Other ID	10	1	3
			Sample Type	ES	ES	ES
			Sampling Date	09/01/19	11/01/19	11/01/19
			Sampling Time	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**			
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01
PAHs						
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	0.10	0.04
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.16	0.05
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	0.09	0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.71	0.27
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	0.17	0.04
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	1.2	0.26
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	1.1	0.26
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.37	0.09
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	0.43	0.11
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.47	0.09
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.17	0.04
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.32	0.07
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.16	0.04
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.04	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.18	0.04
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	5.6	1.4
Phenols						
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3

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Summary of Chemical Analysis
Soil VOC/SVOC Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

Lab No	1444851
Sample ID	TP120
Depth	1.00
Other ID	5
Sample Type	ES
Sampling Date	09/01/19
Sampling Time	n/s

Test	Method	LOD	Units	
VOCs				
Vinyl Chloride	DETSC 3431	0.01	mg/kg	< 0.01
1,1 Dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01
Trans-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01
1,1-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01
Cis-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01
2,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01
Bromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01
Chloroform	DETSC 3431	0.01	mg/kg	< 0.01
1,1,1-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01
1,1-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01
Carbon tetrachloride	DETSC 3431	0.01	mg/kg	< 0.01
Benzene	DETSC 3431	0.01	mg/kg	< 0.01
1,2-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01
Trichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01
1,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01
Dibromomethane	DETSC 3431	0.01	mg/kg	< 0.01
Bromodichloromethane	DETSC 3431	0.01	mg/kg	< 0.01
cis-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01
Toluene	DETSC 3431	0.01	mg/kg	< 0.01
trans-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01
1,1,2-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01
Tetrachloroethylene	DETSC 3431	0.01	mg/kg	< 0.01
1,3-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01
Dibromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01
1,2-dibromoethane	DETSC 3431	0.01	mg/kg	< 0.01
Chlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,1,1,2-tetrachloroethane	DETSC 3431	0.01	mg/kg	< 0.01
Ethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
m+p-Xylene	DETSC 3431	0.01	mg/kg	< 0.01
o-Xylene	DETSC 3431	0.01	mg/kg	< 0.01
Styrene	DETSC 3431*	0.01	mg/kg	< 0.01
Bromoform	DETSC 3431	0.01	mg/kg	< 0.01
Isopropylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
Bromobenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,2,3-trichloropropane	DETSC 3431	0.01	mg/kg	< 0.01
n-propylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
2-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01
1,3,5-trimethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
4-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01
Tert-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,2,4-trimethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Soil VOC/SVOC Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

Lab No	1444851
Sample ID	TP120
Depth	1.00
Other ID	5
Sample Type	ES
Sampling Date	09/01/19
Sampling Time	n/s

Test	Method	LOD	Units	
sec-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
p-isopropyltoluene	DETSC 3431	0.01	mg/kg	< 0.01
1,3-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,4-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
n-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,2-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
1,2-dibromo-3-chloropropane	DETSC 3431	0.01	mg/kg	< 0.01
1,2,4-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
Hexachlorobutadiene	DETSC 3431	0.01	mg/kg	< 0.01
Naphthalene	DETSC 3431	0.01	mg/kg	< 0.01
1,2,3-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01
MTBE	DETSC 3431*	0.01	mg/kg	< 0.01
SVOCs				
Phenol	DETSC 3433	0.1	mg/kg	< 0.1
Aniline	DETSC 3433*	0.1	mg/kg	< 0.1
2-Chlorophenol	DETSC 3433	0.1	mg/kg	< 0.1
Benzyl Alcohol	DETSC 3433	0.1	mg/kg	< 0.1
2-Methylphenol	DETSC 3433	0.1	mg/kg	< 0.1
Bis(2-chloroisopropyl)ether	DETSC 3433	0.1	mg/kg	< 0.1
3&4-Methylphenol	DETSC 3433	0.1	mg/kg	< 0.1
2,4-Dimethylphenol	DETSC 3433	0.1	mg/kg	< 0.1
Bis-(dichloroethoxy)methane	DETSC 3433	0.1	mg/kg	< 0.1
2,4-Dichlorophenol	DETSC 3433	0.1	mg/kg	< 0.1
1,2,4-Trichlorobenzene	DETSC 3433	0.1	mg/kg	< 0.1
4-Chloro-3-methylphenol	DETSC 3433	0.1	mg/kg	< 0.1
2-Methylnaphthalene	DETSC 3433	0.1	mg/kg	< 0.1
Hexachlorocyclopentadiene	DETSC 3433*	0.1	mg/kg	< 0.1
2,4,6-Trichlorophenol	DETSC 3433	0.1	mg/kg	< 0.1
2,4,5-Trichlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1
2-Chloronaphthalene	DETSC 3433	0.1	mg/kg	< 0.1
2-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1
2,4-Dinitrotoluene	DETSC 3433*	0.1	mg/kg	< 0.1
Acenaphthylene	DETSC 3433	0.1	mg/kg	< 0.1
3-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1
Acenaphthene	DETSC 3433	0.1	mg/kg	< 0.1
4-Nitrophenol	DETSC 3433*	0.1	mg/kg	< 0.1
Dibenzofuran	DETSC 3433	0.1	mg/kg	< 0.1
2,6-Dinitrotoluene	DETSC 3433	0.1	mg/kg	< 0.1
2,3,4,6-Tetrachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1
Diethylphthalate	DETSC 3433	0.1	mg/kg	< 0.1
4-Chlorophenylphenylether	DETSC 3433*	0.1	mg/kg	< 0.1
Fluorene	DETSC 3433	0.1	mg/kg	< 0.1

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Soil VOC/SVOC Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

Lab No	1444851
Sample ID	TP120
Depth	1.00
Other ID	5
Sample Type	ES
Sampling Date	09/01/19
Sampling Time	n/s

Test	Method	LOD	Units	
4-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1
2-Methyl-4,6-Dinitrophenol	DETSC 3433*	0.1	mg/kg	< 0.1
Diphenylamine	DETSC 3433	0.1	mg/kg	< 0.1
4-Bromophenylphenylether	DETSC 3433	0.1	mg/kg	< 0.1
Hexachlorobenzene	DETSC 3433	0.1	mg/kg	< 0.1
Pentachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1
Phenanthrene	DETSC 3433	0.1	mg/kg	0.1
Anthracene	DETSC 3433	0.1	mg/kg	< 0.1
Di-n-butylphthalate	DETSC 3433	0.1	mg/kg	< 0.1
Fluoranthene	DETSC 3433	0.1	mg/kg	0.3
Pyrene	DETSC 3433	0.1	mg/kg	0.3
Butylbenzylphthalate	DETSC 3433*	0.1	mg/kg	< 0.1
Benzo(a)anthracene	DETSC 3433	0.1	mg/kg	0.2
Chrysene	DETSC 3433	0.1	mg/kg	0.2
Bis(2-ethylhexyl)phthalate	DETSC 3433	0.1	mg/kg	< 0.1
Di-n-octylphthalate	DETSC 3433	0.1	mg/kg	< 0.1
Benzo(b)fluoranthene	DETSC 3433	0.1	mg/kg	0.2
Benzo(k)fluoranthene	DETSC 3433	0.1	mg/kg	< 0.1
Benzo(a)pyrene	DETSC 3433	0.1	mg/kg	0.2
Indeno(123cd)pyrene	DETSC 3433	0.1	mg/kg	0.1
Dibenzo(ah)anthracene	DETSC 3433	0.1	mg/kg	< 0.1
Benzo(ghi)perylene	DETSC 3433	0.1	mg/kg	0.1
1,4-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	< 0.1
Dimethylphthalate	DETSC 3433	0.1	mg/kg	< 0.1
1,3-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	< 0.1
1,2-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	< 0.1
2,3,5,6-Tetrachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1
Azobenzene	DETSC 3433	0.1	mg/kg	< 0.1
Carbazole	DETSC 3433*	0.1	mg/kg	< 0.1

Key: * -not accredited. n/s -not supplied.

Summary of Asbestos Analysis
Soil Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1444842	BH107 8 2.00	SOIL	NAD	none	Rebecca Burgess
1444843	BH109 4 1.20	SOIL	NAD	none	Rebecca Burgess
1444844	BH110 2 0.30	SOIL	Amosite	bundle of Amosite fibres	Rebecca Burgess
1444845	BH110 7 3.00	SOIL	NAD	none	Rebecca Burgess
1444846	BH112 2 0.30	SOIL	Amosite	bundles of Amosite fibres	Rebecca Burgess
1444847	BH112 12 3.30	SOIL	NAD	none	Rebecca Burgess
1444848	TP119 1 0.20	SOIL	NAD	none	Rebecca Burgess
1444849	TP119 10 3.00	SOIL	NAD	none	Rebecca Burgess
1444850	TP120 1 0.30	SOIL	NAD	none	Rebecca Burgess
1444851	TP120 5 1.00	SOIL	Chrysotile	Chrysotile in microscopic cement	Rebecca Burgess
1444852	TP125 1 0.30	SOIL	Chrysotile Amosite	Chrysotile in microscopic bitumen and bundles of Chrysotile and Amosite in soil	Rebecca Burgess
1444853	TP126 1 0.30	SOIL	Amosite Chrysotile	Amosite in loose fibrous asbestos debris and bundles of Chrysotile fibres in soil	Rebecca Burgess
1444854	TP126 10 2.20	SOIL	NAD	none	Rebecca Burgess
1444855	TP127 1 0.30	SOIL	Amosite Chrysotile	bundles of Chrysotile and Amosite fibres	Rebecca Burgess
1444856	WS105 3 0.30	SOIL	NAD	none	Rebecca Burgess

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.

Summary of Asbestos Quantification Analysis

Soil Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

		Lab No	1444844	1444846	1444851	1444852
		Sample ID	BH110	BH112	TP120	TP125
		Depth	0.30	0.30	1.00	0.30
		Other ID	2	2	5	1
		Sample Type	SOIL	SOIL	SOIL	SOIL
		Sampling Date	11/01/19	11/01/19	09/01/19	11/01/19
		Sampling Time				
Test	**Method**	**Units**				
Total Mass% Asbestos (a+b+c)	DETSC 1102	Mass %	**< 0.001**	**< 0.001**	**0.002**	**0.003**
Gravimetric Quantification (a)	DETSC 1102	Mass %	na	na	0.002	0.002
Detailed Gravimetric Quantification (b)	DETSC 1102	Mass %	<0.001	<0.001	na	<0.001
Quantification by PCOM (c)	DETSC 1102	Mass %	na	na	na	na
Potentially Respirable Fibres (d)	DETSC 1102	Fibres/g	na	na	na	na
Breakdown of Gravimetric Analysis (a)						
Mass of Sample		g	550.04	445.71	802.44	1253.67
ACMs present*		type			Cement	Bitumen
Mass of ACM in sample		g			0.10	0.33
% ACM by mass		%			0.01	0.03
% asbestos in ACM		%			15	8
% asbestos in sample		%			0.002	0.002
Breakdown of Detailed Gravimetric Analysis (b)						
% Amphibole bundles in sample		Mass %	<0.001	<0.001	na	<0.001
% Chrysotile bundles in sample		Mass %	na	na	na	<0.001
Breakdown of PCOM Analysis (c)						
% Amphibole fibres in sample		Mass %	na	na	na	na
% Chrysotile fibres in sample		Mass %	na	na	na	na
Breakdown of Potentially Respirable Fibre Analysis (d)						
Amphibole fibres		Fibres/g	na	na	na	na
Chrysotile fibres		Fibres/g	na	na	na	na

* Denotes test or material description outside of UKAS accreditation.
% asbestos in Asbestos Containing Materials (ACMs) is determined by
by reference to HSG 264.
Recommended sample size for quantification is approximately 1kg
denotes deviating sample

Summary of Asbestos Quantification Analysi

Soil Samples

Our Ref 19-00676-1
Client Ref NW1580
Contract Title Northern Gateway

		Lab No	1444853	1444855
		Sample ID	TP126	TP127
		Depth	0.30	0.30
		Other ID	1	1
		Sample Type	SOIL	SOIL
		Sampling Date	09/01/19	11/01/19
		Sampling Time		
Test	**Method**	**Units**		
Total Mass% Asbestos (a+b+c)	DETSC 1102	Mass %	**0.005**	**< 0.001**
Gravimetric Quantification (a)	DETSC 1102	Mass %	0.004	na
Detailed Gravimetric Quantification (b)	DETSC 1102	Mass %	0.001	<0.001
Quantification by PCOM (c)	DETSC 1102	Mass %	na	na
Potentially Respirable Fibres (d)	DETSC 1102	Fibres/g	na	na
Breakdown of Gravimetric Analysis (a)				
Mass of Sample		g	800.26	770.41
ACMs present*		type	LFAD	
Mass of ACM in sample		g	0.04	
% ACM by mass		%	0.00	
% asbestos in ACM		%	85	
% asbestos in sample		%	0.004	
Breakdown of Detailed Gravimetric Analysis (b)				
% Amphibole bundles in sample		Mass %	na	<0.001
% Chrysotile bundles in sample		Mass %	0.001	<0.001
Breakdown of PCOM Analysis (c)				
% Amphibole fibres in sample		Mass %	na	na
% Chrysotile fibres in sample		Mass %	na	na
Breakdown of Potentially Respirable Fibre Analysis (d)				
Amphibole fibres		Fibres/g	na	na
Chrysotile fibres		Fibres/g	na	na

* Denotes test or material description outside of UKAS accreditation.
% asbestos in Asbestos Containing Materials (ACMs) is determined by
by reference to HSG 264.
Recommended sample size for quantification is approximately 1kg
denotes deviating sample

Information in Support of the Analytical Results

Our Ref 19-00676-1
Client Ref NW1580
Contract Northern Gateway

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1444842	BH107 2.00 SOIL	09/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444843	BH109 1.20 SOIL	09/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444844	BH110 0.30 SOIL	11/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444845	BH110 3.00 SOIL	11/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444846	BH112 0.30 SOIL	11/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444847	BH112 3.30 SOIL	11/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444848	TP119 0.20 SOIL	09/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444849	TP119 3.00 SOIL	09/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444850	TP120 0.30 SOIL	09/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444851	TP120 1.00 SOIL	09/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444852	TP125 0.30 SOIL	11/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444853	TP126 0.30 SOIL	09/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444854	TP126 2.20 SOIL	09/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444855	TP127 0.30 SOIL	11/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444856	WS105 0.30 SOIL	11/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		

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 A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 2002	Organic matter	%	0.1	Air Dried	No	Yes	Yes
DETSC 2003	Loss on ignition	%	0.01	Air Dried	No	Yes	Yes
DETSC 2008	pH	pH Units	1	Air Dried	No	Yes	Yes
DETSC 2024	Sulphide	mg/kg	10	Air Dried	No	Yes	Yes
DETSC 2076	Sulphate Aqueous Extract as SO4	mg/l	10	Air Dried	No	Yes	Yes
DETSC 2084	Total Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2084	Total Organic Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2119	Ammoniacal Nitrogen as N	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide free	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide total	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC 2130	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETSC 2321	Total Sulphate as SO4	%	0.01	Air Dried	No	Yes	Yes
DETSC 2325	Mercury	mg/kg	0.05	Air Dried	No	Yes	Yes
DETSC 3049	Sulphur (free)	mg/kg	0.75	Air Dried	No	Yes	Yes
DETSC2123	Boron (water soluble)	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Arsenic	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Barium	mg/kg	1.5	Air Dried	No	Yes	Yes
DETSC2301	Beryllium	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Cadmium Available	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cadmium	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cobalt	mg/kg	0.7	Air Dried	No	Yes	Yes
DETSC2301	Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETSC2301	Copper	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Manganese	mg/kg	20	Air Dried	No	Yes	Yes
DETSC2301	Molybdenum	mg/kg	0.4	Air Dried	No	Yes	Yes
DETSC2301	Nickel	mg/kg	1	Air Dried	No	Yes	Yes
DETSC2301	Lead	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC2301	Selenium	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC2301	Zinc	mg/kg	1	Air Dried	No	Yes	Yes
DETSC 3072	Ali/Aro C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	1.2	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	0.9	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	0.5	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	0.6	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	m+p Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	o Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3311	C10-C24 Diesel Range Organics (DRO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	C24-C40 Lube Oil Range Organics (LORO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	EPH (C10-C40)	mg/kg	10	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 3303	Acenaphthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Acenaphthylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(b)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(k)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(g,h,i)perylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Dibenzo(a,h)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Naphthalene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Phenanthrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3401	PCB 28 + PCB 31	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 52	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 101	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 118	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 153	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 138	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 180	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB Total	mg/kg	0.01	As Received	No	Yes	Yes

Method details are shown only for those determinands listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS. No Recovery Factors are used in the determination of results. Results reported assume 100% recovery. Full method statements are available on request.

Certificate of Analysis

Certificate Number 19-00650-1

07-Feb-19

Client Allied Exploration & Geotechnics Limited
Unit 25
Stella Gill Industrial Estate
Pelton Fell
DH2 2RG

Our Reference 19-00650-1

Client Reference NW1580

Order No CH1500

Contract Title Northern Gateway

Description 3 Soil samples.

Date Received 15-Jan-19

Date Started 15-Jan-19

Date Completed 07-Feb-19

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

Notes **This report supersedes 19-00650, extra testing.**

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

Adam Fenwick
Contracts Manager

mCERTS
THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING
2139

Summary of Chemical Analysis
Matrix Descriptions

Our Ref 19-00650-1
Client Ref NW1580
Contract Title Northern Gateway

Sample ID	Other ID	Depth	Lab No	Completed	Matrix Description
TP121	2	0.3	1444752	21/01/2019	Very dark brown, gravelly, sandy CLAY
TP121	8	2.3	1444753	21/01/2019	Brown SAND
TP122	2	0.3	1444754	21/01/2019	Very dark brown gravelly, very sandy CLAY

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00650-1
Client Ref NW1580
Contract Title Northern Gateway

	Lab No	1444752	1444753	1444754
	Sample ID	TP121	TP121	TP122
	Depth	0.30	2.30	0.30
	Other ID	2	8	2
	Sample Type	ES	ES	ES
	Sampling Date	11/01/19	11/01/19	11/01/19
	Sampling Time	n/s	n/s	n/s

Test	Method	LOD	Units			
Metals						
Antimony	DETSC 2301*	1	mg/kg	6.6	< 1.0	59
Arsenic	DETSC 2301#	0.2	mg/kg	18	4.5	23
Beryllium	DETSC 2301#	0.2	mg/kg	1.0	< 0.2	1.3
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	1.2	0.8	1.1
Cadmium	DETSC 2301#	0.1	mg/kg	0.4	< 0.1	0.4
Chromium	DETSC 2301#	0.15	mg/kg	15	6.8	15
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	350	10	280
Lead	DETSC 2301#	0.3	mg/kg	440	28	730
Mercury	DETSC 2325#	0.05	mg/kg	0.39	< 0.05	0.18
Nickel	DETSC 2301#	1	mg/kg	28	6.5	24
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	28	8.7	29
Zinc	DETSC 2301#	1	mg/kg	280	35	260
Inorganics						
pH	DETSC 2008#			8.1	8.0	8.1
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.2	< 0.1	< 0.1
Total Organic Carbon	DETSC 2084#	0.5	%	4.3	0.7	3.7
Sulphate Aqueous Extract as SO4	DETSC 2076#	10	mg/l	55		49
Petroleum Hydrocarbons						
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	< 0.6	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	< 1.4	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	< 10	< 10	< 10
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01

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

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00650-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444752	1444753	1444754
			Sample ID	TP121	TP121	TP122
			Depth	0.30	2.30	0.30
			Other ID	2	8	2
			Sample Type	ES	ES	ES
			Sampling Date	11/01/19	11/01/19	11/01/19
			Sampling Time	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**			
PAHs						
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	< 0.10	< 0.10
Phenols						
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3

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

Summary of Asbestos Analysis
Soil Samples

Our Ref 19-00650-1
Client Ref NW1580
Contract Title Northern Gateway

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1444752	TP121 2 0.30	SOIL	NAD	none	Rebecca Burgess
1444753	TP121 8 2.30	SOIL	NAD	none	Rebecca Burgess
1444754	TP122 2 0.30	SOIL	NAD	none	Rebecca Burgess

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 19-00650-1
Client Ref NW1580
Contract Northern Gateway

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1444752	TP121 0.30 SOIL	11/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444753	TP121 2.30 SOIL	11/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444754	TP122 0.30 SOIL	11/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		

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 A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 2002	Organic matter	%	0.1	Air Dried	No	Yes	Yes
DETSC 2003	Loss on ignition	%	0.01	Air Dried	No	Yes	Yes
DETSC 2008	pH	pH Units	1	Air Dried	No	Yes	Yes
DETSC 2024	Sulphide	mg/kg	10	Air Dried	No	Yes	Yes
DETSC 2076	Sulphate Aqueous Extract as SO4	mg/l	10	Air Dried	No	Yes	Yes
DETSC 2084	Total Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2084	Total Organic Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2119	Ammoniacal Nitrogen as N	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide free	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide total	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC 2130	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETSC 2321	Total Sulphate as SO4	%	0.01	Air Dried	No	Yes	Yes
DETSC 2325	Mercury	mg/kg	0.05	Air Dried	No	Yes	Yes
DETSC 3049	Sulphur (free)	mg/kg	0.75	Air Dried	No	Yes	Yes
DETSC2123	Boron (water soluble)	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Arsenic	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Barium	mg/kg	1.5	Air Dried	No	Yes	Yes
DETSC2301	Beryllium	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Cadmium Available	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cadmium	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cobalt	mg/kg	0.7	Air Dried	No	Yes	Yes
DETSC2301	Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETSC2301	Copper	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Manganese	mg/kg	20	Air Dried	No	Yes	Yes
DETSC2301	Molybdenum	mg/kg	0.4	Air Dried	No	Yes	Yes
DETSC2301	Nickel	mg/kg	1	Air Dried	No	Yes	Yes
DETSC2301	Lead	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC2301	Selenium	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC2301	Zinc	mg/kg	1	Air Dried	No	Yes	Yes
DETSC 3072	Ali/Aro C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	1.2	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	0.9	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	0.5	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	0.6	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	m+p Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	o Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3311	C10-C24 Diesel Range Organics (DRO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	C24-C40 Lube Oil Range Organics (LORO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	EPH (C10-C40)	mg/kg	10	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 3303	Acenaphthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Acenaphthylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(b)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(k)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(g,h,i)perylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Dibenzo(a,h)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Naphthalene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Phenanthrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3401	PCB 28 + PCB 31	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 52	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 101	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 118	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 153	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 138	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 180	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB Total	mg/kg	0.01	As Received	No	Yes	Yes

Method details are shown only for those determinands listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS. No Recovery Factors are used in the determination of results. Results reported assume 100% recovery. Full method statements are available on request.

Certificate of Analysis

Certificate Number	19-00541-1	24-Jan-19
Client	Allied Exploration & Geotechnics Limited Unit 25 Stella Gill Industrial Estate Pelton Fell DH2 2RG	
Our Reference	19-00541-1	
Client Reference	NW1580	
Order No	CH1500	
Contract Title	Northern Gateway	
Description	14 Soil samples, 4 Leachate samples.	
Date Received	11-Jan-19	
Date Started	11-Jan-19	
Date Completed	24-Jan-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

Adam Fenwick
Contracts Manager

mCERTS
THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING
2139

Summary of Chemical Analysis
Matrix Descriptions

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

Sample ID	Other ID	Depth	Lab No	Completed	Matrix Description
BH104	4	0.7	1444062	21/01/2019	Very dark brown SAND
BH104	15	4.7	1444063	21/01/2019	Dark brown sandy CLAY
BH104	28	9.7	1444064	21/01/2019	Very dark grey sandy CLAY
BH105	14	3.3	1444065	21/01/2019	Brown gravelly, sandy CLAY
BH106	1	0.3	1444066	21/01/2019	Black gravelly SAND
BH106	7	3.3	1444067	21/01/2019	Very dark brown gravelly, clayey SAND
BH106	17	7.6	1444068	21/01/2019	Dark brown gravelly, sandy CLAY
TP124	3	0.3	1444069	21/01/2019	Very dark brown gravelly SAND
TP124	11	3.2	1444070	21/01/2019	Brown sandy CLAY
WS101	3	0.3	1444071	21/01/2019	Dark brown gravelly, sandy CLAY (Possible made ground - brick)
WS102	5	1	1444072	21/01/2019	Very dark brown gravelly, clayey SAND (Possible made ground - brick)
WS103	4	1	1444073	21/01/2019	Dark brown gravelly, very sandy CLAY (Possible made ground - brick)
WS104	6	1	1444074	21/01/2019	Very dark brown gravelly SAND
WS106	5	1	1444075	21/01/2019	Very dark brown sandy GRAVEL (sample matrix outside MCERTS scope of accreditation)

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

				Lab No	1444062	1444063	1444064	1444065	1444066	1444067
				Sample ID	BH104	BH104	BH104	BH105	BH106	BH106
				Depth	0.70	4.70	9.70	3.30	0.30	3.30
				Other ID	4	15	28	14	1	7
				Sample Type	ES	ES	ES	ES	ES	ES
				Sampling Date	04/01/19	07/01/19	07/01/19	08/01/19	08/01/19	08/01/19
				Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Asbestos Quantification	DETSC 1102	0								
Metals										
Antimony	DETSC 2301*	1	mg/kg	5.9	1.2	1.8	1.1	21	7.8
Arsenic	DETSC 2301#	0.2	mg/kg	23	8.2	19	10	40	28
Beryllium	DETSC 2301#	0.2	mg/kg	2.8	0.7	2.1	0.7	1.3	1.6
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	1.4	0.8	1.3	0.8	0.8	1.3
Cadmium	DETSC 2301#	0.1	mg/kg	0.6	0.2	0.2	0.1	1.0	0.5
Chromium	DETSC 2301#	0.15	mg/kg	16	20	22	18	22	27
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	300	33	100	18	210	180
Lead	DETSC 2301#	0.3	mg/kg	180	42	75	12	370	210
Mercury	DETSC 2325#	0.05	mg/kg	0.45	< 0.05	0.38	< 0.05	0.38	0.37
Nickel	DETSC 2301#	1	mg/kg	48	24	53	18	38	34
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	0.7	< 0.5	1.0	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	66	26	34	26	52	46
Zinc	DETSC 2301#	1	mg/kg	150	79	120	54	340	160
Inorganics										
pH	DETSC 2008#			7.3	9.7	7.8	8.2	6.9	7.9
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1	2.4	< 0.1	0.5	0.2
Cyanide, Free	DETSC 2130#	0.1	mg/kg						
Cyanide, Complex	DETSC 2130*	0.2	mg/kg						
Thiocyanate	DETSC 2130#	0.6	mg/kg						
Total Organic Carbon	DETSC 2084#	0.5	%	29	2.2	13	0.6	24	21
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	< 0.01	< 0.01
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	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 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	0.7	< 0.5	1.4	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	< 0.6	4.3	< 0.6	3.9	6.1
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	< 1.4	9.0	17	14	13
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	15	17	19	19
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	< 10	< 10	15	17	19	19

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

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444062	1444063	1444064	1444065	1444066	1444067
			Sample ID	BH104	BH104	BH104	BH105	BH106	BH106
			Depth	0.70	4.70	9.70	3.30	0.30	3.30
			Other ID	4	15	28	14	1	7
			Sample Type	ES	ES	ES	ES	ES	ES
			Sampling Date	04/01/19	07/01/19	07/01/19	08/01/19	08/01/19	08/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
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
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	0.10	< 0.03	0.04	0.09
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.06	< 0.03	< 0.03	0.04
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	0.06	< 0.03	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.09	0.06	0.56	< 0.03	0.21	0.36
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	0.10	< 0.03	0.06	0.08
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.11	0.04	0.57	< 0.03	0.54	0.40
Pyrene	DETSC 3303#	0.03	mg/kg	0.12	0.04	0.64	< 0.03	0.54	0.38
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.05	< 0.03	0.24	< 0.03	0.28	0.16
Chrysene	DETSC 3303	0.03	mg/kg	0.07	< 0.03	0.25	< 0.03	0.35	0.15
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.05	< 0.03	0.24	< 0.03	0.43	0.16
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.10	< 0.03	0.15	0.05
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.21	< 0.03	0.25	0.11
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.09	< 0.03	0.13	0.05
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	0.11	< 0.03	0.16	0.05
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.48	0.14	3.4	< 0.10	3.2	2.1
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3

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

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444068	1444069	1444070	1444071	1444072	1444073
			Sample ID	BH106	TP124	TP124	WS101	WS102	WS103
			Depth	7.60	0.30	3.20	0.30	1.00	1.00
			Other ID	17	3	11	3	5	4
			Sample Type	ES	ES	ES	ES	ES	ES
			Sampling Date	08/01/19	08/01/19	08/01/19	08/01/19	07/01/19	07/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Asbestos Quantification	DETSC 1102	0							Y
Metals									
Antimony	DETSC 2301*	1	mg/kg	1.4	180	4.8	3.3	1.5	11
Arsenic	DETSC 2301#	0.2	mg/kg	11	61	7.1	12	12	14
Beryllium	DETSC 2301#	0.2	mg/kg	0.5	1.8	0.9	0.8	0.6	0.6
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	2.3	1.6	1.0	1.1	1.3	1.5
Cadmium	DETSC 2301#	0.1	mg/kg	< 0.1	1.6	< 0.1	0.3	0.5	0.3
Chromium	DETSC 2301#	0.15	mg/kg	18	33	20	13	12	16
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	26	4200	59	57	80	60
Lead	DETSC 2301#	0.3	mg/kg	45	12000	110	280	280	490
Mercury	DETSC 2325#	0.05	mg/kg	0.11	2.5	< 0.05	0.16	0.63	0.68
Nickel	DETSC 2301#	1	mg/kg	12	43	27	16	11	15
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	17	86	24	20	19	24
Zinc	DETSC 2301#	1	mg/kg	50	1300	73	97	140	220
Inorganics									
pH	DETSC 2008#			7.7	7.5	7.5	7.8	8.5	8.5
Cyanide, Total	DETSC 2130#	0.1	mg/kg	1.1	89	0.2	0.8	0.4	0.4
Cyanide, Free	DETSC 2130#	0.1	mg/kg						
Cyanide, Complex	DETSC 2130*	0.2	mg/kg						
Thiocyanate	DETSC 2130#	0.6	mg/kg						
Total Organic Carbon	DETSC 2084#	0.5	%	2.6	41	0.7	1.8	2.1	3.4
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	< 0.01	< 0.01
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	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	< 10	< 10	< 10	< 10	< 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	1.2	< 0.9	< 0.9	< 0.9	8.6
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	28
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6	6.4	< 0.6	< 0.6	< 0.6	75
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4	15	< 1.4	< 1.4	< 1.4	88
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10	23	< 10	< 10	< 10	200
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	< 10	23	< 10	< 10	< 10	200

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444068	1444069	1444070	1444071	1444072	1444073
			Sample ID	BH106	TP124	TP124	WS101	WS102	WS103
			Depth	7.60	0.30	3.20	0.30	1.00	1.00
			Other ID	17	3	11	3	5	4
			Sample Type	ES	ES	ES	ES	ES	ES
			Sampling Date	08/01/19	08/01/19	08/01/19	08/01/19	07/01/19	07/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
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
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	18
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.11
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.11	0.04	6.1
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03	< 0.03	< 0.03	0.07	< 0.03	4.0
Phenanthrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.35	0.08	0.58	0.42	20
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03	0.08	< 0.03	0.11	0.08	3.7
Fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.54	0.09	0.59	0.68	13
Pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.55	0.08	0.53	0.70	13
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	0.21	0.04	0.18	0.30	3.7
Chrysene	DETSC 3303	0.03	mg/kg	< 0.03	0.23	0.04	0.21	0.32	4.4
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.24	0.04	0.14	0.36	2.9
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03	0.08	< 0.03	0.08	0.13	1.2
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.18	< 0.03	0.10	0.28	2.7
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03	0.08	< 0.03	0.06	0.12	0.75
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.23
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03	0.10	< 0.03	0.06	0.15	0.93
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	< 0.10	2.7	0.37	2.8	3.6	95
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	12

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444074	1444075
			Sample ID	WS104	WS106
			Depth	1.00	1.00
			Other ID	6	5
			Sample Type	ES	ES
			Sampling Date	08/01/19	08/01/19
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Asbestos Quantification	DETSC 1102	0		Y	Y
Metals					
Antimony	DETSC 2301*	1	mg/kg	3.4	2.5
Arsenic	DETSC 2301#	0.2	mg/kg	15	7.5
Beryllium	DETSC 2301#	0.2	mg/kg	0.5	0.3
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	1.1	1.3
Cadmium	DETSC 2301#	0.1	mg/kg	0.6	0.9
Chromium	DETSC 2301#	0.15	mg/kg	15	11
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	90	79
Lead	DETSC 2301#	0.3	mg/kg	290	140
Mercury	DETSC 2325#	0.05	mg/kg	0.11	0.41
Nickel	DETSC 2301#	1	mg/kg	15	14
Selenium	DETSC 2301#	0.5	mg/kg	0.9	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	23	17
Zinc	DETSC 2301#	1	mg/kg	310	120
Inorganics					
pH	DETSC 2008#			9.0	9.9
Cyanide, Total	DETSC 2130#	0.1	mg/kg	8.5	4.0
Cyanide, Free	DETSC 2130#	0.1	mg/kg	0.2	0.1
Cyanide, Complex	DETSC 2130*	0.2	mg/kg	8.3	3.9
Thiocyanate	DETSC 2130#	0.6	mg/kg	< 0.6	< 0.6
Total Organic Carbon	DETSC 2084#	0.5	%	6.1	4.5
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	< 1.2	15
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	7.2
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	170
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10	190
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	1.0	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	4.3	2.4
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	22	17
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	47	240
Aromatic C5-C35	DETSC 3072*	10	mg/kg	74	260
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	74	450

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444074	1444075
			Sample ID	WS104	WS106
			Depth	1.00	1.00
			Other ID	6	5
			Sample Type	ES	ES
			Sampling Date	08/01/19	08/01/19
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
Benzene	DETSC 3321#	0.01	mg/kg		
Ethylbenzene	DETSC 3321#	0.01	mg/kg		
Toluene	DETSC 3321#	0.01	mg/kg		
Xylene	DETSC 3321#	0.01	mg/kg		
PAHs					
Naphthalene	DETSC 3303#	0.03	mg/kg		
Acenaphthylene	DETSC 3303#	0.03	mg/kg		
Acenaphthene	DETSC 3303#	0.03	mg/kg		
Fluorene	DETSC 3303	0.03	mg/kg		
Phenanthrene	DETSC 3303#	0.03	mg/kg		
Anthracene	DETSC 3303	0.03	mg/kg		
Fluoranthene	DETSC 3303#	0.03	mg/kg		
Pyrene	DETSC 3303#	0.03	mg/kg		
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg		
Chrysene	DETSC 3303	0.03	mg/kg		
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg		
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg		
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg		
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg		
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg		
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg		
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg		
Phenols					
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	0.4

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Summary of Chemical Analysis
Soil VOC/SVOC Samples

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444074	1444075
			Sample ID	WS104	WS106
			Depth	1.00	1.00
			Other ID	6	5
			Sample Type	ES	ES
			Sampling Date	08/01/19	08/01/19
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
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
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

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Summary of Chemical Analysis
Soil VOC/SVOC Samples

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444074	1444075
			Sample ID	WS104	WS106
			Depth	1.00	1.00
			Other ID	6	5
			Sample Type	ES	ES
			Sampling Date	08/01/19	08/01/19
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
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
Naphthalene	DETSC 3431	0.01	mg/kg	< 0.01	0.02
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
SVOCs					
Phenol	DETSC 3433	0.1	mg/kg	0.3	< 0.1
Aniline	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
2-Chlorophenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
Benzyl Alcohol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
2-Methylphenol	DETSC 3433	0.1	mg/kg	0.2	< 0.1
Bis(2-chloroisopropyl)ether	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
3&4-Methylphenol	DETSC 3433	0.1	mg/kg	0.4	< 0.1
2,4-Dimethylphenol	DETSC 3433	0.1	mg/kg	0.2	< 0.1
Bis-(dichloroethoxy)methane	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
2,4-Dichlorophenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
1,2,4-Trichlorobenzene	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
4-Chloro-3-methylphenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
2-Methylnaphthalene	DETSC 3433	0.1	mg/kg	8.8	< 0.1
Hexachlorocyclopentadiene	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
2,4,6-Trichlorophenol	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
2,4,5-Trichlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
2-Chloronaphthalene	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
2-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
2,4-Dinitrotoluene	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
Acenaphthylene	DETSC 3433	0.1	mg/kg	7.7	0.3
3-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
Acenaphthene	DETSC 3433	0.1	mg/kg	5.5	0.4
4-Nitrophenol	DETSC 3433*	0.1	mg/kg	6.2	< 0.1
Dibenzofuran	DETSC 3433	0.1	mg/kg	8.3	0.2
2,6-Dinitrotoluene	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
2,3,4,6-Tetrachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
Diethylphthalate	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
4-Chlorophenylphenylether	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
Fluorene	DETSC 3433	0.1	mg/kg	13	0.3

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Summary of Chemical Analysis
Soil VOC/SVOC Samples

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1444074	1444075
			Sample ID	WS104	WS106
			Depth	1.00	1.00
			Other ID	6	5
			Sample Type	ES	ES
			Sampling Date	08/01/19	08/01/19
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
4-Nitroaniline	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
2-Methyl-4,6-Dinitrophenol	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
Diphenylamine	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
4-Bromophenylphenylether	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
Hexachlorobenzene	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
Pentachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
Phenanthrene	DETSC 3433	0.1	mg/kg	61	1.8
Anthracene	DETSC 3433	0.1	mg/kg	14	0.7
Di-n-butylphthalate	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
Fluoranthene	DETSC 3433	0.1	mg/kg	50	3.0
Pyrene	DETSC 3433	0.1	mg/kg	48	2.7
Butylbenzylphthalate	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
Benzo(a)anthracene	DETSC 3433	0.1	mg/kg	19	1.2
Chrysene	DETSC 3433	0.1	mg/kg	20	1.2
Bis(2-ethylhexyl)phthalate	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
Di-n-octylphthalate	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
Benzo(b)fluoranthene	DETSC 3433	0.1	mg/kg	17	1.7
Benzo(k)fluoranthene	DETSC 3433	0.1	mg/kg	6.5	0.5
Benzo(a)pyrene	DETSC 3433	0.1	mg/kg	17	1.5
Indeno(123cd)pyrene	DETSC 3433	0.1	mg/kg	7.4	0.9
Dibenzo(ah)anthracene	DETSC 3433	0.1	mg/kg	2.4	0.2
Benzo(ghi)perylene	DETSC 3433	0.1	mg/kg	9.5	1.1
1,4-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
Dimethylphthalate	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
1,3-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
1,2-Dinitrobenzene	DETSC 3433*	0.1	mg/kg	11	< 0.1
2,3,5,6-Tetrachlorophenol	DETSC 3433*	0.1	mg/kg	< 0.1	< 0.1
Azobenzene	DETSC 3433	0.1	mg/kg	< 0.1	< 0.1
Carbazole	DETSC 3433*	0.1	mg/kg	3.5	< 0.1

Key: * -not accredited. n/s -not supplied.

WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway
Sample Id BH106 1 0.30

Sample Numbers 1444066 1444076 1444077
Date Analysed 17/01/2019

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084# Total Organic Carbon	%	24	3	5	6
DETSC 2003# Loss On Ignition	%	11	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	48	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	4.0	100	n/a	n/a
DETSC 2008# pH	pH Units	6.9	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached* mg/kg		WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
	2:1	8:1	LS2	LS10			
DETSC 2306 Arsenic as As	2.1	2	0.004	0.02	0.5	2	25
DETSC 2306 Barium as Ba	29	4.8	0.06	< 0.1	20	100	300
DETSC 2306 Cadmium as Cd	< 0.03	< 0.03	< 0.004	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	1.3	8.1	< 0.02	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	8	5.8	0.016	0.061	2	50	100
DETSC 2306 Mercury as Hg	0.02	0.02	< 0.0004	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	5.7	3.8	< 0.02	< 0.1	0.5	10	30
DETSC 2306 Nickel as Ni	1.3	0.6	< 0.02	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	11	5.8	0.02	0.065	0.5	10	50
DETSC 2306 Antimony as Sb	8.6	3.5	0.02	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	0.48	< 0.25	< 0.006	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	13	5.1	0.026	0.062	4	50	200
DETSC 2055 Chloride as Cl	4600	2900	< 20	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	300	200	0.6	2.14	10	150	500
DETSC 2055 Sulphate as SO4	14000	8800	28	< 100	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	82000	67000	164	691.3	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1	1	n/a	n/a
* Dissolved Organic Carbon	9400	7300	18.8	76	500	800	1000

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

Additional Information

DETSC 2008 pH	7	8.5
DETSC 2009 Conductivity uS/cm	117	96.3
* Temperature*	15	16

Mass of Sample Kg*	0.130
Mass of dry Sample Kg*	0.117

Stage 1

Volume of Leachant L2*	0.22
Volume of Eluate VE1*	0.166

Stage 2

Volume of Leachant L8*	0.934
Volume of Eluate VE2*	0.88

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 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway
Sample Id WS102 5 1.00

Sample Numbers 1444072 1444078 1444079
Date Analysed 17/01/2019

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084# Total Organic Carbon	%	2.1	3	5	6
DETSC 2003# Loss On Ignition	%	3.1	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	61	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	4.8	100	n/a	n/a
DETSC 2008# pH	pH Units	8.5	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached* mg/kg		WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
	2:1	8:1	LS2	LS10			
DETSC 2306 Arsenic as As	4.9	5.3	0.01	0.052	0.5	2	25
DETSC 2306 Barium as Ba	18	2.3	0.04	< 0.1	20	100	300
DETSC 2306 Cadmium as Cd	< 0.03	< 0.03	< 0.004	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	1.3	7.1	< 0.02	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	3.8	2.8	0.008	0.03	2	50	100
DETSC 2306 Mercury as Hg	0.04	0.03	< 0.0004	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	3.9	3	< 0.02	< 0.1	0.5	10	30
DETSC 2306 Nickel as Ni	< 0.5	< 0.5	< 0.02	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	5.6	3.9	0.01	< 0.05	0.5	10	50
DETSC 2306 Antimony as Sb	1.9	0.77	< 0.01	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	< 0.25	< 0.25	< 0.006	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	3.2	1.4	0.006	0.017	4	50	200
DETSC 2055 Chloride as Cl	2800	1600	< 20	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	530	190	1.06	2.42	10	150	500
DETSC 2055 Sulphate as SO4	10000	5400	20	< 100	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	95000	57000	190	628.6	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1	1	n/a	n/a
* Dissolved Organic Carbon	6500	4900	13	51.5	500	800	1000

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

Additional Information

DETSC 2008 pH	7.3	8.3
DETSC 2009 Conductivity uS/cm	135	81.8
* Temperature*	15	16

Mass of Sample Kg*	0.140
Mass of dry Sample Kg*	0.124

Stage 1

Volume of Leachant L2*	0.233
Volume of Eluate VE1*	0.192

Stage 2

Volume of Leachant L8*	0.995
Volume of Eluate VE2*	0.92

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 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1444062	BH104 4 0.70	SOIL	NAD	none	Lee Kerridge
1444063	BH104 15 4.70	SOIL	NAD	none	Lee Kerridge
1444064	BH104 28 9.70	SOIL	NAD	none	Lee Kerridge
1444065	BH105 14 3.30	SOIL	NAD	none	Lee Kerridge
1444066	BH106 1 0.30	SOIL	NAD	none	Lee Kerridge
1444067	BH106 7 3.30	SOIL	NAD	none	Lee Kerridge
1444068	BH106 17 7.60	SOIL	NAD	none	Lee Kerridge
1444069	TP124 3 0.30	SOIL	NAD	none	Lee Kerridge
1444070	TP124 11 3.20	SOIL	NAD	none	Lee Kerridge
1444071	WS101 3 0.30	SOIL	NAD	none	Lee Kerridge
1444072	WS102 5 1.00	SOIL	NAD	none	Lee Kerridge
1444073	WS103 4 1.00	SOIL	Amosite	Amosite present in small bundles	Lee Kerridge
1444074	WS104 6 1.00	SOIL	Amosite	Amosite present in small bundles	Lee Kerridge
1444075	WS106 5 1.00	SOIL	Amosite	Amosite present in small bundles	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.

Summary of Asbestos Quantification Analysis
Soil Samples

Our Ref 19-00541-1
Client Ref NW1580
Contract Title Northern Gateway

		Lab No	1444073	1444074	1444075
		Sample ID	WS103	WS104	WS106
		Depth	1.00	1.00	1.00
		Other ID	4	6	5
		Sample Type	SOIL	SOIL	SOIL
		Sampling Date	07/01/19	08/01/19	08/01/19
		Sampling Time			
Test	**Method**	**Units**			
Total Mass% Asbestos (a+b+c)	DETSC 1102	Mass %	**< 0.001**	**< 0.001**	**< 0.001**
Gravimetric Quantification (a)	DETSC 1102	Mass %	na	na	na
Detailed Gravimetric Quantification (b)	DETSC 1102	Mass %	<0.001	<0.001	<0.001
Quantification by PCOM (c)	DETSC 1102	Mass %	na	na	na
Potentially Respirable Fibres (d)	DETSC 1102	Fibres/g	na	na	na
Breakdown of Gravimetric Analysis (a)					
Mass of Sample		g	863.88	176.22	683.69
ACMs present*		type			
Mass of ACM in sample		g			
% ACM by mass		%			
% asbestos in ACM		%			
% asbestos in sample		%			
Breakdown of Detailed Gravimetric Analysis (b)					
% Amphibole bundles in sample		Mass %	<0.001	<0.001	<0.001
% Chrysotile bundles in sample		Mass %	na	na	na
Breakdown of PCOM Analysis (c)					
% Amphibole fibres in sample		Mass %	na	na	na
% Chrysotile fibres in sample		Mass %	na	na	na
Breakdown of Potentially Respirable Fibre Analysis (d)					
Amphibole fibres		Fibres/g	na	na	na
Chrysotile fibres		Fibres/g	na	na	na

* Denotes test or material description outside of UKAS accreditation.
% asbestos in Asbestos Containing Materials (ACMs) is determined by
by reference to HSG 264.
Recommended sample size for quantification is approximately 1kg
denotes deviating sample

Information in Support of the Analytical Results

Our Ref 19-00541-1
Client Ref NW1580
Contract Northern Gateway

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1444062	BH104 0.70 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444063	BH104 4.70 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444064	BH104 9.70 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444065	BH105 3.30 SOIL	08/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444066	BH106 0.30 SOIL	08/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444067	BH106 3.30 SOIL	08/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444068	BH106 7.60 SOIL	08/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444069	TP124 0.30 SOIL	08/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444070	TP124 3.20 SOIL	08/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444071	WS101 0.30 SOIL	08/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x3		
1444072	WS102 1.00 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444073	WS103 1.00 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444074	WS104 1.00 SOIL	08/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x3		
1444075	WS106 1.00 SOIL	08/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x3		
1444076	BH106 0.30 LEACHATE	08/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444077	BH106 0.30 LEACHATE	08/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444078	WS102 1.00 LEACHATE	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1444079	WS102 1.00 LEACHATE	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		

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 A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 2002	Organic matter	%	0.1	Air Dried	No	Yes	Yes
DETSC 2003	Loss on ignition	%	0.01	Air Dried	No	Yes	Yes
DETSC 2008	pH	pH Units	1	Air Dried	No	Yes	Yes
DETSC 2024	Sulphide	mg/kg	10	Air Dried	No	Yes	Yes
DETSC 2076	Sulphate Aqueous Extract as SO4	mg/l	10	Air Dried	No	Yes	Yes
DETSC 2084	Total Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2084	Total Organic Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2119	Ammoniacal Nitrogen as N	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide free	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide total	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC 2130	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETSC 2321	Total Sulphate as SO4	%	0.01	Air Dried	No	Yes	Yes
DETSC 2325	Mercury	mg/kg	0.05	Air Dried	No	Yes	Yes
DETSC 3049	Sulphur (free)	mg/kg	0.75	Air Dried	No	Yes	Yes
DETSC2123	Boron (water soluble)	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Arsenic	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Barium	mg/kg	1.5	Air Dried	No	Yes	Yes
DETSC2301	Beryllium	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Cadmium Available	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cadmium	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cobalt	mg/kg	0.7	Air Dried	No	Yes	Yes
DETSC2301	Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETSC2301	Copper	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Manganese	mg/kg	20	Air Dried	No	Yes	Yes
DETSC2301	Molybdenum	mg/kg	0.4	Air Dried	No	Yes	Yes
DETSC2301	Nickel	mg/kg	1	Air Dried	No	Yes	Yes
DETSC2301	Lead	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC2301	Selenium	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC2301	Zinc	mg/kg	1	Air Dried	No	Yes	Yes
DETSC 3072	Ali/Aro C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	1.2	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	0.9	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	0.5	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	0.6	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	m+p Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	o Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3311	C10-C24 Diesel Range Organics (DRO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	C24-C40 Lube Oil Range Organics (LORO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	EPH (C10-C40)	mg/kg	10	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 3303	Acenaphthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Acenaphthylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(b)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(k)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(g,h,i)perylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Dibenzo(a,h)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Naphthalene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Phenanthrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3401	PCB 28 + PCB 31	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 52	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 101	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 118	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 153	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 138	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 180	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB Total	mg/kg	0.01	As Received	No	Yes	Yes

Method details are shown only for those determinands listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS. No Recovery Factors are used in the determination of results. Results reported assume 100% recovery. Full method statements are available on request.

Certificate of Analysis

Certificate Number	19-00469	18-Jan-19
Client	Allied Exploration & Geotechnics Limited Unit 25 Stella Gill Industrial Estate Pelton Fell DH2 2RG	
Our Reference	19-00469	
Client Reference	NW1580	
Order No	CH1500	
Contract Title	Northern Gateway	
Description	5 Soil samples, 2 Leachate samples.	
Date Received	11-Jan-19	
Date Started	11-Jan-19	
Date Completed	18-Jan-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



Adam Fenwick
Contracts Manager

mCERTS
THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING
2139

Summary of Chemical Analysis
Matrix Descriptions

Our Ref 19-00469
Client Ref NW1580
Contract Title Northern Gateway

Sample ID	Other ID	Depth	Lab No	Completed	Matrix Description
BH103	2	0.3	1443641	18/01/2019	Very dark brown sandy CLAY (Made ground - plastic)
BH103	4	1	1443642	18/01/2019	Very dark brown gravelly, sandy CLAY including some wood (Made ground - glass)
BH103	11	3.2	1443643	18/01/2019	Brown sandy CLAY
BH103	16	4.8	1443644	18/01/2019	Dark red sandy CLAY
BH105	5	0.7	1443645	18/01/2019	Dark brown sandy CLAY

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00469
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1443641	1443642	1443643	1443644	1443645
			Sample ID	BH103	BH103	BH103	BH103	BH105
			Depth	0.30	1.00	3.20	4.80	0.70
			Other ID	2	4	11	16	5
			Sample Type	ES	ES	ES	ES	ES
			Sampling Date	04/01/19	04/01/19	04/01/19	04/01/19	04/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**					
Metals								
Antimony	DETSC 2301*	1	mg/kg	5.0	4.8	1.3	1.3	1.5
Arsenic	DETSC 2301#	0.2	mg/kg	9.5	11	6.1	12	11
Beryllium	DETSC 2301#	0.2	mg/kg	0.5	0.5	0.7	0.8	0.9
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	2.3	1.4	1.2	1.3	1.2
Cadmium	DETSC 2301#	0.1	mg/kg	0.6	0.8	0.2	0.4	0.2
Chromium	DETSC 2301#	0.15	mg/kg	19	19	19	24	23
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0		< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	100	140	46	9.1	31
Lead	DETSC 2301#	0.3	mg/kg	230	210	28	13	26
Mercury	DETSC 2325#	0.05	mg/kg	0.29	0.26	< 0.05	< 0.05	0.11
Nickel	DETSC 2301#	1	mg/kg	17	20	22	29	27
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	21	24	22	28	27
Zinc	DETSC 2301#	1	mg/kg	300	250	99	69	97
Inorganics								
pH	DETSC 2008#			9.1	10.0	8.5	8.7	8.3
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.6	0.6	< 0.1	< 0.1	0.1
Total Organic Carbon	DETSC 2084#	0.5	%	7.1	6.8	1.2	< 0.5	1.6
Petroleum Hydrocarbons								
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 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
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	13		< 1.5	< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	56		< 1.2	< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	65		< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	77		< 3.4	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	210		< 10	< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 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
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	6.8		< 0.9	< 0.9	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	37		< 0.5	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	85		< 0.6	< 0.6	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	120		< 1.4	< 1.4	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	250		< 10	< 10	< 10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	460		< 10	< 10	< 10
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 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.

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00469
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1443641	1443642	1443643	1443644	1443645
			Sample ID	BH103	BH103	BH103	BH103	BH105
			Depth	0.30	1.00	3.20	4.80	0.70
			Other ID	2	4	11	16	5
			Sample Type	ES	ES	ES	ES	ES
			Sampling Date	04/01/19	04/01/19	04/01/19	04/01/19	04/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**					
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	0.62		0.04	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	0.05		< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.30		0.04	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	0.52		0.04	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	1.4		0.20	< 0.03	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	0.44		0.05	< 0.03	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	1.1		0.17	< 0.03	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	1.0		0.16	< 0.03	0.04
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.29		0.06	< 0.03	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	0.35		0.06	< 0.03	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.29		0.06	< 0.03	0.04
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.12		< 0.03	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.20		0.04	< 0.03	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.09		< 0.03	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.03		< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.12		< 0.03	< 0.03	0.05
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	6.8		0.92	< 0.10	0.12
Phenols								
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	0.4	0.4	0.4	< 0.3

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

WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 19-00469
Client Ref NW1580
Contract Title Northern Gateway
Sample Id BH103 4 1.00

Sample Numbers 1443642 1443646 1443647
Date Analysed 17/01/2019

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084# Total Organic Carbon	%	6.8	3	5	6
DETSC 2003# Loss On Ignition	%	11	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	1700	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	22	100	n/a	n/a
DETSC 2008# pH	pH Units	10.0	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	1.8	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached* mg/kg		WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
	2:1	8:1	LS2	LS10			
DETSC 2306 Arsenic as As	2.1	0.97	0.004	0.011	0.5	2	25
DETSC 2306 Barium as Ba	590	20	1.18	0.86	20	100	300
DETSC 2306 Cadmium as Cd	0.2	< 0.03	< 0.004	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	3.9	< 0.25	< 0.02	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	5.4	0.6	0.011	< 0.02	2	50	100
DETSC 2306 Mercury as Hg	0.03	< 0.01	< 0.0004	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	33	9.6	0.07	0.12	0.5	10	30
DETSC 2306 Nickel as Ni	31	1	0.06	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	5.8	0.28	0.01	< 0.05	0.5	10	50
DETSC 2306 Antimony as Sb	3.8	4.7	< 0.01	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	4.1	< 0.25	0.008	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	320	< 1.3	0.64	0.368	4	50	200
DETSC 2055 Chloride as Cl	3200	3100	< 20	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	680	340	1.36	3.79	10	150	500
DETSC 2055 Sulphate as SO4	84000	25000	168	317.9	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	290000	130000	580	1484.1	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1	1	n/a	n/a
* Dissolved Organic Carbon	16000	7700	32	86.5	500	800	1000

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

Additional Information

DETSC 2008 pH	7.3	7.1
DETSC 2009 Conductivity uS/cm	410	179
* Temperature*	15	16

Mass of Sample Kg*	0.140
Mass of dry Sample Kg*	0.101

Stage 1

Volume of Leachant L2*	0.162
Volume of Eluate VE1*	0.116

Stage 2

Volume of Leachant L8*	0.807
Volume of Eluate VE2*	0.75

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 19-00469
Client Ref NW1580
Contract Title Northern Gateway

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1443641	BH103 2 0.30	SOIL	NAD	none	Lee Kerridge
1443643	BH103 11 3.20	SOIL	NAD	none	Lee Kerridge
1443644	BH103 16 4.80	SOIL	NAD	none	Lee Kerridge
1443645	BH105 5 0.70	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 19-00469
Client Ref NW1580
Contract Northern Gateway

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1443641	BH103 0.30 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1443642	BH103 1.00 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1443643	BH103 3.20 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1443644	BH103 4.80 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1443645	BH105 0.70 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1443646	BH103 1.00 LEACHATE	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1443647	BH103 1.00 LEACHATE	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		

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 A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 2002	Organic matter	%	0.1	Air Dried	No	Yes	Yes
DETSC 2003	Loss on ignition	%	0.01	Air Dried	No	Yes	Yes
DETSC 2008	pH	pH Units	1	Air Dried	No	Yes	Yes
DETSC 2024	Sulphide	mg/kg	10	Air Dried	No	Yes	Yes
DETSC 2076	Sulphate Aqueous Extract as SO4	mg/l	10	Air Dried	No	Yes	Yes
DETSC 2084	Total Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2084	Total Organic Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2119	Ammoniacal Nitrogen as N	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide free	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide total	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC 2130	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETSC 2321	Total Sulphate as SO4	%	0.01	Air Dried	No	Yes	Yes
DETSC 2325	Mercury	mg/kg	0.05	Air Dried	No	Yes	Yes
DETSC 3049	Sulphur (free)	mg/kg	0.75	Air Dried	No	Yes	Yes
DETSC2123	Boron (water soluble)	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Arsenic	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Barium	mg/kg	1.5	Air Dried	No	Yes	Yes
DETSC2301	Beryllium	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Cadmium Available	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cadmium	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cobalt	mg/kg	0.7	Air Dried	No	Yes	Yes
DETSC2301	Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETSC2301	Copper	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Manganese	mg/kg	20	Air Dried	No	Yes	Yes
DETSC2301	Molybdenum	mg/kg	0.4	Air Dried	No	Yes	Yes
DETSC2301	Nickel	mg/kg	1	Air Dried	No	Yes	Yes
DETSC2301	Lead	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC2301	Selenium	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC2301	Zinc	mg/kg	1	Air Dried	No	Yes	Yes
DETSC 3072	Ali/Aro C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	1.2	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	0.9	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	0.5	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	0.6	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	m+p Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	o Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3311	C10-C24 Diesel Range Organics (DRO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	C24-C40 Lube Oil Range Organics (LORO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	EPH (C10-C40)	mg/kg	10	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 3303	Acenaphthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Acenaphthylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(b)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(k)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(g,h,i)perylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Dibenzo(a,h)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Naphthalene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Phenanthrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3401	PCB 28 + PCB 31	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 52	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 101	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 118	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 153	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 138	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 180	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB Total	mg/kg	0.01	As Received	No	Yes	Yes

Method details are shown only for those determinands listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS. No Recovery Factors are used in the determination of results. Results reported assume 100% recovery. Full method statements are available on request.

Certificate of Analysis

Certificate Number 19-00333-1

23-Jan-19

Client Allied Exploration & Geotechnics Limited
Unit 25
Stella Gill Industrial Estate
Pelton Fell
DH2 2RG

Our Reference 19-00333-1

Client Reference NW1580

Order No CH1500

Contract Title Northern Gateway

Description 23 Soil samples, 10 Leachate samples.

Date Received 09-Jan-19

Date Started 09-Jan-19

Date Completed 23-Jan-19

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

Notes **This report supersedes 19-00333, extra testing.**

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



Adam Fenwick
Contracts Manager

mCERTS
THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING
2139

Summary of Chemical Analysis
Matrix Descriptions

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

Sample ID	Other ID	Depth	Lab No	Completed	Matrix Description
TP101	2	0.3	1442777	17/01/2019	Dark grey sandy GRAVEL (sample matrix outside MCERTS scope of accreditation)
TP102	2	0.3	1442778	17/01/2019	Dark grey sandy GRAVEL (sample matrix outside MCERTS scope of accreditation)
TP102	6	1.2	1442779	17/01/2019	Brown slightly gravelly, sandy CLAY
TP103	7	1	1442780	17/01/2019	Brown gravelly, sandy CLAY
TP103	11	1.8	1442781	17/01/2019	Brown sandy CLAY
TP104	2	0.3	1442782	17/01/2019	Dark brown clayey, sandy GRAVEL (sample matrix outside MCERTS scope of accreditation)
TP105	2	0.3	1442783	17/01/2019	Dark brown gravelly, sandy CLAY
TP105	5	1.3	1442784	17/01/2019	Dark brown gravelly, sandy CLAY
TP106	3	0.4	1442785	17/01/2019	Dark brown sandy GRAVEL (Made ground - slag) (sample matrix outside MCERTS scope of accreditation)
TP106	10	2.8	1442786	17/01/2019	Brown gravelly, sandy CLAY
TP107	8	1.2	1442787	17/01/2019	Dark brown gravelly, sandy CLAY
TP108	2	0.3	1442788	17/01/2019	Dark brown clayey, sandy GRAVEL (Made ground - slag) (sample matrix outside MCERTS scope of accreditation)
TP109	2	0.3	1442789	17/01/2019	Dark brown clayey, sandy GRAVEL (Made ground - slag) (sample matrix outside MCERTS scope of accreditation)
TP109	5	1.3	1442790	17/01/2019	Dark brown clayey, sandy GRAVEL (Made ground - slag) (sample matrix outside MCERTS scope of accreditation)
TP109	11	3.3	1442791	17/01/2019	Dark brown clayey, sandy GRAVEL (Made ground - slag) (sample matrix outside MCERTS scope of accreditation)
TP110	5	1.3	1442792	17/01/2019	Dark brown gravelly, sandy CLAY including odd rootlets
TP111	2	0.3	1442793	17/01/2019	Dark brown clayey, sandy GRAVEL (Made ground - brick) (sample matrix outside MCERTS scope of accreditation)
TP111	8	2.5	1442794	17/01/2019	Brown gravelly, sandy CLAY
TP112	2	0.3	1442795	17/01/2019	Dark brown gravelly, sandy CLAY (Possible made ground - brick)
TP112	8	2.3	1442796	17/01/2019	Dark brown gravelly, sandy CLAY (Possible made ground - brick)
TP115	2	0.3	1442797	17/01/2019	Dark brown gravelly, sandy CLAY (Made ground - slag)
TP115	5	1.3	1442798	17/01/2019	Dark brown gravelly, sandy CLAY (Made ground - slag)
TP115	11	3.3	1442799	17/01/2019	Dark brown gravelly, sandy CLAY (Made ground - slag)

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1442777	1442778	1442779	1442780	1442781	1442782
			Sample ID	TP101	TP102	TP102	TP103	TP103	TP104
			Depth	0.30	0.30	1.20	1.00	1.80	0.30
			Other ID	2	2	6	7	11	2
			Sample Type	ES	ES	ES	ES	ES	ES
			Sampling Date	03/01/19	03/01/19	03/01/19	03/01/19	03/01/19	03/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Asbestos Quantification	DETSC 1102	0							
Metals									
Antimony	DETSC 2301*	1	mg/kg	1.3	< 1.0	1.2	< 1.0	< 1.0	3.8
Arsenic	DETSC 2301#	0.2	mg/kg	6.8	6.1	10	4.1	8.1	23
Beryllium	DETSC 2301#	0.2	mg/kg	1.0	< 0.2	1.0	0.6	0.8	1.5
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	1.0	0.6	0.7	0.6	0.5	0.4
Cadmium	DETSC 2301#	0.1	mg/kg	0.4	0.4	0.3	0.2	0.2	0.7
Chromium	DETSC 2301#	0.15	mg/kg	21	16	29	8.7	22	48
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	71	21	46	35	27	150
Lead	DETSC 2301#	0.3	mg/kg	26	17	17	20	13	210
Mercury	DETSC 2325#	0.05	mg/kg	< 0.05	< 0.05	< 0.05	0.07	< 0.05	0.34
Nickel	DETSC 2301#	1	mg/kg	22	10	30	12	29	32
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	31	17	31	14	27	160
Zinc	DETSC 2301#	1	mg/kg	95	59	89	67	65	180
Inorganics									
pH	DETSC 2008#			8.9	8.7	8.5	8.3	8.1	7.7
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	0.2
Total Organic Carbon	DETSC 2084#	0.5	%	2.9	3.9	1.6	2.8	2.0	18
Petroleum Hydrocarbons									
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 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
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 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	16
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5		< 1.5	< 1.5	< 1.5	72
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4		< 3.4	< 3.4	< 3.4	230
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10		< 10	< 10	< 10	320
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 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
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 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	12
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5		< 0.5	< 0.5	< 0.5	25
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6		< 0.6	< 0.6	< 0.6	85
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4		< 1.4	< 1.4	< 1.4	200
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10		< 10	< 10	< 10	320
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	< 10		< 10	< 10	< 10	650
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01	
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01	
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01	
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01	

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

	Lab No	1442777	1442778	1442779	1442780	1442781	1442782
	Sample ID	TP101	TP102	TP102	TP103	TP103	TP104
	Depth	0.30	0.30	1.20	1.00	1.80	0.30
	Other ID	2	2	6	7	11	2
	Sample Type	ES	ES	ES	ES	ES	ES
	Sampling Date	03/01/19	03/01/19	03/01/19	03/01/19	03/01/19	03/01/19
	Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
PAHs							
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Acenaphthylene	DETSC 3303#	0.03	mg/kg	0.04		< 0.03	< 0.03	< 0.03	
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.12		< 0.03	0.05	< 0.03	
Anthracene	DETSC 3303	0.03	mg/kg	0.20		< 0.03	< 0.03	< 0.03	
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.28		< 0.03	0.05	< 0.03	
Pyrene	DETSC 3303#	0.03	mg/kg	0.28		< 0.03	0.04	< 0.03	
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.10		< 0.03	< 0.03	< 0.03	
Chrysene	DETSC 3303	0.03	mg/kg	0.12		< 0.03	< 0.03	< 0.03	
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.13		< 0.03	< 0.03	< 0.03	
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.05		< 0.03	< 0.03	< 0.03	
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.08		< 0.03	< 0.03	< 0.03	
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.06		< 0.03	< 0.03	< 0.03	
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.06		< 0.03	< 0.03	< 0.03	
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	1.5		< 0.10	0.15	< 0.10	
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	0.4	< 0.3	< 0.3	0.4	< 0.3	0.8

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1442783	1442784	1442785	1442786	1442787	1442788
			Sample ID	TP105	TP105	TP106	TP106	TP107	TP108
			Depth	0.30	1.30	0.40	2.80	1.20	0.30
			Other ID	2	5	3	10	8	2
			Sample Type	ES	ES	ES	ES	ES	ES
			Sampling Date	04/01/19	04/01/19	04/01/19	04/01/19	03/01/19	04/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
Asbestos Quantification	DETSC 1102	0		Y					
Metals									
Antimony	DETSC 2301*	1	mg/kg	2.2	1.0	2.3	< 1.0	1.2	7.9
Arsenic	DETSC 2301#	0.2	mg/kg	19	12	21	5.0	12	37
Beryllium	DETSC 2301#	0.2	mg/kg	1.3	0.6	2.1	0.6	0.9	1.0
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	0.5	0.2	< 0.2	< 0.2	1.2	0.8
Cadmium	DETSC 2301#	0.1	mg/kg	0.5	0.2	0.2	< 0.1	0.2	0.4
Chromium	DETSC 2301#	0.15	mg/kg	22	23	38	11	23	36
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	94	39	130	17	43	130
Lead	DETSC 2301#	0.3	mg/kg	240	110	40	56	39	100
Mercury	DETSC 2325#	0.05	mg/kg	0.90	0.32	< 0.05	0.11	0.32	< 0.05
Nickel	DETSC 2301#	1	mg/kg	27	20	50	13	29	33
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	33	21	65	15	33	74
Zinc	DETSC 2301#	1	mg/kg	170	88	53	38	62	130
Inorganics									
pH	DETSC 2008#			8.4	8.3	8.6	8.3	7.2	7.6
Cyanide, Total	DETSC 2130#	0.1	mg/kg	8.1	5.1	0.5	0.2	0.2	0.1
Total Organic Carbon	DETSC 2084#	0.5	%	5.3	4.7	35	1.5	4.7	12
Petroleum Hydrocarbons									
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.10	< 0.01	< 0.01		< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.10	< 0.01	< 0.01		< 0.01	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	4.3	< 0.01	< 0.01		< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	1.5		< 1.5	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2	< 1.2	7.1		< 1.2	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5	< 1.5	110		< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4	< 3.4	110		< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 76.3	< 10	220		< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.10	< 0.01	< 0.01		< 0.01	< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.10	< 0.01	< 0.01		< 0.01	< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.10	< 0.01	< 0.01		< 0.01	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	27	11	11		< 0.9	13
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	41	19	19		< 0.5	19
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	40	24	42		< 0.6	39
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	160	98	84		< 1.4	68
Aromatic C5-C35	DETSC 3072*	10	mg/kg	260	150	160		< 10	140
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	340	150	380		< 10	140
Benzene	DETSC 3321#	0.01	mg/kg		< 0.01	< 0.01		< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg		< 0.01	< 0.01		< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg		< 0.01	< 0.01		< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg		< 0.01	< 0.01		< 0.01	< 0.01

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1442783	1442784	1442785	1442786	1442787	1442788
			Sample ID	TP105	TP105	TP106	TP106	TP107	TP108
			Depth	0.30	1.30	0.40	2.80	1.20	0.30
			Other ID	2	5	3	10	8	2
			Sample Type	ES	ES	ES	ES	ES	ES
			Sampling Date	04/01/19	04/01/19	04/01/19	04/01/19	03/01/19	04/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**						
PAHs									
Naphthalene	DETSC 3303#	0.03	mg/kg		0.04	0.07		< 0.03	0.28
Acenaphthylene	DETSC 3303#	0.03	mg/kg		0.70	0.14		< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg		< 0.03	0.04		< 0.03	0.59
Fluorene	DETSC 3303	0.03	mg/kg		0.10	0.04		< 0.03	0.48
Phenanthrene	DETSC 3303#	0.03	mg/kg		0.14	0.56		< 0.03	2.5
Anthracene	DETSC 3303	0.03	mg/kg		0.51	0.18		< 0.03	0.61
Fluoranthene	DETSC 3303#	0.03	mg/kg		0.20	0.96		0.03	2.5
Pyrene	DETSC 3303#	0.03	mg/kg		0.51	2.4		0.03	2.5
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg		0.20	0.80		< 0.03	0.70
Chrysene	DETSC 3303	0.03	mg/kg		0.22	1.1		< 0.03	0.78
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg		0.37	1.1		< 0.03	0.50
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg		0.37	0.30		< 0.03	0.17
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg		0.24	0.99		< 0.03	0.38
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg		0.52	0.55		< 0.03	0.10
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg		0.07	0.15		< 0.03	0.04
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg		2.3	1.0		< 0.03	0.15
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg		6.4	10		< 0.10	12
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	0.7	0.4	0.6	0.4	0.4	0.5

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00333-1
Client Ref NW1580
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				Lab No	1442789	1442790	1442791	1442792	1442793	1442794
				Sample ID	TP109	TP109	TP109	TP110	TP111	TP111
				Depth	0.30	1.30	3.30	1.30	0.30	2.50
				Other ID	2	5	11	5	2	8
				Sample Type	ES	ES	ES	ES	ES	ES
				Sampling Date	04/01/19	04/01/19	04/01/19	07/01/19	07/01/19	07/01/19
				Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Asbestos Quantification	DETSC 1102	0								
Metals										
Antimony	DETSC 2301*	1	mg/kg	4.1	3.0	4.8	11	4.3	< 1.0
Arsenic	DETSC 2301#	0.2	mg/kg	28	71	19	34	18	4.5
Beryllium	DETSC 2301#	0.2	mg/kg	2.6	2.1	2.0	1.9	0.9	0.6
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	0.7	1.0	0.7	0.7	0.7	0.6
Cadmium	DETSC 2301#	0.1	mg/kg	0.5	0.4	0.2	0.6	0.6	0.1
Chromium	DETSC 2301#	0.15	mg/kg	19	15	18	21	26	13
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Copper	DETSC 2301#	0.2	mg/kg	300	110	150	300	86	14
Lead	DETSC 2301#	0.3	mg/kg	1300	180	330	520	71	12
Mercury	DETSC 2325#	0.05	mg/kg	18	1.1	1.2	1.6	0.25	< 0.05
Nickel	DETSC 2301#	1	mg/kg	39	29	38	38	28	15
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	53	40	43	59	74	16
Zinc	DETSC 2301#	1	mg/kg	310	93	99	240	180	28
Inorganics										
pH	DETSC 2008#			7.6	8.2	7.6	7.3	7.8	7.7
Cyanide, Total	DETSC 2130#	0.1	mg/kg	0.8	0.2	0.2	0.5	< 0.1	< 0.1
Total Organic Carbon	DETSC 2084#	0.5	%	27	17	13	28	12	0.5
Petroleum Hydrocarbons										
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 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
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 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
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5		< 1.5	< 1.5	< 1.5	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4		< 3.4	< 3.4	< 3.4	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10		< 10	< 10	< 10	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 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
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 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
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5		< 0.5	< 0.5	< 0.5	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6		< 0.6	< 0.6	< 0.6	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4		< 1.4	< 1.4	< 1.4	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10		< 10	< 10	< 10	< 10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	< 10		< 10	< 10	< 10	< 10
Benzene	DETSC 3321#	0.01	mg/kg	< 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
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

	Lab No	1442789	1442790	1442791	1442792	1442793	1442794
	Sample ID	TP109	TP109	TP109	TP110	TP111	TP111
	Depth	0.30	1.30	3.30	1.30	0.30	2.50
	Other ID	2	5	11	5	2	8
	Sample Type	ES	ES	ES	ES	ES	ES
	Sampling Date	04/01/19	04/01/19	04/01/19	07/01/19	07/01/19	07/01/19
	Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
PAHs							
Naphthalene	DETSC 3303#	0.03	mg/kg	< 0.03		0.03	0.19	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.04		< 0.03	0.20	< 0.03	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03		< 0.03	0.20	< 0.03	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.26		0.22	1.5	0.16	< 0.03
Anthracene	DETSC 3303	0.03	mg/kg	0.04		0.05	0.35	0.09	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.35		0.27	1.2	0.35	< 0.03
Pyrene	DETSC 3303#	0.03	mg/kg	0.39		0.30	1.2	0.40	< 0.03
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.15		0.12	0.36	0.16	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	0.20		0.14	0.40	0.20	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.16		0.13	0.32	0.17	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.06		0.05	0.13	0.08	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.13		0.11	0.24	0.10	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.08		0.07	0.11	0.07	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.11		0.10	0.13	0.07	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	2.0		1.6	6.5	1.8	< 0.10
Phenols									
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	0.5	0.5	0.6	< 0.3	< 0.3	0.4

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1442795	1442796	1442797	1442798	1442799
			Sample ID	TP112	TP112	TP115	TP115	TP115
			Depth	0.30	2.30	0.30	1.30	3.30
			Other ID	2	8	2	5	11
			Sample Type	ES	ES	ES	ES	ES
			Sampling Date	07/01/19	07/01/19	07/01/19	07/01/19	07/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**					
Asbestos Quantification	DETSC 1102	0						
Metals								
Antimony	DETSC 2301*	1	mg/kg	55	20	12	8.2	12
Arsenic	DETSC 2301#	0.2	mg/kg	19	44	40	25	40
Beryllium	DETSC 2301#	0.2	mg/kg	2.2	1.6	2.2	3.9	2.3
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	0.7	0.7	0.9	1.0	0.5
Cadmium	DETSC 2301#	0.1	mg/kg	0.3	0.3	0.4	0.3	0.5
Chromium	DETSC 2301#	0.15	mg/kg	18	18	25	27	17
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0		< 1.0
Copper	DETSC 2301#	0.2	mg/kg	270	150	300	260	310
Lead	DETSC 2301#	0.3	mg/kg	290	210	460	190	520
Mercury	DETSC 2325#	0.05	mg/kg	0.45	0.29	0.63	0.44	1.0
Nickel	DETSC 2301#	1	mg/kg	38	35	45	50	40
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	54	46	76	58	61
Zinc	DETSC 2301#	1	mg/kg	120	91	130	88	180
Inorganics								
pH	DETSC 2008#			6.1	6.5	6.5	6.5	6.9
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1	0.3	0.4	68
Total Organic Carbon	DETSC 2084#	0.5	%	13	11	27	17	32
Petroleum Hydrocarbons								
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01		< 0.01		< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01		< 0.01		< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01		< 0.01		< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	< 1.5		< 1.5		< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	< 1.2		< 1.2		< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	< 1.5		< 1.5		< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	< 3.4		< 3.4		< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	< 10		< 10		< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 0.01		< 0.01		< 0.01
Aromatic C7-C8	DETSC 3321*	0.01	mg/kg	< 0.01		< 0.01		< 0.01
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01		< 0.01		< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	< 0.9		< 0.9		< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	< 0.5		< 0.5		< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	< 0.6		< 0.6		< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	< 1.4		< 1.4		< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	< 10		< 10		< 10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	< 10		< 10		< 10
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01		< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01		< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01		< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01		< 0.01		< 0.01

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Summary of Chemical Analysis
Soil Samples

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1442795	1442796	1442797	1442798	1442799
			Sample ID	TP112	TP112	TP115	TP115	TP115
			Depth	0.30	2.30	0.30	1.30	3.30
			Other ID	2	8	2	5	11
			Sample Type	ES	ES	ES	ES	ES
			Sampling Date	07/01/19	07/01/19	07/01/19	07/01/19	07/01/19
			Sampling Time	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**					
PAHs								
Naphthalene	DETSC 3303#	0.03	mg/kg	0.04		0.09		0.12
Acenaphthylene	DETSC 3303#	0.03	mg/kg	< 0.03		0.04		0.06
Acenaphthene	DETSC 3303#	0.03	mg/kg	< 0.03		0.05		0.08
Fluorene	DETSC 3303	0.03	mg/kg	< 0.03		0.04		0.06
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.11		0.54		0.71
Anthracene	DETSC 3303	0.03	mg/kg	< 0.03		0.26		0.33
Fluoranthene	DETSC 3303#	0.03	mg/kg	0.12		1.0		1.2
Pyrene	DETSC 3303#	0.03	mg/kg	0.10		1.0		1.2
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.04		0.45		0.53
Chrysene	DETSC 3303	0.03	mg/kg	0.06		0.49		0.58
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.05		0.55		0.67
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	< 0.03		0.19		0.24
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03		0.39		0.50
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	< 0.03		0.15		0.20
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	< 0.03		0.04		0.06
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	< 0.03		0.18		0.23
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	0.52		5.5		6.7
Phenols								
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	1.0	0.5	0.4	0.4

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Summary of Chemical Analysis
Soil VOC Samples

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1442782	1442783
			Sample ID	TP104	TP105
			Depth	0.30	0.30
			Other ID	2	2
			Sample Type	ES	ES
			Sampling Date	03/01/19	04/01/19
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
VOCs					
Vinyl Chloride	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,1 Dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Trans-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,1-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Cis-1,2-dichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
2,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Bromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Chloroform	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,1,1-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,1-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Carbon tetrachloride	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Benzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,2-dichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Trichloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,2-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Dibromomethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Bromodichloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
cis-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Toluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
trans-1,3-dichloropropene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,1,2-trichloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Tetrachloroethylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,3-dichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Dibromochloromethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,2-dibromoethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Chlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,1,1,2-tetrachloroethane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Ethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
m+p-Xylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
o-Xylene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Styrene	DETSC 3431*	0.01	mg/kg	< 0.01	< 0.10
Bromoform	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Isopropylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Bromobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,2,3-trichloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
n-propylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
2-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,3,5-trimethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
4-chlorotoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Tert-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,2,4-trimethylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10

Key: * -not accredited. n/s -not supplied.

Summary of Chemical Analysis
Soil VOC Samples

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1442782	1442783
			Sample ID	TP104	TP105
			Depth	0.30	0.30
			Other ID	2	2
			Sample Type	ES	ES
			Sampling Date	03/01/19	04/01/19
			Sampling Time	n/s	n/s
Test	**Method**	**LOD**	**Units**		
sec-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
p-isopropyltoluene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,3-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,4-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
n-butylbenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,2-dichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,2-dibromo-3-chloropropane	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,2,4-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Hexachlorobutadiene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
Naphthalene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
1,2,3-trichlorobenzene	DETSC 3431	0.01	mg/kg	< 0.01	< 0.10
MTBE	DETSC 3431*	0.01	mg/kg	< 0.01	< 0.10

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WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway
Sample Id TP102 2 0.30

Sample Numbers 1442778 1442800 1442801
Date Analysed 16/01/2019

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084# Total Organic Carbon	%	3.9	3	5	6
DETSC 2003# Loss On Ignition	%	1.3	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	0.03	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	79	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	4.1	100	n/a	n/a
DETSC 2008# pH	pH Units	8.7	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached* mg/kg		WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
	2:1	8:1	LS2	LS10			
DETSC 2306 Arsenic as As	0.62	0.54	< 0.002	< 0.01	0.5	2	25
DETSC 2306 Barium as Ba	10	4.7	0.02	< 0.1	20	100	300
DETSC 2306 Cadmium as Cd	< 0.03	< 0.03	< 0.004	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	0.45	0.25	< 0.02	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	2.3	2.4	0.005	0.024	2	50	100
DETSC 2306 Mercury as Hg	< 0.01	< 0.01	< 0.0004	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	< 1.1	< 1.1	< 0.02	< 0.1	0.5	10	30
DETSC 2306 Nickel as Ni	< 0.5	< 0.5	< 0.02	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	1.2	0.75	< 0.01	< 0.05	0.5	10	50
DETSC 2306 Antimony as Sb	0.31	< 0.17	< 0.01	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	0.36	< 0.25	< 0.006	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	4.1	3.2	0.008	0.034	4	50	200
DETSC 2055 Chloride as Cl	850	680	< 20	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	150	< 100	0.3	0.26	10	150	500
DETSC 2055 Sulphate as SO4	2100	1500	< 20	< 100	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	44000	26000	88	291.6	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1	1	n/a	n/a
* Dissolved Organic Carbon	3900	4800	< 10	< 50	500	800	1000

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

Additional Information

DETSC 2008 pH	6.4	7.2
DETSC 2009 Conductivity uS/cm	62.3	36.4
* Temperature*	16	15

Mass of Sample Kg*	0.120
Mass of dry Sample Kg*	0.116

Stage 1

Volume of Leachant L2*	0.228
Volume of Eluate VE1*	0.204

Stage 2

Volume of Leachant L8*	0.928
Volume of Eluate VE2*	0.81

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 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway
Sample Id TP106 10 2.80

Sample Numbers 1442786 1442802 1442803
Date Analysed 16/01/2019

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084# Total Organic Carbon	%	1.5	3	5	6
DETSC 2003# Loss On Ignition	%	1.7	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	190	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	47	100	n/a	n/a
DETSC 2008# pH	pH Units	8.3	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached* mg/kg		WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
	2:1	8:1	LS2	LS10			
DETSC 2306 Arsenic as As	0.43	0.36	< 0.002	< 0.01	0.5	2	25
DETSC 2306 Barium as Ba	11	4.8	0.02	< 0.1	20	100	300
DETSC 2306 Cadmium as Cd	< 0.03	< 0.03	< 0.004	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	0.52	< 0.25	< 0.02	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	0.9	0.8	< 0.004	< 0.02	2	50	100
DETSC 2306 Mercury as Hg	< 0.01	< 0.01	< 0.0004	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	1.5	< 1.1	< 0.02	< 0.1	0.5	10	30
DETSC 2306 Nickel as Ni	< 0.5	< 0.5	< 0.02	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	0.27	0.25	< 0.01	< 0.05	0.5	10	50
DETSC 2306 Antimony as Sb	< 0.17	< 0.17	< 0.01	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	0.33	0.27	< 0.006	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	2.3	< 1.3	0.005	< 0.01	4	50	200
DETSC 2055 Chloride as Cl	1200	980	< 20	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	150	< 100	0.3	0.24	10	150	500
DETSC 2055 Sulphate as SO4	4800	2700	< 20	< 100	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	52000	23000	104	276.4	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1	1	n/a	n/a
* Dissolved Organic Carbon	4500	4400	< 10	< 50	500	800	1000

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

Additional Information

DETSC 2008 pH	6.6	7.1
DETSC 2009 Conductivity uS/cm	74.3	32.1
* Temperature*	14	14

Mass of Sample Kg*	0.140
Mass of dry Sample Kg*	0.123

Stage 1

Volume of Leachant L2*	0.229
Volume of Eluate VE1*	0.197

Stage 2

Volume of Leachant L8*	0.985
Volume of Eluate VE2*	0.827

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.*
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WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway
Sample Id TP109 5 1.30

Sample Numbers 1442790 1442804 1442805
Date Analysed 16/01/2019

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084# Total Organic Carbon	%	17	3	5	6
DETSC 2003# Loss On Ignition	%	11	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	38	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	9.9	100	n/a	n/a
DETSC 2008# pH	pH Units	8.2	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached* mg/kg		WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
	2:1	8:1	LS2	LS10			
DETSC 2306 Arsenic as As	0.61	0.81	< 0.002	< 0.01	0.5	2	25
DETSC 2306 Barium as Ba	21	13	0.04	0.14	20	100	300
DETSC 2306 Cadmium as Cd	< 0.03	< 0.03	< 0.004	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	1.4	0.61	< 0.02	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	1.2	2.2	< 0.004	0.02	2	50	100
DETSC 2306 Mercury as Hg	< 0.01	< 0.01	< 0.0004	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	1.5	< 1.1	< 0.02	< 0.1	0.5	10	30
DETSC 2306 Nickel as Ni	< 0.5	0.6	< 0.02	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	0.17	0.46	< 0.01	< 0.05	0.5	10	50
DETSC 2306 Antimony as Sb	0.48	0.26	< 0.01	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	0.94	0.32	< 0.006	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	3.5	5.4	0.007	0.051	4	50	200
DETSC 2055 Chloride as Cl	1400	1300	< 20	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	630	170	1.26	2.42	10	150	500
DETSC 2055 Sulphate as SO4	27000	7300	54	104	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	110000	46000	220	560.6	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1	1	n/a	n/a
* Dissolved Organic Carbon	4500	5900	< 10	56.8	500	800	1000

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

Additional Information

DETSC 2008 pH	6.7	7
DETSC 2009 Conductivity uS/cm	161	65.6
* Temperature*	14	15

Mass of Sample Kg*	0.140
Mass of dry Sample Kg*	0.117

Stage 1

Volume of Leachant L2*	0.211
Volume of Eluate VE1*	0.184

Stage 2

Volume of Leachant L8*	0.937
Volume of Eluate VE2*	0.762

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WASTE ACCEPTANCE CRITERIA TESTING ANALYTICAL REPORT

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway
Sample Id TP112 8 2.30

Sample Numbers 1442796 1442806 1442807
Date Analysed 16/01/2019

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084# Total Organic Carbon	%	11	3	5	6
DETSC 2003# Loss On Ignition	%	8.1	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	31	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	2.2	100	n/a	n/a
DETSC 2008# pH	pH Units	6.5	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached* mg/kg		WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
	2:1	8:1	LS2	LS10			
DETSC 2306 Arsenic as As	0.16	0.21	< 0.002	< 0.01	0.5	2	25
DETSC 2306 Barium as Ba	32	17	0.06	0.19	20	100	300
DETSC 2306 Cadmium as Cd	0.05	< 0.03	< 0.004	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	< 0.25	< 0.25	< 0.02	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	1	0.8	< 0.004	< 0.02	2	50	100
DETSC 2306 Mercury as Hg	< 0.01	< 0.01	< 0.0004	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	< 1.1	< 1.1	< 0.02	< 0.1	0.5	10	30
DETSC 2306 Nickel as Ni	2.9	1.2	< 0.02	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	< 0.09	0.1	< 0.01	< 0.05	0.5	10	50
DETSC 2306 Antimony as Sb	0.53	0.39	< 0.01	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	0.36	< 0.25	< 0.006	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	15	7.1	0.03	0.084	4	50	200
DETSC 2055 Chloride as Cl	2800	1500	< 20	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	< 100	< 100	< 0.02	< 0.1	10	150	500
DETSC 2055 Sulphate as SO4	69000	29000	138	354.7	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	140000	63000	280	754.5	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1	1	n/a	n/a
* Dissolved Organic Carbon	3400	4100	< 10	< 50	500	800	1000

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

Additional Information

DETSC 2008 pH	6.6	6.9
DETSC 2009 Conductivity uS/cm	202	89.9
* Temperature*	14	15

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

Stage 1

Volume of Leachant L2*	0.227
Volume of Eluate VE1*	0.198

Stage 2

Volume of Leachant L8*	0.979
Volume of Eluate VE2*	0.766

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WASTE ACCEPTANCE CRITERIA TESTING
ANALYTICAL REPORT

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway
Sample Id TP115 5 1.30

Sample Numbers 1442798 1442808 1442809
Date Analysed 16/01/2019

Test Results On Waste

Determinand and Method Reference	Units	Result	WAC Limit Values: Inert Waste	SNRHW	Hazardous Waste
DETSC 2084# Total Organic Carbon	%	17	3	5	6
DETSC 2003# Loss On Ignition	%	6.6	n/a	n/a	10
DETSC 3321# BTEX	mg/kg	< 0.04	6	n/a	n/a
DETSC 3401# PCBs (7 congeners)	mg/kg	< 0.01	1	n/a	n/a
DETSC 3311# TPH (C10 - C40)	mg/kg	210	500	n/a	n/a
DETSC 3301 PAHs	mg/kg	14	100	n/a	n/a
DETSC 2008# pH	pH Units	6.5	n/a	>6	n/a
DETSC 2073* Acid Neutralisation Capacity (pH4)	mol/kg	< 1	n/a	TBE	TBE
DETSC 2073* Acid Neutralisation Capacity (pH7)	mol/kg	< 1	n/a	TBE	TBE

Test Results On Leachate

Determinand and Method Reference	Conc in Eluate ug/l		Amount Leached* mg/kg		WAC Limit Values (Limit values for LS10 Leachate): Inert Waste	SNRHW	Hazardous Waste
	2:1	8:1	LS2	LS10			
DETSC 2306 Arsenic as As	1.1	0.72	0.002	< 0.01	0.5	2	25
DETSC 2306 Barium as Ba	7.4	3.6	< 0.02	< 0.1	20	100	300
DETSC 2306 Cadmium as Cd	< 0.03	< 0.03	< 0.004	< 0.02	0.04	1	5
DETSC 2306 Chromium as Cr	0.75	0.37	< 0.02	< 0.1	0.5	10	70
DETSC 2306 Copper as Cu	5.4	3.5	0.011	0.038	2	50	100
DETSC 2306 Mercury as Hg	0.05	0.03	< 0.0004	< 0.002	0.01	0.2	2
DETSC 2306 Molybdenum as Mo	< 1.1	< 1.1	< 0.02	< 0.1	0.5	10	30
DETSC 2306 Nickel as Ni	< 0.5	< 0.5	< 0.02	< 0.1	0.4	10	40
DETSC 2306 Lead as Pb	6.5	4.7	0.01	< 0.05	0.5	10	50
DETSC 2306 Antimony as Sb	7.2	4	0.01	< 0.05	0.06	0.7	5
DETSC 2306 Selenium as Se	< 0.25	< 0.25	< 0.006	< 0.03	0.1	0.5	7
DETSC 2306 Zinc as Zn	6.5	3.9	0.013	0.043	4	50	200
DETSC 2055 Chloride as Cl	2600	1100	< 20	< 100	800	15,000	25,000
DETSC 2055* Fluoride as F	250	< 100	0.5	0.42	10	150	500
DETSC 2055 Sulphate as SO4	16000	5400	32	< 100	1000	20,000	50,000
DETSC 2009* Total Dissolved Solids	49000	17000	98	223.2	4000	60,000	100,000
DETSC 2130 Phenol Index	< 100	< 100	< 0.2	< 1	1	n/a	n/a
* Dissolved Organic Carbon	4800	5500	< 10	53.8	500	800	1000

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

Additional Information

DETSC 2008 pH	6.8	7.2
DETSC 2009 Conductivity uS/cm	69.5	24.4
* Temperature*	14	15

Mass of Sample Kg*	0.130
Mass of dry Sample Kg*	0.120

Stage 1

Volume of Leachant L2*	0.231
Volume of Eluate VE1*	0.2

Stage 2

Volume of Leachant L8*	0.963
Volume of Eluate VE2*	0.745

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Summary of Asbestos Analysis
Soil Samples

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1442777	TP101 2 0.30	SOIL	NAD	none	Rebecca Burgess
1442778	TP102 2 0.30	SOIL	NAD	none	Rebecca Burgess
1442779	TP102 6 1.20	SOIL	NAD	none	Rebecca Burgess
1442782	TP104 2 0.30	SOIL	NAD	none	Rebecca Burgess
1442783	TP105 2 0.30	SOIL	Chrysotile	Chrysotile in microscopic board debris	Rebecca Burgess
1442784	TP105 5 1.30	SOIL	NAD	none	Rebecca Burgess
1442785	TP106 3 0.40	SOIL	NAD	none	Rebecca Burgess
1442788	TP108 2 0.30	SOIL	NAD	none	Rebecca Burgess
1442789	TP109 2 0.30	SOIL	NAD	none	Rebecca Burgess
1442791	TP109 11 3.30	SOIL	NAD	none	Rebecca Burgess
1442792	TP110 5 1.30	SOIL	NAD	none	Rebecca Burgess
1442793	TP111 2 0.30	SOIL	NAD	none	Rebecca Burgess
1442795	TP112 2 0.30	SOIL	NAD	none	Rebecca Burgess
1442796	TP112 8 2.30	SOIL	NAD	none	Rebecca Burgess
1442797	TP115 2 0.30	SOIL	NAD	none	Rebecca Burgess
1442799	TP115 11 3.30	SOIL	NAD	none	Rebecca Burgess

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.

Summary of Asbestos Quantification Analysis
Soil Samples

Our Ref 19-00333-1
Client Ref NW1580
Contract Title Northern Gateway

Lab No	1442783
Sample ID	TP105
Depth	0.30
Other ID	2
Sample Type	SOIL
Sampling Date	04/01/19
Sampling Time	

Test	Method	Units	
Total Mass% Asbestos (a+b+c)	DETSC 1102	Mass %	**0.006**
Gravimetric Quantification (a)	DETSC 1102	Mass %	0.006
Detailed Gravimetric Quantification (b)	DETSC 1102	Mass %	na
Quantification by PCOM (c)	DETSC 1102	Mass %	na
Potentially Respirable Fibres (d)	DETSC 1102	Fibres/g	na
Breakdown of Gravimetric Analysis (a)			
Mass of Sample		g	785.25
ACMs present*		type	ASBD
Mass of ACM in sample		g	0.12
% ACM by mass		%	0.02
% asbestos in ACM		%	40.00
% asbestos in sample		%	0.01
Breakdown of Detailed Gravimetric Analysis (b)			
% Amphibole bundles in sample		Mass %	na
% Chrysotile bundles in sample		Mass %	na
Breakdown of PCOM Analysis (c)			
% Amphibole fibres in sample		Mass %	na
% Chrysotile fibres in sample		Mass %	na
Breakdown of Potentially Respirable Fibre Analysis (d)			
Amphibole fibres		Fibres/g	na
Chrysotile fibres		Fibres/g	na

* Denotes test or material description outside of UKAS accreditation.
% asbestos in Asbestos Containing Materials (ACMs) is determined by
by reference to HSG 264.
Recommended sample size for quantification is approximately 1kg
denotes deviating sample

Information in Support of the Analytical Results

Our Ref 19-00333-1
Client Ref NW1580
Contract Northern Gateway

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1442777	TP101 0.30 SOIL	03/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442778	TP102 0.30 SOIL	03/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442779	TP102 1.20 SOIL	03/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442780	TP103 1.00 SOIL	03/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442781	TP103 1.80 SOIL	03/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442782	TP104 0.30 SOIL	03/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442783	TP105 0.30 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442784	TP105 1.30 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442785	TP106 0.40 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442786	TP106 2.80 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442787	TP107 1.20 SOIL	03/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442788	TP108 0.30 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442789	TP109 0.30 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442790	TP109 1.30 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442791	TP109 3.30 SOIL	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442792	TP110 1.30 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442793	TP111 0.30 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442794	TP111 2.50 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442795	TP112 0.30 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442796	TP112 2.30 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442797	TP115 0.30 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		

Information in Support of the Analytical Results

Our Ref 19-00333-1
Client Ref NW1580
Contract Northern Gateway

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1442798	TP115 1.30 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442799	TP115 3.30 SOIL	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442800	TP102 0.30 LEACHATE		GJ 250ml x2, GJ 60ml x2, PT 1L x2	Sample date not supplied	
1442801	TP102 0.30 LEACHATE		GJ 250ml x2, GJ 60ml x2, PT 1L x2	Sample date not supplied	
1442802	TP106 2.80 LEACHATE	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442803	TP106 2.80 LEACHATE	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442804	TP109 1.30 LEACHATE	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442805	TP109 1.30 LEACHATE	04/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442806	TP112 2.30 LEACHATE	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442807	TP112 2.30 LEACHATE	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442808	TP115 1.30 LEACHATE	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442809	TP115 1.30 LEACHATE	07/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		

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 A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 2002	Organic matter	%	0.1	Air Dried	No	Yes	Yes
DETSC 2003	Loss on ignition	%	0.01	Air Dried	No	Yes	Yes
DETSC 2008	pH	pH Units	1	Air Dried	No	Yes	Yes
DETSC 2024	Sulphide	mg/kg	10	Air Dried	No	Yes	Yes
DETSC 2076	Sulphate Aqueous Extract as SO4	mg/l	10	Air Dried	No	Yes	Yes
DETSC 2084	Total Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2084	Total Organic Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2119	Ammoniacal Nitrogen as N	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide free	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide total	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC 2130	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETSC 2321	Total Sulphate as SO4	%	0.01	Air Dried	No	Yes	Yes
DETSC 2325	Mercury	mg/kg	0.05	Air Dried	No	Yes	Yes
DETSC 3049	Sulphur (free)	mg/kg	0.75	Air Dried	No	Yes	Yes
DETSC2123	Boron (water soluble)	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Arsenic	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Barium	mg/kg	1.5	Air Dried	No	Yes	Yes
DETSC2301	Beryllium	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Cadmium Available	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cadmium	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cobalt	mg/kg	0.7	Air Dried	No	Yes	Yes
DETSC2301	Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETSC2301	Copper	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Manganese	mg/kg	20	Air Dried	No	Yes	Yes
DETSC2301	Molybdenum	mg/kg	0.4	Air Dried	No	Yes	Yes
DETSC2301	Nickel	mg/kg	1	Air Dried	No	Yes	Yes
DETSC2301	Lead	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC2301	Selenium	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC2301	Zinc	mg/kg	1	Air Dried	No	Yes	Yes
DETSC 3072	Ali/Aro C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	1.2	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	0.9	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	0.5	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	0.6	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	m+p Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	o Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3311	C10-C24 Diesel Range Organics (DRO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	C24-C40 Lube Oil Range Organics (LORO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	EPH (C10-C40)	mg/kg	10	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 3303	Acenaphthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Acenaphthylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(b)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(k)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(g,h,i)perylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Dibenzo(a,h)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Naphthalene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Phenanthrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3401	PCB 28 + PCB 31	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 52	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 101	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 118	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 153	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 138	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 180	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB Total	mg/kg	0.01	As Received	No	Yes	Yes

Method details are shown only for those determinands listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS. No Recovery Factors are used in the determination of results. Results reported assume 100% recovery. Full method statements are available on request.

Certificate of Analysis

Certificate Number 19-00312-1

23-Jan-19

Client Allied Exploration & Geotechnics Limited
Unit 25
Stella Gill Industrial Estate
Pelton Fell
DH2 2RG

Our Reference 19-00312-1

Client Reference NW1580

Order No CH1500

Contract Title Northern Gateway

Description 4 Soil samples.

Date Received 09-Jan-19

Date Started 09-Jan-19

Date Completed 23-Jan-19

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

Notes **This report supersedes 19-00312, amendments.**

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

Adam Fenwick
Contracts Manager

mCERTS
THE ENVIRONMENT AGENCY'S MONITORING CERTIFICATION SCHEME

UKAS TESTING
2139

Summary of Chemical Analysis
Matrix Descriptions

Our Ref 19-00312-1
Client Ref NW1580
Contract Title Northern Gateway

Sample ID	Other ID	Depth	Lab No	Completed	Matrix Description
BH101	4	0.8	1442640	21/01/2019	Dark brown very gravelly SAND
TP102	2	0.3	1442641	21/01/2019	Very dark brown sandy, clayey GRAVEL (sample matrix outside MCERTS scope of accreditation)
BH102	10	3.5	1442642	21/01/2019	Dark brown gravelly, sandy CLAY
BH101	18	4.8	1445043	21/01/2019	Very dark brown gravelly, sandy CLAY

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00312-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1442640	1442641	1442642	1445043
			Sample ID	BH101	TP102	BH102	BH101
			Depth	0.80	0.30	3.50	4.80
			Other ID	4	2	10	18
			Sample Type	ES	ES	ES	ES
			Sampling Date	03/01/19	03/01/19	03/01/19	03/01/19
			Sampling Time	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
Metals							
Antimony	DETSC 2301*	1	mg/kg	1.2	< 1.0	1.2	1.1
Arsenic	DETSC 2301#	0.2	mg/kg	5.2	7.5	9.3	9.5
Beryllium	DETSC 2301#	0.2	mg/kg	0.2	0.2	0.8	0.8
Boron, Water Soluble	DETSC 2123#	0.2	mg/kg	0.6	< 0.2	0.5	0.7
Cadmium	DETSC 2301#	0.1	mg/kg	0.9	0.6	0.2	0.2
Chromium	DETSC 2301#	0.15	mg/kg	5.7	14	16	20
Chromium, Hexavalent	DETSC 2204*	1	mg/kg	< 1.0	< 1.0	< 1.0	< 1.0
Copper	DETSC 2301#	0.2	mg/kg	50	31	27	28
Lead	DETSC 2301#	0.3	mg/kg	38	21	91	53
Mercury	DETSC 2325#	0.05	mg/kg	0.16	< 0.05	0.17	0.11
Nickel	DETSC 2301#	1	mg/kg	7.9	12	19	25
Selenium	DETSC 2301#	0.5	mg/kg	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	DETSC 2301#	0.8	mg/kg	12	15	22	26
Zinc	DETSC 2301#	1	mg/kg	46	72	88	61
Inorganics							
pH	DETSC 2008#			8.3	8.5	8.3	8.3
Cyanide, Total	DETSC 2130#	0.1	mg/kg	< 0.1	< 0.1	< 0.1	0.1
Total Organic Carbon	DETSC 2084#	0.5	%	9.2	3.2	3.1	1.8
Petroleum Hydrocarbons							
Aliphatic C5-C6	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C6-C8	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	1.2	< 0.01
Aliphatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatic C10-C12	DETSC 3072#	1.5	mg/kg	2.7	< 1.5	130	< 1.5
Aliphatic C12-C16	DETSC 3072#	1.2	mg/kg	15	< 1.2	240	< 1.2
Aliphatic C16-C21	DETSC 3072#	1.5	mg/kg	57	< 1.5	160	< 1.5
Aliphatic C21-C35	DETSC 3072#	3.4	mg/kg	350	< 3.4	120	< 3.4
Aliphatic C5-C35	DETSC 3072*	10	mg/kg	420	< 10	650	< 10
Aromatic C5-C7	DETSC 3321*	0.01	mg/kg	< 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
Aromatic C8-C10	DETSC 3321*	0.01	mg/kg	< 0.01	< 0.01	10	< 0.01
Aromatic C10-C12	DETSC 3072#	0.9	mg/kg	3.7	< 0.9	42	< 0.9
Aromatic C12-C16	DETSC 3072#	0.5	mg/kg	11	< 0.5	110	< 0.5
Aromatic C16-C21	DETSC 3072#	0.6	mg/kg	56	< 0.6	150	< 0.6
Aromatic C21-C35	DETSC 3072#	1.4	mg/kg	670	< 1.4	170	< 1.4
Aromatic C5-C35	DETSC 3072*	10	mg/kg	740	< 10	490	< 10
TPH Ali/Aro Total	DETSC 3072*	10	mg/kg	1200	< 10	1100	< 10
Benzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Ethylbenzene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	DETSC 3321#	0.01	mg/kg	< 0.01	< 0.01	1.9	< 0.01

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

Summary of Chemical Analysis
Soil Samples

Our Ref 19-00312-1
Client Ref NW1580
Contract Title Northern Gateway

			Lab No	1442640	1442641	1442642	1445043
			Sample ID	BH101	TP102	BH102	BH101
			Depth	0.80	0.30	3.50	4.80
			Other ID	4	2	10	18
			Sample Type	ES	ES	ES	ES
			Sampling Date	03/01/19	03/01/19	03/01/19	03/01/19
			Sampling Time	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**				
PAHs							
Naphthalene	DETSC 3303#	0.03	mg/kg	0.17	< 0.03	< 0.03	< 0.03
Acenaphthylene	DETSC 3303#	0.03	mg/kg	0.04	0.05	< 0.03	< 0.03
Acenaphthene	DETSC 3303#	0.03	mg/kg	0.17	< 0.03	0.11	< 0.03
Fluorene	DETSC 3303	0.03	mg/kg	0.13	< 0.03	0.13	< 0.03
Phenanthrene	DETSC 3303#	0.03	mg/kg	0.72	0.11	0.28	0.06
Anthracene	DETSC 3303	0.03	mg/kg	2.2	0.22	0.08	< 0.03
Fluoranthene	DETSC 3303#	0.03	mg/kg	3.3	0.46	0.17	0.04
Pyrene	DETSC 3303#	0.03	mg/kg	2.5	0.45	0.19	0.05
Benzo(a)anthracene	DETSC 3303#	0.03	mg/kg	0.49	0.15	0.07	< 0.03
Chrysene	DETSC 3303	0.03	mg/kg	0.72	0.21	0.08	< 0.03
Benzo(b)fluoranthene	DETSC 3303#	0.03	mg/kg	0.46	0.19	0.05	< 0.03
Benzo(k)fluoranthene	DETSC 3303#	0.03	mg/kg	0.16	0.07	< 0.03	< 0.03
Benzo(a)pyrene	DETSC 3303#	0.03	mg/kg	0.26	0.10	0.04	< 0.03
Indeno(1,2,3-c,d)pyrene	DETSC 3303#	0.03	mg/kg	0.14	0.05	< 0.03	< 0.03
Dibenzo(a,h)anthracene	DETSC 3303#	0.03	mg/kg	0.04	< 0.03	< 0.03	< 0.03
Benzo(g,h,i)perylene	DETSC 3303#	0.03	mg/kg	0.18	0.05	< 0.03	< 0.03
PAH - USEPA 16, Total	DETSC 3303	0.1	mg/kg	12	2.1	1.2	0.15
Phenols							
Phenol - Monohydric	DETSC 2130#	0.3	mg/kg	< 0.3	0.5	0.9	< 0.3

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

Summary of Asbestos Analysis
Soil Samples

Our Ref 19-00312-1
Client Ref NW1580
Contract Title Northern Gateway

Lab No	Sample ID	Material Type	Result	Comment*	Analyst
1442640	BH101 4 0.80	SOIL	NAD	none	Keith Wilson
1442641	TP102 2 0.30	SOIL	NAD	none	Keith Wilson
1442642	BH102 10 3.50	SOIL	NAD	none	Keith Wilson
1445043	BH101 18 4.80	SOIL	NAD	none	A Christodoulou

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 19-00312-1
Client Ref NW1580
Contract Northern Gateway

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
1442640	BH101 0.80 SOIL	03/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442641	TP102 0.30 SOIL	03/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1442642	BH102 3.50 SOIL	03/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		
1445043	BH101 4.80 SOIL	03/01/19	GJ 250ml x2, GJ 60ml x2, PT 1L x2		

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 A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 2002	Organic matter	%	0.1	Air Dried	No	Yes	Yes
DETSC 2003	Loss on ignition	%	0.01	Air Dried	No	Yes	Yes
DETSC 2008	pH	pH Units	1	Air Dried	No	Yes	Yes
DETSC 2024	Sulphide	mg/kg	10	Air Dried	No	Yes	Yes
DETSC 2076	Sulphate Aqueous Extract as SO4	mg/l	10	Air Dried	No	Yes	Yes
DETSC 2084	Total Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2084	Total Organic Carbon	%	0.5	Air Dried	No	Yes	Yes
DETSC 2119	Ammoniacal Nitrogen as N	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide free	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Cyanide total	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC 2130	Phenol - Monohydric	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC 2130	Thiocyanate	mg/kg	0.6	Air Dried	No	Yes	Yes
DETSC 2321	Total Sulphate as SO4	%	0.01	Air Dried	No	Yes	Yes
DETSC 2325	Mercury	mg/kg	0.05	Air Dried	No	Yes	Yes
DETSC 3049	Sulphur (free)	mg/kg	0.75	Air Dried	No	Yes	Yes
DETSC2123	Boron (water soluble)	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Arsenic	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Barium	mg/kg	1.5	Air Dried	No	Yes	Yes
DETSC2301	Beryllium	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Cadmium Available	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cadmium	mg/kg	0.1	Air Dried	No	Yes	Yes
DETSC2301	Cobalt	mg/kg	0.7	Air Dried	No	Yes	Yes
DETSC2301	Chromium	mg/kg	0.15	Air Dried	No	Yes	Yes
DETSC2301	Copper	mg/kg	0.2	Air Dried	No	Yes	Yes
DETSC2301	Manganese	mg/kg	20	Air Dried	No	Yes	Yes
DETSC2301	Molybdenum	mg/kg	0.4	Air Dried	No	Yes	Yes
DETSC2301	Nickel	mg/kg	1	Air Dried	No	Yes	Yes
DETSC2301	Lead	mg/kg	0.3	Air Dried	No	Yes	Yes
DETSC2301	Selenium	mg/kg	0.5	Air Dried	No	Yes	Yes
DETSC2301	Zinc	mg/kg	1	Air Dried	No	Yes	Yes
DETSC 3072	Ali/Aro C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	1.2	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	1.5	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aliphatic C21-C35	mg/kg	3.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	0.9	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C12	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C10-C35	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	0.5	As Received	No	Yes	Yes
DETSC 3072	Aromatic C12-C16	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	0.6	As Received	No	Yes	Yes
DETSC 3072	Aromatic C16-C21	mg/kg	10	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETSC 3072	Aromatic C21-C35	mg/kg	1.4	As Received	No	Yes	Yes
DETS 062	Benzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Ethylbenzene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Toluene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	m+p Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETS 062	o Xylene	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3311	C10-C24 Diesel Range Organics (DRO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	C24-C40 Lube Oil Range Organics (LORO)	mg/kg	10	As Received	No	Yes	Yes
DETSC 3311	EPH (C10-C40)	mg/kg	10	As Received	No	Yes	Yes

Appendix A - Details of Analysis

Method	Parameter	Units	Limit of Detection	Sample Preparation	Sub-Contracted	UKAS	MCERTS
DETSC 3303	Acenaphthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Acenaphthylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(a)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(b)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(k)fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Benzo(g,h,i)perylene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Dibenzo(a,h)anthracene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Fluoranthene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Indeno(1,2,3-c,d)pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Naphthalene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Phenanthrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3303	Pyrene	mg/kg	0.03	As Received	No	Yes	Yes
DETSC 3401	PCB 28 + PCB 31	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 52	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 101	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 118	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 153	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 138	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB 180	mg/kg	0.01	As Received	No	Yes	Yes
DETSC 3401	PCB Total	mg/kg	0.01	As Received	No	Yes	Yes

Method details are shown only for those determinands listed in Annex A of the MCERTS standard. Anything not included on this list falls outside the scope of MCERTS. No Recovery Factors are used in the determination of results. Results reported assume 100% recovery. Full method statements are available on request.

Quality Control

Quality Systems.

Derwentside Environmental Testing Services employs numerous measures to ensure high levels of confidence in the results produced. Our laboratory has been accredited by the United Kingdom Accreditation Service (UKAS) since its inception and operates in full compliance with the internationally recognised standard ISO17025 and the Environment Agency's MCERTS (Monitoring & Certification Scheme) standard for soils and waters, which provides greater assurance to all parties of the reliability of data from chemical analysis.

To obtain a copy of our full UKAS schedule visit the UKAS website at www.ukas.org and search for our laboratory number 2139.

2139

Proficiency Testing Schemes.

DETS participates in seven external proficiency testing schemes in order to monitor and ensure the continuing quality of analysis. These schemes are:

Internal Quality Control.

DETS runs a strict internal quality control system. A minimum of 5% of all samples that undergo analysis in our laboratories are quality control samples. This way we can ensure a high level of confidence in all of the analytical data produced. In addition, MCERTS accredited tests must meet strict, ongoing limits for precision and bias in order to maintain their accreditation status.

SAMPLE HOLDING TIME INFORMATION

Soil

Analyte	Container type	Minimum sample required	Reference	Maximum holding time from sampling	
				pre drying/extraction[1]	post drying/extraction[2]
Ammonium	Glass or plastic	20g	BS ISO18512:2007	1 week	
Anions	Glass or plastic	20g	BS ISO18512:2007	1 month	3 years
BTEX	60ml glass jar	Full container	EPA 8260	2 weeks	N/A
Conductivity	Glass or plastic	20g	BS ISO18512:2007	1 week	3 years
Cyanide	Glass or plastic	20g	EPA 9010B/9012	2 weeks	
Heavy metals	Glass or plastic	10g	BS ISO18512:2007	6 months	30 years
Hexavalent chromium	Glass or plastic	20g	BS ISO18512:2007	1 month	
Loss on ignition	Glass or plastic	10g	BS ISO18512:2007	1 month	
OCP	Glass	20g	BS ISO18512:2007	1 month	
Oil & grease	Glass	20g	EPA 9070/1	1 month	
Organic matter/TOC	Glass or plastic	20g	BS ISO18512:2007	1 month	
PAH	Glass	20g	EPA 8100/8270	2 weeks	6 weeks
PCB	Glass	20g	BS ISO18512:2007	1 month	
pH	Glass or plastic	20g	BS ISO18512:2007	1 week	3 years
Phenols	Glass	20g	EPA 8270	2 weeks	6 weeks
PRO	60ml glass jar	Full container	EPA 8015	2 weeks	N/A
Sulphide	Glass or plastic	20g	BRE SD1	3 weeks	1 month
SVOC	Glass	20g	EPA 8270	2 weeks	6 weeks
TEM/CEM	Glass	20g	EPA 418.1	2 weeks	6 weeks
Thiocyanate	Glass or plastic	20g	EPA 9251	No special requirement	
Total sulphur	Glass or plastic	20g	BS ISO18512:2007	1 month	3 years
TPH (C10-C40)	Glass	20g	EPA 418.1	2 weeks	6 weeks
VOC	60ml glass jar	Full container	EPA 8260	2 weeks	N/A

Sample storage environment 5°C

1. From sampling to extraction
2. Once extracted

Waters

Analyte	Container type	Min sample required (ml)	Reference	Preservative required	Max holding time until extraction
Alkalinity	Glass or plastic	100	EPA 310.2	none	2 weeks
Ammonium	Glass or plastic	20	ISO 5667 3:2012	Sulphuric acid	3 weeks
BOD	Glass or plastic	500	EPA 405.1 5120B	none	2 days
BTEX	Glass vial	Full container	Lab validation	none	2 weeks
Chloride	Glass or plastic	20	ISO 5667 3:2012	none	1 month
COD	Glass or plastic	20	ISO 5667 3:2012	Sulphuric acid	1 month
Conductivity/TDS	Glass or plastic	100	EPA 160.1	none	1 week
Cyanide	Plastic	50	EPA 9012/335.3	Sodium hydroxide	2 weeks
Hexavalent chromium	Glass or plastic	20	ISO 5667 3:2012	none	4 days
Metals	Glass or plastic	20	ISO 5667 3:2012	Nitric acid	1 month
Nitrate	Glass or plastic	20	EPA 353.2	none	2 days
Nitrite	Glass or plastic	20	EPA 600/4 079-020	none	2 days
OCP	Glass	500	EPA 8081A/608	none	1 week
Oil & grease	Glass	500	ISO 5667 3:2012	Hydrochloric acid	1 month
PAH	Glass	500	ISO 5667 3:2012	none	1 week
pH	Glass or plastic	50	Lab validation	none	1 week
PCB	Glass	500	EPA 8082A	none	6 weeks
Phenols	Glass	500	ISO 5667 3:2012	Sulphuric acid	3 weeks
Phosphate	Glass or plastic	20	ISO 5667 3:2012	Sulphuric acid	1 month
PRO	Glass vial	Full container	EPA 8015	none	2 weeks
Sulphate	Glass or plastic	20	ISO 5667 3:2012	none	1 month
Sulphide	Plastic	50	ISO 5667 3:2012	NaOH/Zinc acetate	1 week
Suspended solids	Glass or plastic	100	EPA 160.2 2540D	none	1 week
SVOC	Glass	500	EPA 8270/625	none	1 week
TOC	Glass or plastic	20	ISO 5667 3:2012	Sulphuric/Phosphoric acid	1 week
TON	Glass or plastic	20	EPA 353.2	none	1 month
TPH/EPH	Glass	500	Lab validation	none	1 weeks
VOC	Glass vial	Full container	Lab validation	none	1 week

Sample storage environment 3°C ± 2°C

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETS 036	**Leachate Preparation** **(NRA Method and BS EN 12457 Parts 1-3)**	Leachates are prepared as per the NRA (1994) method and as per BS EN 12457 Parts 1 - 3 one and two stage leachate preparation.	Leaching Test Method for the Assessment of Contaminated Land, Interim Guidance, NRA(1994) BS EN 12457 Part 1,2 & 3	n/a	Not Accredited
DETS 073	**Acid Neutralisation Capacity of Soils and Other Solids**	ANC is a measure of the buffering capacity of soils and other waste materials. The analysis measures the amount of acid required to bring the sample to a fixed pH. The initial pH of the sample extract must be measured before analysis begins. Analysis is performed by the addition of acid in conjunction with pH measurement by pH meter until the specified pH has been reached as indicated by the meter. The result is expressed in mol/kg (dry wt).	Annex B (Preliminary determination of the acid/base consumption) – CEN/TC 292 – WI 292046 – Characterization of waste – Leaching behaviour tests – Acid and Base neutralization capacity test	1.0 mol/kg	Not Accredited
DETS 074	**Low Level PAH by HPLC Fluorescence**	PAH is extracted from one litre of filtered water sample by solid phase extraction. PAH is eluted from the SPE column with DCM evaporated to dryness under nitrogen and redissolved in acetonitrile. Analysis of samples is carried out by HPLC fluorescence.	EPA Method 550 The Analyst 2001, 126:1336-1331 Phenomonex Strata X Application Note for PAH by SPE	0.01ug/L each 5.0 ug/L Total	Not Accredited

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 1001	**Sample Pre-Treatment and Preparation of Solids**	Solid samples are classified and identified. Samples requiring analysis for unstable or volatile determinands are analysed as received. Samples requiring analysis for stable and non-volatile determinands are dried at <30◦C or 50◦C, depending on requirements, for a minimum of 16hrs (overnight). Dried samples are crushed in a jaw crusher, if necessary, and then ground using a mechanical mixer mill and sieved through a 250µm sieve to ensure they are homogenous.	BS1377:1990 – Soils for Civil Engineering Purposes The preparation and pre-treatment of potentially contaminated soils prior to chemical analysis – MEWAM – 2006 – Environment Agency (Updated procedure under preparation)	n/a	Not Accredited
DETSC 1002	**Description of Soil Sample Type**	This method outlines the procedure used to describe soil samples with respect to basic type, predominant colour and inclusions. The procedure is carried out during the sample preparation stage.	BS 5930:Section 6:1999	n/a	Not Accredited
DETSC 1003	**Stone and Glass / Metal / Plastic Content of Soil**	This method outlines the procedure used to determine the Stone and Glass/Metal/Plastic content of soil samples. The procedure is carried out during the sample preparation stage.	BS 3882:2007 BS 1377:1990	0.1%	Not Accredited
DETSC 1004	**Moisture Content/Loss on Drying of Soil**	Loss on drying is determined by loss of mass on drying in an oven set at 28ºC or 50ºC. Moisture content is determined by loss of mass on drying in an oven set at 105ºC. The procedure is carried out during the sample preparation stage.	Practical Environmental Analysis. Radojevic & Bashkin. RSC 1999 BS 1377: Part 2:1990 DETS drying time study	0.1%	Not Accredited
DETSC 1101	**Asbestos - Bulk Analysis**	Samples are examined visually for the presence of asbestos containing materials or asbestos fibres. Suspect fibres are removed from the sample and examined using polarised light microscopy to determine whether they are asbestos fibres. If no asbestos fibres are identified by the method after an adequate length of examination time, and after at least two small pinch samples have been examined, then the sample may be reported as 'NAD' (no asbestos detected).	HSG 248 Asbestos: The Analysis Guide for Sampling, Analysis and Clearance Procedures. 2005 McCrone W.C., Asbestos Identification (Second Edition), The McCrone Research Institute, 1987 LAB 30, Application of ISO/IEC17025 for Asbestos Sampling and Testing, UKAS, Edition 2, April 2008	n/a	UKAS

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 1102	**Quantification of asbestos in soils, loose aggregates and ballast**	The method of quantification is divided into three procedures: Gravimetric analysis, detailed gravimetric analysis and PCOM analysis. The analysis may be affected by the client's requirements as determined by contract review, and by the nature of the asbestos found in the sample, e.g. whether ACMs are present, and whether fibre bundles large enough to pick out using tweezers are have been found in the sample.	HSG 248 Asbestos: The Analysis Guide for Sampling, Analysis and Clearance Procedures. 2005 HSG264 Asbestos: The survey guide. HSE Books, 2010. Davies, L. S.T., Wetherill, G. Z., McIntosh, C., McGonagle, C., Addison, J. 1996. Development and validation of an analytical method to determine the amount of asbestos in soils and loose aggregates. HSE Contract Research Report N0. 83/1996. HSE Books	Gravimetric Analysis: 0.01% for 1kg sample Detailed Gravimetric Analysis: 0.001% for 50g sample PCOM Analysis: 0.001%	UKAS
DETSC 1103	**Asbestos Water Absorption Test**	This test involves a sample of the asbestos product being dried and weighed before being immersed in water for a period of time. The sample is then removed from the water and re-weighed. If the amount of water absorbed is <30% by weight, then the sample should be reported as 'Not Licensed'. If ≥30% water is absorbed then the sample should be reported as being 'Licensed', i.e. an asbestos material for which a licence is required to work on.	Work with Materials Containing Asbestos: Approved Code of Practice and Guidance. HSE Books, 2006.	n/a	UKAS
DETSC 2002	**Organic matter content of soil**	The procedure is based upon Walkley and Black's method. Organic matter in soil is oxidised with potassium dichromate in the presence of concentrated sulphuric acid. The excess dichromate is titrated with ferrous sulphate using diphenylamine as an external indicator. The organic matter content is calculated from the amount of dichromate used during the oxidation process based on an empirical relationship.	BS1377 : Part 3 : 1990 Method 3 BS1377 : Part 1 : 1990 BS 3882:2007	0.1%	UKAS MCERTS(Soils)

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

DETSC 2003	**Loss On Ignition**	Soil is ignited at 440C and the amount of sample lost on ignition is determined gravimetrically. Other specified temperatures may be used but are not accredited.	BS1377 : Part 3 : 1990 Method 4 BS1377 : Part 1 : 1990	0.01%	UKAS MCERTS(Soils)
Method Number	**Title**	**Description**	**Reference**	**LOD**	**Accreditation Status**
DETSC 2004	**Sulphate Content of Soil and Water**	The sulphate in the soil is dissolved in dilute hydrochloric acid, or in an aqueous extract having a water:soil ratio of 2:1 and the insoluble residue is removed by filtration. Waters are also filtered prior to analysis. The sulphate in the filtrate is precipitated as barium sulphate which is then filtered, ignited and weighed.	BS1377 : Part 3 : 1990 Method 5 BS1377 : Part 1 : 1990 BRE SD1: 2005 Concrete in Aggressive Ground	**Acid Soluble:** 0.01% **Water Soluble** 100mg/l **Waters** 10mg/l	UKAS MCERTS(Soils)
DETSC 2005	**Carbonate content of soil by Rapid Titration**	The carbonate present in the soil reacts with a known excess of hydrochloric acid liberating carbon dioxide. The acid remaining after the reaction is determined by titration against sodium hydroxide. The result is calculated in terms of the equivalent proportion of carbon dioxide.	BS 1377: Part 1: 1990. BS 1377: Part 3: 1990: Method 5	1%	UKAS
DETSC 2006	**Water Soluble Chloride Content of Soil & Chloride Content of Water**	The chloride in the soil is dissolved in water and the insoluble material is removed by filtration. Waters are filtered before analysis. The chloride is analysed by Mohr's method. The chloride in a neutral solution is titrated against standard silver nitrate using potassium chromate as an indicator. The colour change is from yellow to brick red.	BS1377 : Part 3 : 1990 Method 7.2 BS1377: Part 1: 1990	**Soil:** 0.01% **Water:** 10mg/l	UKAS MCERTS(Soils)
DETSC 2007	**Acid Soluble Chloride Content of Soil and Concrete**	The chloride in the sample is dissolved in nitric acid and the insoluble material is removed by filtration. The dissolved chloride is analysed by Volhard's method. The chloride in solution is precipitated with a known excess of standard silver nitrate. The excess silver nitrate is titrated against standard ammonium thiocyanate using ferric alum as an indicator. The colour change is white to red.	BS1377 : Part 3 : 1990 Method 7.3 BS1377: Part 1: 1990 BS 1881-124:1988	0.01%	UKAS

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2008	**pH Value of Soil and Water**	The pH value of a soil suspension in water or a groundwater sample is determined electrometrically using a glass electrode.	BS1377: Part 3: 1990 – Soils for Civil Engineering Purposes – Chemical and Electrochemical Methods	n/a	UKAS (Soils + Waters) MCERTS (Soils + Waters-Trade Effluent only)
DETSC 2009	**Electrical Conductivity of Soil & Water**	The electrical conductance of a soil suspension in water or of a water sample is determined by voltammetry using a conductivity meter. In some cases, the soil may need to be extracted with an aqueous solution of an inorganic salt e.g. the conductivity of topsoil is determined by preparing a suspension of the soil in saturated calcium sulphate.	Standard Methods for the Examination of water and Wastewater Part 2510B 21st Edition 2005 APHA, AWWA, WEF BS3882:2007 Specification for Topsoil	1uS/cm	UKAS
DETSC 2019	**Loose Packed Dry Soil Density**	Dried, ground soil is transferred to a dry, tared measuring cylinder and the volume recorded. The cylinder and its contents are then weighed and the density of the soil calculated.	BS3882:2007 Specification for Topsoil	n/a	Not Accredited

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2024	**Sulphide in Soil and Water by Iodometry**	Hydrogen sulphide is liberated by acidification of the sample with hydrochloric acid in a steam distillation unit. The hydrogen sulphide produced is carried over with the steam and is absorbed in alkaline zinc acetate. The zinc sulphide produced reacts with iodine formed when iodate-iodide is acidified and the excess iodine titrated with standard thiosulphate.	In House Method based on: Environment Agency The determination of easily liberated sulphide in soils and similar matrices (2010) - Blue Book 228 Method D - The determination of easily liberated sulphide in as received or air-dried samples following acid steam distillation with iodometric titration. Environment Agency The determination of sulphide in waters and associated materials (2007) Draft Method D - The determination of easily liberated sulphide in as received or air-dried samples following phosphoric acid steam distillation with iodometric titration.	**Soils:** 10mg/kg . **Waters:** 250ug/l	**Soils:** UKAS MCERTS(Soils) **Waters:** Not Accredited
DETSC 2030	**Alkalinity in Water**	Alkalinity of a water sample is determined by indicator end point titration with a strong acid from sample pH to pH8.3 (where applicable) and then to pH4.5. From the titres obtained the total alkalinity and concentrations and types of alkalinity present can be calculated.	SCA Method ISBN 0 11 751601 5 The Determination of Alkalinity and Acidity in Water 1981 Instruction Manual for Skalar SP50 Robotic Analyser	20mg/l as CaCO3	UKAS MCERTS(Waters) Trade Effluent only
DETSC 2031	**5 Day Biochemical Oxygen Demand**	The sample, either diluted or undiluted, is placed in a BOD bottle and the initial dissolved oxygen content of the sample is measured using a dissolved oxygen meter. The bottle is placed in an incubator at 20ºC in the dark for 5 days. After this time the bottle is removed and the residual dissolved oxygen content of the sample is measured. The BOD of the sample is calculated from the reduction in the concentration of dissolved oxygen over 5 days.	SCA Method ISBN 0 117522120 5 Day Biochemical Oxygen Demand (BOD5) Second Edition 1988	1 mg/l	UKAS MCERTS(Waters)- Trade Effluent only

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2032	**Chemical Oxygen Demand**	Oxidisable substances react with sulphuric acid – potassium dichromate solution in the presence of silver sulphate as a catalyst. Chloride is masked by mercury sulphate. The reduction in the yellow colouration of Cr6+ is evaluated using a spectrophotometer for the low range tubes (LCK 314) whilst the green colouration of Cr3+ is evaluated for the medium and high range tubes (LCK 014 and LCK 114).	Environment Agency The determination of chemical oxygen demand in waters and effluents (2007) Methods for the Examination of Waters and Associated Materials	10 mg/l	UKAS MCERTS(Waters)-Trade Effluent only
DETSC 2033	**Total and Dissolved Organic Carbon in Water**	The term TOC (Total Organic Carbon) is used to describe the total content of organically bound carbon in dissolved and undissolved compounds. The TOC content is expressed in mg/l. If DOC (Dissolved Organic Carbon) is required, samples are filtered through a 0.45µm filter paper prior to analysis. Inorganic carbon is expelled by acidification of the sample. TOC is then determined by digestion of the sample with sulphuric acid and peroxodisulphate. Carbon containing compounds are transformed into carbon dioxide. The carbon dioxide evolves and reacts with an indicator solution. The colour change is measured using a spectrophotometer.	Hach-Lange Technical Instructions: LCK 385, LCK 386, LCK 387	2 mg/l	UKAS
DETSC 2034	**Suspended and Settleable Solids in Water**	Suspended matter is removed from a measured volume of sample by filtration under reduced pressure through a pre-treated, pre-weighed glass fibre filter paper. The paper is washed with deionised water to remove dissolved salts and the total suspended matter is determined gravimetrically after drying at 105 ±5°C Settleable solids are determined by subtracting the solids left in suspension after settlement for 1 hour (or other agreed time) from the total suspended matter in the sample.	SCA Method ISBN 011 751957 X Suspended, Settleable and Total Dissolved Solids in Waters and Effluents 1980	5 mg/l	**Suspended Solids:** UKAS MCERTS(Waters)-Trade Effluent only **Settleable Solids:** Not Accredited

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2035	**Total Dissolved Solids in Water**	Water samples are pre-filtered to remove any suspended solids and evaporated in an oven at 180°C. The amount of residual dissolved solids is determined gravimetrically. An estimate of the total dissolved solids can be obtained by measuring the conductivity of the sample. This method is not accredited.	SCA Method ISBN 011 751957 X Suspended, Settleable and Total Dissolved Solids in Waters and Effluents 1980 BS1377: Part 3 : 1990 Section 8	5 mg/l	UKAS
DETSC 2047	**Formaldehyde in Water**	Formaldehyde in soil is extracted in water, with a water to soil ratio of 10:1. The insoluble residue is removed by filtration prior to analysis. Waters are filtered prior to analysis to remove any particulates in suspension. Formaldehyde in the extract or water sample reacts with chromatropic acid-sulphuric acid solution to form a purple coloured complex. The absorbance of the coloured solution is read at 580nm using a suitable visible spectrophotometer.	Formaldehyde by visible absorption spectrophotometry – Method 3500, Issue 2 – NIOSH Manual of Analytical Methods, Fourth edition, August 1994	**Soil:** 0.2mg/kg **Water:** 20µg/l	Not Accredited
DETSC 2048	**Dissolved Oxygen Content of Water**	The dissolved oxygen content of the sample is measured using a dissolved oxygen meter either electrochemically or by fluorescence, or by the titrimetric method developed by Winkler.	SCA Method ISBN 0.11 751442X Dissolved Oxygen in Natural and Waste Waters 1979	0.1 mg/l	Not Accredited
DETSC 2055	**Anions in Water and Aqueous Soil Extracts by Ion Chromatography**	Liquid samples and aqueous soil extracts are filtered through a 0.22µm syringe filter prior to analysis. The filtered samples are injected into an Ion Chromatograph. The anions of interest are separated on the basis of their affinity for the active sites of the column packing material. The separated anions are converted into their highly conductive acid forms and measured by conductivity. The anions are identified on the basis of retention time as compared to standards and quantisation is by measurement of peak area.	Standard Methods for the Examination of Water and Wastewater Section 4110 21st Edition 2005 APHA, AWWA, WEF	**Soil:** 1.0 mg/kg **Water:** 0.1 mg/L	UKAS

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2076	**Sulphate and Magnesium Content of 2:1 Aqueous Extract of Soil by ICP-OES**	The sulphate and magnesium in the soil are extracted in an aqueous extract having water: soil ratio of 2:1 and the insoluble material is removed by filtration. The concentrations of sulphate and magnesium in the filtrate are determined by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). The wavelengths used for identification and quantification are 181.972nm for sulphate and 285.213nm for magnesium.	BS1377 : Part 3: 1990 Method 5 BS1377 : Part 1: 1990 TRL 447 Sulphate Specification for Structural Backfills 2005 BRE SD1:2005 Concrete in Aggressive Ground 2005	10mg/L	**Sulphate:** UKAS MCERTS(Soils) **Magnesium:** Not Accredited
DETSC 2084	**Total Organic Carbon by PrimacATC Analyser**	Soil samples are treated with phosphoric acid to expel any inorganic carbonates. The samples are then heated at high temperature in a continuous flow of air so that any organic carbon is oxidised to carbon dioxide. The gas is then allowed to cool and analysed by an infra-red detector.	PrimacsATC Analyser – User Manual, Skalar	0.47%	MCERTS(Soils)
DETSC 2085	**Total and Dissolved Organic Carbon in Water**	**Direct TOC Analysis** The sample is acidified, stirred and purged to remove the IC before the sample is injected and handled as in the TC Analysis. The sample is filtered before acidification for DOC. **TC Analysis** The sample is injected by an automated septum less rotary port into a high temperature reactor. In the reactor, at a temperature of 750 - 950°C all organic and inorganic carbon is oxidized to the gaseous carbon dioxide (CO2). The catalyst that is present in the reactor catalysis the oxidation to completion. A flow of air transports these oxidation products to the detectors. The oxygen required for reaction is taken from the airflow. The products are led into the non-dispersive infrared detector where the carbon dioxide is determined. The carbon dioxide is measured at a wavelength of 4.2 µm by NDIR detection.	Standard Methods for the Examination of Water and Wastewater Section 5310 B 21st Edition 2005 APHA, AWWA, WEF HMSO Methods for the Examination of Waters and Associated Materials – The Instrumental Determination of Total Organic Carbon and Related Determinands 1995	lmg/l as C	UKAS

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2119	**Exchangeable Ammonia in Soil**	An intense blue-green complex, related to indophenol blue, is formed by the reaction of ammonia with hypochlorite and sodium salicylate, with sodium nitroprusside acting as a catalyst. The complex is measured at 655nm and is related to the ammonia concentration by means of a calibration curve. Sodium citrate is added to overcome interfering ions.	MAFF/ADAS Reference Book 427 – the Analysis of Agricultural Materials – Method 53, Ammonium, Nitrate and Nitrite-Nitrogen, Potassium Chloride Extractable	0.5mg/kg	UKAS MCERTS(Soils)
DETSC 2120	**Ammonia in Water by Spectrophotometry**	An intense blue-green complex, related to indophenol blue, is formed by the reaction of ammonia with hypochlorite and sodium salicylate, with sodium nitroprusside acting as a catalyst. The complex is measured at 655nm and is related to the ammonia concentration by means of a calibration curve. Sodium citrate is added to overcome interfering ions.	Environment Agency Ammonia in Waters 1981 ISBN 0117516139 Methods for the Examination of Waters and Associated Materials	20µg/l	UKAS
DETSC 2121	**Total Kjeldahl Nitrogen Content of Soils and Waters**	The sample is digested with sulphuric acid and a mixture of catalysts to convert organic nitrogen to ammonia. The sample is then distilled under alkaline conditions, and the distilled ammonia is absorbed in sulphuric acid. The ammonia content of the distillate is then determined colorimetrically either using the UV/vis spectrophotometer or the Konelab 60i. Ammonia reacts with hypochlorite ions generated by the alkaline hydrolysis of sodium dichloroisocyanurate to form monochloramine. Monochloramine reacts with salicylate ions in the presence of sodium nitroprusside at around pH 12.6 to form a blue compound. The absorbance of this compound is measured spectrophotometrically at wavelength 660nm	The Analysis of Agricultural Materials – MAFF/ADAS Reference Book 427 – HMSO BS 3882: 2007 Specification for topsoil Standard Methods for the Examination of Water and Wastewater Part 4500-N. 21st Edition 2005 APHA, WWA, WEF	**Soil:** 0.01% **Water:** 2mg/l	Not Accredited
DETSC 2123	**Water Soluble Boron in Soil & Boron in Water**	Boron in soil is extracted in boiling saline water. Waters are filtered prior to analysis to remove any particulates in suspension. The water soluble boron in the extract or filtrate reacts with azomethine–H to produce a yellow coloured complex. The resulting colour absorbance is measured at 420nm using a suitable visible spectrophotometer.	SecondSite Property (now National Grid Property Holdings) - Guidance for assessing and managing potential contamination on former gasworks and associated sites (Part I) (Version 3) Method 17.12 The analysis of Agricultural materials MAFF/ADAS – reference book 427	**Soil:** 0.2mg/kg **Water:** 100ug/L	UKAS MCERTS(Soils)

			HMSO		

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2130	**Cyanides & Monohydric Phenols by Skalar**	Water samples are filtered through a 0.45µm syringe filter and solid samples are extracted with 1M caustic soda prior to analysis on the automated flow analyser. The method determines total cyanide, easily liberated cyanide, complex cyanide, thiocyanate and monohydric phenols	Skalar methods: I295-001 w/r+P7 I295-002 w/r+P7 293-902 w/r+P7 497-001	**Soils mg/kg:** Total & Free CN=0.1, Thio=0.6, Phenol=0.3 **Waters ug/L:** Total CN=40, Free CN=20, Thio=20, Phenol=100	UKAS MCERTS(Soils)
DETSC 2140	**Sugar in Mixing Water for Cement**	Waters are filtered prior to analysis to remove any particulates in suspension. The sugar in the filtrate reacts with phenol and sulphuric acid to produce a yellow-orange coloured complex. The resulting colour absorbance is measured at 490nm using a suitable visible spectrophotometer.	Colorimetric Method for Determination of Sugars and Related Substances MICHEL DUBOIS, K. A. GILLES, J. K. HAMILTON, P. A. REBERS, and FRED SMITH - Division of Biochemistry, University of Minnesota, St. Paul, Minnesota.	10mg/l	Not Accredited
DETSC 2201	**Nitrite in Waters and Leachates by Konelab 60i**	Nitrite is determined colorimetrically using the Konelab60i autoanalyser. The nitrite colour reaction occurs at pH 2.0 to 2.5 by coupling diazotized Sulphanilamide with N-1-naphthyl-ethylenediamine. The absorbance of this compound is measured spectrophotometrically at 520nm.	Standard Methods for the Examination of Water and Wastewater Part 4500-NO2 B – 21st Edition 2005 APHA, AWWA, WEF Aquakem Method Nitrite in Waters Iss No 2 Methods for the Examination of Water and Associated Materials Oxidised Nitrogen in Waters 1981.	0.04mg/l (as N)	UKAS

			EPA Method 354.1 Nitrite, spectrophotometric (Approved at 40 CFR Part 136, not approved at Part 141)		

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2202	**Total Oxidised Nitrogen in Waters and Leachates by Konelab 60i**	Nitrate is reduced to nitrite by hydrazine under alkaline conditions. The total nitrite ions are then reacted with sulphanilamide and N-1-naphthylethylenediamine dihydrochloride under acidic conditions to form a reddish purple azo-dye. The absorbance of this compound is measured spectrophotometrically at 540 nm using the Konelab 60i autoanalyser.	Standard Methods for the Examination of Water and Wastewater Part 4500-NO2 B and Part 4500-NO3 H – 21st Edition 2005 APHA, AWWA, WEF Aquakem Method Total Oxidised Nitrogen. Methods for the Examination of Water and Associated Materials Oxidised Nitrogen in Waters 1981. EPA Method 353.1 Nitrate, Nitrite Colorimetric Automated Hydrazine Reduction (Approved at 40 CFR Part 136, Not approved at Part 141)	0.7mg/l (as N)	UKAS
DETSC 2203	**Hexavalent Chromium in Waters and Leachates by Konelab 60i**	Hexavalent Chromium is determined colorimetrically using the Konelab 60i autoanalyser. Hexavalent chromium reacts with diphenylcarbizide in acid solution and produces a red-violet colour. The absorbance of this compound is measured spectrophotometrically at 540nm.	Standard Methods for the Examination of Water and Wastewater Part 3500-Cr – 21st Edition 2005 APHA, AWWA, WEF USEPA 7196-A Aquakem Method. Hexavalent Chromium	10µg/l	UKAS
DETSC 2204	**Hexavalent Chromium in Soil by Konelab 60i**	Hexavalent Chromium is determined colorimetrically using the Konelab 60i autoanalyser. Hexavalent chromium reacts with diphenylcarbizide in acid solution and produces a red-violet colour. The absorbance of this compound is measured spectrophotometrically at 540nm.	Aquakem Method. Hexavalent Chromium	1mg/kg	Not Accredited

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2205	**Reactive & Total Phosphorus in Waters and Leachates by Konelab 60i**	Phosphate is determined colorimetrically using the Konelab60i autoanalyser. The orthophosphate ion reacts with ammonium molybdate and antimony potassium tartrate under acidic conditions to form a 12-molybdophosphoric acid complex. The complex is then reduced with ascorbic acid to form a blue heteropoly compound. The absorbance of this compound is measured spectrophotometrically at wavelength 880nm.	Standard Methods for the Examination of Water and Wastewater Part 4500-P E– 21st Edition 2005 APHA, AWWA, WEF Aquakem Method. Phosphate in Waters Issue 2	0.01mg/l	**Reactive Phosphorus:** UKAS MCERTS (Waters-Trade Effluent only) **Total Phosphorus:** Not Accredited
DETSC 2206	**High Level Ammonia in Waters and Leachates by Konelab 60i**	Ammonia is determined colorimetrically using the Konelab60i autoanalyser. Ammonia reacts with hypochlorite ions generated by the alkaline hydrolysis of sodium dichloroisocyanurate to form monochloramine. Monochloramine reacts with salicylate ions in the presence of sodium nitroprusside at around pH 12.6 to form a blue compound. The absorbance of this compound is measured spectrophotometrically at wavelength 660nm.	Methods for the Examination of Waters and Associated Materials Ammonia in Waters 1981 ISBN 0117516139. Aquakem Method. Ammonia in Waters Issue 2	0.8mg/l	UKAS
DETSC 2207	**Low Level Ammonia in Waters and Leachates by Konelab 60i**	Ammonia is determined colorimetrically using the Konelab60i autoanalyser. Ammonia reacts with hypochlorite ions generated by the alkaline hydrolysis of sodium dichloroisocyanurate to form monochloramine. Monochloramine reacts with salicylate ions in the presence of sodium nitroprusside at around pH 12.6 to form a blue compound. The absorbance of this compound is measured spectrophotometrically at wavelength 660nm.	Methods for the Examination of Waters and Associated Materials Ammonia in Waters 1981 ISBN 0117516139. Aquakem Method. Ammonia in Waters Issue 2	0.015mg/l	UKAS

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2208	**Sulphide in Waters and Leachates by Konelab 60i**	Sulphide is determined colorimetrically using the Konelab60i autoanalyser. Potassium Dichromate converts N-N-Diethyl-p-phenylenediamine to the free radical which reacts rapidly with sulphide to produce the coloured 'DPD Blue' or 'Ethylene Blue'. The absorbance can then be measured at wavelength 660nm.	The determination of sulphide in waters and associated materials (2007) - SCA - Draft (March 2007) Aquakem Method. Sulphide SP001 Issue 2 Standard Methods for the Examination of Water and Wastewater, 21st Edition 2005, Part 4500. ISBN0-87553-223-3	10µg/l	UKAS
DETSC 2210	**Ferrous Iron in Waters and Leachates by Konelab 60i**	Three molecules of phenanthroline chelate with each atom of ferrous iron to form an orange/red complex. The intensity of the coloured solution is stable between pH3 to pH9. Rapid colour development occurs between pH2.9 and pH3.5 in the presence of excess phenanthroline. The resulting colour absorbance is measured at 510nm	Aquakem Method Ferrous Iron FIR001 Issue 2	0.1mg/l	Not Accredited
DETSC 2211	**Silicate in Waters and Leachates by Konelab 60i**	Reactive forms of silicon in acid solution, below pH2, react with ammonium molybdate ions to form a yellow silicomolybdate. Ascorbic acid reduces the yellow silicomolybdate to produce a blue silicomolybdate complex. Oxalic acid is added to destroy any molybdophosphoric acid formed.	ASTM D7126 - 10 Standard Test Method for On-Line Colorimetric Measurement of Silica Aquakem Method Silica SIL Issue 2	0.1mg/l	Not Accredited
DETSC 2301	**Metals in Soil by ICP-OES** As, Ba, Be, Cd, Cr, Co, Cu, Fe, Mn, Mo, Ni, Pb, Se, V, Zn	Metals in soil are extracted using aqua regia and their concentrations are determined by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Any metals not listed can be determined but are not accredited under UKAS or MCERTS for soils.	Standard Methods for the Examination of Water and Wastewater Part 3120 B – 21st Edition 2005, AWWA, WEF	**mg/kg:** As, Be Cu, Ni =0.2, Ba=1.5, Cd=0.1, Cr=0.15, Co=0.7, Mn=20, Mo=0.4, Pb=0.3, Fe=1200, Se=0.5, V=0.8, Zn=1.0	UKAS (all listed) MCERTS (All soils listed except Fe)

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2302	**Metals in Waters by ICP-OES** Al, As, Ca, Cd, Cr, Cu, Fe, K, Mg, Mn, Na, Ni, Pb, Se, Zn	Concentrations of metals in water are determined by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Any metals not listed can be determined but are not accredited under UKAS or MCERTS for waters	Standard Methods for the Examination of Water and Wastewater Part 3120 B – 21st Edition 2005 APHA, AWWA, WEF	**µg/l:** Al=6.5, As= 7.1, Ca=100, Cd=0.3, Cr=0.75, Cu=0.75, Fe=70, K=20, Mg=5, Na=12, Ni=2.7, Pb=4, Se=11.3, Zn=3.8	**Dissolved:** UKAS (all listed) MCERTS(Waters)-Trade Effluent only (Al, Cd, Cr, Cu, Ni, Pb, Zn) **Total:** Not Accredited
DETSC 2303	**Total Hardness (By Calculation)**	The concentrations of calcium and magnesium are determined using the appropriate methodologies. The hardness is a measure of the sum of the calcium and magnesium concentration expressed as calcium carbonate.	Standard Methods for the Examination of Water and Wastewater Part 3120 B – 21st Edition 2005 APHA, AWWA, WEF	n/a	UKAS
DETSC 2304	**Zinc Equivalent in Soil (By Calculation)**	The concentrations of copper, nickel and zinc concentrations are determined using the appropriate methodologies. The zinc equivalent is a measure of the combined toxicity of the three metals, relative to the toxicity of zinc.	n/a	n/a	Not Accredited
DETSC 2306	**Metals in Waters by ICP-MS** Ag, Al, As, Ba, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, P, Pb, Sb, Se, Sn, V, Zn	Concentrations of metals in water are determined by Inductively Coupled Plasma Mass Spectroscopy (ICP-MS). Any metals not listed can be determined but are not accredited under UKAS.	Standard Methods for the Examination of Water and Wastewater Part 3125 B – 21st Edition 2005 APHA, AWWA, WEF	**µg/l:** Ag=0.13, Al=10.0, As=0.16, Ba=0.26, Ca=90, Cd=0.03, Co=0.16, Cr=0.25, Cu=0.40, Fe=5.50, Hg=0.01, K=80, Mg=20, Mn=0.22, Mo=1.1, Na=70, Ni=0.50, P=18.0, Pb=0.09, Sb=0.17, Se=0.25, Sn=0.40, V=0.60, Zn=1.3	**Dissolved:** UKAS (all listed) **Total:** Not Accredited

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2320	**Total Sulphur in Soil by ICP**	Sulphur compounds in soil are extracted using aqua regia and the insoluble residue is removed by filtration. The concentration of sulphur in the filtrate is determined by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Loss of sulphur as H2S is prevented by oxidation of the sulphur compounds to sulphate by the aqua regia.	TRL 447 Sulphate Specification for Structural Backfills 2005 BRE SD1 Concrete in Aggressive Ground 2005	0.01%	UKAS
DETSC 2321	**Total Sulphate content of Soil by ICP-OES**	The sulphate in the soil is extracted in dilute hydrochloric acid and the insoluble residue is removed by filtration. The filtrate is made up to volume and the concentration of sulphate in the filtrate is determined by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES).	BS1377 : Part 3: 1990 Method 5 BS1377 : Part 1 : 1990	0.01%	UKAS MCERTS(Soils)
DETSC 2322	**Total Potential Sulfate and Total Oxidisable Sulphur (By Calculation)**	Sulphur compounds in soil are extracted using aqua regia and the insoluble residue is removed by filtration. The concentration of sulphur in the filtrate is determined by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Loss of sulphur as H2S is prevented by oxidation of the sulphur compounds to sulphate by the aqua regia. The wavelength used for identification and quantification of sulphate is 181.972nm. The sulphate in the soil is extracted in dilute hydrochloric acid and the insoluble residue is removed by filtration. The filtrate is made up to volume and the concentration of sulphate in the filtrate is determined by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). The wavelength used for identification and quantification of sulphate is 181.972nm. The two results obtained from the above tests may then be combined to calculate the Total Potential Sulphate and Total Oxidisable Sulphur content	BS1377 : Part 3: 1990 Method 5 BS1377 : Part 1 : 1990	0.01%	Not Accredited

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2324	**Mercury in Waters by Atomic Fluorescence Spectroscopy**	Waters and aqueous samples are preserved by fixing with concentrated nitric acid. Treatment with tin (II) chloride reduces mercury (II) to mercury (0) vapour which is detected using atomic fluorescence spectrometry.	Standard Methods for the Examination of Water and Wastewater Part 3112 B – 21st Edition 2005 APHA, AWWA, WEF PSA Method – Millennium Merlin Method for Total Mercury in Drinking, Surface, Ground, Industrial and Domestic Wastewaters and Saline Waters	0.05µg/l	UKAS
DETSC 2325	**Mercury in Soil Atomic Fluorescence Spectroscopy**	The mercury is extracted from soil in aqua regia with gentle refluxing. The extract is filtered to remove particulates and diluted to volume. Treatment with tin (II) chloride reduces mercury (II) to mercury (0) vapour which is detected using atomic fluorescence spectrometry.	PSA Method – Millennium Merlin Method for Mercury in Sludge, Soils and Sediments	0.05 mg/kg	UKAS MCERTS(Soils)
DETSC 2332	**Inorganic and Methyl Mercury Speciation**	Soils are air-dried and crushed before being subjected to a two-stage microwave extraction procedure for Inorganic (Hg(II)) and Methyl (MeHg) mercury. Waters and aqueous samples are filtered to remove particulates. An aliquot is separated via HPLC before treatment with bromate-bromide and tin (II) chloride to generate mercury and the mercury is determined by atomic fluorescence spectroscopy.	USEPA Method 3200 – Mercury Species Fractionation and Quantification by Microwave Assisted Extraction. PSA Application Note 053 – Mercury Speciation Using The Millenium Merlin Speciation System	**Soil:** 100µg/kg **Water:** 1µg/l	Not Accredited
DETSC 2333	**Elemental Mercury Speciation**	Soils, waters and aqueous samples are tested on an as-received bases. A known quantity of sample is extracted using argon and the released elemental mercury is trapped. The trapped mercury is released upon heating in a scarifier module and determined by atomic fluorescence spectroscopy.		**Soil:** 0.6µg/kg **Water:** 1µg/l	Not Accredited

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Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 2400	**Unified Barge Bioaccessible Metals in Soils**	The Unified BARGE Method (UBM) is a an in vitro method for simulating the human digestive system. Synthetic digestive fluids are used to simulate the fluids present in the body. Both inorganic solutions (Containing inorganic salts such as KCl, NaCletc), and organic solutions (Containing organic compounds such as Urea, Glucose etc) are mixed with enzymes to produce 4 Synthetic digestive fluids saliva (S), Gastric fluid (G), duodenal fluid (D) and bile (B). These solutions are then used to mimic the effect of a sample passing through a human gastro intestinal tract by shaking portions of the sample at 37^0C, human body temperature (17.4).	EPA 9200.2-86 April 2012- Standard Operating Procedure for an In Vitro Bioaccessibility Assay for Lead in Soil BGS Chemical& Biological Hazards Programme Open Report OR/07/027 - Inter-laboratory Trial of a Unified Bioaccessibility Procedure	V = 1.0mg/kg Cr = 5.0mg/kg Co = 1.0mg/kg Ni = 5.0mg/kg As = 0.5mg/kg Se = 0.5mg/kg Cd = 0.5mg/kg Pb = 1.0mg/kg	Not Accredited
DETSC 3001	**Solvent Extractable Matter in Soil**	Soil samples are extracted with a water-immiscible solvent and filtered to remove the water. The solvent is evaporated and the amount of extractable matter in the sample is determined gravimetrically.	In-house method based on:- Problems Arising from the Redevelopment of Gas Works and Similar Sites - AERE Harwell Laboratory 1981. Environmental Agency The Determination of Material Extractable by Carbon Tetrachloride and of Certain Hydrocarbon Oil and Grease Components in sewage Sludge – 1978	40mg/kg	**Toluene & Cyclohexane:** UKAS **Other Solvents:** Not Accredited
DETSC 3002	**Oil & Grease/Solvent Extractable Matter in Waters**	A known volume of sample is acidified to pH<2 and extracted three times with an organic solvent, such as n-Hexane, in a separating funnel. The solvent is removed by evaporation and the amount of extractable matter in the sample is determined gravimetrically.	APHA 21st Edition, 2005 – Method 5520 B. Oil & Grease - Partition Gravimetric Method USEPA Method 1664, Revision A: n-Hexane Extractable Material (HEM: Oil & Grease) and Silica Treated N-Hexane Extractable Material (SGT-HEM; Non Polar Material) by Extraction and Gravimetry.	1mg/l for 500ml sample	UKAS

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Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 3049	**Elemental Sulphur in Soils and Waters by HPLC**	Soils are extracted in dichloromethane (DCM) by sonication. The elemental sulphur concentration is determined by high performance liquid chromatography (HPLC) with UV detection using a C_{18} (e.g. 250mm x 4.6mm) column and a mobile phase composed of 95% methanol and 5% water. Waters and aqueous extracts of soils are extracted using DCM in a separating funnel, filtered, and the concentration determined using HPLC.	National Grid Property Holdings Limited, Methods for the Collection and Analysis of Samples from National Grid Sites, Version 1, September 2006. Section 3.12 Soil Analysis: Elemental Sulphur.	**Soil:** 0.75mg/kg **Waters:** 90ug/l	**Soil:** UKAS MCERTS(Soils) **Water:** UKAS
DETSC 3072	**Aliphatic / Aromatic TPH by GC-FID**	Aliphatic and aromatic petroleum hydrocarbons (C_{10}-C_{35}) are extracted from soil and water using n-Hexane. The fractions are separated by solid phase extraction using silica columns, whereby the aliphatic fraction is eluted first with n-Hexane and the aromatic portion is eluted second with dichloromethane. The total, aliphatic, and aromatic concentrations are determined by gas chromatography flame ionisation detection (GC-FID) using a capillary column and hydrogen as the carrier gas. The chromatographic data is further characterized by subdivision into approximate boiling point/carbon number ranges with respect to n-alkane retention time markers.	National Grid Property Holdings Limited, Methods for the Collection and Analysis of Samples from National Grid Sites, Version 1, September 2006. Section 3.12 Soil Analysis: Draft TNRCC Method 1006	**Soil mg/kg:** AL10-12 =1.5 AL12-16 =1.2 AL16-21 =1.5 AL21-35 =3.4 AR10-12 =0.9 AR12-16 =0.5 AR16-21 =0.6 AR21-35 =1.4 **Water:** 1ug/l	**Soil:** UKAS MCERTS(Soils) (C10-C35 only) **Water:** Not Accredited
DETSC 3301	**PAH in Soil by GC-FID**	Soils and associated materials are extracted in dichloromethane (DCM) using sonication. The PAH concentration is recorded both as "Total PAH" and as "Speciated PAH", specified in terms of the 16 US EPA "Priority Pollutant" Polycyclic Aromatic Hydrocarbons. Concentrations are determined by gas chromatography using a BPX 50 (30m; 0.25µm ID; 0.25µm film) capillary column (or equivalent).	In-house method based on US EPA Method 8100, Polynuclear Aromatic Hydrocarbons	0.5 mg/kg each 1.6 mg/kg Total PAH	UKAS (16 PAH's only)
DETSC 3302	**Hexane / Acetone Extracted PAH in Soil by GC-FID**	Soils are extracted into hexane: acetone by shaking. The PAH concentration is recorded both as "Total PAH" and as "Speciated PAH", specified in terms of the 16 US EPA "Priority Pollutant" Polycyclic Aromatic Hydrocarbons. Concentrations are determined by gas chromatography using a BPX 50 (30m; 0.25µm ID; 0.25µm film) capillary column (or equivalent).	In-house method based on US EPA Method 8100, Polynuclear Aromatic Hydrocarbons	0.1 mg/kg each 1.6 mg/kg Total PAH	Not Accredited

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Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 3303	**Polyaromatic Hydrocarbons in Soils by GC-MS**	The PAHs in the soil sample are extracted into hexane: acetone by shaking. The PAHs in the extract are separated by gas chromatography and identified by the mass selective detector. The concentration of each PAH is determined by referencing individual mass peak areas to the appropriate internal standard mass peak area. Quantification is carried out within the instrument software.	In-house method based on EPA Method 8270- US EPA Method 8270, Revision C, Semivolatile Organic Compounds by Gas Chromatography – Mass Spectrometry (GC/MS)	0.03 mg/kg each 0.10 mg/kg Total PAH	UKAS (All 16 PAH's) MCERTS (not Fluorene, Anthracene, Chrysene or Total)
DETSC 3304	**Polyaromatic Hydrocarbons in Waters by GC-MS**	The PAHs in the water sample are extracted into dichloromethane by shaking. The PAHs in the extract are separated by gas chromatography and identified by the mass selective detector. The concentration of each PAH is determined by referencing individual mass peak areas to the appropriate internal standard mass peak area. Quantification is carried out within the Instrument software.	In-house method based on EPA Method 8270- US EPA Method 8270, Revision 3, Semivolatile Organic Compounds by Gas Chromatography – Mass Spectrometry (GC/MS) In-house method based on EPA Method 3510C- EPA Method 3510C, Revision 3, Separatory Funnel Liquid-Liquid Extraction	10 ng/l each	UKAS (16 PAH's only)
DETSC 3311	**Extractable Petroleum Hydrocarbons (EPH) in Soil, Ballast and Water**	This method is designed to determine total concentrations of extractable petroleum hydrocarbons (EPH) in solid and aqueous matrices. This method uses a dichloromethane (DCM) extraction followed by quantification using gas chromatography/flame ionisation detection (GC-FID) analysis using a 1:1 mixture of diesel and mineral oil as calibration standards and n-alkane markers to establish the boiling point ranges. This method is used for the quantitative analysis of "Total EPH" (C10-C40) and as "Speciated EPH", specified in terms of the "diesel range" (C10-C24), and "mineral oil range" (C24-C40).	USEPA Method 3550C – Ultrasonic Extraction USEPA Method 8015B – Non-Halogenated Organics Using GC/FID	**Soil:** 10 mg/kg **Ballast:** 10mg/kg **Water:** 10µg/l	**Soil:** UKAS MCERTS(Soils) **Water:** UKAS

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Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 3312	**Hexane Extractable Petroleum Hydrocarbons (HPH)**	This method is designed to determine total concentrations of extractable petroleum hydrocarbons (EPH) in solid matrices. This method uses a hexane: acetone (9.4) extraction followed by quantification using gas chromatography/flame ionisation detection (GC-FID) analysis using a 1:1 mixture of diesel and mineral oil as calibration standards and n-alkane markers to establish the boiling point ranges. This method is used for the quantitative analysis of "Total EPH" (C10-C40) and as "Speciated EPH", specified in terms of the "diesel range" (C10- C24) and "mineral oil range" (C24-C40).	USEPA Method 8015B – Non-Halogenated Organics Using GC/FID	**Soil:** 5 mg/kg	Not Accredited
DETSC 3321	**BTEX, MTBE & PRO in Soils by Headspace GC-FID**	BTEX, MTBE and PRO in soils are determined via Headspace GC-FID. Individual aromatic compounds are quantified by external calibration against known standards. PRO range is banded using alkane markers to define retention time windows.	EPA Methods 5021 and 8015D	0.01 mg/kg	UKAS MCERTS(Soils) Not accredited for PRO range (C5-10)
DETSC 3322	**BTEX, MTBE & PRO in Waters & Leachates by Headspace GC-FID**	BTEX, MTBE and PRO in soils are determined via Headspace GC-FID. Individual aromatic compounds are quantified by external calibration against known standards. PRO range is banded using alkane markers to define retention time windows.	EPA Methods 5021 and 8015D	1 µg/l	UKAS
DETSC 3401	**PCBs in Soils by GC-MS**	An as-received soil sample is extracted in Hexane:Acetone (1:2) using sonication methodology. The sample is separated by gas chromatography and identified by mass selective detector. Quantification is carried out within the instrument software.	EPA Method 8082 - Polychlorinated Biphenyls (PCBs) by Gas Chromatography.	**µg/kg** PCB 28=1.25 PCB 52=1.12 PCB 101=1.32 PCB 118=1.43 PCB 153=2.08 PCB 138=1.35 PCB 180=1.42	UKAS MCERTS(Soils)

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Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 3402	**Polychlorinated Biphenols in Waters by GC/MS**	The water sample is extracted in DCM on a reciprocal shaker. The sample is separated by gas chromatography and identified by mass selective detector. Quantification is carried out within the GC-MS software using an internal standard.	EPA Method 8082 - Polychlorinated Biphenyls (PCBs) by Gas Chromatography.	**ng/l** PCB 28=208 PCB 52=161 PCB 101=211 PCB 118+123=513 PCB 153=163 PCB 138=107 PCB 180=132 PCB 105=133 PCB 114=253 PCB 126=399 PCB 156=253 PCB 157=119 PCB 167=248 PCB 169=181 PCB 189=271 PCB 77=202 PCB 81=186	UKAS
DETSC 3432	**Volatile Organic Compounds in Waters by Headspace GC-MS**	The method covers the range of volatile organic compounds with boiling points up to 220°C. Water samples are heated and agitated in a crimp cap vial. This drives the volatile components in to the headspace. An aliquot of the headspace is taken and injected in to a gas chromatograph with mass selective detection (GC-MS).The detector operates in full scan mode and is calibrated with standards containing known concentrations of the compounds of interest.	USEPA Method 8260B Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS), Revision 2, December 1996	1 ug/l except: DCM (27), 2,2-Dichloropropane (2), Bromochloromethane (4), Bromodichloromethane (4), m+p-Xylene (2), 1,3-Dichlorobenzene (2)	UKAS except: Trichlorofluoromethane, Methylene Chloride, 1,1,1-Trichloroethane,

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Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 3433	**Semi-Volatile Organic Compounds in Soils by GCMS**	The SVOCs in the soil sample are extracted into DCM: Acetone by shaking. The SVOCs in the extract are separated by gas chromatography and identified by the mass selective detector. The concentration of each SVOC is determined by referencing individual mass peak areas to the appropriate internal standard mass peak area. Quantification is carried out within the instrument software.	In-house method based on EPA Method 8270- US EPA Method 8270, Revision 3, Semi volatile Organic Compounds by Gas Chromatography – Mass Spectrometry (GC/MS)	Individual SVOCs 0.1 mg/kg	UKAS
DETSC 5001	**Ash Content of Coal**	The ash content of the sample is determined gravimetrically. A known weight of the sample is placed in a prepared ash crucible and placed in a furnace. The furnace is heated to 750ºC ±10ºC where the temperature is maintained. Following combustion the crucible and sample are removed, cooled and reweighed.	ASTM D3174-11 BS 1016-104.4 1998 ISO 1171: 2010	0.1%	UKAS
DETSC 5002	**Ash & LOI Content of Solid Biomass & Solid Recovered Fuels**	The ash and LOI content of the sample is determined gravimetrically. A known weight of the sample is placed in a prepared ash crucible and placed in a furnace. The furnace is heated to 550ºC ±10ºC where the temperature is maintained. Following combustion the crucible and sample are removed, cooled and reweighed.	BS EN 14775:2009 BS EN 15403:2011	0.1%	UKAS
DETSC 5003	**Volatile Matter Content of Solid Biomass, Solid Recovered Fuels and Coal**	A known weight of the sample produced for volatile matter determination is placed in a suitable crucible fitted with a lid. The crucible and sample is weighed and heated in a furnace with a limited air through put at a temperature of 900ºC ±10ºC for 7 minutes. The sample and crucible are re-weighed and the volatile matter content determined by difference.	BSEN15148:2009 – Solid Biofuels Determination of the Content of Volatile Matter BS EN 15402:2011 - Solid Recovered Fuels - Determination of the Content of Volatile Matter	0.1%	UKAS

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Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 5004	**Total Moisture / Dry Solids Content of Solid Biomass & Solid Recovered Fuels & Coal**	The sample produced for general analysis is placed into a suitable prepared and weighed tray and reweighed. The sample is dried at 105ºC to constant weight and the total moisture / dry solids content is calculated from the reduction in weight.	BSEN 14774 Parts 1 & 2 2009 DD CEN/TS 15414 Parts 1 & 2: 2010	0.1%	UKAS
DETSC 5005	**Analysis Moisture Content of Solid Biomass, Solid Recovered Fuels & Coal**	The sample produced for total moisture determination in accordance with DETSC 5009 or DETSC 5010 is placed in a suitable pre-weighed tray and reweighed. The sample is then dried at 105°C ±2°C to constant weight and then weighed again. The analysis moisture content is calculated from the reduction in weight.	BS EN 14774-3 2009 BS EN 15414-3 2011 BS 1016-104.1 -1999 ISO 11722 – 1999	n/a	UKAS
DETSC 5007	**Calorific Value of Solid Biomass, Solid Recovered Fuels & Coal**	Calorific value of a material is determined in an Isoperbol calorimeter by burning it in pure oxygen in a combustion bomb. A known amount of sample is placed in a combustion bomb which is then pressurised to 30bar with oxygen. A calorimeter bucket is filled with a known amount of deionised water which is placed in the calorimeter and the bomb placed in the bucket. The system is allowed to equilibrate and the bomb fired by electrical connection. The difference in temperature of the water in the calorimeter bucket caused by the ignition of the material in the bomb is measured and the calorific value calculated	BS EN 14918: Solid biofuels – Determination of calorific value BS EN 15400: Solid recovered fuels - Determination of calorific value	1MJ/kg	UKAS
DETSC 5008	**Calorific Value of Soil**	A known amount of sample material is burnt in a combustion bomb that is immersed in water in a calorimeter and the difference in the water temperature before and after ignition measured. The calorific value of the sample material is calculated making any necessary corrections for heat generation not associated with the combusting sample. A gelatine capsule will be required to assist combustion which is also corrected for in the final calculations.	BS 1016-105 1992 ISO 19208 ASTM 5865	1MJ/kg	UKAS

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Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 5009	**Sample Preparation of Solid Biomass & Solid Recovered Fuels**	If analysis is required on the original material (i.e. Bulk Density) a sub-sample will be taken after initial mixing after which the sample is then reduced by cutting/chopping oversized pieces of material. The material is then mixed and subdivided by manual means during which process representative samples are taken for analysis i.e. total moisture. The remainder of the sample is dried and then reduced to <1mm and again mixed and subdivided to produce the sample for laboratory analysis.	BS EN 14780:2011 BS EN 15413:2011	n/a	Not Accredited
DETSC 5010	**Sample Preparation of Coal**	If required the sample received is first mixed and a sample taken for bulk density or bulk density is carried out on the whole initial sample. The remaining sample or the whole sample used for bulk density is then reduced to <10mm preferably by jaw crushing. The material is then mixed and subdivided by mechanical or manual means during which process representative samples are taken for any analysis required at this stage i.e. total moisture, The remainder of the sample is again mixed and subdivided to produce the sample for laboratory analysis which may require drying prior to crushing to <212 microns. If there is excessive water content a pre- drying stage of the whole sample may have to be carried out before sample blending and subdivision commences.	BS ISO 13909-4: 2001	n/a	Not Accredited
DETSC 5011	**Calculation of Fixed Carbon Content of Coal, SRF and Solid Biomass Fuels**	The total moisture, analysis moisture, ash and volatile matter content are determined by approved methods. The values obtained are deducted from 100 and this gives the fixed carbon value of the fuel.	DD CENT/S 15296:2006 BS 1016.100:1994 BS ISO 17246:2005	0.1%	Not Accredited

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 5012	**Determination of Biomass Content of SRF**	Approximately 5g of the sample is dissolved in 150ml of 78% Sulphuric Acid for 16 hours ±2 hours after which 35ml of 30% Hydrogen Peroxide is added and the sample left for an additional 5 hours ±1 hour. At the end of this period 300ml of deionised water is added to the sample and the residue remaining filtered off using a glass fibre filter paper, washing the residue with an additional 300ml of deionised water. The filter paper and residue are placed in a pre-weighed crucible and dried at 1500C until completely dry. The filter paper is reweighed after drying and the non biomass residue determined. Corrections for carbonates content is made by determining the ash content of the original sample and the non biomass residue remaining. The result can also be expressed by percentage calorific value by performing a calorific valve on the solid captured on the filter paper.	BS EN 15440 Solid recovered fuels - Methods for the determination of biomass content	n/a	UKAS
DETSC 5013	**Determination Of Carbon, Hydrogen, Nitrogen & Oxygen In Solid Biomass, Solid Recovered Fuels & Coal**	A known mass of fuel is weighed into tin capsules which are dropped sequentially into the combustion reactor prior to the arrival of oxygen. The sample and tin capsule react with oxygen and combust at temperatures of 1700-1800 °C and the sample is broken down into its elemental components N2, CO2, and H2O. High performance copper wires absorb the excess oxygen not used for sample combustion. The gases flow through the gas chromatographic (GC) separation column which is kept at a constant temperature. As they pass through the GC column, the gases are separated and are detected sequentially by the thermal conductivity detector (TCD). The TCD generates a signal, which is proportional to the amount of element in the sample. The instrument software compares the elemental peak to a known standard material (after calibration) and generates a report for each element on a weight basis. The oxygen is calculated by deducting these quantities from 100 along with the moisture, ash, sulphur & chlorine contents determined by other methods.	BS EN 15104:2011 Solid biofuels - Determination of total content of carbon, hydrogen and nitrogen - Instrumental methods BS EN 15407:2011 Solid recovered fuels - Methods for the determination of carbon (C), hydrogen (H) and nitrogen(N) content BS EN 15296:2011 Solid biofuels - Conversion of analytical results from one basis to another	Carbon 0.10% Nitrogen 0.30% Hydrogen 0.30% Oxygen 3.55%	UKAS

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 5014	**Metals in Coal, SRF and Biomass by ICP**	Metals in coal, solid recovered fuel (SRF) and biomass samples are extracted by microwave using Hydrogen Peroxide (to oxidise and break down organic matter) and Aqua Regia (to dissolve the matrix and hold the metals in solution). Their concentrations are determined by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES).	BS EN 15410 - Solid recovered fuels - Methods for the determination of the content of major elements (Al, Ca, Fe, K, Mg, Na, P, Si, Ti) BS EN 15411 - Solid recovered fuels - Methods for the determination of the content of trace elements (As, Ba, Be, Cd, Co, Cr, Cu, Hg, Mo, Mn, Ni, Pb, Sb, Se, Tl, V and Zn) BS EN 15290 - Solid biofuels - Determination of major elements - Al, Ca, Fe, Mg, P, K, Si, Na and Ti BS EN 15297 - Solid biofuels - Determination of minor elements - As, Cd, Co, Cr, Cu, Hg, Mn, Mo, Ni, Pb, Sb, V and Zn	**0.1 mg/kg:** As, Be, Cd, Co, Mn, Ni, P, Pb, Sb, Se, Sn, Ti, V, Zn **0.2mg/kg:** Cr, Cu, Tl **0.5mg/kg:** Mo **1mg/kg:** Al, Fe, K, Mg **5mg/kg:** Ca **10mg/kg:** Ag, Ba, Rh, Sr, Te	UKAS: Al, As (SRF only), Ca, Cd, Co, Cr, Cu, K, Mg, Mn, Na (SRF only), Ni, P, Pb, Se, Sn, Tl, V, Zn All other metals not accredited
DETSC 5015	**Mercury in Coal, SRF and Biomass by Atomic Fluorescence Spectroscopy**	The mercury is extracted from coal, SRF and biomass in aqua regia with gentle refluxing. The extract is filtered to remove particulates and diluted to volume. Treatment of the resulting solution with tin (II) chloride reduces mercury (II) to mercury (0) vapour which is then quantitatively detected using atomic fluorescence spectrometry.	PSA Method – Millennium Merlin Method for Mercury in Sludge, Soils and Sediments.	0.055mg/kg	UKAS

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 5016	**Total Sulphur Content Of Coal, SRF And Biomass**	Sulphur compounds in SRF and biomass are extracted using aqua regia / hydrogen peroxide and the insoluble residue is removed by filtration. The concentration of sulphur in the filtrate is determined by Inductively Coupled Plasma Optical Emission Spectroscopy (ICP-OES). Loss of sulphur as H2S is prevented by oxidation of the sulphur compounds to sulphate by the aqua regia. The use of hydrogen peroxide enhances the oxidation properties of nitric acid especially in the digestion of organics. Sulphur compounds in coal are determined by ICP-OES from the aqueous washings of the combustion products after firing in a bomb calorimeter.	TRL Report TRL447 (Updated) - Sulphate specification for structural backfills 2005	0.001mg/kg	UKAS
DETSC 5017	**Sulphur, Chlorine, Fluorine & Bromine Content of Solid Biomass, Solid Recovered Fuels and Coal by IC**	A known weight of fuel is burnt in a pressurised bomb in pure oxygen. After firing of the bomb, it is stood for a minimum of five minutes to allow the combustion products to settle then the oxygen is slowly released over a period of at least three minutes. The bomb is then taken apart and the bomb electrodes rinsed with deionised water into the inside of the bomb. These washings are then decanted into a 50ml volumetric flask. The inside of the bomb is rinsed with deionised water and the washings added to those in the volumetric flask. The contents of the volumetric flask are made up to volume with deionised water and stored for the analysis of sulphur, chloride, fluoride and bromide by ion chromatography.	Operating Instruction Manual No. 442M 6200 Parr Oxygen Bomb Calorimeter Operating Instruction Manual No. 205M 1108 Oxygen Combustion Bomb Operating Instruction Manual No. 454M 6510 Water Handling System	0.01% Chlorine 0.01% Fluorine 0.01% Bromine 0.04% Sulphur (Coal only)	UKAS

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 5018	**XRF Analysis of Coal, Biomass, SRF and Cement**	When X-rays are targeted at a material they will cause electrons to be ejected from the component atoms (Ionisation). The ejection of electrons will cause the electronic structure of the component atoms to become unstable resulting in electrons from the higher energy outer orbitals "falling" into the inner orbitals to compensate. This causes a release of energy in the form of a photon equal to the energy difference between the two orbitals involved. Thus the material emits radiation which has energy characteristics of the atoms present. In energy dispersive X-ray fluorescence the fluorescent X-rays emitted are directed to a detector from which the data is processed by a multichannel analyser, producing a digital spectrum which is processed to obtain analytical data. The instrument analytical parameters are set up for the matrix type. A sample cell is prepared by placing a piece of prolene film over the outer cell and then inserting the inner cell. This gives a complete cell with a clear prolene base. A portion of the sample is placed into the cell and then analysed.	Rigaku NEX CG EDXRF instruction manual	**Cement:** 0.01% BaO, Cr_2O_3, CuO, PbO, Rb_2O, SrO, ZnO 0.02% Cl, V_2O_5 0.05% TiO_2 0.1% Mn_2O_3, P_2O_5, SO_3 0.5% K_2O 1% Al_2O_3, CaO, CdO, Co_2O_3, Fe_2O_3, MgO, Na_2O, NiO, SiO_2, Y_2O_3 **Fuel:** 0.01% Co, Cr, Cu, I, Li, Mn, Ni, P, Pb, Sn, Ti, V, Zn 0.02% Al, Ba, S, Si 0.1% Mg 0.2% Ca 0.5% As, Cd, Hg, Mo, Na, Sb, Se, Th, Tl 1% Ag	UKAS Al, As, Ca, Cd, Co, Cr, Cu, Fe, Hg, K, Mg, Mn, Mo, Na, Ni, P, Sb, Si, Sn, Tl, Ti, V, Zn Al2O3, BaO, CaO, Cl, Cr2O3, CuO, Fe2O3, K2O, MgO, Mn2O3, Na2O, P2O5, PbO, Rb2O, SiO2, SO3, SrO, TiO2, V2O5, ZnO All other testing not accredited
DETSC 5019	**Determination of Biodegradable Municipal Waste Content (Compositional Analysis)**	The method is based on handpicking the BMW fraction from the municipal waste sample, and then weighing the amount of BMW sorted and expressing this as a percentage on a wet weight basis of the weight of the whole municipal waste sample.	ENVIRONMENT AGENCY: Guidance on monitoring of MBT and other treatment processes for the landfill allowances schemes (LATS and LAS) for England and Wales	n/a	Not Accredited
DETSC 5020	**Determination of Bulk Density in Solid Biomass and Solid Recovered Fuels**	The test portion is filled into a standard container of a given size and shape and weighed afterwards. Bulk density is calculated from the net weight per standard volume and reported for the moisture content.	BS EN 15103:2009 Solid Biofuels- Determination of bulk density BS EN 15401:2010 Solid Recovered Fuels- Determination of bulk density	0.5kg/m^3	Not Accredited

DETS INFO 001 – ANALYTICAL METHOD SUMMARY

Method Number	Title	Description	Reference	LOD	Accreditation Status
DETSC 5021	**Auto Ignition Temperature**	A quantity of the sample is placed into a metal tray or crucible and placed into an oven or furnace. The temperature of the oven / furnace is increased in predefined increments and the temperature in which the sample ignites is noted.	None	25°C	Not Accredited

Appendix C

Soil Screening

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Hole Ref	BH101	TP110	WS105	WS104	TP109	BH112	BH112	BH107	TP111	TP105
Easting	384796.682	384638.835	384294.085	384569.278	384661.431	384401.713	384401.713	384824.812	384592.029	384843.779
Northing	399802.989	399640.942	399279.174	399463.63	399650.774	399486.259	399486.259	399485.537	399655.215	399726.261
Sample Top (m)	0.80	1.30	0.30	1.00	1.30	3.30	0.30	2.00	0.30	1.30
Sample Date	03/01/2019	07/01/2019	10/01/2019	08/01/2019	04/01/2019	10/01/2019	10/01/2019	09/01/2019	07/01/2019	03/01/2019
Investigation	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
Geology	MG	MG	MG	MG	MG	CHES	MG	MG	MG	MG

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max										
Asbestos Analysts Comments	#N/A	#N/A	#N/A	0 of 56	7	0.0	0.0		na	na	na	present in small bundles		na	es of Amosite	na	na	na
Asbestos (Presence of)	Presence	#N/A		7 of 56	7	0.0	0.0		NAD	NAD	NAD	Amosite		NAD	Amosite	NAD	NAD	NAD
pH	None	-		64 of 64	0	6.1	11.7		8.3	7.3	8.7	9.0	8.2	9.3	8.5	8.3	7.8	8.3
Cyanide	800	mg/kg	#N/A	36 of 64	0	0.1	89.0		< 0.1	0.5	0.8	8.5	0.2	< 0.1	< 0.1	< 0.1	< 0.1	5.1
Sulphate as SO4	#N/A	mg/l	#N/A	2 of 2	0	49.0	55.0											
Mercury	13.6	mg/kg	#N/A	46 of 64	1	0.1	18.0		0.2	1.6	0.1	0.1	1.1	< 0.05	0.2	< 0.05	0.3	0.3
Cadmium	85	mg/kg	#N/A	60 of 64	0	0.1	4.7		0.9	0.6	4.7	0.6	0.4	0.1	0.3	0.2	0.6	0.2
Chromium	907	mg/kg	#N/A	64 of 64	0	5.7	48.0		5.7	21.0	38.0	15.0	15.0	11.0	15.0	24.0	26.0	23.0
Arsenic	39.9	mg/kg	#N/A	64 of 64	6	4.1	71.0		5.2	34.0	12.0	15.0	71.0	4.5	8.5	9.0	18.0	12.0
Beryllium	1.72	mg/kg	#N/A	62 of 64	13	0.2	3.9		0.2	1.9	0.4	0.5	2.1	0.4	0.4	0.8	0.9	0.6
Copper	7130	mg/kg	#N/A	64 of 64	0	8.9	4200.0		50.0	300.0	190.0	90.0	110.0	8.9	40.0	25.0	86.0	39.0
Lead	310	mg/kg	#N/A	64 of 64	15	12.0	12000.0		38.0	520.0	490.0	290.0	180.0	66.0	300.0	18.0	71.0	110.0
Selenium	430	mg/kg	#N/A	5 of 64	0	0.5	1.0		< 0.5	< 0.5	0.7	0.9	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	651	mg/kg	#N/A	64 of 64	0	8.7	160.0		12.0	59.0	27.0	23.0	40.0	19.0	22.0	30.0	74.0	21.0
Antimony	618	mg/kg	#N/A	56 of 64	0	1.0	180.0		1.2	11.0	6.3	3.4	3.0	< 1.0	5.1	1.2	4.3	1.0
Chromium - Hexavalent	21	mg/kg	#N/A	0 of 61	0	0.0	0.0		< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nickel	181	mg/kg	#N/A	64 of 64	0	6.5	53.0		7.9	38.0	42.0	15.0	29.0	12.0	12.0	28.0	28.0	20.0
Zinc	40400	mg/kg	#N/A	64 of 64	0	28.0	1700.0		46.0	240.0	1700.0	310.0	93.0	36.0	95.0	57.0	180.0	88.0
m,p xylenes	427.6926186	mg/kg	p-Xylene	0 of 5	0	0.0	0.0					< 0.01						
4-Isopropyltoluene	1240	mg/kg	Aromatic >EC1	0 of 5	0	0.0	0.0					< 0.01						
Isopropylbenzene	95.4	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Tert-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0					< 0.01						
1,2,3-Trichloropropane	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0					< 0.01						
1,2-Dibromo-3-Chloropropane	None	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,2,4-Trimethylbenzene	3.31	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Ethylbenzene	439.7179703	mg/kg		0 of 64	0	0.0	0.0		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	3927.6251	mg/kg		0 of 64	0	0.0	0.0		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	427.6926186	mg/kg	p-Xylene	1 of 59	0	1.9	1.9		< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene	1.42187881	mg/kg		0 of 64	0	0.0	0.0		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2-Dichlorobenzene	133	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
2-Chlorotoluene	2.41	mg/kg	chlorobenzene	0 of 5	0	0.0	0.0					< 0.01						
O-Xylene	475.7207618	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Hexachlorobutadiene (HCBD)	1.79	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,2,3 Trichlorobenzene	8.81	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Trichloroethene	0.0797	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,1,2-Trichloroethane	5.53	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,2-Dichloropropane	0.121	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,1-Dichloroethene	1.17	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,1-Dichloroethane	10.9	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Bromodichloromethane	0.096	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Tribromomethane	None	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Chloroethene	0.00153	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Bromochloromethane	None	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Dibromomethane	0.096	mg/kg	hodichlorometl	0 of 5	0	0.0	0.0					< 0.01						
1,1,1-Trichloroethane	40.4	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Chloroform	4.22	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,1,1,2-Tetrachloroethane	8.2	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
2,2-Dichloropropane	None	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,1-Dichloropropene	3.3	mg/kg	Benzene	0 of 5	0	0.0	0.0					< 0.01						
trachloromethane (Carbon Tetra Chlorid	0.128	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
cis1,3-Dichloropropene	None	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,3-Dichlorobenzene	2.45	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Methyl tert-butyl ether (MTBE)	319	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
trans-1,2-Dichloroethene	1.02	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
cis-1,2-Dichloroethene	0.559	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,3-Dichloropropane	None	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Sec-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0					< 0.01						
Tetrachloroethene	0.92	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Dibromochloromethane	None	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,2,4-Trichlorobenzene	15.3	mg/kg		0 of 5	0	0.0	0.0					< 0.01						

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max											
Hole Ref									BH101	TP110	WS105	WS104	TP109	BH112	BH112	BH107	TP111	TP105
Easting									384796.682	384638.835	384294.085	384569.278	384661.431	384401.713	384401.713	384824.812	384592.029	384843.779
Northing									399802.989	399640.942	399279.174	399463.63	399650.774	399486.259	399486.259	399485.537	399655.215	399726.261
Sample Top (m)									0.80	1.30	0.30	1.00	1.30	3.30	0.30	2.00	0.30	1.30
Sample Date									03/01/2019	07/01/2019	10/01/2019	08/01/2019	04/01/2019	10/01/2019	10/01/2019	09/01/2019	07/01/2019	03/01/2019
Investigation									AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
Geology									MG	MG	MG	MG	MG	CHES	MG	MG	MG	MG
Chlorobenzene	2.41	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Bromobenzene	6.96	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,3,5-Trimethylbenzene	3.31	mg/kg	l-Trimethylben	0 of 5	0	0.0	0.0					< 0.01						
1,2-Dibromoethane	0.096	mg/kg	nodichlorometl	0 of 5	0	0.0	0.0					< 0.01						
1,4-Dichlorobenzene	332	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
4-Chlorotoluene	2.41	mg/kg	chlorobenzene	0 of 5	0	0.0	0.0					< 0.01						
n-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0					< 0.01						
n-propylbenzene	323	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
trans-1,3-Dichloropropene	None	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Styrene	236	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
1,2-Dichloroethane	0.0227	mg/kg		0 of 5	0	0.0	0.0					< 0.01						
Acenaphthylene	5970	#N/A	#N/A	13 of 57	0	0.0	7.7		0.0	< 0.03	< 0.03	7.7		< 0.03	< 0.03	< 0.03	< 0.03	0.7
Dibenz-a-h-anthracene	0.32	#N/A	#N/A	18 of 57	2	0.0	2.4		0.0	< 0.03	< 0.03	2.4		< 0.03	0.1	< 0.03	< 0.03	0.1
Acenaphthene	6040	#N/A	#N/A	26 of 57	0	0.0	6.1		0.2	0.2	0.1	5.5		< 0.03	0.0	< 0.03	< 0.03	< 0.03
Total BTEX	None	mg/kg		0 of 8	0	0.0	0.0						< 0.04					
4-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
4-Nitrophenol	None	mg/kg		1 of 3	0	6.2	6.2					6.2						
Dimethylphthalate	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
P-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Benzyl Alcohol	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
4-Bromophenyl Phenyl Ether	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0					< 0.1						
Azobenzene	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
2,4-Dimethylphenol	1040	mg/kg		1 of 3	0	0.2	0.2					0.2						
Phenol	1200	mg/kg		1 of 3	0	0.3	0.3					0.3						
Bis(2-chloroethoxy)methane	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Bis(2-ethylhexyl)phthalate	4090	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Di-N-Octyl Phthalate	4920	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Hexachlorobenzene (HCB)	6.38	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
2,4-Dichlorophenol	186	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
2,4-Dinitrotoluene	254	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Diphenylamine	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Bis(2-chloroisopropyl)ether	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
O-Dinitrobenzene	None	mg/kg		1 of 3	0	11.0	11.0					11.0						
2-Methyl-4,6-Dinitrophenol	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
2,3,4,6-Tetrachlorophenol	229	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
4-Chloro-3-Methylphenol	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
2,6-Dinitrotoluene	125	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Aniline	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0					< 0.1						
4-Chlorophenyl Phenyl Ether	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Hexachlorocyclopentadiene	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Diethylphthalate	8970	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Di-N-Butyl Phthalate	645	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Butylbenzylphthalate	63800	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
Carbazole	None	mg/kg		1 of 3	0	3.5	3.5					3.5						
Pentachlorophenol (PCP)	30.6	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
2,4,6-Trichlorophenol	231	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
2-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
2-Methylnaphthalene	13.2	mg/kg	naphthalene	1 of 3	0	8.8	8.8					8.8						
2-Chloronaphthalene	31.6	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
2,3,5,6-Tetrachlorophenol	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
2-Methylphenol	9930	mg/kg		1 of 3	0	0.2	0.2					0.2						
2-Chlorophenol	207	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
2,4,5-Trichlorophenol	231	mg/kg	6-Trichlorophe	0 of 3	0	0.0	0.0					< 0.1						
3-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
M-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0					< 0.1						
3/4 Methylphenol	10000	mg/kg		1 of 3	0	0.4	0.4					0.4						
Phenol (Monohydric)	1200	#N/A	#N/A	23 of 64	0	0.4	12.0		< 0.3	< 0.3	< 0.3	< 0.3	0.5	< 0.3	< 0.3	< 0.3	< 0.3	0.4
Loss on ignition	None	%		8 of 8	0	1.3	11.0						11.0					
Total Organic Carbon	None	%		63 of 64	0	0.5	41.0		9.2	28.0	2.2	6.1	17.0	0.5	1.8	1.1	12.0	4.7
Napthalene	13.2	mg/kg		25 of 59	1	0.0	18.0		0.2	0.2	0.0	< 0.01		< 0.03	< 0.03	< 0.03	< 0.03	0.0

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max		Hole Ref	BH101	TP110	WS105	WS104	TP109	BH112	BH112	BH107	TP111	TP105
									Easting	384796.682	384638.835	384294.085	384569.278	384661.431	384401.713	384401.713	384824.812	384592.029	384843.779
									Northing	399802.989	399640.942	399279.174	399463.63	399650.774	399486.259	399486.259	399485.537	399655.215	399726.261
									Sample Top (m)	0.80	1.30	0.30	1.00	1.30	3.30	0.30	2.00	0.30	1.30
									Sample Date	03/01/2019	07/01/2019	10/01/2019	08/01/2019	04/01/2019	10/01/2019	10/01/2019	09/01/2019	07/01/2019	03/01/2019
									Investigation	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
									Geology	MG	MG	MG	MG	MG	CHES	MG	MG	MG	MG
Anthracene	**36600**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**14.0**			2.2	0.4	0.0	14.0		< 0.03	0.1	< 0.03	0.1	0.5
Benzo(k)fluoranthene	**107**	**#N/A**	**#N/A**	**32 of 57**	**0**	**0.0**	**6.5**			0.2	0.1	0.0	6.5		< 0.03	0.2	< 0.03	0.1	0.4
Chrysene	**31.9**	**#N/A**	**#N/A**	**39 of 57**	**0**	**0.0**	**20.0**			0.7	0.4	0.1	20.0		< 0.03	0.4	< 0.03	0.2	0.2
Pyrene	**3790**	**#N/A**	**#N/A**	**44 of 57**	**0**	**0.0**	**48.0**			2.5	1.2	0.3	48.0		< 0.03	0.9	< 0.03	0.4	0.5
Benzo (g,h,i) perylene	**359**	**#N/A**	**#N/A**	**34 of 57**	**0**	**0.0**	**9.5**			0.2	0.1	0.0	9.5		< 0.03	0.3	< 0.03	0.1	2.3
Indeno(1,2,3-cd)pyrene	**46**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**7.4**			0.1	0.1	0.0	7.4		< 0.03	0.3	< 0.03	0.1	0.5
Benzo(b)fluoranthene	**4.06**	**#N/A**	**#N/A**	**39 of 57**	**2**	**0.0**	**17.0**			0.5	0.3	0.1	17.0		< 0.03	0.5	< 0.03	0.2	0.4
Fluoranthene	**1580**	**#N/A**	**#N/A**	**43 of 57**	**0**	**0.0**	**50.0**			3.3	1.2	0.3	50.0		< 0.03	0.9	< 0.03	0.4	0.2
Benzo(a)pyrene	**3.23**	**#N/A**	**#N/A**	**35 of 57**	**2**	**0.0**	**17.0**			0.3	0.2	0.1	17.0		< 0.03	0.4	< 0.03	0.1	0.2
Benzo(a)anthracene	**15**	**#N/A**	**#N/A**	**38 of 57**	**1**	**0.0**	**19.0**			0.5	0.4	0.1	19.0		< 0.03	0.4	< 0.03	0.2	0.2
Phenanthrene	**1520**	**#N/A**	**#N/A**	**42 of 57**	**0**	**0.1**	**61.0**			0.7	1.5	0.3	61.0		< 0.03	0.4	< 0.03	0.2	0.1
Fluorene	**4460**	**#N/A**	**#N/A**	**24 of 57**	**0**	**0.0**	**13.0**			0.1	0.2	0.0	13.0		< 0.03	0.0	< 0.03	< 0.03	0.1
Pah,Total	**None**	**mg/kg**		**45 of 59**	**0**	**0.1**	**95.0**			12.0	6.5	1.4		9.9	< 0.10	4.8	< 0.10	1.8	6.4
Dibenzofuran	**3.23**	**mg/kg**	**benzo(a)pyrene**	**2 of 3**	**1**	**0.2**	**8.3**						8.3						
Aliphatics >C8-10	**155**	**mg/kg**		**1 of 59**	**0**	**4.3**	**4.3**			< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C7-8	**3928**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**			< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C8-10	**269**	**mg/kg**		**1 of 59**	**0**	**10.0**	**10.0**			< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatics >C5-6	**161**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**			< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatics >C6-8	**529**	**mg/kg**		**1 of 59**	**0**	**1.2**	**1.2**			< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C5-7	**1.4**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**			< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C12-16	**2480**	**#N/A**	**#N/A**	**16 of 59**	**0**	**0.7**	**110.0**			11.0	< 0.5	< 0.5	4.3		< 0.5	< 0.5	< 0.5	< 0.5	19.0
Aromatics >C16-21	**1817**	**#N/A**	**#N/A**	**20 of 59**	**0**	**3.9**	**150.0**			56.0	< 0.6	< 0.6	22.0		< 0.6	< 0.6	< 0.6	< 0.6	24.0
Aromatics >C10-12	**1240**	**#N/A**	**#N/A**	**11 of 59**	**0**	**1.0**	**42.0**			3.7	< 0.9	< 0.9	1.0		< 0.9	< 0.9	< 0.9	< 0.9	11.0
Aliphatics >C12-16	**4370**	**#N/A**	**#N/A**	**11 of 59**	**0**	**3.7**	**240.0**			15.0	< 1.2	< 1.2	< 1.2		< 1.2	< 1.2	< 1.2	< 1.2	< 1.2
Aromatics >C21-35	**1930**	**#N/A**	**#N/A**	**21 of 59**	**0**	**9.0**	**670.0**			670.0	< 1.4	< 1.4	47.0		< 1.4	< 1.4	< 1.4	< 1.4	98.0
Aliphatics >C16-21	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**7.2**	**160.0**			57.0	< 1.5	< 1.5	< 1.5		< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatics >C10-12	**767**	**#N/A**	**#N/A**	**7 of 59**	**0**	**1.5**	**130.0**			2.7	< 1.5	< 1.5	< 1.5		< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatics >C21-35	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**35.0**	**350.0**			350.0	< 3.4	< 3.4	< 3.4		< 3.4	< 3.4	< 3.4	< 3.4	< 3.4
Aliphatics >C5-35	**None**	**#N/A**	**#N/A**	**11 of 59**	**0**	**52.0**	**650.0**			420.0	< 10	< 10	< 10		< 10	< 10	< 10	< 10	< 10
TPH >C10-40	**None**	**mg/kg**		**8 of 8**	**0**	**31.0**	**1700.0**							38.0					

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	TP105	TP109	BH103	BH105	WS103	WS102	BH103	TP104	TP111	TP112	BH105	BH106
								384843.779	384661.431	384689.014	384463.735	384813.849	384761.314	384689.014	384780.328	384592.029	384552.675	384463.735	384459.989
								399726.261	399650.774	399695.588	399571.588	399611.16	399589.102	399695.588	399749.164	399655.215	399614.062	399571.588	399509.165
								0.30	0.30	3.20	0.70	1.00	1.00	4.80	0.30	2.50	0.30	3.30	0.30
								03/01/2019	04/01/2019	04/01/2019	04/01/2019	07/01/2019	07/01/2019	04/01/2019	03/01/2019	07/01/2019	07/01/2019	08/01/2019	07/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	MG	MG	MG	MG	MM	MG	CHES	MG	ALV	MG
Asbestos Analysts Comments	#N/A	#N/A	#N/A	0 of 56	7	0.0	0.0	microscopic b	na	na	na	resent in smal	na	na	na		na	na	na
Asbestos (Presence of)	Presence	#N/A		7 of 56	7	0.0	0.0	Chrysotile	NAD	NAD	NAD	Amosite	NAD	NAD	NAD		NAD	NAD	NAD
pH	None	-		64 of 64	0	6.1	11.7	8.4	7.6	8.5	8.3	8.5	8.5	8.7	7.7	7.7	6.1	8.2	6.9
Cyanide	800	mg/kg	#N/A	36 of 64	0	0.1	89.0	8.1	0.8	< 0.1	0.1	0.4	0.4	< 0.1	0.2	< 0.1	< 0.1	< 0.1	0.5
Sulphate as SO4	#N/A	mg/l	#N/A	2 of 2	0	49.0	55.0												
Mercury	13.6	mg/kg	#N/A	46 of 64	1	0.1	18.0	0.9	18.0	< 0.05	0.1	0.7	0.6	< 0.05	0.3	< 0.05	0.5	< 0.05	0.4
Cadmium	85	mg/kg	#N/A	60 of 64	0	0.1	4.7	0.5	0.5	0.2	0.2	0.3	0.5	0.4	0.7	0.1	0.3	0.1	1.0
Chromium	907	mg/kg	#N/A	64 of 64	0	5.7	48.0	22.0	19.0	19.0	23.0	16.0	12.0	24.0	48.0	13.0	18.0	18.0	22.0
Arsenic	39.9	mg/kg	#N/A	64 of 64	6	4.1	71.0	19.0	28.0	6.1	11.0	14.0	12.0	12.0	23.0	4.5	19.0	10.0	40.0
Beryllium	1.72	mg/kg	#N/A	62 of 64	13	0.2	3.9	1.3	2.6	0.7	0.9	0.6	0.6	0.8	1.5	0.6	2.2	0.7	1.3
Copper	7130	mg/kg	#N/A	64 of 64	0	8.9	4200.0	94.0	300.0	46.0	31.0	60.0	80.0	9.1	150.0	14.0	270.0	18.0	210.0
Lead	310	mg/kg	#N/A	64 of 64	15	12.0	12000.0	240.0	1300.0	28.0	26.0	490.0	280.0	13.0	210.0	12.0	290.0	12.0	370.0
Selenium	430	mg/kg	#N/A	5 of 64	0	0.5	1.0	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1.0
Vanadium	651	mg/kg	#N/A	64 of 64	0	8.7	160.0	33.0	53.0	22.0	27.0	24.0	19.0	28.0	160.0	16.0	54.0	26.0	52.0
Antimony	618	mg/kg	#N/A	56 of 64	0	1.0	180.0	2.2	4.1	1.3	1.5	11.0	1.5	1.3	3.8	< 1.0	55.0	1.1	21.0
Chromium - Hexavalent	21	mg/kg	#N/A	0 of 61	0	0.0	0.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0		< 1.0	< 1.0	< 1.0
Nickel	181	mg/kg	#N/A	64 of 64	0	6.5	53.0	27.0	39.0	22.0	27.0	15.0	11.0	29.0	32.0	15.0	38.0	18.0	38.0
Zinc	40400	mg/kg	#N/A	64 of 64	0	28.0	1700.0	170.0	310.0	99.0	97.0	220.0	140.0	69.0	180.0	28.0	120.0	54.0	340.0
m,p xylenes	427.6926186	mg/kg	p-Xylene	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
4-Isopropyltoluene	1240	mg/kg	Aromatic >EC1	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Isopropylbenzene	95.4	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Tert-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,2,3-Trichloropropane	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,2-Dibromo-3-Chloropropane	None	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,2,4-Trimethylbenzene	3.31	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Ethylbenzene	439.7179703	mg/kg		0 of 64	0	0.0	0.0	< 0.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	3927.6251	mg/kg		0 of 64	0	0.0	0.0	< 0.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	427.6926186	mg/kg	p-Xylene	1 of 59	0	1.9	1.9		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01
Benzene	1.42187881	mg/kg		0 of 64	0	0.0	0.0	< 0.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2-Dichlorobenzene	133	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
2-Chlorotoluene	2.41	mg/kg	chlorobenzene	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
O-Xylene	475.7207618	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Hexachlorobutadiene (HCBD)	1.79	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,2,3 Trichlorobenzene	8.81	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Trichloroethene	0.0797	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,1,2-Trichloroethane	5.53	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,2-Dichloropropane	0.121	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,1-Dichloroethene	1.17	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,1-Dichloroethane	10.9	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Bromodichloromethane	0.096	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Tribromomethane	None	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Chloroethene	0.00153	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Bromochloromethane	None	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Dibromomethane	0.096	mg/kg	hodichloromet	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,1,1-Trichloroethane	40.4	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Chloroform	4.22	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,1,1,2-Tetrachloroethane	8.2	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
2,2-Dichloropropane	None	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,1-Dichloropropene	3.3	mg/kg	Benzene	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
trachloromethane (Carbon Tetra Chlorid	0.128	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
cis1,3-Dichloropropene	None	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,3-Dichlorobenzene	2.45	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Methyl tert-butyl ether (MTBE)	319	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
trans-1,2-Dichloroethene	1.02	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
cis-1,2-Dichloroethene	0.559	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,3-Dichloropropane	None	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Sec-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Tetrachloroethene	0.92	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Dibromochloromethane	None	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,2,4-Trichlorobenzene	15.3	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	TP105	TP109	BH103	BH105	WS103	WS102	BH103	TP104	TP111	TP112	BH105	BH106
								384843.779	384661.431	384689.014	384463.735	384813.849	384761.314	384689.014	384780.328	384592.029	384552.675	384463.735	384459.989
								399726.261	399650.774	399695.588	399571.588	399611.16	399589.102	399695.588	399749.164	399655.215	399614.062	399571.588	399509.165
								0.30	0.30	3.20	0.70	1.00	1.00	4.80	0.30	2.50	0.30	3.30	0.30
								03/01/2019	04/01/2019	04/01/2019	04/01/2019	07/01/2019	07/01/2019	04/01/2019	03/01/2019	07/01/2019	07/01/2019	08/01/2019	07/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	MG	MG	MG	MG	MM	MG	CHES	MG	ALV	MG
Chlorobenzene	2.41	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Bromobenzene	6.96	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,3,5-Trimethylbenzene	3.31	mg/kg	-Trimethylben	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,2-Dibromoethane	0.096	mg/kg	nodichlorometl	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,4-Dichlorobenzene	332	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
4-Chlorotoluene	2.41	mg/kg	chlorobenzene	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
n-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0	< 0.10							< 0.01				
n-propylbenzene	323	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
trans-1,3-Dichloropropene	None	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Styrene	236	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
1,2-Dichloroethane	0.0227	mg/kg		0 of 5	0	0.0	0.0	< 0.10							< 0.01				
Acenaphthylene	5970	#N/A	#N/A	13 of 57	0	0.0	7.7		< 0.03	< 0.03	< 0.03	0.1	< 0.03	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03
Dibenz-a-h-anthracene	0.32	#N/A	#N/A	18 of 57	2	0.0	2.4		< 0.03	< 0.03	< 0.03	0.2	< 0.03	< 0.03		< 0.03	< 0.03	< 0.03	0.0
Acenaphthene	6040	#N/A	#N/A	26 of 57	0	0.0	6.1		0.0	0.0	< 0.03	6.1	0.0	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03
Total BTEX	None	mg/kg		0 of 8	0	0.0	0.0						< 0.04						< 0.04
4-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0												
4-Nitrophenol	None	mg/kg		1 of 3	0	6.2	6.2												
Dimethylphthalate	None	mg/kg		0 of 3	0	0.0	0.0												
P-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0												
Benzyl Alcohol	None	mg/kg		0 of 3	0	0.0	0.0												
4-Bromophenyl Phenyl Ether	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0												
Azobenzene	None	mg/kg		0 of 3	0	0.0	0.0												
2,4-Dimethylphenol	1040	mg/kg		1 of 3	0	0.2	0.2												
Phenol	1200	mg/kg		1 of 3	0	0.3	0.3												
Bis(2-chloroethoxy)methane	None	mg/kg		0 of 3	0	0.0	0.0												
Bis(2-ethylhexyl)phthalate	4090	mg/kg		0 of 3	0	0.0	0.0												
Di-N-Octyl Phthalate	4920	mg/kg		0 of 3	0	0.0	0.0												
Hexachlorobenzene (HCB)	6.38	mg/kg		0 of 3	0	0.0	0.0												
2,4-Dichlorophenol	186	mg/kg		0 of 3	0	0.0	0.0												
2,4-Dinitrotoluene	254	mg/kg		0 of 3	0	0.0	0.0												
Diphenylamine	None	mg/kg		0 of 3	0	0.0	0.0												
Bis(2-chloroisopropyl)ether	None	mg/kg		0 of 3	0	0.0	0.0												
O-Dinitrobenzene	None	mg/kg		1 of 3	0	11.0	11.0												
2-Methyl-4,6-Dinitrophenol	None	mg/kg		0 of 3	0	0.0	0.0												
2,3,4,6-Tetrachlorophenol	229	mg/kg		0 of 3	0	0.0	0.0												
4-Chloro-3-Methylphenol	None	mg/kg		0 of 3	0	0.0	0.0												
2,6-Dinitrotoluene	125	mg/kg		0 of 3	0	0.0	0.0												
Aniline	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0												
4-Chlorophenyl Phenyl Ether	None	mg/kg		0 of 3	0	0.0	0.0												
Hexachlorocyclopentadiene	None	mg/kg		0 of 3	0	0.0	0.0												
Diethylphthalate	8970	mg/kg		0 of 3	0	0.0	0.0												
Di-N-Butyl Phthalate	645	mg/kg		0 of 3	0	0.0	0.0												
Butylbenzylphthalate	63800	mg/kg		0 of 3	0	0.0	0.0												
Carbazole	None	mg/kg		1 of 3	0	3.5	3.5												
Pentachlorophenol (PCP)	30.6	mg/kg		0 of 3	0	0.0	0.0												
2,4,6-Trichlorophenol	231	mg/kg		0 of 3	0	0.0	0.0												
2-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0												
2-Methylnaphthalene	13.2	mg/kg	naphthalene	1 of 3	0	8.8	8.8												
2-Chloronaphthalene	31.6	mg/kg		0 of 3	0	0.0	0.0												
2,3,5,6-Tetrachlorophenol	None	mg/kg		0 of 3	0	0.0	0.0												
2-Methylphenol	9930	mg/kg		1 of 3	0	0.2	0.2												
2-Chlorophenol	207	mg/kg		0 of 3	0	0.0	0.0												
2,4,5-Trichlorophenol	231	mg/kg	6-Trichlorophe	0 of 3	0	0.0	0.0												
3-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0												
M-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0												
3/4 Methylphenol	10000	mg/kg		1 of 3	0	0.4	0.4												
Phenol (Monohydric)	1200	#N/A	#N/A	23 of 64	0	0.4	12.0	0.7	0.5	0.4	< 0.3	12.0	< 0.3	0.4	0.8	0.4	< 0.3	< 0.3	< 0.3
Loss on ignition	None	%		8 of 8	0	1.3	11.0						3.1						11.0
Total Organic Carbon	None	%		63 of 64	0	0.5	41.0	5.3	27.0	1.2	1.6	3.4	2.1	< 0.5	18.0	0.5	13.0	0.6	24.0
Napthalene	13.2	mg/kg		25 of 59	1	0.0	18.0	< 0.10	< 0.03	0.0	< 0.03	18.0	< 0.03	< 0.03	< 0.01	< 0.03	0.0	< 0.03	0.0

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	TP105	TP109	BH103	BH105	WS103	WS102	BH103	TP104	TP111	TP112	BH105	BH106
								384843.779	384661.431	384689.014	384463.735	384813.849	384761.314	384689.014	384780.328	384592.029	384552.675	384463.735	384459.989
								399726.261	399650.774	399695.588	399571.588	399611.16	399589.102	399695.588	399749.164	399655.215	399614.062	399571.588	399509.165
								0.30	0.30	3.20	0.70	1.00	1.00	4.80	0.30	2.50	0.30	3.30	0.30
								03/01/2019	04/01/2019	04/01/2019	04/01/2019	07/01/2019	07/01/2019	04/01/2019	03/01/2019	07/01/2019	07/01/2019	08/01/2019	07/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	MG	MG	MG	MG	MM	MG	CHES	MG	ALV	MG
Anthracene	**36600**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**14.0**		0.0	0.1	< 0.03	3.7	0.1	< 0.03		< 0.03	< 0.03	< 0.03	0.1
Benzo(k)fluoranthene	**107**	**#N/A**	**#N/A**	**32 of 57**	**0**	**0.0**	**6.5**		0.1	< 0.03	< 0.03	1.2	0.1	< 0.03		< 0.03	< 0.03	< 0.03	0.2
Chrysene	**31.9**	**#N/A**	**#N/A**	**39 of 57**	**0**	**0.0**	**20.0**		0.2	0.1	< 0.03	4.4	0.3	< 0.03		< 0.03	0.1	< 0.03	0.4
Pyrene	**3790**	**#N/A**	**#N/A**	**44 of 57**	**0**	**0.0**	**48.0**		0.4	0.2	0.0	13.0	0.7	< 0.03		< 0.03	0.1	< 0.03	0.5
Benzo (g,h,i) perylene	**359**	**#N/A**	**#N/A**	**34 of 57**	**0**	**0.0**	**9.5**		0.1	< 0.03	0.1	0.9	0.2	< 0.03		< 0.03	< 0.03	< 0.03	0.2
Indeno(1,2,3-cd)pyrene	**46**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**7.4**		0.1	< 0.03	< 0.03	0.8	0.1	< 0.03		< 0.03	< 0.03	< 0.03	0.1
Benzo(b)fluoranthene	**4.06**	**#N/A**	**#N/A**	**39 of 57**	**2**	**0.0**	**17.0**		0.2	0.1	0.0	2.9	0.4	< 0.03		< 0.03	0.1	< 0.03	0.4
Fluoranthene	**1580**	**#N/A**	**#N/A**	**43 of 57**	**0**	**0.0**	**50.0**		0.4	0.2	< 0.03	13.0	0.7	< 0.03		< 0.03	0.1	< 0.03	0.5
Benzo(a)pyrene	**3.23**	**#N/A**	**#N/A**	**35 of 57**	**2**	**0.0**	**17.0**		0.1	0.0	< 0.03	2.7	0.3	< 0.03		< 0.03	< 0.03	< 0.03	0.3
Benzo(a)anthracene	**15**	**#N/A**	**#N/A**	**38 of 57**	**1**	**0.0**	**19.0**		0.2	0.1	< 0.03	3.7	0.3	< 0.03		< 0.03	0.0	< 0.03	0.3
Phenanthrene	**1520**	**#N/A**	**#N/A**	**42 of 57**	**0**	**0.1**	**61.0**		0.3	0.2	< 0.03	20.0	0.4	< 0.03		< 0.03	0.1	< 0.03	0.2
Fluorene	**4460**	**#N/A**	**#N/A**	**24 of 57**	**0**	**0.0**	**13.0**		< 0.03	0.0	< 0.03	4.0	< 0.03	< 0.03		< 0.03	< 0.03	< 0.03	< 0.03
Pah,Total	**None**	**mg/kg**		**45 of 59**	**0**	**0.1**	**95.0**		2.0	0.9	0.1	95.0	3.6	< 0.10		< 0.10	0.5	< 0.10	3.2
Dibenzofuran	**3.23**	**mg/kg**	**benzo(a)pyrene**	**2 of 3**	**1**	**0.2**	**8.3**												
Aliphatics >C8-10	**155**	**mg/kg**		**1 of 59**	**0**	**4.3**	**4.3**	4.3	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C7-8	**3928**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C8-10	**269**	**mg/kg**		**1 of 59**	**0**	**10.0**	**10.0**	< 0.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatics >C5-6	**161**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatics >C6-8	**529**	**mg/kg**		**1 of 59**	**0**	**1.2**	**1.2**	< 0.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C5-7	**1.4**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.10	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C12-16	**2480**	**#N/A**	**#N/A**	**16 of 59**	**0**	**0.7**	**110.0**	41.0	< 0.5	< 0.5	< 0.5	28.0	< 0.5	< 0.5	25.0	< 0.5	< 0.5	< 0.5	1.4
Aromatics >C16-21	**1817**	**#N/A**	**#N/A**	**20 of 59**	**0**	**3.9**	**150.0**	40.0	< 0.6	< 0.6	< 0.6	75.0	< 0.6	< 0.6	85.0	< 0.6	< 0.6	< 0.6	3.9
Aromatics >C10-12	**1240**	**#N/A**	**#N/A**	**11 of 59**	**0**	**1.0**	**42.0**	27.0	< 0.9	< 0.9	< 0.9	8.6	< 0.9	< 0.9	12.0	< 0.9	< 0.9	< 0.9	< 0.9
Aliphatics >C12-16	**4370**	**#N/A**	**#N/A**	**11 of 59**	**0**	**3.7**	**240.0**	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	16.0	< 1.2	< 1.2	< 1.2	< 1.2
Aromatics >C21-35	**1930**	**#N/A**	**#N/A**	**21 of 59**	**0**	**9.0**	**670.0**	160.0	< 1.4	< 1.4	< 1.4	88.0	< 1.4	< 1.4	200.0	< 1.4	< 1.4	17.0	14.0
Aliphatics >C16-21	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**7.2**	**160.0**	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	72.0	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatics >C10-12	**767**	**#N/A**	**#N/A**	**7 of 59**	**0**	**1.5**	**130.0**	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatics >C21-35	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**35.0**	**350.0**	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4	230.0	< 3.4	< 3.4	< 3.4	< 3.4
Aliphatics >C5-35	**None**	**#N/A**	**#N/A**	**11 of 59**	**0**	**52.0**	**650.0**	< 76.3	< 10	< 10	< 10	< 10	< 10	< 10	320.0	< 10	< 10	< 10	< 10
TPH >C10-40	**None**	**mg/kg**		**8 of 8**	**0**	**31.0**	**1700.0**						61.0						48.0

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	TP103	TP122	TP108	BH106	TP107	BH102	BH106	BH109	BH104	BH103	BH104	BH101
								384772.82	384423.36	384655.011	384459.989	384737.823	384763.18	384459.989	384562.256	384607.46	384689.014	384607.46	384796.682
								399769.313	399438.117	399693.93	399509.165	399704.019	399691.375	399509.165	399392.535	399631.24	399695.588	399631.24	399802.989
								1.80	0.30	0.30	3.30	1.20	3.50	7.60	1.20	4.70	0.30	9.70	4.80
								03/01/2019	11/01/2019	04/01/2019	08/01/2019	03/01/2019	03/01/2019	08/01/2019	09/01/2019	04/01/2019	04/01/2019	07/01/2019	03/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								GTD	MG	MG	MG	MG	MG	GTD	MG	MG	MG	MG	MG
Asbestos Analysts Comments	#N/A	#N/A	#N/A	0 of 56	7	0.0	0.0		na	na	na		na	na	na	na	na	na	na
Asbestos (Presence of)	Presence	#N/A		7 of 56	7	0.0	0.0		NAD	NAD	NAD		NAD	NAD	NAD	NAD	NAD	NAD	NAD
pH	None	-		64 of 64	0	6.1	11.7	8.1	8.1	7.6	7.9	7.2	8.3	7.7	11.4	9.7	9.1	7.8	8.3
Cyanide	800	mg/kg	#N/A	36 of 64	0	0.1	89.0	< 0.1	< 0.1	0.1	0.2	0.2	< 0.1	1.1	< 0.1	< 0.1	0.6	2.4	0.1
Sulphate as SO4	#N/A	mg/l	#N/A	2 of 2	0	49.0	55.0		49.0										
Mercury	13.6	mg/kg	#N/A	46 of 64	1	0.1	18.0	< 0.05	0.2	< 0.05	0.4	0.3	0.2	0.1	0.2	< 0.05	0.3	0.4	0.1
Cadmium	85	mg/kg	#N/A	60 of 64	0	0.1	4.7	0.2	0.4	0.4	0.5	0.2	0.2	< 0.1	0.5	0.2	0.6	0.2	0.2
Chromium	907	mg/kg	#N/A	64 of 64	0	5.7	48.0	22.0	15.0	36.0	27.0	23.0	16.0	18.0	17.0	20.0	19.0	22.0	20.0
Arsenic	39.9	mg/kg	#N/A	64 of 64	6	4.1	71.0	8.1	23.0	37.0	28.0	12.0	9.3	11.0	6.7	8.2	9.5	19.0	9.5
Beryllium	1.72	mg/kg	#N/A	62 of 64	13	0.2	3.9	0.8	1.3	1.0	1.6	0.9	0.8	0.5	0.4	0.7	0.5	2.1	0.8
Copper	7130	mg/kg	#N/A	64 of 64	0	8.9	4200.0	27.0	280.0	130.0	180.0	43.0	27.0	26.0	19.0	33.0	100.0	100.0	28.0
Lead	310	mg/kg	#N/A	64 of 64	15	12.0	12000.0	13.0	730.0	100.0	210.0	39.0	91.0	45.0	77.0	42.0	230.0	75.0	53.0
Selenium	430	mg/kg	#N/A	5 of 64	0	0.5	1.0	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	0.7	< 0.5
Vanadium	651	mg/kg	#N/A	64 of 64	0	8.7	160.0	27.0	29.0	74.0	46.0	33.0	22.0	17.0	21.0	26.0	21.0	34.0	26.0
Antimony	618	mg/kg	#N/A	56 of 64	0	1.0	180.0	< 1.0	59.0	7.9	7.8	1.2	1.2	1.4	1.4	1.2	5.0	1.8	1.1
Chromium - Hexavalent	21	mg/kg	#N/A	0 of 61	0	0.0	0.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nickel	181	mg/kg	#N/A	64 of 64	0	6.5	53.0	29.0	24.0	33.0	34.0	29.0	19.0	12.0	11.0	24.0	17.0	53.0	25.0
Zinc	40400	mg/kg	#N/A	64 of 64	0	28.0	1700.0	65.0	260.0	130.0	160.0	62.0	88.0	50.0	74.0	79.0	300.0	120.0	61.0
m,p xylenes	427.6926186	mg/kg	p-Xylene	0 of 5	0	0.0	0.0												
4-Isopropyltoluene	1240	mg/kg	Aromatic >EC1	0 of 5	0	0.0	0.0												
Isopropylbenzene	95.4	mg/kg		0 of 5	0	0.0	0.0												
Tert-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0												
1,2,3-Trichloropropane	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0												
1,2-Dibromo-3-Chloropropane	None	mg/kg		0 of 5	0	0.0	0.0												
1,2,4-Trimethylbenzene	3.31	mg/kg		0 of 5	0	0.0	0.0												
Ethylbenzene	439.7179703	mg/kg		0 of 64	0	0.0	0.0	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	3927.6251	mg/kg		0 of 64	0	0.0	0.0	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	427.6926186	mg/kg	p-Xylene	1 of 59	0	1.9	1.9	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	1.9	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene	1.42187881	mg/kg		0 of 64	0	0.0	0.0	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2-Dichlorobenzene	133	mg/kg		0 of 5	0	0.0	0.0												
2-Chlorotoluene	2.41	mg/kg	chlorobenzene	0 of 5	0	0.0	0.0												
O-Xylene	475.7207618	mg/kg		0 of 5	0	0.0	0.0												
Hexachlorobutadiene (HCBD)	1.79	mg/kg		0 of 5	0	0.0	0.0												
1,2,3 Trichlorobenzene	8.81	mg/kg		0 of 5	0	0.0	0.0												
Trichloroethene	0.0797	mg/kg		0 of 5	0	0.0	0.0												
1,1,2-Trichloroethane	5.53	mg/kg		0 of 5	0	0.0	0.0												
1,2-Dichloropropane	0.121	mg/kg		0 of 5	0	0.0	0.0												
1,1-Dichloroethene	1.17	mg/kg		0 of 5	0	0.0	0.0												
1,1-Dichloroethane	10.9	mg/kg		0 of 5	0	0.0	0.0												
Bromodichloromethane	0.096	mg/kg		0 of 5	0	0.0	0.0												
Tribromomethane	None	mg/kg		0 of 5	0	0.0	0.0												
Chloroethene	0.00153	mg/kg		0 of 5	0	0.0	0.0												
Bromochloromethane	None	mg/kg		0 of 5	0	0.0	0.0												
Dibromomethane	0.096	mg/kg	hodichlorometl	0 of 5	0	0.0	0.0												
1,1,1-Trichloroethane	40.4	mg/kg		0 of 5	0	0.0	0.0												
Chloroform	4.22	mg/kg		0 of 5	0	0.0	0.0												
1,1,1,2-Tetrachloroethane	8.2	mg/kg		0 of 5	0	0.0	0.0												
2,2-Dichloropropane	None	mg/kg		0 of 5	0	0.0	0.0												
1,1-Dichloropropene	3.3	mg/kg	Benzene	0 of 5	0	0.0	0.0												
trachloromethane (Carbon Tetra Chlorid	0.128	mg/kg		0 of 5	0	0.0	0.0												
cis1,3-Dichloropropene	None	mg/kg		0 of 5	0	0.0	0.0												
1,3-Dichlorobenzene	2.45	mg/kg		0 of 5	0	0.0	0.0												
Methyl tert-butyl ether (MTBE)	319	mg/kg		0 of 5	0	0.0	0.0												
trans-1,2-Dichloroethene	1.02	mg/kg		0 of 5	0	0.0	0.0												
cis-1,2-Dichloroethene	0.559	mg/kg		0 of 5	0	0.0	0.0												
1,3-Dichloropropane	None	mg/kg		0 of 5	0	0.0	0.0												
Sec-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0												
Tetrachloroethene	0.92	mg/kg		0 of 5	0	0.0	0.0												
Dibromochloromethane	None	mg/kg		0 of 5	0	0.0	0.0												
1,2,4-Trichlorobenzene	15.3	mg/kg		0 of 5	0	0.0	0.0												

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	TP103	TP122	TP108	BH106	TP107	BH102	BH106	BH109	BH104	BH103	BH104	BH101
								384772.82	384423.36	384655.011	384459.989	384737.823	384763.18	384459.989	384562.256	384607.46	384689.014	384607.46	384796.682
								399769.313	399438.117	399693.93	399509.165	399704.019	399691.375	399509.165	399392.535	399631.24	399695.588	399631.24	399802.989
								1.80	0.30	0.30	3.30	1.20	3.50	7.60	1.20	4.70	0.30	9.70	4.80
								03/01/2019	11/01/2019	04/01/2019	08/01/2019	03/01/2019	03/01/2019	08/01/2019	09/01/2019	04/01/2019	04/01/2019	07/01/2019	03/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								GTD	MG	MG	MG	MG	MG	GTD	MG	MG	MG	MG	MG
Chlorobenzene	2.41	mg/kg		0 of 5	0	0.0	0.0												
Bromobenzene	6.96	mg/kg		0 of 5	0	0.0	0.0												
1,3,5-Trimethylbenzene	3.31	mg/kg	-Trimethylben	0 of 5	0	0.0	0.0												
1,2-Dibromoethane	0.096	mg/kg	nodichlorometl	0 of 5	0	0.0	0.0												
1,4-Dichlorobenzene	332	mg/kg		0 of 5	0	0.0	0.0												
4-Chlorotoluene	2.41	mg/kg	chlorobenzene	0 of 5	0	0.0	0.0												
n-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0												
n-propylbenzene	323	mg/kg		0 of 5	0	0.0	0.0												
trans-1,3-Dichloropropene	None	mg/kg		0 of 5	0	0.0	0.0												
Styrene	236	mg/kg		0 of 5	0	0.0	0.0												
1,2-Dichloroethane	0.0227	mg/kg		0 of 5	0	0.0	0.0												
Acenaphthylene	5970	#N/A	#N/A	13 of 57	0	0.0	7.7	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.1	< 0.03	< 0.03
Dibenz-a-h-anthracene	0.32	#N/A	#N/A	18 of 57	2	0.0	2.4	< 0.03	< 0.03	0.0	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	< 0.03	0.0	< 0.03	< 0.03
Acenaphthene	6040	#N/A	#N/A	26 of 57	0	0.0	6.1	< 0.03	< 0.03	0.6	0.0	< 0.03	0.1	< 0.03	0.2	< 0.03	0.3	0.1	< 0.03
Total BTEX	None	mg/kg		0 of 8	0	0.0	0.0												
4-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0												
4-Nitrophenol	None	mg/kg		1 of 3	0	6.2	6.2												
Dimethylphthalate	None	mg/kg		0 of 3	0	0.0	0.0												
P-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0												
Benzyl Alcohol	None	mg/kg		0 of 3	0	0.0	0.0												
4-Bromophenyl Phenyl Ether	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0												
Azobenzene	None	mg/kg		0 of 3	0	0.0	0.0												
2,4-Dimethylphenol	1040	mg/kg		1 of 3	0	0.2	0.2												
Phenol	1200	mg/kg		1 of 3	0	0.3	0.3												
Bis(2-chloroethoxy)methane	None	mg/kg		0 of 3	0	0.0	0.0												
Bis(2-ethylhexyl)phthalate	4090	mg/kg		0 of 3	0	0.0	0.0												
Di-N-Octyl Phthalate	4920	mg/kg		0 of 3	0	0.0	0.0												
Hexachlorobenzene (HCB)	6.38	mg/kg		0 of 3	0	0.0	0.0												
2,4-Dichlorophenol	186	mg/kg		0 of 3	0	0.0	0.0												
2,4-Dinitrotoluene	254	mg/kg		0 of 3	0	0.0	0.0												
Diphenylamine	None	mg/kg		0 of 3	0	0.0	0.0												
Bis(2-chloroisopropyl)ether	None	mg/kg		0 of 3	0	0.0	0.0												
O-Dinitrobenzene	None	mg/kg		1 of 3	0	11.0	11.0												
2-Methyl-4,6-Dinitrophenol	None	mg/kg		0 of 3	0	0.0	0.0												
2,3,4,6-Tetrachlorophenol	229	mg/kg		0 of 3	0	0.0	0.0												
4-Chloro-3-Methylphenol	None	mg/kg		0 of 3	0	0.0	0.0												
2,6-Dinitrotoluene	125	mg/kg		0 of 3	0	0.0	0.0												
Aniline	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0												
4-Chlorophenyl Phenyl Ether	None	mg/kg		0 of 3	0	0.0	0.0												
Hexachlorocyclopentadiene	None	mg/kg		0 of 3	0	0.0	0.0												
Diethylphthalate	8970	mg/kg		0 of 3	0	0.0	0.0												
Di-N-Butyl Phthalate	645	mg/kg		0 of 3	0	0.0	0.0												
Butylbenzylphthalate	63800	mg/kg		0 of 3	0	0.0	0.0												
Carbazole	None	mg/kg		1 of 3	0	3.5	3.5												
Pentachlorophenol (PCP)	30.6	mg/kg		0 of 3	0	0.0	0.0												
2,4,6-Trichlorophenol	231	mg/kg		0 of 3	0	0.0	0.0												
2-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0												
2-Methylnaphthalene	13.2	mg/kg	naphthalene	1 of 3	0	8.8	8.8												
2-Chloronaphthalene	31.6	mg/kg		0 of 3	0	0.0	0.0												
2,3,5,6-Tetrachlorophenol	None	mg/kg		0 of 3	0	0.0	0.0												
2-Methylphenol	9930	mg/kg		1 of 3	0	0.2	0.2												
2-Chlorophenol	207	mg/kg		0 of 3	0	0.0	0.0												
2,4,5-Trichlorophenol	231	mg/kg	6-Trichlorophe	0 of 3	0	0.0	0.0												
3-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0												
M-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0												
3/4 Methylphenol	10000	mg/kg		1 of 3	0	0.4	0.4												
Phenol (Monohydric)	1200	#N/A	#N/A	23 of 64	0	0.4	12.0	< 0.3	< 0.3	0.5	< 0.3	0.4	0.9	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3	< 0.3
Loss on ignition	None	%		8 of 8	0	1.3	11.0												
Total Organic Carbon	None	%		63 of 64	0	0.5	41.0	2.0	3.7	12.0	21.0	4.7	3.1	2.6	1.6	2.2	7.1	13.0	1.8
Napthalene	13.2	mg/kg		25 of 59	1	0.0	18.0	< 0.03	< 0.03	0.3	0.1	< 0.03	< 0.03	< 0.03	0.2	< 0.03	0.6	0.1	< 0.03

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	TP103	TP122	TP108	BH106	TP107	BH102	BH106	BH109	BH104	BH103	BH104	BH101
								384772.82	384423.36	384655.011	384459.989	384737.823	384763.18	384459.989	384562.256	384607.46	384689.014	384607.46	384796.682
								399769.313	399438.117	399693.93	399509.165	399704.019	399691.375	399509.165	399392.535	399631.24	399695.588	399631.24	399802.989
								1.80	0.30	0.30	3.30	1.20	3.50	7.60	1.20	4.70	0.30	9.70	4.80
								03/01/2019	11/01/2019	04/01/2019	08/01/2019	03/01/2019	03/01/2019	08/01/2019	09/01/2019	04/01/2019	04/01/2019	07/01/2019	03/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								GTD	MG	MG	MG	MG	MG	GTD	MG	MG	MG	MG	MG
Anthracene	**36600**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**14.0**	< 0.03	< 0.03	0.6	0.1	< 0.03	0.1	< 0.03	0.2	< 0.03	0.4	0.1	< 0.03
Benzo(k)fluoranthene	**107**	**#N/A**	**#N/A**	**32 of 57**	**0**	**0.0**	**6.5**	< 0.03	< 0.03	0.2	0.1	< 0.03	< 0.03	< 0.03	0.1	< 0.03	0.1	0.1	< 0.03
Chrysene	**31.9**	**#N/A**	**#N/A**	**39 of 57**	**0**	**0.0**	**20.0**	< 0.03	< 0.03	0.8	0.2	< 0.03	0.1	< 0.03	0.4	< 0.03	0.4	0.3	< 0.03
Pyrene	**3790**	**#N/A**	**#N/A**	**44 of 57**	**0**	**0.0**	**48.0**	< 0.03	< 0.03	2.5	0.4	0.0	0.2	< 0.03	0.9	0.0	1.0	0.6	0.1
Benzo (g,h,i) perylene	**359**	**#N/A**	**#N/A**	**34 of 57**	**0**	**0.0**	**9.5**	< 0.03	< 0.03	0.2	0.1	< 0.03	< 0.03	< 0.03	0.1	< 0.03	0.1	0.1	< 0.03
Indeno(1,2,3-cd)pyrene	**46**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**7.4**	< 0.03	< 0.03	0.1	0.1	< 0.03	< 0.03	< 0.03	0.1	< 0.03	0.1	0.1	< 0.03
Benzo(b)fluoranthene	**4.06**	**#N/A**	**#N/A**	**39 of 57**	**2**	**0.0**	**17.0**	< 0.03	< 0.03	0.5	0.2	< 0.03	0.1	< 0.03	0.3	< 0.03	0.3	0.2	< 0.03
Fluoranthene	**1580**	**#N/A**	**#N/A**	**43 of 57**	**0**	**0.0**	**50.0**	< 0.03	< 0.03	2.5	0.4	0.0	0.2	< 0.03	0.9	0.0	1.1	0.6	0.0
Benzo(a)pyrene	**3.23**	**#N/A**	**#N/A**	**35 of 57**	**2**	**0.0**	**17.0**	< 0.03	< 0.03	0.4	0.1	< 0.03	0.0	< 0.03	0.2	< 0.03	0.2	0.2	< 0.03
Benzo(a)anthracene	**15**	**#N/A**	**#N/A**	**38 of 57**	**1**	**0.0**	**19.0**	< 0.03	< 0.03	0.7	0.2	< 0.03	0.1	< 0.03	0.3	< 0.03	0.3	0.2	< 0.03
Phenanthrene	**1520**	**#N/A**	**#N/A**	**42 of 57**	**0**	**0.1**	**61.0**	< 0.03	< 0.03	2.5	0.4	< 0.03	0.3	< 0.03	1.0	0.1	1.4	0.6	0.1
Fluorene	**4460**	**#N/A**	**#N/A**	**24 of 57**	**0**	**0.0**	**13.0**	< 0.03	< 0.03	0.5	< 0.03	< 0.03	0.1	< 0.03	0.1	< 0.03	0.5	0.1	< 0.03
Pah,Total	**None**	**mg/kg**		**45 of 59**	**0**	**0.1**	**95.0**	< 0.10	< 0.10	12.0	2.1	< 0.10	1.2	< 0.10	5.2	0.1	6.8	3.4	0.2
Dibenzofuran	**3.23**	**mg/kg**	**benzo(a)pyrene**	**2 of 3**	**1**	**0.2**	**8.3**												
Aliphatics >C8-10	**155**	**mg/kg**		**1 of 59**	**0**	**4.3**	**4.3**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C7-8	**3928**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C8-10	**269**	**mg/kg**		**1 of 59**	**0**	**10.0**	**10.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	10.0	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatics >C5-6	**161**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatics >C6-8	**529**	**mg/kg**		**1 of 59**	**0**	**1.2**	**1.2**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	1.2	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C5-7	**1.4**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C12-16	**2480**	**#N/A**	**#N/A**	**16 of 59**	**0**	**0.7**	**110.0**	< 0.5	< 0.5	19.0	< 0.5	< 0.5	110.0	< 0.5	< 0.5	< 0.5	37.0	0.7	< 0.5
Aromatics >C16-21	**1817**	**#N/A**	**#N/A**	**20 of 59**	**0**	**3.9**	**150.0**	< 0.6	< 0.6	39.0	6.1	< 0.6	150.0	< 0.6	5.5	< 0.6	85.0	4.3	< 0.6
Aromatics >C10-12	**1240**	**#N/A**	**#N/A**	**11 of 59**	**0**	**1.0**	**42.0**	< 0.9	< 0.9	13.0	< 0.9	< 0.9	42.0	< 0.9	< 0.9	< 0.9	6.8	< 0.9	< 0.9
Aliphatics >C12-16	**4370**	**#N/A**	**#N/A**	**11 of 59**	**0**	**3.7**	**240.0**	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	240.0	< 1.2	5.8	< 1.2	56.0	< 1.2	< 1.2
Aromatics >C21-35	**1930**	**#N/A**	**#N/A**	**21 of 59**	**0**	**9.0**	**670.0**	< 1.4	< 1.4	68.0	13.0	< 1.4	170.0	< 1.4	71.0	< 1.4	120.0	9.0	< 1.4
Aliphatics >C16-21	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**7.2**	**160.0**	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	160.0	< 1.5	8.3	< 1.5	65.0	< 1.5	< 1.5
Aliphatics >C10-12	**767**	**#N/A**	**#N/A**	**7 of 59**	**0**	**1.5**	**130.0**	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	130.0	< 1.5	2.5	< 1.5	13.0	< 1.5	< 1.5
Aliphatics >C21-35	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**35.0**	**350.0**	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4	120.0	< 3.4	35.0	< 3.4	77.0	< 3.4	< 3.4
Aliphatics >C5-35	**None**	**#N/A**	**#N/A**	**11 of 59**	**0**	**52.0**	**650.0**	< 10	< 10	< 10	< 10	< 10	650.0	< 10	52.0	< 10	210.0	< 10	< 10
TPH >C10-40	**None**	**mg/kg**		**8 of 8**	**0**	**31.0**	**1700.0**												

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	BH110	TP121	TP120	TP120	TP103	TP112	TP121	TP126	WS106	BH110	TP124	TP124
								384353.882	384442.251	384451.844	384451.844	384772.82	384552.675	384442.251	384574.85	384611.937	384353.882	384763.554	384763.554
								399440.903	399393.368	399460.069	399460.069	399769.313	399614.062	399393.368	399411.048	399505.689	399440.903	399485.198	399485.198
								0.30	0.30	1.00	0.30	1.00	2.30	2.30	0.30	1.00	3.00	3.20	0.30
								10/01/2019	11/01/2019	09/01/2019	09/01/2019	03/01/2019	07/01/2019	11/01/2019	09/01/2019	08/01/2019	10/01/2019	11/01/2019	11/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	MG	MG	ALV	MG	MG	MG	MG	MG	GTD	MG
Asbestos Analysts Comments	#N/A	#N/A	#N/A	0 of 56	7	0.0	0.0	le of Amosite f	na	e in microscopi	na		na	na	s debris and b	present in sma	na	na	na
Asbestos (Presence of)	Presence	#N/A		7 of 56	7	0.0	0.0	Amosite	NAD	Chrysotile	NAD		NAD	NAD	mosite Chrysoti	Amosite	NAD	NAD	NAD
pH	None	-		64 of 64	0	6.1	11.7	10.5	8.1	8.3	10.1	8.3	6.5	8.0	10.2	9.9	11.7	7.5	7.5
Cyanide	800	mg/kg	#N/A	36 of 64	0	0.1	89.0	0.1	0.2	0.3	0.4	< 0.1	< 0.1	< 0.1	0.1	4.0	< 0.1	0.2	89.0
Sulphate as SO4	#N/A	mg/l	#N/A	2 of 2	0	49.0	55.0		55.0										
Mercury	13.6	mg/kg	#N/A	46 of 64	1	0.1	18.0	< 0.05	0.4	0.1	0.1	0.1	0.3	< 0.05	0.7	0.4	0.1	< 0.05	2.5
Cadmium	85	mg/kg	#N/A	60 of 64	0	0.1	4.7	0.3	0.4	0.6	0.9	0.2	0.3	< 0.1	3.0	0.9	0.2	< 0.1	1.6
Chromium	907	mg/kg	#N/A	64 of 64	0	5.7	48.0	22.0	15.0	22.0	19.0	8.7	18.0	6.8	18.0	11.0	13.0	20.0	33.0
Arsenic	39.9	mg/kg	#N/A	64 of 64	6	4.1	71.0	6.2	18.0	19.0	16.0	4.1	44.0	4.5	9.5	7.5	7.1	7.1	61.0
Beryllium	1.72	mg/kg	#N/A	62 of 64	13	0.2	3.9	0.4	1.0	1.9	1.2	0.6	1.6	< 0.2	0.5	0.3	0.5	0.9	1.8
Copper	7130	mg/kg	#N/A	64 of 64	0	8.9	4200.0	46.0	350.0	120.0	110.0	35.0	150.0	10.0	39.0	79.0	22.0	59.0	4200.0
Lead	310	mg/kg	#N/A	64 of 64	15	12.0	12000.0	37.0	440.0	96.0	2100.0	20.0	210.0	28.0	120.0	140.0	1900.0	110.0	12000.0
Selenium	430	mg/kg	#N/A	5 of 64	0	0.5	1.0	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	651	mg/kg	#N/A	64 of 64	0	8.7	160.0	38.0	28.0	35.0	23.0	14.0	46.0	8.7	34.0	17.0	20.0	24.0	86.0
Antimony	618	mg/kg	#N/A	56 of 64	0	1.0	180.0	2.1	6.6	3.7	2.7	< 1.0	20.0	< 1.0	2.6	2.5	< 1.0	4.8	180.0
Chromium - Hexavalent	21	mg/kg	#N/A	0 of 61	0	0.0	0.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nickel	181	mg/kg	#N/A	64 of 64	0	6.5	53.0	25.0	28.0	28.0	17.0	12.0	35.0	6.5	18.0	14.0	11.0	27.0	43.0
Zinc	40400	mg/kg	#N/A	64 of 64	0	28.0	1700.0	91.0	280.0	140.0	140.0	67.0	91.0	35.0	520.0	120.0	74.0	73.0	1300.0
m,p xylenes	427.6926186	mg/kg	p-Xylene	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
4-Isopropyltoluene	1240	mg/kg	Aromatic >EC1	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Isopropylbenzene	95.4	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Tert-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,2,3-Trichloropropane	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,2-Dibromo-3-Chloropropane	None	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,2,4-Trimethylbenzene	3.31	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Ethylbenzene	439.7179703	mg/kg		0 of 64	0	0.0	0.0	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	3927.6251	mg/kg		0 of 64	0	0.0	0.0	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	427.6926186	mg/kg	p-Xylene	1 of 59	0	1.9	1.9	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01
Benzene	1.42187881	mg/kg		0 of 64	0	0.0	0.0	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2-Dichlorobenzene	133	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
2-Chlorotoluene	2.41	mg/kg	chlorobenzene	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
O-Xylene	475.7207618	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Hexachlorobutadiene (HCBD)	1.79	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,2,3 Trichlorobenzene	8.81	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Trichloroethene	0.0797	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,1,2-Trichloroethane	5.53	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,2-Dichloropropane	0.121	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,1-Dichloroethene	1.17	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,1-Dichloroethane	10.9	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Bromodichloromethane	0.096	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Tribromomethane	None	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Chloroethene	0.00153	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Bromochloromethane	None	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Dibromomethane	0.096	mg/kg	hodichlorometl	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,1,1-Trichloroethane	40.4	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Chloroform	4.22	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,1,1,2-Tetrachloroethane	8.2	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
2,2-Dichloropropane	None	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,1-Dichloropropene	3.3	mg/kg	Benzene	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
trachloromethane (Carbon Tetra Chlorid	0.128	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
cis1,3-Dichloropropene	None	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,3-Dichlorobenzene	2.45	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Methyl tert-butyl ether (MTBE)	319	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
trans-1,2-Dichloroethene	1.02	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
cis-1,2-Dichloroethene	0.559	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,3-Dichloropropane	None	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Sec-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Tetrachloroethene	0.92	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Dibromochloromethane	None	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,2,4-Trichlorobenzene	15.3	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	BH110	TP121	TP120	TP120	TP103	TP112	TP121	TP126	WS106	BH110	TP124	TP124
								384353.882	384442.251	384451.844	384451.844	384772.82	384552.675	384442.251	384574.85	384611.937	384353.882	384763.554	384763.554
								399440.903	399393.368	399460.069	399460.069	399769.313	399614.062	399393.368	399411.048	399505.689	399440.903	399485.198	399485.198
								0.30	0.30	1.00	0.30	1.00	2.30	2.30	0.30	1.00	3.00	3.20	0.30
								10/01/2019	11/01/2019	09/01/2019	09/01/2019	03/01/2019	07/01/2019	11/01/2019	09/01/2019	08/01/2019	10/01/2019	11/01/2019	11/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	MG	MG	ALV	MG	MG	MG	MG	MG	GTD	MG
Chlorobenzene	2.41	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Bromobenzene	6.96	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,3,5-Trimethylbenzene	3.31	mg/kg	-Trimethylben	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,2-Dibromoethane	0.096	mg/kg	nodichlorometl	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,4-Dichlorobenzene	332	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
4-Chlorotoluene	2.41	mg/kg	chlorobenzene	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
n-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0			< 0.01						< 0.01			
n-propylbenzene	323	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
trans-1,3-Dichloropropene	None	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Styrene	236	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
1,2-Dichloroethane	0.0227	mg/kg		0 of 5	0	0.0	0.0			< 0.01						< 0.01			
Acenaphthylene	5970	#N/A	#N/A	13 of 57	0	0.0	7.7	0.2	< 0.03	< 0.1	< 0.03	< 0.03		< 0.03	< 0.03	0.3	< 0.03	< 0.03	< 0.03
Dibenz-a-h-anthracene	0.32	#N/A	#N/A	18 of 57	2	0.0	2.4	0.5	< 0.03	< 0.1	< 0.03	< 0.03		< 0.03	0.1	0.2	0.0	< 0.03	< 0.03
Acenaphthene	6040	#N/A	#N/A	26 of 57	0	0.0	6.1	0.5	< 0.03	< 0.1	< 0.03	< 0.03		< 0.03	0.2	0.4	0.5	< 0.03	< 0.03
Total BTEX	None	mg/kg		0 of 8	0	0.0	0.0						< 0.04						
4-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
4-Nitrophenol	None	mg/kg		1 of 3	0	6.2	6.2			< 0.1						< 0.1			
Dimethylphthalate	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
P-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Benzyl Alcohol	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
4-Bromophenyl Phenyl Ether	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Azobenzene	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
2,4-Dimethylphenol	1040	mg/kg		1 of 3	0	0.2	0.2			< 0.1						< 0.1			
Phenol	1200	mg/kg		1 of 3	0	0.3	0.3			< 0.1						< 0.1			
Bis(2-chloroethoxy)methane	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Bis(2-ethylhexyl)phthalate	4090	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Di-N-Octyl Phthalate	4920	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Hexachlorobenzene (HCB)	6.38	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
2,4-Dichlorophenol	186	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
2,4-Dinitrotoluene	254	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Diphenylamine	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Bis(2-chloroisopropyl)ether	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
O-Dinitrobenzene	None	mg/kg		1 of 3	0	11.0	11.0			< 0.1						< 0.1			
2-Methyl-4,6-Dinitrophenol	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
2,3,4,6-Tetrachlorophenol	229	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
4-Chloro-3-Methylphenol	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
2,6-Dinitrotoluene	125	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Aniline	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0			< 0.1						< 0.1			
4-Chlorophenyl Phenyl Ether	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Hexachlorocyclopentadiene	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Diethylphthalate	8970	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Di-N-Butyl Phthalate	645	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Butylbenzylphthalate	63800	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
Carbazole	None	mg/kg		1 of 3	0	3.5	3.5			< 0.1						< 0.1			
Pentachlorophenol (PCP)	30.6	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
2,4,6-Trichlorophenol	231	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
2-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
2-Methylnaphthalene	13.2	mg/kg	naphthalene	1 of 3	0	8.8	8.8			< 0.1						< 0.1			
2-Chloronaphthalene	31.6	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
2,3,5,6-Tetrachlorophenol	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
2-Methylphenol	9930	mg/kg		1 of 3	0	0.2	0.2			< 0.1						< 0.1			
2-Chlorophenol	207	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
2,4,5-Trichlorophenol	231	mg/kg	6-Trichlorophe	0 of 3	0	0.0	0.0			< 0.1						< 0.1			
3-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
M-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0			< 0.1						< 0.1			
3/4 Methylphenol	10000	mg/kg		1 of 3	0	0.4	0.4			< 0.1						< 0.1			
Phenol (Monohydric)	1200	#N/A	#N/A	23 of 64	0	0.4	12.0	< 0.3	< 0.3	< 0.3	< 0.3	0.4	1.0	< 0.3	< 0.3	0.4	< 0.3	< 0.3	< 0.3
Loss on ignition	None	%		8 of 8	0	1.3	11.0						8.1						
Total Organic Carbon	None	%		63 of 64	0	0.5	41.0	3.3	4.3	16.0	4.5	2.8	11.0	0.7	2.2	4.5	1.7	0.7	41.0
Napthalene	13.2	mg/kg		25 of 59	1	0.0	18.0	0.2	< 0.03	< 0.01	< 0.03	< 0.03		< 0.03	0.2	0.0	0.4	< 0.03	< 0.03

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	BH110	TP121	TP120	TP120	TP103	TP112	TP121	TP126	WS106	BH110	TP124	TP124
								384353.882	384442.251	384451.844	384451.844	384772.82	384552.675	384442.251	384574.85	384611.937	384353.882	384763.554	384763.554
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								0.30	0.30	1.00	0.30	1.00	2.30	2.30	0.30	1.00	3.00	3.20	0.30
								10/01/2019	11/01/2019	09/01/2019	09/01/2019	03/01/2019	07/01/2019	11/01/2019	09/01/2019	08/01/2019	10/01/2019	11/01/2019	11/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	MG	MG	ALV	MG	MG	MG	MG	MG	GTD	MG
Anthracene	**36600**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**14.0**	1.1	< 0.03	< 0.1	< 0.03	< 0.03		< 0.03	0.4	0.7	0.4	< 0.03	0.1
Benzo(k)fluoranthene	**107**	**#N/A**	**#N/A**	**32 of 57**	**0**	**0.0**	**6.5**	1.5	< 0.03	< 0.1	< 0.03	< 0.03		< 0.03	0.2	0.5	0.2	< 0.03	0.1
Chrysene	**31.9**	**#N/A**	**#N/A**	**39 of 57**	**0**	**0.0**	**20.0**	3.0	< 0.03	0.2	0.0	< 0.03		< 0.03	0.7	1.2	0.5	0.0	0.2
Pyrene	**3790**	**#N/A**	**#N/A**	**44 of 57**	**0**	**0.0**	**48.0**	6.1	< 0.03	0.3	0.1	0.0		< 0.03	1.7	2.7	1.2	0.1	0.6
Benzo (g,h,i) perylene	**359**	**#N/A**	**#N/A**	**34 of 57**	**0**	**0.0**	**9.5**	2.7	< 0.03	0.1	< 0.03	< 0.03		< 0.03	0.2	1.1	0.2	< 0.03	0.1
Indeno(1,2,3-cd)pyrene	**46**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**7.4**	2.2	< 0.03	0.1	< 0.03	< 0.03		< 0.03	0.2	0.9	0.2	< 0.03	0.1
Benzo(b)fluoranthene	**4.06**	**#N/A**	**#N/A**	**39 of 57**	**2**	**0.0**	**17.0**	4.5	< 0.03	0.2	< 0.03	< 0.03		< 0.03	0.6	1.7	0.5	0.0	0.2
Fluoranthene	**1580**	**#N/A**	**#N/A**	**43 of 57**	**0**	**0.0**	**50.0**	6.7	< 0.03	0.3	0.1	0.1		< 0.03	1.9	3.0	1.5	0.1	0.5
Benzo(a)pyrene	**3.23**	**#N/A**	**#N/A**	**35 of 57**	**2**	**0.0**	**17.0**	3.9	< 0.03	0.2	< 0.03	< 0.03		< 0.03	0.4	1.5	0.4	< 0.03	0.2
Benzo(a)anthracene	**15**	**#N/A**	**#N/A**	**38 of 57**	**1**	**0.0**	**19.0**	2.8	< 0.03	0.2	< 0.03	< 0.03		< 0.03	0.6	1.2	0.4	0.0	0.2
Phenanthrene	**1520**	**#N/A**	**#N/A**	**42 of 57**	**0**	**0.1**	**61.0**	3.1	< 0.03	0.1	0.1	0.1		< 0.03	1.6	1.8	1.6	0.1	0.4
Fluorene	**4460**	**#N/A**	**#N/A**	**24 of 57**	**0**	**0.0**	**13.0**	0.4	< 0.03	< 0.1	< 0.03	< 0.03		< 0.03	0.2	0.3	0.3	< 0.03	< 0.03
Pah,Total	**None**	**mg/kg**		**45 of 59**	**0**	**0.1**	**95.0**	39.0	< 0.10		0.2	0.2	2.2	< 0.10	9.1		8.1	0.4	2.7
Dibenzofuran	**3.23**	**mg/kg**	**benzo(a)pyrene**	**2 of 3**	**1**	**0.2**	**8.3**			< 0.1						0.2			
Aliphatics >C8-10	**155**	**mg/kg**		**1 of 59**	**0**	**4.3**	**4.3**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C7-8	**3928**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C8-10	**269**	**mg/kg**		**1 of 59**	**0**	**10.0**	**10.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatics >C5-6	**161**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aliphatics >C6-8	**529**	**mg/kg**		**1 of 59**	**0**	**1.2**	**1.2**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C5-7	**1.4**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Aromatics >C12-16	**2480**	**#N/A**	**#N/A**	**16 of 59**	**0**	**0.7**	**110.0**	2.9	< 0.5	< 0.5	< 0.5	< 0.5		< 0.5	< 0.5	2.4	< 0.5	< 0.5	< 0.5
Aromatics >C16-21	**1817**	**#N/A**	**#N/A**	**20 of 59**	**0**	**3.9**	**150.0**	27.0	< 0.6	< 0.6	< 0.6	< 0.6		< 0.6	9.2	17.0	< 0.6	< 0.6	6.4
Aromatics >C10-12	**1240**	**#N/A**	**#N/A**	**11 of 59**	**0**	**1.0**	**42.0**	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9		< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	1.2
Aliphatics >C12-16	**4370**	**#N/A**	**#N/A**	**11 of 59**	**0**	**3.7**	**240.0**	4.1	< 1.2	< 1.2	< 1.2	< 1.2		< 1.2	8.7	15.0	< 1.2	< 1.2	< 1.2
Aromatics >C21-35	**1930**	**#N/A**	**#N/A**	**21 of 59**	**0**	**9.0**	**670.0**	350.0	< 1.4	< 1.4	< 1.4	< 1.4		< 1.4	97.0	240.0	< 1.4	< 1.4	15.0
Aliphatics >C16-21	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**7.2**	**160.0**	14.0	< 1.5	< 1.5	< 1.5	< 1.5		< 1.5	19.0	7.2	< 1.5	< 1.5	< 1.5
Aliphatics >C10-12	**767**	**#N/A**	**#N/A**	**7 of 59**	**0**	**1.5**	**130.0**	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5		< 1.5	2.8	< 1.5	< 1.5	< 1.5	< 1.5
Aliphatics >C21-35	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**35.0**	**350.0**	120.0	< 3.4	< 3.4	< 3.4	< 3.4		< 3.4	86.0	170.0	< 3.4	< 3.4	< 3.4
Aliphatics >C5-35	**None**	**#N/A**	**#N/A**	**11 of 59**	**0**	**52.0**	**650.0**	140.0	< 10	< 10	< 10	< 10		< 10	120.0	190.0	< 10	< 10	< 10
TPH >C10-40	**None**	**mg/kg**		**8 of 8**	**0**	**31.0**	**1700.0**						31.0						

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	TP125	TP115	TP102	TP127	BH104	TP126	TP115	TP102	TP115	BH102	TP119	BH103
								384525.517	384456.531	384698.516	384520.567	384607.46	384574.85	384456.531	384698.516	384456.531	384763.18	384483.283	384689.014
								399388.873	399526.838	399742.661	399360.521	399631.24	399411.048	399526.838	399742.661	399526.838	399691.375	399475.961	399695.588
								0.30	0.30	1.20	0.30	0.70	2.20	1.30	0.30	3.30	0.30	0.20	1.00
								10/01/2019	07/01/2019	03/01/2019	10/01/2019	04/01/2019	09/01/2019	07/01/2019	03/01/2019	07/01/2019	24/01/2019	09/01/2019	04/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	GTD	MG	MG	MG	MG	MG	MG	MG	MG	MG
Asbestos Analysts Comments	**#N/A**	**#N/A**	**#N/A**	**0 of 56**	**7**	**0.0**	**0.0**	n and bundles	na	na	hrysotile and A	na	na		na	na	na	na	
Asbestos (Presence of)	**Presence**	**#N/A**		**7 of 56**	**7**	**0.0**	**0.0**	hrysotile Amosit	NAD	NAD	mosite Chrysoti	NAD	NAD		NAD	NAD	NAD	NAD	
pH	**None**	**-**		**64 of 64**	**0**	**6.1**	**11.7**	10.2	6.5	8.5	9.8	7.3	8.7	6.5	8.7	6.9	10.6	11.6	10.0
Cyanide	**800**	**mg/kg**	**#N/A**	**36 of 64**	**0**	**0.1**	**89.0**	0.2	0.3	< 0.1	< 0.1	< 0.1	< 0.1	0.4	< 0.1	68.0	< 0.1	< 0.1	0.6
Sulphate as SO4	**#N/A**	**mg/l**	**#N/A**	**2 of 2**	**0**	**49.0**	**55.0**												
Mercury	**13.6**	**mg/kg**	**#N/A**	**46 of 64**	**1**	**0.1**	**18.0**	0.4	0.6	< 0.05	0.2	0.5	0.1	0.4	< 0.05	1.0	0.4	< 0.05	0.3
Cadmium	**85**	**mg/kg**	**#N/A**	**60 of 64**	**0**	**0.1**	**4.7**	0.7	0.4	0.3	0.4	0.6	0.1	0.3	0.6	0.5	1.0	0.6	0.8
Chromium	**907**	**mg/kg**	**#N/A**	**64 of 64**	**0**	**5.7**	**48.0**	31.0	25.0	29.0	19.0	16.0	19.0	27.0	14.0	17.0	23.0	12.0	19.0
Arsenic	**39.9**	**mg/kg**	**#N/A**	**64 of 64**	**6**	**4.1**	**71.0**	14.0	40.0	10.0	17.0	23.0	6.6	25.0	7.5	40.0	16.0	4.1	11.0
Beryllium	**1.72**	**mg/kg**	**#N/A**	**62 of 64**	**13**	**0.2**	**3.9**	0.7	2.2	1.0	0.7	2.8	0.6	3.9	0.2	2.3	1.1	< 0.2	0.5
Copper	**7130**	**mg/kg**	**#N/A**	**64 of 64**	**0**	**8.9**	**4200.0**	41.0	300.0	46.0	37.0	300.0	16.0	260.0	31.0	310.0	140.0	59.0	140.0
Lead	**310**	**mg/kg**	**#N/A**	**64 of 64**	**15**	**12.0**	**12000.0**	830.0	460.0	17.0	87.0	180.0	27.0	190.0	17.0	520.0	530.0	47.0	210.0
Selenium	**430**	**mg/kg**	**#N/A**	**5 of 64**	**0**	**0.5**	**1.0**	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	**651**	**mg/kg**	**#N/A**	**64 of 64**	**0**	**8.7**	**160.0**	39.0	76.0	31.0	26.0	66.0	26.0	58.0	17.0	61.0	36.0	10.0	24.0
Antimony	**618**	**mg/kg**	**#N/A**	**56 of 64**	**0**	**1.0**	**180.0**	4.9	12.0	1.2	1.5	5.9	1.1	8.2	< 1.0	12.0	7.6	1.3	4.8
Chromium - Hexavalent	**21**	**mg/kg**	**#N/A**	**0 of 61**	**0**	**0.0**	**0.0**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0		< 1.0	< 1.0	< 1.0	< 1.0	
Nickel	**181**	**mg/kg**	**#N/A**	**64 of 64**	**0**	**6.5**	**53.0**	18.0	45.0	30.0	16.0	48.0	15.0	50.0	12.0	40.0	26.0	7.5	20.0
Zinc	**40400**	**mg/kg**	**#N/A**	**64 of 64**	**0**	**28.0**	**1700.0**	150.0	130.0	89.0	100.0	150.0	53.0	88.0	72.0	180.0	500.0	100.0	250.0
m,p xylenes	**427.6926186**	**mg/kg**	**p-Xylene**	**0 of 5**	**0**	**0.0**	**0.0**												
4-Isopropyltoluene	**1240**	**mg/kg**	**Aromatic >EC1**	**0 of 5**	**0**	**0.0**	**0.0**												
Isopropylbenzene	**95.4**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Tert-Butylbenzene	**1.42187881**	**mg/kg**	**Benzene**	**0 of 5**	**0**	**0.0**	**0.0**												
1,2,3-Trichloropropane	**1.42187881**	**mg/kg**	**Benzene**	**0 of 5**	**0**	**0.0**	**0.0**												
1,2-Dibromo-3-Chloropropane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
1,2,4-Trimethylbenzene	**3.31**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Ethylbenzene	**439.7179703**	**mg/kg**		**0 of 64**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	**3927.6251**	**mg/kg**		**0 of 64**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	**427.6926186**	**mg/kg**	**p-Xylene**	**1 of 59**	**0**	**1.9**	**1.9**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene	**1.42187881**	**mg/kg**		**0 of 64**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2-Dichlorobenzene	**133**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
2-Chlorotoluene	**2.41**	**mg/kg**	**chlorobenzene**	**0 of 5**	**0**	**0.0**	**0.0**												
O-Xylene	**475.7207618**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Hexachlorobutadiene (HCBD)	**1.79**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
1,2,3 Trichlorobenzene	**8.81**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Trichloroethene	**0.0797**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
1,1,2-Trichloroethane	**5.53**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
1,2-Dichloropropane	**0.121**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
1,1-Dichloroethene	**1.17**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
1,1-Dichloroethane	**10.9**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Bromodichloromethane	**0.096**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Tribromomethane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Chloroethene	**0.00153**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Bromochloromethane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Dibromomethane	**0.096**	**mg/kg**	**hodichlorometl**	**0 of 5**	**0**	**0.0**	**0.0**												
1,1,1-Trichloroethane	**40.4**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Chloroform	**4.22**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
1,1,1,2-Tetrachloroethane	**8.2**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
2,2-Dichloropropane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
1,1-Dichloropropene	**3.3**	**mg/kg**	**Benzene**	**0 of 5**	**0**	**0.0**	**0.0**												
trachloromethane (Carbon Tetra Chlorid	**0.128**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
cis1,3-Dichloropropene	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
1,3-Dichlorobenzene	**2.45**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Methyl tert-butyl ether (MTBE)	**319**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
trans-1,2-Dichloroethene	**1.02**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
cis-1,2-Dichloroethene	**0.559**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
1,3-Dichloropropane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Sec-Butylbenzene	**1.42187881**	**mg/kg**	**Benzene**	**0 of 5**	**0**	**0.0**	**0.0**												
Tetrachloroethene	**0.92**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
Dibromochloromethane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												
1,2,4-Trichlorobenzene	**15.3**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**												

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	TP125	TP115	TP102	TP127	BH104	TP126	TP115	TP102	TP115	BH102	TP119	BH103
								384525.517	384456.531	384698.516	384520.567	384607.46	384574.85	384456.531	384698.516	384456.531	384763.18	384483.283	384689.014
								399388.873	399526.838	399742.661	399360.521	399631.24	399411.048	399526.838	399742.661	399526.838	399691.375	399475.961	399695.588
								0.30	0.30	1.20	0.30	0.70	2.20	1.30	0.30	3.30	0.30	0.20	1.00
								10/01/2019	07/01/2019	03/01/2019	10/01/2019	04/01/2019	09/01/2019	07/01/2019	03/01/2019	07/01/2019	24/01/2019	09/01/2019	04/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	GTD	MG	MG	MG	MG	MG	MG	MG	MG	MG
Chlorobenzene	2.41	mg/kg		0 of 5	0	0.0	0.0												
Bromobenzene	6.96	mg/kg		0 of 5	0	0.0	0.0												
1,3,5-Trimethylbenzene	3.31	mg/kg	-Trimethylben	0 of 5	0	0.0	0.0												
1,2-Dibromoethane	0.096	mg/kg	nodichlorometl	0 of 5	0	0.0	0.0												
1,4-Dichlorobenzene	332	mg/kg		0 of 5	0	0.0	0.0												
4-Chlorotoluene	2.41	mg/kg	chlorobenzene	0 of 5	0	0.0	0.0												
n-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0												
n-propylbenzene	323	mg/kg		0 of 5	0	0.0	0.0												
trans-1,3-Dichloropropene	None	mg/kg		0 of 5	0	0.0	0.0												
Styrene	236	mg/kg		0 of 5	0	0.0	0.0												
1,2-Dichloroethane	0.0227	mg/kg		0 of 5	0	0.0	0.0												
Acenaphthylene	5970	#N/A	#N/A	13 of 57	0	0.0	7.7	< 0.03	0.0	< 0.03	< 0.03	< 0.03	< 0.03		0.1	0.1	0.1	< 0.03	
Dibenz-a-h-anthracene	0.32	#N/A	#N/A	18 of 57	2	0.0	2.4	0.0	0.0	< 0.03	0.0	< 0.03	< 0.03		< 0.03	0.1	0.1	< 0.03	
Acenaphthene	6040	#N/A	#N/A	26 of 57	0	0.0	6.1	0.3	0.1	< 0.03	0.2	< 0.03	< 0.03		< 0.03	0.1	0.7	< 0.03	
Total BTEX	None	mg/kg		0 of 8	0	0.0	0.0							< 0.04	< 0.04				< 0.04
4-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0												
4-Nitrophenol	None	mg/kg		1 of 3	0	6.2	6.2												
Dimethylphthalate	None	mg/kg		0 of 3	0	0.0	0.0												
P-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0												
Benzyl Alcohol	None	mg/kg		0 of 3	0	0.0	0.0												
4-Bromophenyl Phenyl Ether	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0												
Azobenzene	None	mg/kg		0 of 3	0	0.0	0.0												
2,4-Dimethylphenol	1040	mg/kg		1 of 3	0	0.2	0.2												
Phenol	1200	mg/kg		1 of 3	0	0.3	0.3												
Bis(2-chloroethoxy)methane	None	mg/kg		0 of 3	0	0.0	0.0												
Bis(2-ethylhexyl)phthalate	4090	mg/kg		0 of 3	0	0.0	0.0												
Di-N-Octyl Phthalate	4920	mg/kg		0 of 3	0	0.0	0.0												
Hexachlorobenzene (HCB)	6.38	mg/kg		0 of 3	0	0.0	0.0												
2,4-Dichlorophenol	186	mg/kg		0 of 3	0	0.0	0.0												
2,4-Dinitrotoluene	254	mg/kg		0 of 3	0	0.0	0.0												
Diphenylamine	None	mg/kg		0 of 3	0	0.0	0.0												
Bis(2-chloroisopropyl)ether	None	mg/kg		0 of 3	0	0.0	0.0												
O-Dinitrobenzene	None	mg/kg		1 of 3	0	11.0	11.0												
2-Methyl-4,6-Dinitrophenol	None	mg/kg		0 of 3	0	0.0	0.0												
2,3,4,6-Tetrachlorophenol	229	mg/kg		0 of 3	0	0.0	0.0												
4-Chloro-3-Methylphenol	None	mg/kg		0 of 3	0	0.0	0.0												
2,6-Dinitrotoluene	125	mg/kg		0 of 3	0	0.0	0.0												
Aniline	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0												
4-Chlorophenyl Phenyl Ether	None	mg/kg		0 of 3	0	0.0	0.0												
Hexachlorocyclopentadiene	None	mg/kg		0 of 3	0	0.0	0.0												
Diethylphthalate	8970	mg/kg		0 of 3	0	0.0	0.0												
Di-N-Butyl Phthalate	645	mg/kg		0 of 3	0	0.0	0.0												
Butylbenzylphthalate	63800	mg/kg		0 of 3	0	0.0	0.0												
Carbazole	None	mg/kg		1 of 3	0	3.5	3.5												
Pentachlorophenol (PCP)	30.6	mg/kg		0 of 3	0	0.0	0.0												
2,4,6-Trichlorophenol	231	mg/kg		0 of 3	0	0.0	0.0												
2-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0												
2-Methylnaphthalene	13.2	mg/kg	naphthalene	1 of 3	0	8.8	8.8												
2-Chloronaphthalene	31.6	mg/kg		0 of 3	0	0.0	0.0												
2,3,5,6-Tetrachlorophenol	None	mg/kg		0 of 3	0	0.0	0.0												
2-Methylphenol	9930	mg/kg		1 of 3	0	0.2	0.2												
2-Chlorophenol	207	mg/kg		0 of 3	0	0.0	0.0												
2,4,5-Trichlorophenol	231	mg/kg	6-Trichlorophe	0 of 3	0	0.0	0.0												
3-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0												
M-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0												
3/4 Methylphenol	10000	mg/kg		1 of 3	0	0.4	0.4												
Phenol (Monohydric)	1200	#N/A	#N/A	23 of 64	0	0.4	12.0	< 0.3	0.5	< 0.3	< 0.3	< 0.3	< 0.3	0.4	< 0.3	0.4	< 0.3	< 0.3	0.4
Loss on ignition	None	%		8 of 8	0	1.3	11.0							6.6	1.3				11.0
Total Organic Carbon	None	%		63 of 64	0	0.5	41.0	3.1	27.0	1.6	2.7	29.0	0.7	17.0	3.9	32.0	7.1	0.9	6.8
Napthalene	13.2	mg/kg		25 of 59	1	0.0	18.0	0.2	0.1	< 0.03	0.1	0.0	< 0.03		< 0.03	0.1	0.2	< 0.03	

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	TP125	TP115	TP102	TP127	BH104	TP126	TP115	TP102	TP115	BH102	TP119	BH103
								384525.517	384456.531	384698.516	384520.567	384607.46	384574.85	384456.531	384698.516	384456.531	384763.18	384483.283	384689.014
								399388.873	399526.838	399742.661	399360.521	399631.24	399411.048	399526.838	399742.661	399526.838	399691.375	399475.961	399695.588
								0.30	0.30	1.20	0.30	0.70	2.20	1.30	0.30	3.30	0.30	0.20	1.00
								10/01/2019	07/01/2019	03/01/2019	10/01/2019	04/01/2019	09/01/2019	07/01/2019	03/01/2019	07/01/2019	24/01/2019	09/01/2019	04/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	GTD	MG	MG	MG	MG	MG	MG	MG	MG	MG
Anthracene	**36600**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**14.0**	0.3	0.3	< 0.03	0.2	< 0.03	< 0.03		0.2	0.3	1.0	< 0.03	
Benzo(k)fluoranthene	**107**	**#N/A**	**#N/A**	**32 of 57**	**0**	**0.0**	**6.5**	0.2	0.2	< 0.03	0.2	< 0.03	< 0.03		0.1	0.2	1.0	0.1	
Chrysene	**31.9**	**#N/A**	**#N/A**	**39 of 57**	**0**	**0.0**	**20.0**	0.5	0.5	< 0.03	0.4	0.1	< 0.03		0.2	0.6	2.0	0.1	
Pyrene	**3790**	**#N/A**	**#N/A**	**44 of 57**	**0**	**0.0**	**48.0**	1.2	1.0	< 0.03	1.1	0.1	< 0.03		0.5	1.2	5.6	0.2	
Benzo (g,h,i) perylene	**359**	**#N/A**	**#N/A**	**34 of 57**	**0**	**0.0**	**9.5**	0.2	0.2	< 0.03	0.2	< 0.03	< 0.03		0.1	0.2	0.9	0.1	
Indeno(1,2,3-cd)pyrene	**46**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**7.4**	0.2	0.2	< 0.03	0.2	< 0.03	< 0.03		0.1	0.2	0.8	0.1	
Benzo(b)fluoranthene	**4.06**	**#N/A**	**#N/A**	**39 of 57**	**2**	**0.0**	**17.0**	0.4	0.6	< 0.03	0.5	0.1	< 0.03		0.2	0.7	2.4	0.1	
Fluoranthene	**1580**	**#N/A**	**#N/A**	**43 of 57**	**0**	**0.0**	**50.0**	1.3	1.0	< 0.03	1.2	0.1	< 0.03		0.5	1.2	6.4	0.2	
Benzo(a)pyrene	**3.23**	**#N/A**	**#N/A**	**35 of 57**	**2**	**0.0**	**17.0**	0.3	0.4	< 0.03	0.3	< 0.03	< 0.03		0.1	0.5	2.4	0.1	
Benzo(a)anthracene	**15**	**#N/A**	**#N/A**	**38 of 57**	**1**	**0.0**	**19.0**	0.4	0.5	< 0.03	0.4	0.1	< 0.03		0.2	0.5	2.1	0.1	
Phenanthrene	**1520**	**#N/A**	**#N/A**	**42 of 57**	**0**	**0.1**	**61.0**	1.1	0.5	< 0.03	0.7	0.1	< 0.03		0.1	0.7	2.3	0.1	
Fluorene	**4460**	**#N/A**	**#N/A**	**24 of 57**	**0**	**0.0**	**13.0**	0.2	0.0	< 0.03	0.1	< 0.03	< 0.03		< 0.03	0.1	0.4	< 0.03	
Pah,Total	**None**	**mg/kg**		**45 of 59**	**0**	**0.1**	**95.0**	6.6	5.5	< 0.10	5.6	0.5	< 0.10	14.0	2.1	6.7	28.0	1.0	22.0
Dibenzofuran	**3.23**	**mg/kg**	**benzo(a)pyrene**	**2 of 3**	**1**	**0.2**	**8.3**												
Aliphatics >C8-10	**155**	**mg/kg**		**1 of 59**	**0**	**4.3**	**4.3**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	
Aromatics >C7-8	**3928**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	
Aromatics >C8-10	**269**	**mg/kg**		**1 of 59**	**0**	**10.0**	**10.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	
Aliphatics >C5-6	**161**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	
Aliphatics >C6-8	**529**	**mg/kg**		**1 of 59**	**0**	**1.2**	**1.2**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	
Aromatics >C5-7	**1.4**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01	< 0.01	< 0.01	
Aromatics >C12-16	**2480**	**#N/A**	**#N/A**	**16 of 59**	**0**	**0.7**	**110.0**	< 0.5	< 0.5	< 0.5	4.2	< 0.5	< 0.5		< 0.5	< 0.5	11.0	< 0.5	
Aromatics >C16-21	**1817**	**#N/A**	**#N/A**	**20 of 59**	**0**	**3.9**	**150.0**	< 0.6	< 0.6	< 0.6	12.0	< 0.6	< 0.6		< 0.6	< 0.6	52.0	< 0.6	
Aromatics >C10-12	**1240**	**#N/A**	**#N/A**	**11 of 59**	**0**	**1.0**	**42.0**	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9	< 0.9		< 0.9	< 0.9	< 0.9	< 0.9	
Aliphatics >C12-16	**4370**	**#N/A**	**#N/A**	**11 of 59**	**0**	**3.7**	**240.0**	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2	< 1.2		< 1.2	< 1.2	9.3	3.7	
Aromatics >C21-35	**1930**	**#N/A**	**#N/A**	**21 of 59**	**0**	**9.0**	**670.0**	< 1.4	< 1.4	< 1.4	53.0	< 1.4	< 1.4		< 1.4	< 1.4	250.0	< 1.4	
Aliphatics >C16-21	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**7.2**	**160.0**	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5		< 1.5	< 1.5	22.0	25.0	
Aliphatics >C10-12	**767**	**#N/A**	**#N/A**	**7 of 59**	**0**	**1.5**	**130.0**	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5	< 1.5		< 1.5	< 1.5	2.4	< 1.5	
Aliphatics >C21-35	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**35.0**	**350.0**	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4	< 3.4		< 3.4	< 3.4	120.0	91.0	
Aliphatics >C5-35	**None**	**#N/A**	**#N/A**	**11 of 59**	**0**	**52.0**	**650.0**	< 10	< 10	< 10	< 10	< 10	< 10		< 10	< 10	160.0	120.0	
TPH >C10-40	**None**	**mg/kg**		**8 of 8**	**0**	**31.0**	**1700.0**							210.0	79.0				1700.0

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	TP101	WS101	TP109	TP106	TP106	TP119
								384759.647	384734.621	384661.431	384830.717	384830.717	384483.283
								399818.495	399613.694	399650.774	399695.601	399695.601	399475.961
								0.30	0.30	3.30	2.80	0.40	3.00
								03/01/2019	08/01/2019	04/01/2019	03/01/2019	03/01/2019	09/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	MG	MG	MG	CHES
Asbestos Analysts Comments	**#N/A**	**#N/A**	**#N/A**	**0 of 56**	**7**	**0.0**	**0.0**	na	na	na		na	na
Asbestos (Presence of)	**Presence**	**#N/A**		**7 of 56**	**7**	**0.0**	**0.0**	NAD	NAD	NAD		NAD	NAD
pH	**None**	**-**		**64 of 64**	**0**	**6.1**	**11.7**	8.9	7.8	7.6	8.3	8.6	7.4
Cyanide	**800**	**mg/kg**	**#N/A**	**36 of 64**	**0**	**0.1**	**89.0**	< 0.1	0.8	0.2	0.2	0.5	< 0.1
Sulphate as SO4	**#N/A**	**mg/l**	**#N/A**	**2 of 2**	**0**	**49.0**	**55.0**						
Mercury	**13.6**	**mg/kg**	**#N/A**	**46 of 64**	**1**	**0.1**	**18.0**	< 0.05	0.2	1.2	0.1	< 0.05	< 0.05
Cadmium	**85**	**mg/kg**	**#N/A**	**60 of 64**	**0**	**0.1**	**4.7**	0.4	0.3	0.2	< 0.1	0.2	0.1
Chromium	**907**	**mg/kg**	**#N/A**	**64 of 64**	**0**	**5.7**	**48.0**	21.0	13.0	18.0	11.0	38.0	15.0
Arsenic	**39.9**	**mg/kg**	**#N/A**	**64 of 64**	**6**	**4.1**	**71.0**	6.8	12.0	19.0	5.0	21.0	12.0
Beryllium	**1.72**	**mg/kg**	**#N/A**	**62 of 64**	**13**	**0.2**	**3.9**	1.0	0.8	2.0	0.6	2.1	0.5
Copper	**7130**	**mg/kg**	**#N/A**	**64 of 64**	**0**	**8.9**	**4200.0**	71.0	57.0	150.0	17.0	130.0	19.0
Lead	**310**	**mg/kg**	**#N/A**	**64 of 64**	**15**	**12.0**	**12000.0**	26.0	280.0	330.0	56.0	40.0	18.0
Selenium	**430**	**mg/kg**	**#N/A**	**5 of 64**	**0**	**0.5**	**1.0**	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Vanadium	**651**	**mg/kg**	**#N/A**	**64 of 64**	**0**	**8.7**	**160.0**	31.0	20.0	43.0	15.0	65.0	36.0
Antimony	**618**	**mg/kg**	**#N/A**	**56 of 64**	**0**	**1.0**	**180.0**	1.3	3.3	4.8	< 1.0	2.3	1.3
Chromium - Hexavalent	**21**	**mg/kg**	**#N/A**	**0 of 61**	**0**	**0.0**	**0.0**	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Nickel	**181**	**mg/kg**	**#N/A**	**64 of 64**	**0**	**6.5**	**53.0**	22.0	16.0	38.0	13.0	50.0	16.0
Zinc	**40400**	**mg/kg**	**#N/A**	**64 of 64**	**0**	**28.0**	**1700.0**	95.0	97.0	99.0	38.0	53.0	67.0
m,p xylenes	**427.6926186**	**mg/kg**	**p-Xylene**	**0 of 5**	**0**	**0.0**	**0.0**						
4-Isopropyltoluene	**1240**	**mg/kg**	**Aromatic >EC1**	**0 of 5**	**0**	**0.0**	**0.0**						
Isopropylbenzene	**95.4**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Tert-Butylbenzene	**1.42187881**	**mg/kg**	**Benzene**	**0 of 5**	**0**	**0.0**	**0.0**						
1,2,3-Trichloropropane	**1.42187881**	**mg/kg**	**Benzene**	**0 of 5**	**0**	**0.0**	**0.0**						
1,2-Dibromo-3-Chloropropane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
1,2,4-Trimethylbenzene	**3.31**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Ethylbenzene	**439.7179703**	**mg/kg**		**0 of 64**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Toluene	**3927.6251**	**mg/kg**		**0 of 64**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Xylene	**427.6926186**	**mg/kg**	**p-Xylene**	**1 of 59**	**0**	**1.9**	**1.9**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
Benzene	**1.42187881**	**mg/kg**		**0 of 64**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
1,2-Dichlorobenzene	**133**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
2-Chlorotoluene	**2.41**	**mg/kg**	**chlorobenzene**	**0 of 5**	**0**	**0.0**	**0.0**						
O-Xylene	**475.7207618**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Hexachlorobutadiene (HCBD)	**1.79**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
1,2,3 Trichlorobenzene	**8.81**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Trichloroethene	**0.0797**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
1,1,2-Trichloroethane	**5.53**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
1,2-Dichloropropane	**0.121**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
1,1-Dichloroethene	**1.17**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
1,1-Dichloroethane	**10.9**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Bromodichloromethane	**0.096**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Tribromomethane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Chloroethene	**0.00153**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Bromochloromethane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Dibromomethane	**0.096**	**mg/kg**	**hodichlorometh**	**0 of 5**	**0**	**0.0**	**0.0**						
1,1,1-Trichloroethane	**40.4**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Chloroform	**4.22**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
1,1,1,2-Tetrachloroethane	**8.2**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
2,2-Dichloropropane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
1,1-Dichloropropene	**3.3**	**mg/kg**	**Benzene**	**0 of 5**	**0**	**0.0**	**0.0**						
trachloromethane (Carbon Tetra Chlorid	**0.128**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
cis1,3-Dichloropropene	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
1,3-Dichlorobenzene	**2.45**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Methyl tert-butyl ether (MTBE)	**319**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
trans-1,2-Dichloroethene	**1.02**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
cis-1,2-Dichloroethene	**0.559**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
1,3-Dichloropropane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Sec-Butylbenzene	**1.42187881**	**mg/kg**	**Benzene**	**0 of 5**	**0**	**0.0**	**0.0**						
Tetrachloroethene	**0.92**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
Dibromochloromethane	**None**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						
1,2,4-Trichlorobenzene	**15.3**	**mg/kg**		**0 of 5**	**0**	**0.0**	**0.0**						

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	Units	Surrogate?	Total > LOD	Total > GAC	Min	Max	TP101	WS101	TP109	TP106	TP106	TP119
								384759.647	384734.621	384661.431	384830.717	384830.717	384483.283
								399818.495	399613.694	399650.774	399695.601	399695.601	399475.961
								0.30	0.30	3.30	2.80	0.40	3.00
								03/01/2019	08/01/2019	04/01/2019	03/01/2019	03/01/2019	09/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	MG	MG	MG	CHES
Chlorobenzene	2.41	mg/kg		0 of 5	0	0.0	0.0						
Bromobenzene	6.96	mg/kg		0 of 5	0	0.0	0.0						
1,3,5-Trimethylbenzene	3.31	mg/kg	-Trimethylben	0 of 5	0	0.0	0.0						
1,2-Dibromoethane	0.096	mg/kg	nodichloromet	0 of 5	0	0.0	0.0						
1,4-Dichlorobenzene	332	mg/kg		0 of 5	0	0.0	0.0						
4-Chlorotoluene	2.41	mg/kg	chlorobenzene	0 of 5	0	0.0	0.0						
n-Butylbenzene	1.42187881	mg/kg	Benzene	0 of 5	0	0.0	0.0						
n-propylbenzene	323	mg/kg		0 of 5	0	0.0	0.0						
trans-1,3-Dichloropropene	None	mg/kg		0 of 5	0	0.0	0.0						
Styrene	236	mg/kg		0 of 5	0	0.0	0.0						
1,2-Dichloroethane	0.0227	mg/kg		0 of 5	0	0.0	0.0						
Acenaphthylene	5970	#N/A	#N/A	13 of 57	0	0.0	7.7	0.0	< 0.03	< 0.03		0.1	< 0.03
Dibenz-a-h-anthracene	0.32	#N/A	#N/A	18 of 57	2	0.0	2.4	< 0.03	< 0.03	< 0.03		0.2	< 0.03
Acenaphthene	6040	#N/A	#N/A	26 of 57	0	0.0	6.1	< 0.03	0.1	< 0.03		0.0	< 0.03
Total BTEX	None	mg/kg		0 of 8	0	0.0	0.0				< 0.04		
4-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0						
4-Nitrophenol	None	mg/kg		1 of 3	0	6.2	6.2						
Dimethylphthalate	None	mg/kg		0 of 3	0	0.0	0.0						
P-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0						
Benzyl Alcohol	None	mg/kg		0 of 3	0	0.0	0.0						
4-Bromophenyl Phenyl Ether	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0						
Azobenzene	None	mg/kg		0 of 3	0	0.0	0.0						
2,4-Dimethylphenol	1040	mg/kg		1 of 3	0	0.2	0.2						
Phenol	1200	mg/kg		1 of 3	0	0.3	0.3						
Bis(2-chloroethoxy)methane	None	mg/kg		0 of 3	0	0.0	0.0						
Bis(2-ethylhexyl)phthalate	4090	mg/kg		0 of 3	0	0.0	0.0						
Di-N-Octyl Phthalate	4920	mg/kg		0 of 3	0	0.0	0.0						
Hexachlorobenzene (HCB)	6.38	mg/kg		0 of 3	0	0.0	0.0						
2,4-Dichlorophenol	186	mg/kg		0 of 3	0	0.0	0.0						
2,4-Dinitrotoluene	254	mg/kg		0 of 3	0	0.0	0.0						
Diphenylamine	None	mg/kg		0 of 3	0	0.0	0.0						
Bis(2-chloroisopropyl)ether	None	mg/kg		0 of 3	0	0.0	0.0						
O-Dinitrobenzene	None	mg/kg		1 of 3	0	11.0	11.0						
2-Methyl-4,6-Dinitrophenol	None	mg/kg		0 of 3	0	0.0	0.0						
2,3,4,6-Tetrachlorophenol	229	mg/kg		0 of 3	0	0.0	0.0						
4-Chloro-3-Methylphenol	None	mg/kg		0 of 3	0	0.0	0.0						
2,6-Dinitrotoluene	125	mg/kg		0 of 3	0	0.0	0.0						
Aniline	1.42187881	mg/kg	Benzene	0 of 3	0	0.0	0.0						
4-Chlorophenyl Phenyl Ether	None	mg/kg		0 of 3	0	0.0	0.0						
Hexachlorocyclopentadiene	None	mg/kg		0 of 3	0	0.0	0.0						
Diethylphthalate	8970	mg/kg		0 of 3	0	0.0	0.0						
Di-N-Butyl Phthalate	645	mg/kg		0 of 3	0	0.0	0.0						
Butylbenzylphthalate	63800	mg/kg		0 of 3	0	0.0	0.0						
Carbazole	None	mg/kg		1 of 3	0	3.5	3.5						
Pentachlorophenol (PCP)	30.6	mg/kg		0 of 3	0	0.0	0.0						
2,4,6-Trichlorophenol	231	mg/kg		0 of 3	0	0.0	0.0						
2-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0						
2-Methylnaphthalene	13.2	mg/kg	naphthalene	1 of 3	0	8.8	8.8						
2-Chloronaphthalene	31.6	mg/kg		0 of 3	0	0.0	0.0						
2,3,5,6-Tetrachlorophenol	None	mg/kg		0 of 3	0	0.0	0.0						
2-Methylphenol	9930	mg/kg		1 of 3	0	0.2	0.2						
2-Chlorophenol	207	mg/kg		0 of 3	0	0.0	0.0						
2,4,5-Trichlorophenol	231	mg/kg	6-Trichlorophe	0 of 3	0	0.0	0.0						
3-Nitroaniline	None	mg/kg		0 of 3	0	0.0	0.0						
M-Dinitrobenzene	None	mg/kg		0 of 3	0	0.0	0.0						
3/4 Methylphenol	10000	mg/kg		1 of 3	0	0.4	0.4						
Phenol (Monohydric)	1200	#N/A	#N/A	23 of 64	0	0.4	12.0	0.4	< 0.3	0.6	0.4	0.6	< 0.3
Loss on ignition	None	%		8 of 8	0	1.3	11.0				1.7		
Total Organic Carbon	None	%		63 of 64	0	0.5	41.0	2.9	1.8	13.0	1.5	35.0	0.7
Napthalene	13.2	mg/kg		25 of 59	1	0.0	18.0	< 0.03	< 0.03	0.0		0.1	< 0.03

Screened against Residential (no plant uptake) - 6% SOM

Soil Concentration exceeds GAC 100

								TP101	WS101	TP109	TP106	TP106	TP119
								384759.647	384734.621	384661.431	384830.717	384830.717	384483.283
								399818.495	399613.694	399650.774	399695.601	399695.601	399475.961
								0.30	0.30	3.30	2.80	0.40	3.00
								03/01/2019	08/01/2019	04/01/2019	03/01/2019	03/01/2019	09/01/2019
								AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								MG	MG	MG	MG	MG	CHES
Contaminant Name	**GAC**	**Units**	**Surrogate?**	**Total > LOD**	**Total > GAC**	**Min**	**Max**						
Anthracene	**36600**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**14.0**	0.2	0.1	0.1		0.2	< 0.03
Benzo(k)fluoranthene	**107**	**#N/A**	**#N/A**	**32 of 57**	**0**	**0.0**	**6.5**	0.1	0.1	0.1		0.3	< 0.03
Chrysene	**31.9**	**#N/A**	**#N/A**	**39 of 57**	**0**	**0.0**	**20.0**	0.1	0.2	0.1		1.1	< 0.03
Pyrene	**3790**	**#N/A**	**#N/A**	**44 of 57**	**0**	**0.0**	**48.0**	0.3	0.5	0.3		2.4	< 0.03
Benzo (g,h,i) perylene	**359**	**#N/A**	**#N/A**	**34 of 57**	**0**	**0.0**	**9.5**	0.1	0.1	0.1		1.0	< 0.03
Indeno(1,2,3-cd)pyrene	**46**	**#N/A**	**#N/A**	**33 of 57**	**0**	**0.0**	**7.4**	0.1	0.1	0.1		0.6	< 0.03
Benzo(b)fluoranthene	**4.06**	**#N/A**	**#N/A**	**39 of 57**	**2**	**0.0**	**17.0**	0.1	0.1	0.1		1.1	< 0.03
Fluoranthene	**1580**	**#N/A**	**#N/A**	**43 of 57**	**0**	**0.0**	**50.0**	0.3	0.6	0.3		1.0	< 0.03
Benzo(a)pyrene	**3.23**	**#N/A**	**#N/A**	**35 of 57**	**2**	**0.0**	**17.0**	0.1	0.1	0.1		1.0	< 0.03
Benzo(a)anthracene	**15**	**#N/A**	**#N/A**	**38 of 57**	**1**	**0.0**	**19.0**	0.1	0.2	0.1		0.8	< 0.03
Phenanthrene	**1520**	**#N/A**	**#N/A**	**42 of 57**	**0**	**0.1**	**61.0**	0.1	0.6	0.2		0.6	< 0.03
Fluorene	**4460**	**#N/A**	**#N/A**	**24 of 57**	**0**	**0.0**	**13.0**	< 0.03	0.1	< 0.03		0.0	< 0.03
Pah,Total	**None**	**mg/kg**		**45 of 59**	**0**	**0.1**	**95.0**	1.5	2.8	1.6	47.0	10.0	< 0.10
Dibenzofuran	**3.23**	**mg/kg**	**benzo(a)pyrene**	**2 of 3**	**1**	**0.2**	**8.3**						
Aliphatics >C8-10	**155**	**mg/kg**		**1 of 59**	**0**	**4.3**	**4.3**	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01
Aromatics >C7-8	**3928**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01
Aromatics >C8-10	**269**	**mg/kg**		**1 of 59**	**0**	**10.0**	**10.0**	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01
Aliphatics >C5-6	**161**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01
Aliphatics >C6-8	**529**	**mg/kg**		**1 of 59**	**0**	**1.2**	**1.2**	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01
Aromatics >C5-7	**1.4**	**mg/kg**		**0 of 59**	**0**	**0.0**	**0.0**	< 0.01	< 0.01	< 0.01		< 0.01	< 0.01
Aromatics >C12-16	**2480**	**#N/A**	**#N/A**	**16 of 59**	**0**	**0.7**	**110.0**	< 0.5	< 0.5	< 0.5		19.0	< 0.5
Aromatics >C16-21	**1817**	**#N/A**	**#N/A**	**20 of 59**	**0**	**3.9**	**150.0**	< 0.6	< 0.6	< 0.6		42.0	< 0.6
Aromatics >C10-12	**1240**	**#N/A**	**#N/A**	**11 of 59**	**0**	**1.0**	**42.0**	< 0.9	< 0.9	< 0.9		11.0	< 0.9
Aliphatics >C12-16	**4370**	**#N/A**	**#N/A**	**11 of 59**	**0**	**3.7**	**240.0**	< 1.2	< 1.2	< 1.2		7.1	< 1.2
Aromatics >C21-35	**1930**	**#N/A**	**#N/A**	**21 of 59**	**0**	**9.0**	**670.0**	< 1.4	< 1.4	< 1.4		84.0	< 1.4
Aliphatics >C16-21	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**7.2**	**160.0**	< 1.5	< 1.5	< 1.5		110.0	< 1.5
Aliphatics >C10-12	**767**	**#N/A**	**#N/A**	**7 of 59**	**0**	**1.5**	**130.0**	< 1.5	< 1.5	< 1.5		1.5	< 1.5
Aliphatics >C21-35	**48900**	**#N/A**	**#N/A**	**11 of 59**	**0**	**35.0**	**350.0**	< 3.4	< 3.4	< 3.4		110.0	< 3.4
Aliphatics >C5-35	**None**	**#N/A**	**#N/A**	**11 of 59**	**0**	**52.0**	**650.0**	< 10	< 10	< 10		220.0	< 10
TPH >C10-40	**None**	**mg/kg**		**8 of 8**	**0**	**31.0**	**1700.0**				190.0		

Appendix D

Phytotoxic Screening

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	GAC Units	Total > LOD	Total > GAC	Min	Max		Hole Ref	BH101	TP110	WS105	WS104	TP109	BH112	BH112	BH107	TP111	TP105	TP105	TP109	BH103	BH105
								Easting	384796.682	384638.835	384294.085	384569.278	384661.431	384401.713	384401.713	384824.812	384592.029	384843.779	384843.779	384661.431	384689.014	384463.735
								Northing	399802.989	399640.942	399279.174	399463.63	399650.774	399486.259	399486.259	399485.537	399655.215	399726.261	399726.261	399650.774	399695.588	399571.588
								Sample Top (m)	0.80	1.30	0.30	1.00	1.30	3.30	0.30	2.00	0.30	1.30	0.30	0.30	3.20	0.70
								Sample Date	03/01/2019	07/01/2019	10/01/2019	08/01/2019	04/01/2019	10/01/2019	10/01/2019	09/01/2019	07/01/2019	03/01/2019	03/01/2019	04/01/2019	04/01/2019	04/01/2019
								Investigation	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								Geology	MG	MG	MG	MG	MG	CHES	MG	MG	MG	MG	MG	MG	MG	MG
Arsenic	**50**	**mg/kg**	**64 of 64**	**2**	**4.1**	**71**			5.2	34.0	12.0	15.0	71.0	4.5	8.5	9.0	18.0	12.0	19.0	28.0	6.1	11.0
Cadmium	**3**	**mg/kg**	**60 of 64**	**1**	**0.1**	**4.7**			0.9	0.6	4.7	0.6	0.4	0.1	0.3	0.2	0.6	0.2	0.5	0.5	0.2	0.2
Chromium	**400**	**mg/kg**	**64 of 64**	**0**	**5.7**	**48**			5.7	21.0	38.0	15.0	15.0	11.0	15.0	24.0	26.0	23.0	22.0	19.0	19.0	23.0
Copper	**200**	**mg/kg**	**64 of 64**	**11**	**8.9**	**4200**			50.0	300.0	190.0	90.0	110.0	8.9	40.0	25.0	86.0	39.0	94.0	300.0	46.0	31.0
Lead	**300**	**mg/kg**	**64 of 64**	**15**	**12.0**	**12000**			38.0	520.0	490.0	290.0	180.0	66.0	300.0	18.0	71.0	110.0	240.0	1300.0	28.0	26.0
Mercury	**1**	**mg/kg**	**46 of 64**	**5**	**0.1**	**18**			0.2	1.6	0.1	0.1	1.1	< 0.05	0.2	< 0.05	0.3	0.3	0.9	18.0	< 0.05	0.1
Nickel	**110**	**mg/kg**	**64 of 64**	**0**	**6.5**	**53**			7.9	38.0	42.0	15.0	29.0	12.0	12.0	28.0	28.0	20.0	27.0	39.0	22.0	27.0
Selenium	**2**	**mg/kg**	**5 of 64**	**0**	**0.5**	**1**			< 0.5	< 0.5	0.7	0.9	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	**300**	**mg/kg**	**64 of 64**	**7**	**28.0**	**1700**			46.0	240.0	1700.0	310.0	93.0	36.0	95.0	57.0	180.0	88.0	170.0	310.0	99.0	97.0
pH	**-**	**-**	**64 of 64**	**0**	**6.1**	**11.7**			8.3	7.3	8.7	9.0	8.2	9.3	8.5	8.3	7.8	8.3	8.4	7.6	8.5	8.3

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	GAC Units	Total > LOD	Total > GAC	Min	Max		Hole Ref	WS103	WS102	BH103	TP104	TP111	TP112	BH105	BH106	TP103	TP122	TP108	BH106	TP107	BH102
								Easting	384813.849	384761.314	384689.014	384780.328	384592.029	384552.675	384463.735	384459.989	384772.82	384423.36	384655.011	384459.989	384737.823	384763.18
								Northing	399611.16	399589.102	399695.588	399749.164	399655.215	399614.062	399571.588	399509.165	399769.313	399438.117	399693.93	399509.165	399704.019	399691.375
								Sample Top (m)	1.00	1.00	4.80	0.30	2.50	0.30	3.30	0.30	1.80	0.30	0.30	3.30	1.20	3.50
								Sample Date	07/01/2019	07/01/2019	04/01/2019	03/01/2019	07/01/2019	07/01/2019	08/01/2019	07/01/2019	03/01/2019	11/01/2019	04/01/2019	08/01/2019	03/01/2019	03/01/2019
								Investigation	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								Geology	MG	MG	MM	MG	CHES	MG	ALV	MG	GTD	MG	MG	MG	MG	MG
Arsenic	**50**	**mg/kg**	**64 of 64**	**2**	**4.1**	**71**			14.0	12.0	12.0	23.0	4.5	19.0	10.0	40.0	8.1	23.0	37.0	28.0	12.0	9.3
Cadmium	**3**	**mg/kg**	**60 of 64**	**1**	**0.1**	**4.7**			0.3	0.5	0.4	0.7	0.1	0.3	0.1	1.0	0.2	0.4	0.4	0.5	0.2	0.2
Chromium	**400**	**mg/kg**	**64 of 64**	**0**	**5.7**	**48**			16.0	12.0	24.0	48.0	13.0	18.0	18.0	22.0	22.0	15.0	36.0	27.0	23.0	16.0
Copper	**200**	**mg/kg**	**64 of 64**	**11**	**8.9**	**4200**			60.0	80.0	9.1	150.0	14.0	270.0	18.0	210.0	27.0	280.0	130.0	180.0	43.0	27.0
Lead	**300**	**mg/kg**	**64 of 64**	**15**	**12.0**	**12000**			490.0	280.0	13.0	210.0	12.0	290.0	12.0	370.0	13.0	730.0	100.0	210.0	39.0	91.0
Mercury	**1**	**mg/kg**	**46 of 64**	**5**	**0.1**	**18**			0.7	0.6	< 0.05	0.3	< 0.05	0.5	< 0.05	0.4	< 0.05	0.2	< 0.05	0.4	0.3	0.2
Nickel	**110**	**mg/kg**	**64 of 64**	**0**	**6.5**	**53**			15.0	11.0	29.0	32.0	15.0	38.0	18.0	38.0	29.0	24.0	33.0	34.0	29.0	19.0
Selenium	**2**	**mg/kg**	**5 of 64**	**0**	**0.5**	**1**			< 0.5	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	1.0	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	**300**	**mg/kg**	**64 of 64**	**7**	**28.0**	**1700**			220.0	140.0	69.0	180.0	28.0	120.0	54.0	340.0	65.0	260.0	130.0	160.0	62.0	88.0
pH	**-**	**-**	**64 of 64**	**0**	**6.1**	**11.7**			8.5	8.5	8.7	7.7	7.7	6.1	8.2	6.9	8.1	8.1	7.6	7.9	7.2	8.3

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	GAC Units	Total > LOD	Total > GAC	Min	Max		Hole Ref	BH106	BH109	BH104	BH103	BH104	BH101	BH110	TP121	TP120	TP120	TP103	TP112	TP121	TP126
								Easting	384459.989	384562.256	384607.46	384689.014	384607.46	384796.682	384353.882	384442.251	384451.844	384451.844	384772.82	384552.675	384442.251	384574.85
								Northing	399509.165	399392.535	399631.24	399695.588	399631.24	399802.989	399440.903	399393.368	399460.069	399460.069	399769.313	399614.062	399393.368	399411.048
								Sample Top (m)	7.60	1.20	4.70	0.30	9.70	4.80	0.30	0.30	1.00	0.30	1.00	2.30	2.30	0.30
								Sample Date	08/01/2019	09/01/2019	04/01/2019	04/01/2019	07/01/2019	03/01/2019	10/01/2019	11/01/2019	09/01/2019	09/01/2019	03/01/2019	07/01/2019	11/01/2019	09/01/2019
								Investigation	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								Geology	GTD	MG	MG	MG	MG	MG	MG	MG	MG	MG	ALV	MG	MG	MG
Arsenic	**50**	**mg/kg**	**64 of 64**	**2**	**4.1**	**71**			11.0	6.7	8.2	9.5	19.0	9.5	6.2	18.0	19.0	16.0	4.1	44.0	4.5	9.5
Cadmium	**3**	**mg/kg**	**60 of 64**	**1**	**0.1**	**4.7**			< 0.1	0.5	0.2	0.6	0.2	0.2	0.3	0.4	0.6	0.9	0.2	0.3	< 0.1	3.0
Chromium	**400**	**mg/kg**	**64 of 64**	**0**	**5.7**	**48**			18.0	17.0	20.0	19.0	22.0	20.0	22.0	15.0	22.0	19.0	8.7	18.0	6.8	18.0
Copper	**200**	**mg/kg**	**64 of 64**	**11**	**8.9**	**4200**			26.0	19.0	33.0	100.0	100.0	28.0	46.0	350.0	120.0	110.0	35.0	150.0	10.0	39.0
Lead	**300**	**mg/kg**	**64 of 64**	**15**	**12.0**	**12000**			45.0	77.0	42.0	230.0	75.0	53.0	37.0	440.0	96.0	2100.0	20.0	210.0	28.0	120.0
Mercury	**1**	**mg/kg**	**46 of 64**	**5**	**0.1**	**18**			0.1	0.2	< 0.05	0.3	0.4	0.1	< 0.05	0.4	0.1	0.1	0.1	0.3	< 0.05	0.7
Nickel	**110**	**mg/kg**	**64 of 64**	**0**	**6.5**	**53**			12.0	11.0	24.0	17.0	53.0	25.0	25.0	28.0	28.0	17.0	12.0	35.0	6.5	18.0
Selenium	**2**	**mg/kg**	**5 of 64**	**0**	**0.5**	**1**			< 0.5	< 0.5	< 0.5	< 0.5	0.7	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	**300**	**mg/kg**	**64 of 64**	**7**	**28.0**	**1700**			50.0	74.0	79.0	300.0	120.0	61.0	91.0	280.0	140.0	140.0	67.0	91.0	35.0	520.0
pH	**-**	**-**	**64 of 64**	**0**	**6.1**	**11.7**			7.7	11.4	9.7	9.1	7.8	8.3	10.5	8.1	8.3	10.1	8.3	6.5	8.0	10.2

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	GAC Units	Total > LOD	Total > GAC	Min	Max		Hole Ref	WS106	BH110	TP124	TP124	TP125	TP115	TP102	TP127	BH104	TP126	TP115	TP102	TP115	BH102
								Easting	384611.937	384353.882	384763.554	384763.554	384525.517	384456.531	384698.516	384520.567	384607.46	384574.85	384456.531	384698.516	384456.531	384763.18
								Northing	399505.689	399440.903	399485.198	399485.198	399388.873	399526.838	399742.661	399360.521	399631.24	399411.048	399526.838	399742.661	399526.838	399691.375
								Sample Top (m)	1.00	3.00	3.20	0.30	0.30	0.30	1.20	0.30	0.70	2.20	1.30	0.30	3.30	0.30
								Sample Date	08/01/2019	10/01/2019	11/01/2019	11/01/2019	10/01/2019	07/01/2019	03/01/2019	10/01/2019	04/01/2019	09/01/2019	07/01/2019	03/01/2019	07/01/2019	24/01/2019
								Investigation	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								Geology	MG	MG	GTD	MG	MG	MG	GTD	MG	MG	MG	MG	MG	MG	MG
Arsenic	**50**	**mg/kg**	**64 of 64**	**2**	**4.1**	**71**			7.5	7.1	7.1	61.0	14.0	40.0	10.0	17.0	23.0	6.6	25.0	7.5	40.0	16.0
Cadmium	**3**	**mg/kg**	**60 of 64**	**1**	**0.1**	**4.7**			0.9	0.2	< 0.1	1.6	0.7	0.4	0.3	0.4	0.6	0.1	0.3	0.6	0.5	1.0
Chromium	**400**	**mg/kg**	**64 of 64**	**0**	**5.7**	**48**			11.0	13.0	20.0	33.0	31.0	25.0	29.0	19.0	16.0	19.0	27.0	14.0	17.0	23.0
Copper	**200**	**mg/kg**	**64 of 64**	**11**	**8.9**	**4200**			79.0	22.0	59.0	4200.0	41.0	300.0	46.0	37.0	300.0	16.0	260.0	31.0	310.0	140.0
Lead	**300**	**mg/kg**	**64 of 64**	**15**	**12.0**	**12000**			140.0	1900.0	110.0	12000.0	830.0	460.0	17.0	87.0	180.0	27.0	190.0	17.0	520.0	530.0
Mercury	**1**	**mg/kg**	**46 of 64**	**5**	**0.1**	**18**			0.4	0.1	< 0.05	2.5	0.4	0.6	< 0.05	0.2	0.5	0.1	0.4	< 0.05	1.0	0.4
Nickel	**110**	**mg/kg**	**64 of 64**	**0**	**6.5**	**53**			14.0	11.0	27.0	43.0	18.0	45.0	30.0	16.0	48.0	15.0	50.0	12.0	40.0	26.0
Selenium	**2**	**mg/kg**	**5 of 64**	**0**	**0.5**	**1**			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	**300**	**mg/kg**	**64 of 64**	**7**	**28.0**	**1700**			120.0	74.0	73.0	1300.0	150.0	130.0	89.0	100.0	150.0	53.0	88.0	72.0	180.0	500.0
pH	**-**	**-**	**64 of 64**	**0**	**6.1**	**11.7**			9.9	11.7	7.5	7.5	10.2	6.5	8.5	9.8	7.3	8.7	6.5	8.7	6.9	10.6

Soil Concentration exceeds GAC 100

Contaminant Name	GAC	GAC Units	Total > LOD	Total > GAC	Min	Max		Hole Ref	TP119	BH103	TP101	WS101	TP109	TP106	TP106	TP119
								Easting	384483.283	384689.014	384759.647	384734.621	384661.431	384830.717	384830.717	384483.283
								Northing	399475.961	399695.588	399818.495	399613.694	399650.774	399695.601	399695.601	399475.961
								Sample Top (m)	0.20	1.00	0.30	0.30	3.30	2.80	0.40	3.00
								Sample Date	09/01/2019	04/01/2019	03/01/2019	08/01/2019	04/01/2019	03/01/2019	03/01/2019	09/01/2019
								Investigation	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019	AEG 2019
								Geology	MG	MG	MG	MG	MG	MG	MG	CHES
Arsenic	**50**	**mg/kg**	**64 of 64**	**2**	**4.1**	**71**			4.1	11.0	6.8	12.0	19.0	5.0	21.0	12.0
Cadmium	**3**	**mg/kg**	**60 of 64**	**1**	**0.1**	**4.7**			0.6	0.8	0.4	0.3	0.2	< 0.1	0.2	0.1
Chromium	**400**	**mg/kg**	**64 of 64**	**0**	**5.7**	**48**			12.0	19.0	21.0	13.0	18.0	11.0	38.0	15.0
Copper	**200**	**mg/kg**	**64 of 64**	**11**	**8.9**	**4200**			59.0	140.0	71.0	57.0	150.0	17.0	130.0	19.0
Lead	**300**	**mg/kg**	**64 of 64**	**15**	**12.0**	**12000**			47.0	210.0	26.0	280.0	330.0	56.0	40.0	18.0
Mercury	**1**	**mg/kg**	**46 of 64**	**5**	**0.1**	**18**			< 0.05	0.3	< 0.05	0.2	1.2	0.1	< 0.05	< 0.05
Nickel	**110**	**mg/kg**	**64 of 64**	**0**	**6.5**	**53**			7.5	20.0	22.0	16.0	38.0	13.0	50.0	16.0
Selenium	**2**	**mg/kg**	**5 of 64**	**0**	**0.5**	**1**			< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Zinc	**300**	**mg/kg**	**64 of 64**	**7**	**28.0**	**1700**			100.0	250.0	95.0	97.0	99.0	38.0	53.0	67.0
pH	**-**	**-**	**64 of 64**	**0**	**6.1**	**11.7**			11.6	10.0	8.9	7.8	7.6	8.3	8.6	7.4

Appendix 9.1a

Flood Risk Assessment

BAM

Victoria North Infrastructure and Enabling Works

Flood Risk Assessment

VNIF-ARP-ZZ-YYY-RP-CD-0002

P04 | 28 April 2022

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 282022

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ARUP

Document verification

ARUP

Job title		Victoria North Infrastructure and Enabling Works			**Job number** 282022
Document title		Flood Risk Assessment			**File reference**
Document ref		VNIF-ARP-ZZ-YYY-RP-CD-0002			
Revision	**Date**	**Filename**			
P01	30 Nov 2021	Description	First draft		
			Prepared by	Checked by	Approved by
		Name	Emily Stoddart	Drew Hunter/ Ryan Griffiths	Melanie Edwards
		Signature			
P02	28 Jan 2022	Filename	Flood Risk Assessment – Planning Application 2		
		Description	Revised after updated flood modelling received		
			Prepared by	Checked by	Approved by
		Name	Emily Stoddart	Drew Hunter/ Ryan Griffiths	Melanie Edwards
		Signature			
P03.01	11 Feb 22	Filename			
		Description	Updated to clarify the proposed mitigation proposals		
			Prepared by	Checked by	Approved by
		Name	Ryan Griffiths	Lanzhu Shao	Michael Wilton
		Signature			
P03.02	16 Mar 22	Filename			
		Description	Updated to reflected updated hydraulic modelling		
			Prepared by	Checked by	Approved by
		Name	Ryan Griffiths	Lanzhu Shao	Michael Wilton
		Signature			
			Issue Document verification with document		✓

Document Verification

Job title		Victoria North Infrastructure and Enabling Works			**Job number** 282022
Document title		Flood Risk Assessment			**File reference**
Document ref		VNIF-ARP-ZZ-YYY-RP-CD-0002			
Revision	**Date**	**Filename**	Main Works FRA V5.docx		
P03	19 Apr 2022	**Description**	Updated to reflect approved hydraulic modelling		
			Prepared by	Checked by	Approved by
		Name	Ryan Griffiths	Ryan Griffiths	Michael Wilton
		Signature			
P04	26 Apr 2022	**Filename**	Main Works FRA V5.1.docx		
		Description	Updated with AY and PF comments		
			Prepared by	Checked by	Approved by
		Name	Ryan Griffiths	Ryan Griffiths	Michael Wilton
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
		Filename			
		Description			
			Prepared by	Checked by	Approved by
		Name			
		Signature			
				Issue Document Verification with Document	✓

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1 Introduction

Arup has been commissioned by BAM to produce a Flood Risk Assessment (FRA) for the Victoria North HIF Infrastructure Works. These works are for the installation and construction of infrastructure elements to allow for the future development of the land included within the red line boundary. Separate planning applications are to be submitted for works proposed downstream of the site within the River Irk and for the development of the plots at later a date.

The proposed development covers an area of approximately 15.74ha, a proportion of this area includes the future development plots and which will be delivered separately to the HIF Infrastructure works. The site currently consists of a combination of greenfield and brownfield industrialised landscape and parkland. The proposed development under the HIF scheme includes land remediation, landscaping of green areas and public realm, a new access road and utilities provisions and diversions including foul and surface water drainage.

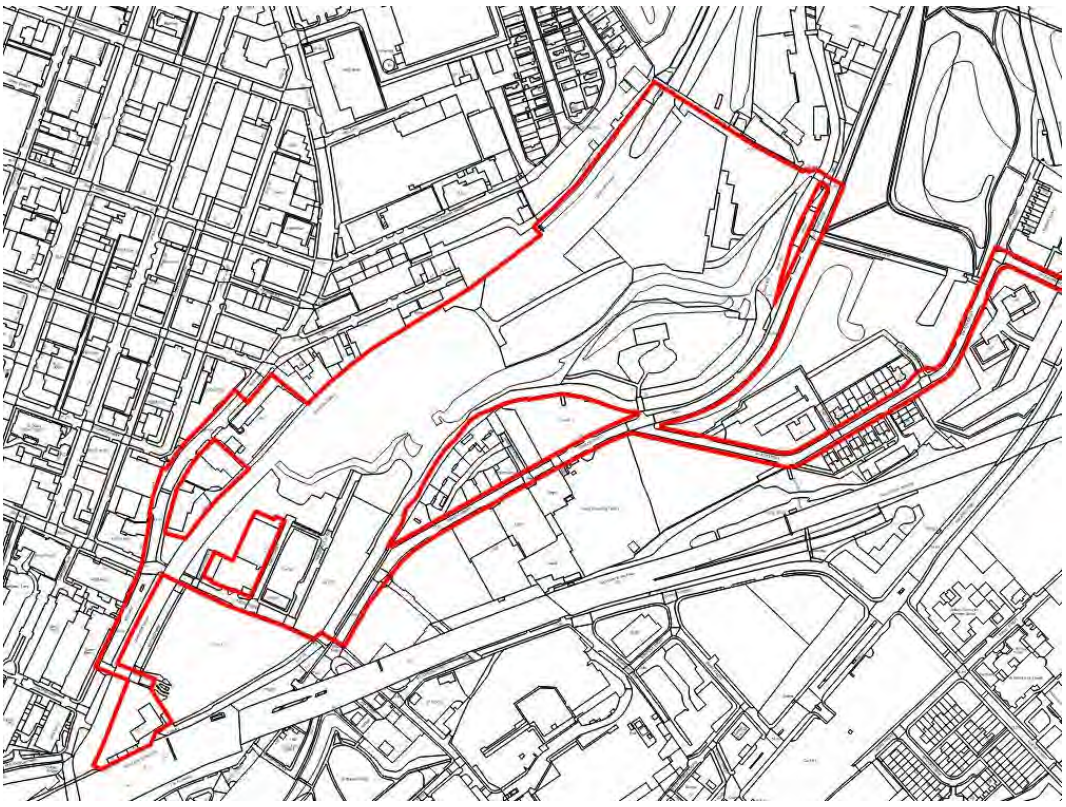


Figure 1 Victoria North HIF Works Boundary

The infrastructure and enabling works, flood alleviation works and the plot development on land controlled and owned by MCC and FEC at Red Bank constitutes the “Development Project”. This FRA is prepared in respect of the HIF Infrastructure Works (the Proposed Development) (Application 2). Four planning applications in total will be made, as follows:

- HIF Advance Enabling Works (referred to hereafter as ‘Application 1’). – for which planning permission has been granted, as explained below.

- City River Park (Phase 1), Future Development Platforms, New Spine Road, and Associated Infrastructure Works (HIF Infrastructure Works - referred to hereafter as 'Application 2'). i.e. this application, submitted by MCC.
- HIF Flood Defence Works (referred to hereafter as 'Application 3').
- Red Bank Neighbourhood (referred to hereafter as 'Application 4').

It is noted that, although the applications are given numbered references, this does not depict the order in which the applications are to be submitted and does not denote a pre-determined sequencing.

Application 1 for the HIF Advance Enabling Works was submitted to MCC on 25th November 2021 (planning ref. 132252/VO/2021) and was approved on 23rd December 2021

The majority of the HIF Infrastructure Works are related to level and layout changes (as discussed in section 3) and the provision of new utilities connections including surface water drainage. The boundary as shown in Figure 1 also includes a section of Red Bank, Roger Street, Dantzic Street and a section South of Dantzic Street. Within these existing roads the proposed works are limited to modifications of existing and installation of proposed utilities within the existing highway corridor. No changes to layout or levels are proposed within these areas and therefore they have been excluded from the FRA as there are no changes to the existing conditions.

The works are in areas of flood zones 1, 2 and 3. The majority of the works to modify levels and install new infrastructure will be within flood zone 1, identified within the project as the Plateau area of works, these areas are at a low risk of flooding. The areas around and within plots RB06-RB08, the area of St Catherine's Wood and the roads including Dantzic Street to the south of the river, are a mix of flood zones 2 and 3, these areas are at a high risk of flooding from fluvial sources.

This FRA has been produced to support the planning application submission for the HIF infrastructure works. The future development of the plots will be covered by a further FRA under a separate flood risk assessment. At present the areas identified as part of the HIF Infrastructure works will also remain at the same level of risk for the plot development. The future application will therefore need to take into account this risk and provide suitable mitigation for the development plots.

There are also proposals for works to be undertaken to the River Irk as part of the wider scheme which will be undertaken under a separate planning application. These works aim to reduce the flood risk within the area by making improvements to the river channel and removing potential flow throttle points. These works are likely to be undertaken within a similar timescale to the HIF Infrastructure Works. However as this scheme has not been finalised the flood risk reduction these works will provide cannot be taken into account for this application.

This report summarises the flood risk due to all potential sources, assesses the impact of the proposed HIF Infrastructure Works development and recommends flood management measures to mitigate the impacts of the works.

The FRA has been developed with reference to the following data and guidance:

- EA flood maps
- Updated fluvial flood extents baseline conducted by Arup for the Victoria North HIF proposals dated December 2021.
- National Planning Policy Framework
- Manchester, Salford and Trafford Strategic Flood Risk Assessment

2 Site location

The Victoria North HIF site lies to the north of Manchester Victoria Train Station to the east of Red Bank and north of Dantzic Street. The site mostly consists of post-industrial land and areas of hardstanding, as well as some buildings with industrial uses, which are mostly disused. Historically the area to the north of the site was used as railway sidings which is now disused and forms a plateau above the River Irk valley to the South East. The works covers an area of approximately 15.74ha and is shown by the red line boundary below in Figure 2.

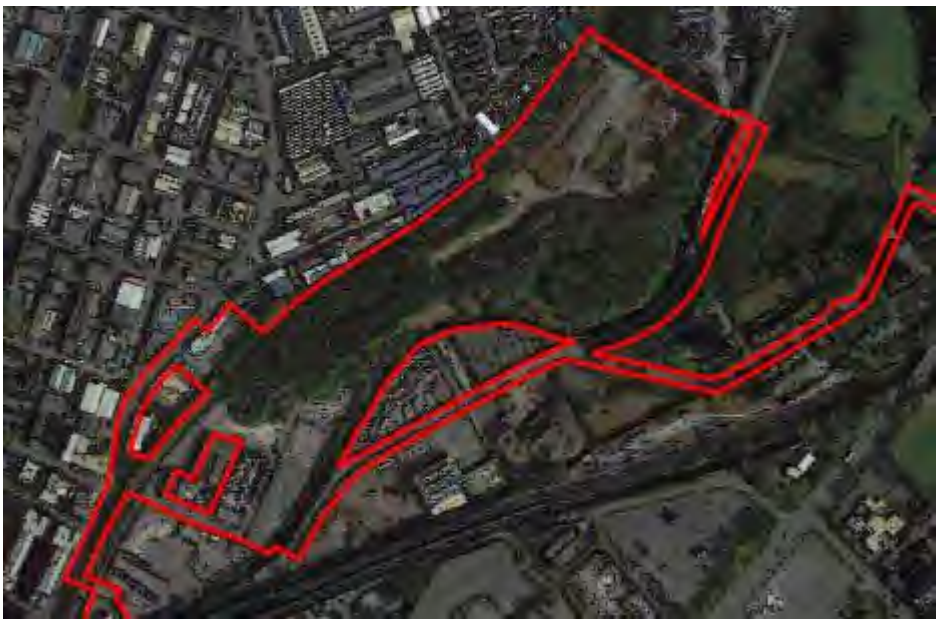


Figure 2 Victoria North HIF Infrastructure Works Site Location

3 Development proposals

The HIF Infrastructure Works will involve land remediation, modifications to existing levels and slopes, landscaping of green areas and public realm, new access road, and utilities provisions and diversions including foul and surface water. Under the HIF infrastructure works, no infrastructure will be delivered on-plot other than land remediation. All works covered within this FRA are therefore classified as Less Vulnerable within the Flood Risk vulnerability classification. The wider future development of the Victoria North site will include the build of multiple high density residential and commercial buildings and public realm and as discussed above will be covered by future planning applications.



Figure 3 Proposed development arrangement

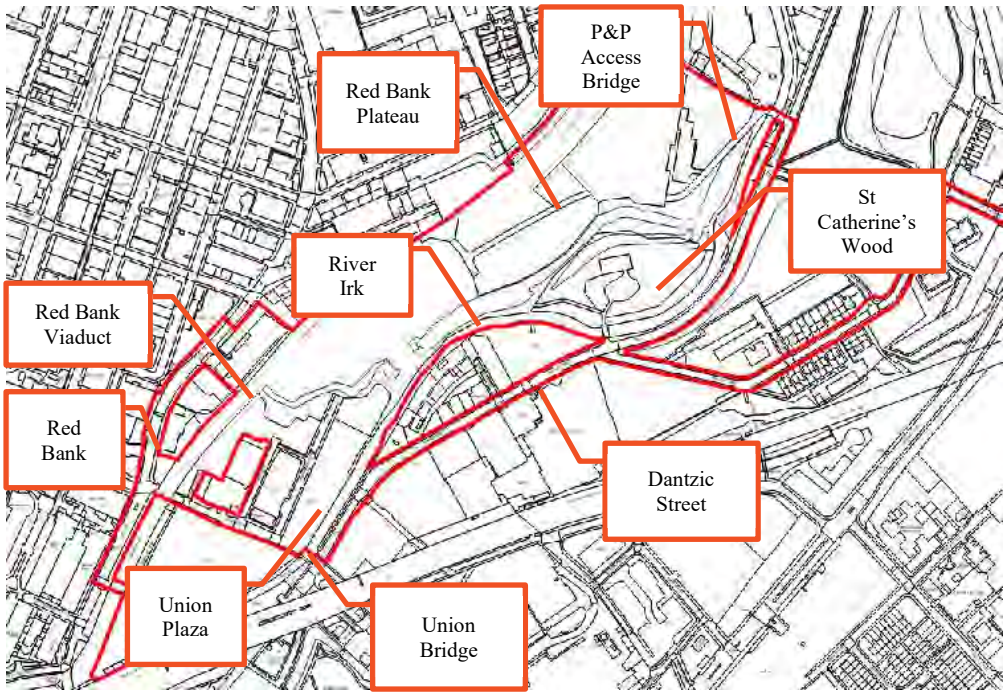


Figure 4 Proposed HIF works areas for reference

3.1 Plateau Area

Works within the Plateau Area of the site involve the construction of an access road, the installation of services including surface water drainage and the remediation and remodelling of the ground in the area to form development platforms RB12b, RB01, RB02, RB03, RB04, RB05a, RB05b and RB05c. This area lies wholly within flood zone 1 due to its relatively elevated position above the river and surround ground.

3.2 St Catherine's wood

Works within the existing St Catherine's wood are proposed to improve the amenity value of the area, including new footways, play equipment and the removal of sections of the existing river walls to improve the amenity and ecological value of the river. The below indicative section Figure 5 shows how the areas where the river wall is to be removed may look. The proposed walkway balustrades will be designed to minimise the chance of debris being caught within them during a flood event. This will be achieved by ensuring the walkways are as high as possible above the normal river level and the balustrades/handrails will be lightweight and have maximum openings to allow debris to pass through them if necessary.

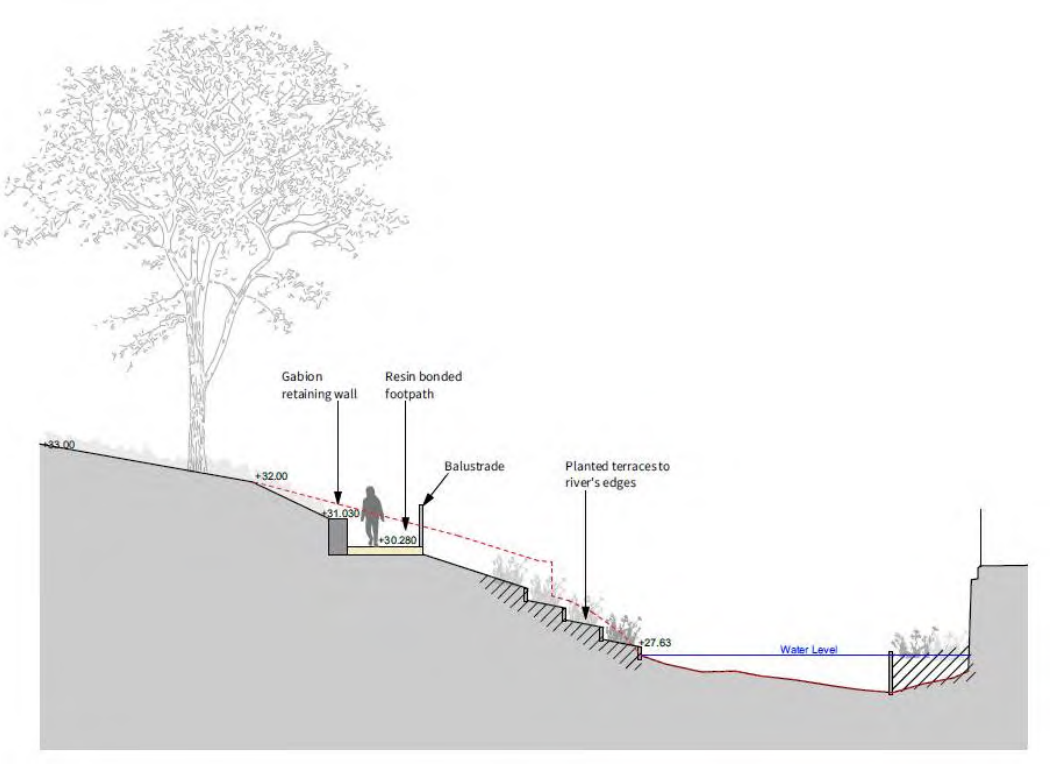


Figure 5 St Catherine's Wood river wall removal indicative section

Further west along the river the existing steep sided bank, which shows some signs of instability will be remodelled to reduce the gradients and ensure that it will be stable in the long term, see Figure 6 below showing proposed modifications. The existing river wall along this section will be maintained at its current height and in its present condition.

It is proposed that a bridge is to be incorporated in a future phase of the works and this has therefore not been included in this FRA. Any flood risk impact of this future bridge will be considered in future as part of a later planning application.

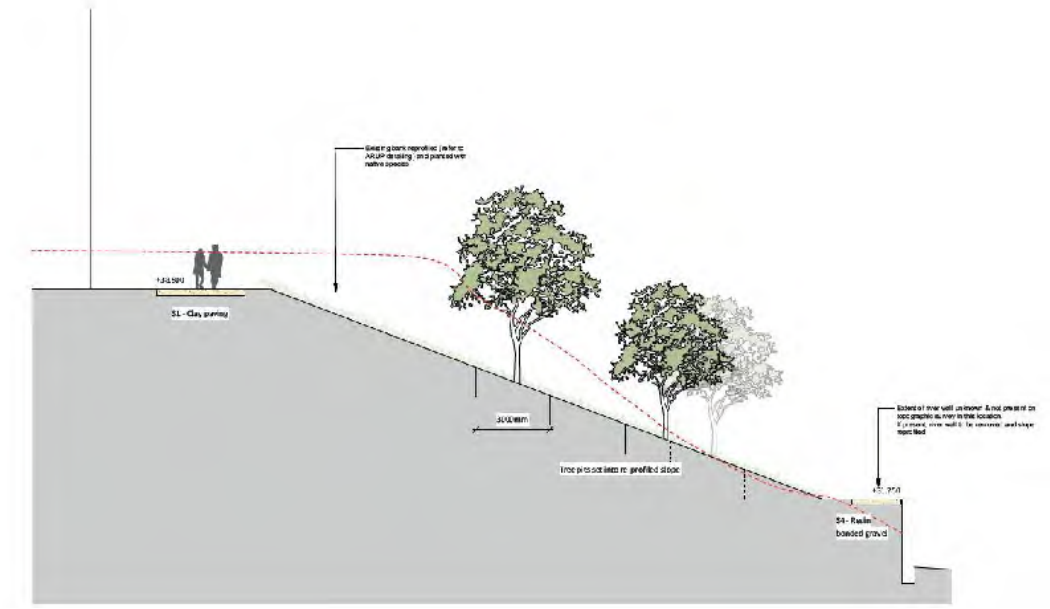


Figure 6 St Catherine's Wood bank reprofile indicative section

3.3 Dantzic Street

Works within Dantzic street will be the diversion of existing services, installation of new services and modifications to the existing sewers to allow for new connections. All works will be undertaken within the existing highway corridor. No modifications to the levels or alignment of the highway will be included in the works.

3.4 Red Bank terrace

Within the area between the Plateau and Rb06, 07 and 08 it is proposed to create a terraced access route, this will include the remodelling of an existing slope to reduce the gradients to allow for accessible footpaths to be formed. An indicative section is shown in Figure 7.

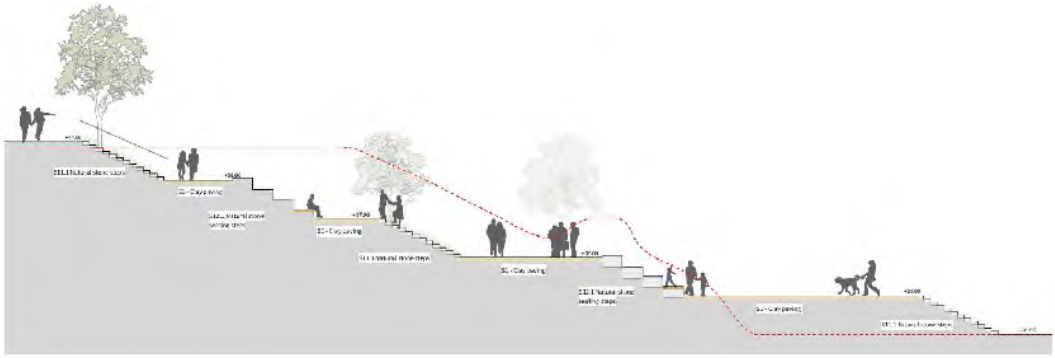


Figure 7 Red Bank Terrace indicative section

The extent of the works to the terrace have been designed to ensure that where levels are to be increased above existing this does not enter into the current EA flood zone 2 extents from the flood maps.

3.5 Union Plaza and RB06, 07 and 08

It is proposed that the existing river wall adjacent to plots RB06 and RB07 are to be removed and a terraced plaza adjacent to the river is created, improving the amenity value of the river. Figure 8 shows a proposed indicative section within the remodelled section.

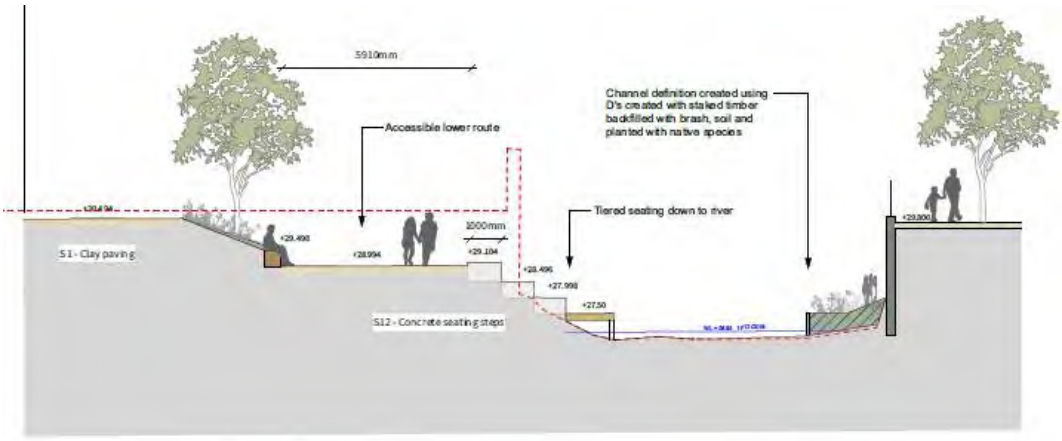


Figure 8 Typical indicative section through the Union Plaza terracing

The proposed stepped terrace area will open up the existing walled bank to provide a more open environment. The ground level immediately adjacent to the river will be reduced. Within this area it is also proposed that a buried 'U-tube' trench service crossing will be installed which will require works within the river channel, it is proposed to reinstate the river bed at the same level as existing, to ensure there is no adverse effect on the current flow and flood regime.

Beyond the terracing, the land between the plots RB06 and 07 will be landscaped as part of the works, including the installation of services and surface water drainage.

Plots RB06 and 07 will be remediated as part of the works to create development platforms. RB08 will not be included within the works. The existing highways within the vicinity of the plots will remaining as existing with some minor works.

4 Site specific flood risk

4.1 Fluvial flood risk

4.1.1 Flood zone extents

The EA flood maps show that the site sits in areas of flood zones 1, 2 and 3. Figure 9 is an extract of the existing EA flood map.



Figure 9 Flood Zones 2 and 3 from the EA Flood Map for Planning

The majority of the site sits within flood zone 1, this is due to the relatively elevated nature of the site compared to the river.

Where the site is at risk of fluvial flooding the majority of the site is within flood zone 2 including St Catherine's Wood and Plots RB06 and 08. There is a small area along the River edge and at the south east corner of RB07 which is within flood zone 3.

The Manchester, Salford and Trafford SFRA identifies areas within flood zone 3b which is the functional flood plain for the River Irk in Figure 10. These extents are shown to follow the edges of the river channel within the site, therefore all areas of flood zone 3 are considered as flood zone 3a. It is noted that the extent of flood zone 3a varies between the SFRA and the EA flood maps. The SFRA suggests that plot RB07 and land adjacent to the river are within flood zone 3, and that more land surrounding RB08 is in flood zone 2.

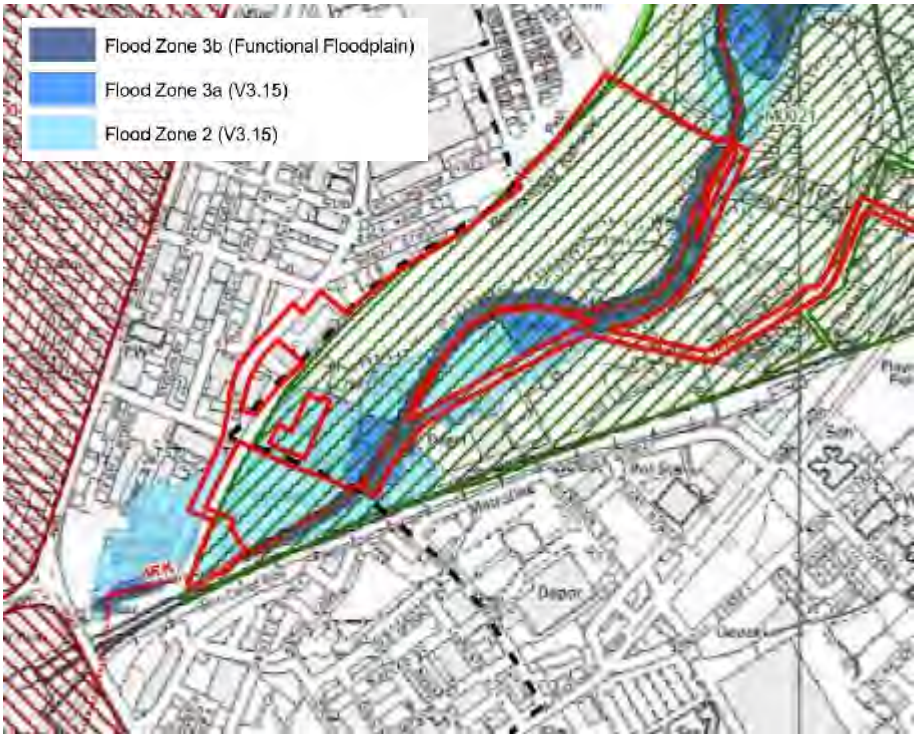


Figure 10 Flood Zone Extents identified in the Manchester, Salford and Trafford SFRA (note: flood zones 2 and 3a will be taken from EA flood maps and updated modelling)

As part of the future downstream improvement works to the River Irk, Arup are currently working with the EA to develop a new hydraulic model, this will then be used to determine which works river downstream of the site will achieve the best reduction in flood risk, within the budget allocated.

Whilst the new model is being agreed the proposals for HIF Infrastructure Works have been modelled using an 'interim 2021 model'. The aim of this interim 2021 model is to undertake a like-for-like comparison between the existing levels and the proposed HIF Infrastructure Works landscaping alterations. The results of this model have been included in Appendix A. This interim model uses a "precautionary approach" to the hydrology as requested by the EA, this has led to an increase in flows within the River for all storm events over that used to create the EA flood maps. This "precautionary approach" means that the extent of areas within flood zone 3 increase within plots RB06 and RB07. The proposed removal of a river wall upstream of Union Bridge is shown by this model to increase flood risk locally and off-site. Further discussion on the impact of the scheme and proposed mitigation measures are outlined in section 5.

4.1.2 Victoria North river works

As discussed above there is a separate project within the Victoria North development, which is also to be funded by HIF to improve the river channel downstream of the site. The objective of these works is to reduce the flood risk within and downstream of the site. At present this work has not been completed and therefore any future improvements this scheme will bring cannot be included in this FRA.

The future river works are anticipated to have an end date similar to that of the HIF Infrastructure Works and therefore the risk identified by the interim modelling works in Appendix A are likely to be temporary or to not occur at all depending upon the timing of the two projects. The future river works scheme will include a planning application and FRA to support them, however the timescales for these are unlikely to align with the planning submission for the HIF Infrastructure Works and therefore mitigation measures to take account of the increased flood risk identified in the model will be required.

4.2 Surface water flood risk

Figure 11 shows the flood risk from surface water for the site according to the EA Flood Map for Planning. This shows there are localised areas of low, medium and high risk for surface water flooding.



Figure 11 Surface Water Flood Extents extracted from EA Flood Map for Planning (High Risk ≥3.3%, 1< Medium Risk <3.3%, 0.1%< Low Risk <1%, Very Low Risk ≤0.1%)

The areas of high risk from surface water flooding are predominantly evident within the existing river channel and so represent the permanent water within the channel. Onsite other areas of concentrated surface water flood risk (low to medium) are shown along Dantzic Street, Hargreave's Street and Chase Street.

The areas of surface water flooding are a result of localised low points in the existing topography of the site. Although a large proportion of the site is not positively drained, initial geotechnical investigation indicates that infiltration varies due to large areas of made ground beneath the site. Therefore, overland flow is likely across the site which may contribute to surface water flooding. The proposed development will include resurfacing of many areas with identified

localised surface water flood risk, proposed levels will be designed to mitigate the risk of flooding.

Immediately downstream from site there is an area with high risk of surface water flooding. Any mitigations or proposals for the site within the red line boundary shall not worsen the surface water flood risk further downstream. The southern area within the red works boundary will not be developed by HIF.

4.3 Ground water flood risk

The Manchester, Salford and Trafford Strategic Flood Risk Assessment doesn't identify the site as an area at risk of groundwater flooding. The groundwater level is anticipated to be below most proposed works. However, measures to control groundwater inflow will be implemented if required.

4.4 Flooding from public sewers

The site sits within the Conurbation Core Critical Drainage Area (CDA) as identified in the Manchester, Salford and Trafford SFRA. This means that the area is particularly sensitive to an increase in surface water runoff due to new development and is likely associated with historic flooding in the area. This could be a result of the capacity of the existing sewer network or other watercourses including culverts. In 2020 the CSOs within the site boundary spilled a total of 108 times for a total of 660 hours[1], with the most spills occurring at the Dantzic Street/Warford Street CSO. This indicates that there may be reduced capacity in these combined sewers.

Any proposed new connections to existing sewers will consider existing sewer capacity to ensure that flooding is not worsened as a result of the works. Measures set out in section 6. will reduce the impact of the development on the existing sewers and reduce surface water flooding. SuDS will be utilised as far as possible and surface water will be discharged to the River Irk to reduce the surface water discharge to existing sewers, and to prevent worsening CSO spill rates.

4.5 Reservoir flood risk

Reservoir risk is considered to be low. The EA's flood risk from reservoirs map indicates reservoir flood risk along the river channel, therefore this has been considered as fluvial flood risk and is summarised in section 4.1.

4.6 Sequential Test

The proposed development is within the area covered by the Victoria North Strategic Regeneration Framework (SRF) which was endorsed by MCC in 2019. The framework sits alongside the MC adopted development plan and is therefore a material consideration in planning decisions. The SRF sets out the vision to deliver 15,000 homes supported by social and physical infrastructure. As the

[1] The Rivers Trust: https://www.theriverstrust.org/key-issues/sewage-in-rivers

proposed development lies wholly within the SRF area it is considered that the sequential test has already been satisfied for this development.

4.7 Existing flood risk conclusions

The main flood risk mechanisms for the site have been identified as fluvial and surface water. The impact of both of these mechanisms varies across the site as a result of levels changes and differing drainage catchments.

The plateau area sits within flood zone 1 and so has low risk of flooding from the River Irk. Development on the Plateau should be designed to prevent surface water flood risk from worsening in this area or elsewhere. This should be applied to all plots on the Plateau as well as the proposed Plateau Road.

The proposed St Catherine's Wood area sits mostly in flood zone 1. A small area of the park is within flood zone 2 as shown by the EA flood maps. The interim 2021 model shows limited changes between the 'existing' and proposed HIF Infrastructure Works scenario in this area, using the updated "precautionary approach" hydrology. The proposed land use for this area is parkland, this should be designed to ensure that water compatible zones are located in areas of higher flood risk close to the river. Due to its proximity to the river, development here should prevent additional spatial restrictions on the river flow to prevent flood risk worsening downstream.

The area north of the River around plots RB06, 07 and 08 currently sits mostly within flood zone 2, with an area in the south east corner of RB07 in flood zone 3 according to the EA flood maps. The area south of the River including Dantzic Street is also within both flood zone 2 and 3 as shown by both the EA flood maps. The interim 2021 model shows that the extent of flood zone 3 areas for the existing scenario increases to include all of RB06 and 07 with the modified "precautionary approach" hydrology, due to the increased flow within the river channel.

5 Impact of proposed scheme

5.1 Fluvial

The interim 2021 model has been used to assess the impact of the proposed works on the flood levels. This is a like-for-like comparison against the existing scenario – both using the "precautionary approach" hydrology. The results show that the proposed development will change the flood levels in channel and within vicinity of the proposed development. This interim model and modelling report have been accepted and approved by the EA.

Appendix A includes the detailed modelling report, below summarises the results. Appendix B also includes extracted detailed plans for the figures 6, 9 and 10 from the modelling report.

Collyhurst weir

There is a small reduction in the 1 in 100 year plus climate change flood levels by 0.04m, this reduction continues upstream towards HMG paints, after which the difference is negligible.

Upstream of Union Bridge

Localised increases in flood risk are shown to the right bank of Union Bridge due to the proposed removal of a river wall in this location, as shown in Figure 12 and 13. The increases in flood levels impact on the development plots RB06 and 07. Flood depths within the site for the 1 in 100 year events are increased by +0.035m compared to the existing scenario with the wall in place to the north of Union Bridge. For the 1 in 1000 year event the increase is +0.015m over the existing condition.

Levels to the southern bank of the Irk (Dantzic Street) are decreased as the water is allowed to freely re-enter the channel under the proposed scenario. Water levels within the river are also significantly reduced upstream of Union Street Bridge, this is due to the flows being able to propagate over the flood plain, to the north due to the wall being removed. Figure 14 shows the impact of the removal of the wall on the flows during the 1 in 1000 year event. This shows the greater propagation of flows during extreme events with the wall removed.

Downstream of Union Bridge

Flood levels for all events excluding the 1 in 1000 year are shown to be increased to the right bank downstream of Union Street Bridge, this is due to the removal of the wall allowing an increase in overland flow within the site and south onto Roger Street. The increase in flood level is approximately +0.01 to +0.02m, from existing flood levels of 0.63m, this leads to a small increase in the flood extents for the events up to the 1 in 100 year plus climate change event. In the 1 in 1000 year event the flood depths and extents are as existing. It should be noted that there is also a decrease in flood risk to the south bank downstream of Union Street Bridge in the proposed scenario, likely due to increased flows leaving the northern bank and propagating within the RB06, 07 and 08 plot area.

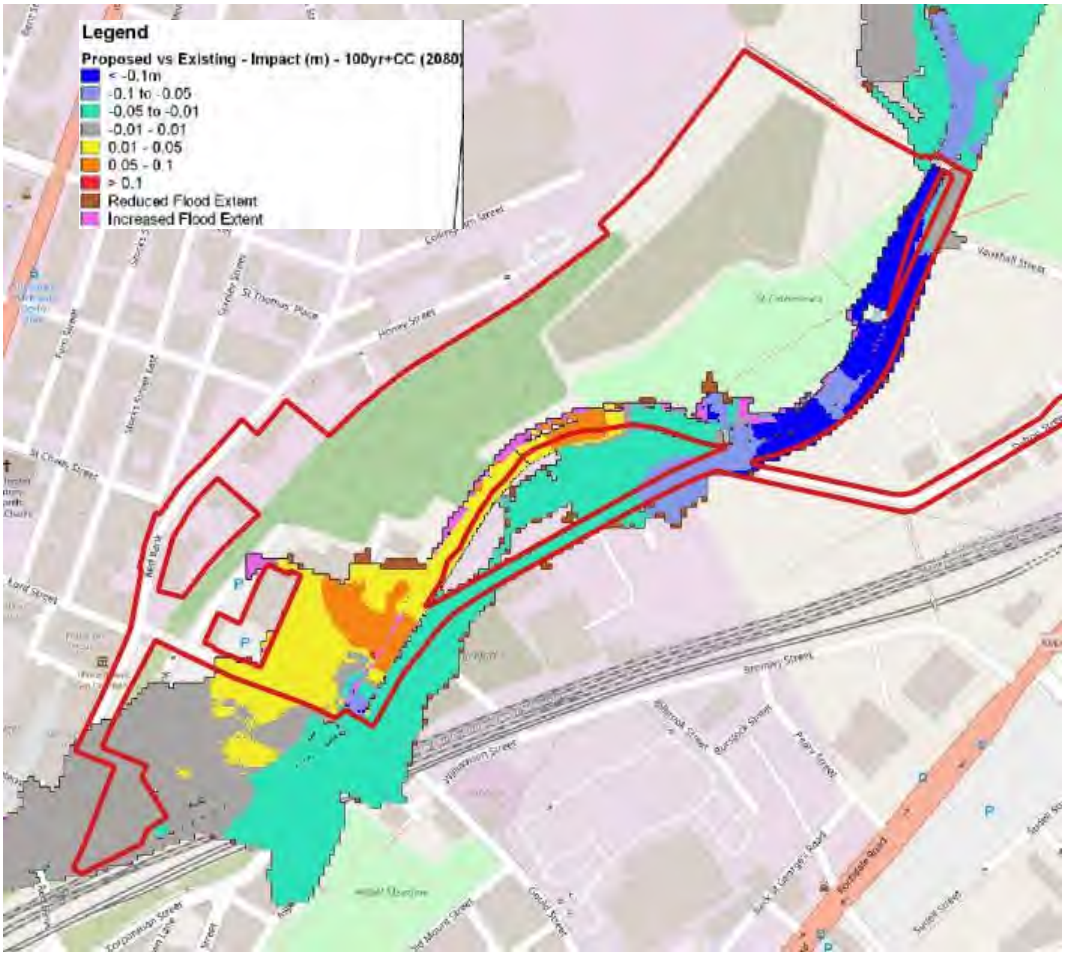


Figure 12 Impacts of scheme on flood depth and extent from interim 2021 modelling for 100 year plus climate change event. Note that extents are indicative only as this model uses a 'precautionary approach' to the hydrology.

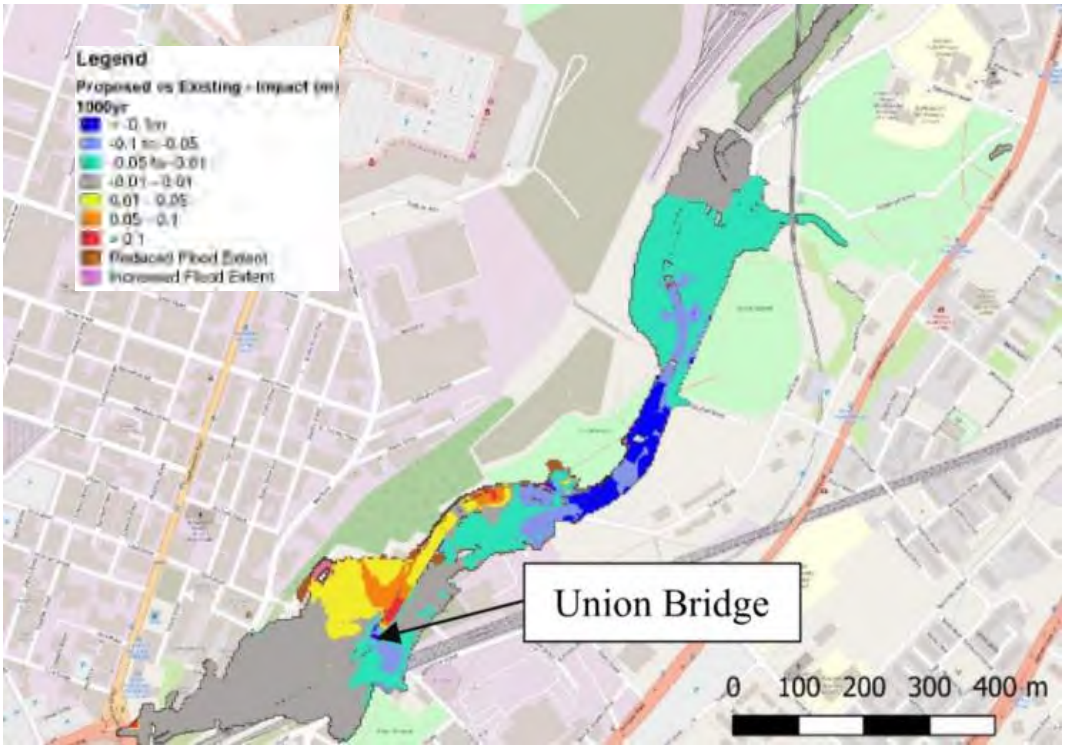


Figure 13 Impacts of scheme on flood depth and extent from interim 2021 modelling for 1000 year event. Note that extents are indicative only as this model uses a 'precautionary approach' to the hydrology.

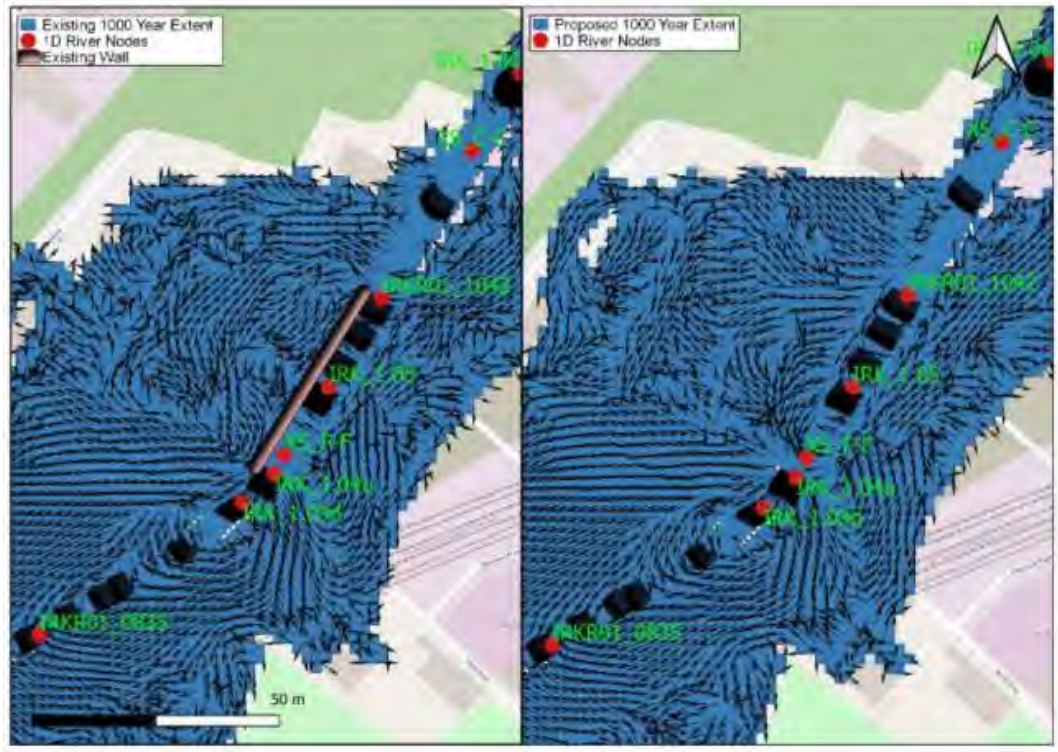


Figure 14 interim 2021 modelled out of bank flow (1000 year) under exiting condition (left) and proposed removal of river wall (right).

5.2 Surface water

The sitewide drainage strategy has been developed in coordination with the HIF river works team and the on-plot developers in order to achieve the best strategy to prevent flooding by all mechanisms. The drainage strategy will restrict discharge to the watercourse to greenfield runoff rates and utilise SuDS, including basins and rain gardens, to attenuate and store surface water runoff to prevent worsening the surface water flood risk as a result of the works. The drainage strategy can be found in appendix D which discusses the proposed approach to surface water drainage.

6 Flood risk management measures

6.1 Fluvial

As the site sits within areas of flood zones 1, 2 and 3, different management approaches will be needed for different areas.

Upper plateau

The plateau lies within Flood Zone 1 where there is a risk of flooding <0.1%. Development in these areas is at low risk from fluvial flooding. Existing flow regimes in these areas will be maintained to ensure flood risk is not worsened and a suitable drainage strategy will be adopted to manage surface water runoff.

St Catherine's Wood

The majority of St Catherine's Wood lies within Flood Zone 1 where there is a risk of flooding <0.1%. The proposed alterations to the rivers walls have been shown to reduce the flood levels adjacent to the banks of the River Irk within the area of the wood and therefore the proposed works reduce the flood risk in this area slightly. The proposed works will be undertaken to ensure that features such as balustrades etc. will not be susceptible to capturing debris which could increase flood risk.

There is a small area of the existing park within the flood zone. To ensure that users remain safe during extreme events safe egress from the park needs to be considered. As part of the park management plan a flood evacuation/management plan should be incorporated. This would provide details of how the public would be informed of the risks posed by extreme events and how the park will be managed during events which may pose a risk.

Dantzic Street

The area to the south of the River Irk along Dantzic Street is shown as being within Flood Zone 2 on the EA flood maps. The modelling work using the precautionary approach suggests that this area would fall within Flood Zone 3 if this model were used to determine the zones for the existing scenario. However, the modelling has shown that the proposed works to the banks of the Irk as part of the works will reduce the flood levels within this area and therefore improve flood

risk. Development in these areas should follow the Environment Agency Standing Advice. A suitable water management strategy should be developed for both plots and public realm south of the river. This should be developed with consideration of flood levels and is likely to require consideration of flood resistant and flood resilient measures to manage the potential impact for the development. A suitable access and egress strategy should also be included in the proposals to ensure occupants of the site have a means of escape during flood events. These elements will be considered when the FRA for the future plot development application is produced.

South of Roger Street (Offsite)

As identified above the proposed works will have the effect of increasing the flood risk off the site to the south of Roger Street by +0.01m and increase the flood extents. As stated in the NPPF the development should not materially increase the risk of flooding elsewhere. It is therefore proposed to construct a bund within Union Plaza to reduce the propagation of flows beyond the site boundary. The proposal seeks to replicate the effect of the existing wall, despite being in an alternative position. Figures 15 and 16 show the proposal for the bund.

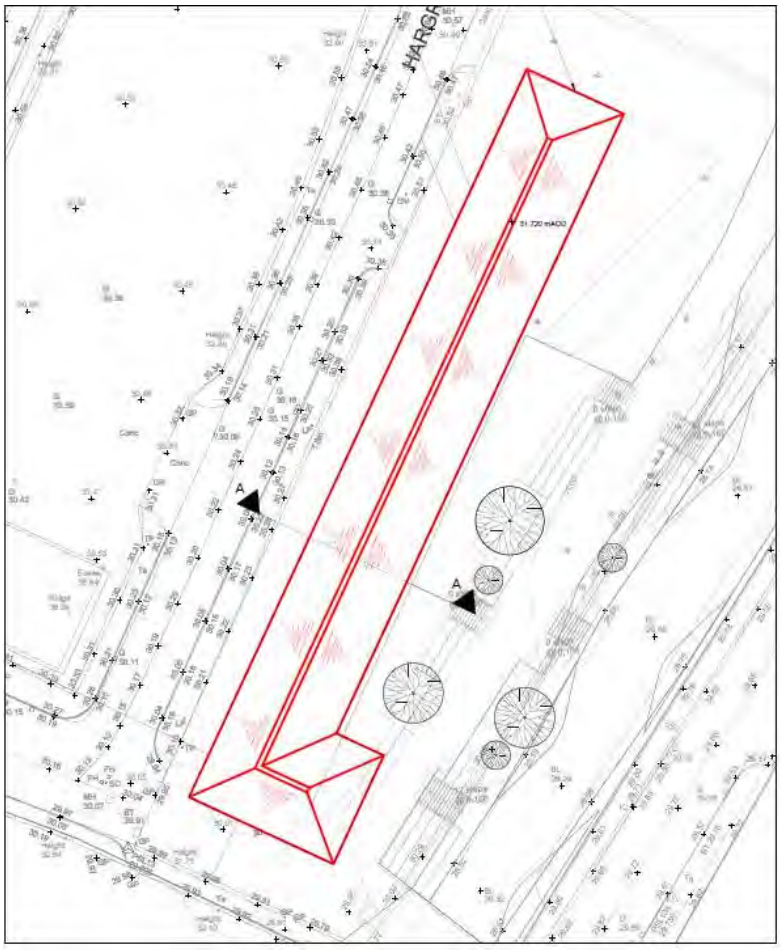


Figure 15 Proposed bund

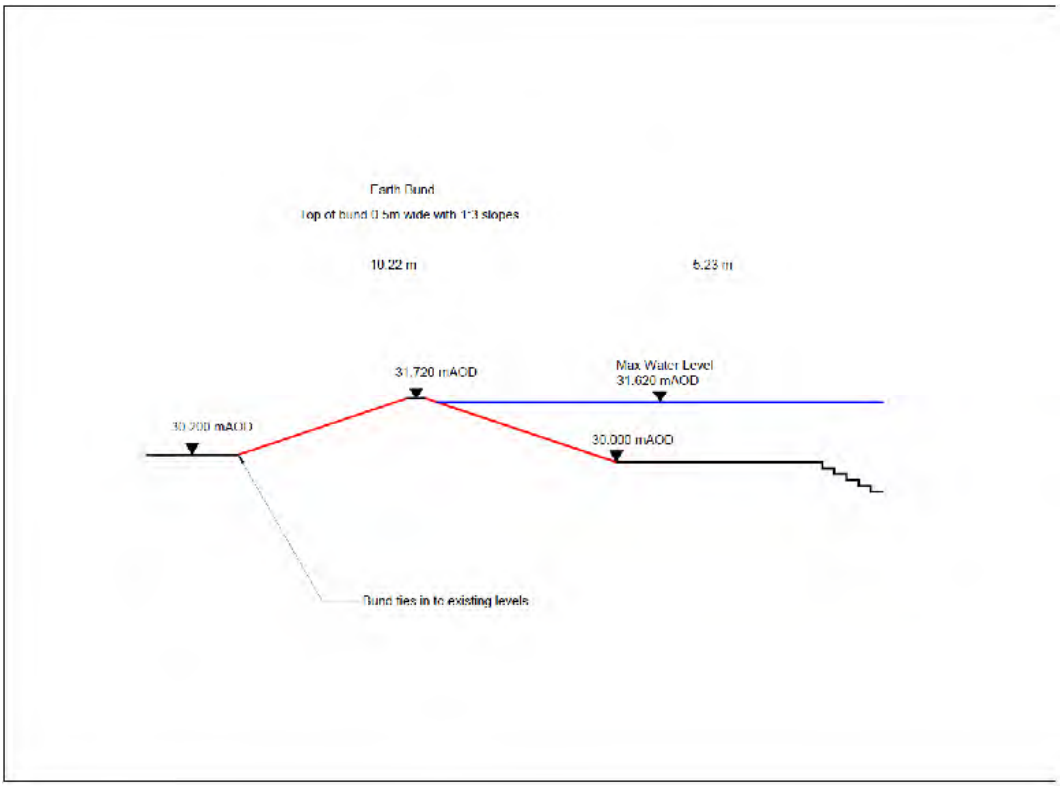


Figure 16 Bund section A-A

The bund has been incorporated into the interim 2021 model to determine the impact of the proposal on the flood risk. Figures 17 and 18 show the flood extents modelled with the proposed bund incorporated.

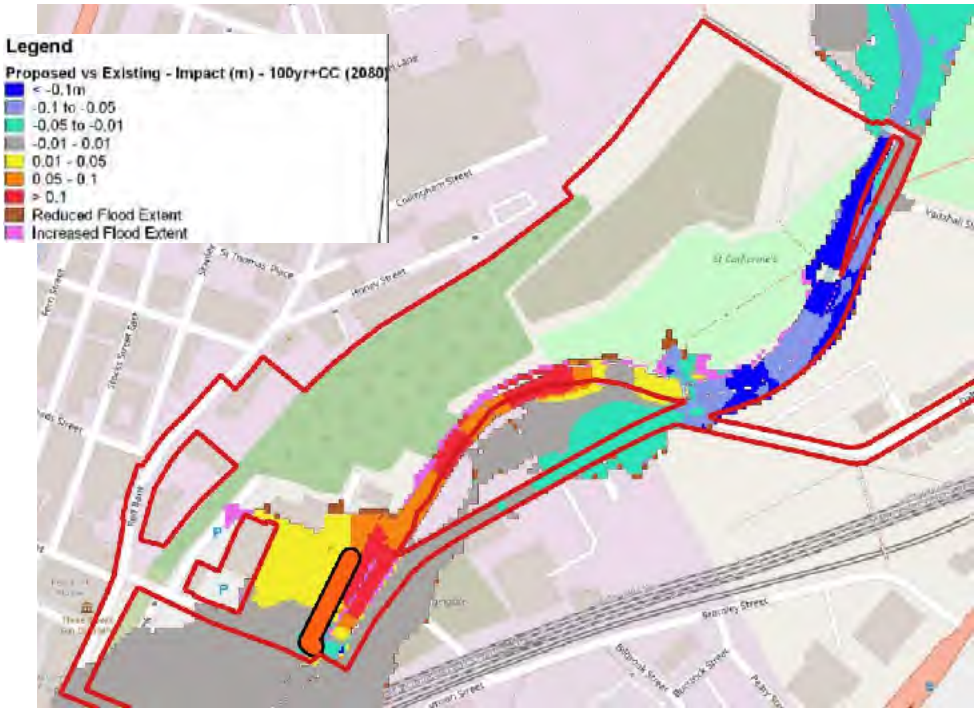


Figure 17 Impacts of scheme including the bund on flood depth and extent from interim 2021 modelling for 100 year plus climate change event. Note that extents are indicative only as this model uses a 'precautionary approach' to the hydrology.

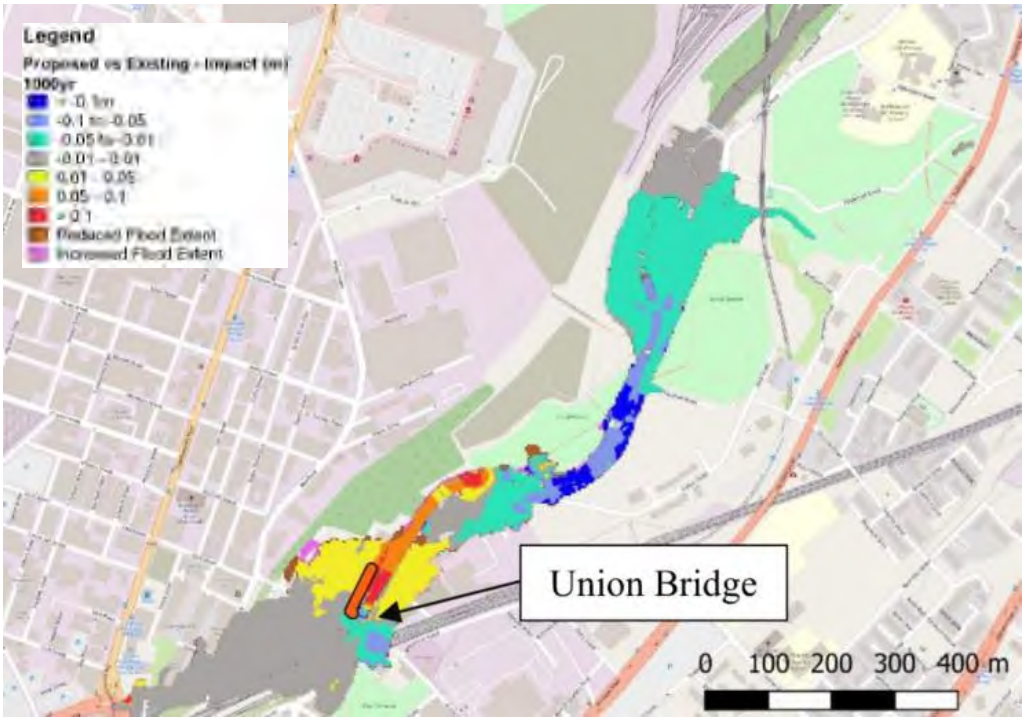


Figure 18 Impacts of scheme including the bund on flood depth and extent from interim 2021 modelling for 1000 year event. Note that extents are indicative only as this model uses a 'precautionary approach' to the hydrology.

Figures 19 and 20 show the proposed works modelled flood risk with and without the proposed bund when compared to the existing condition.

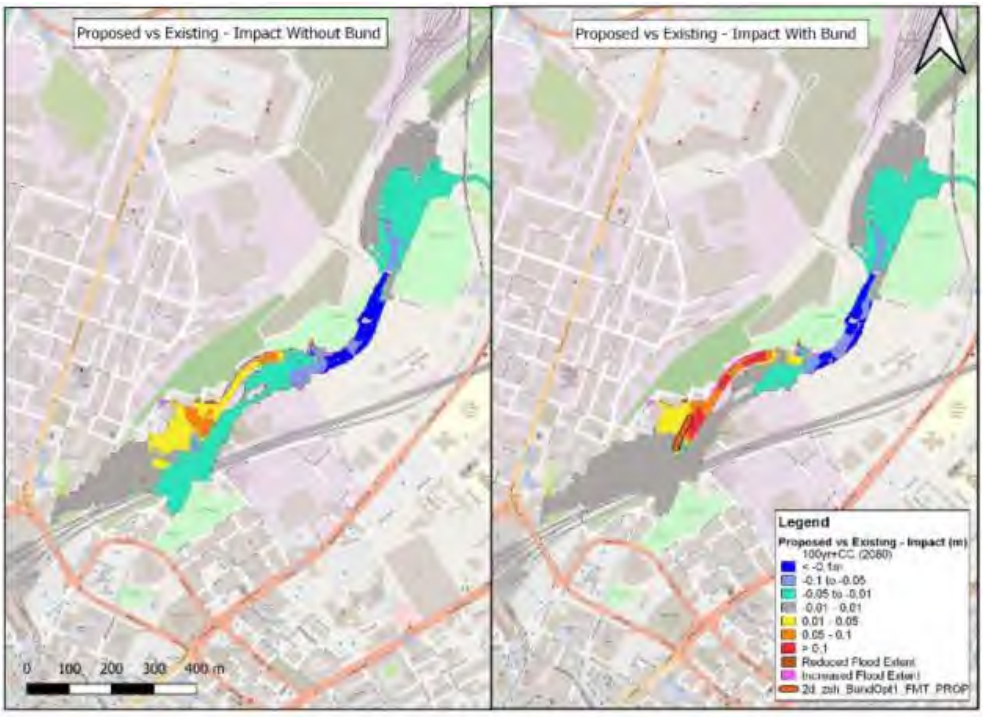


Figure 19 Interim model flood extents proposed mitigation bund comparison 1 in 100 year plus climate change event

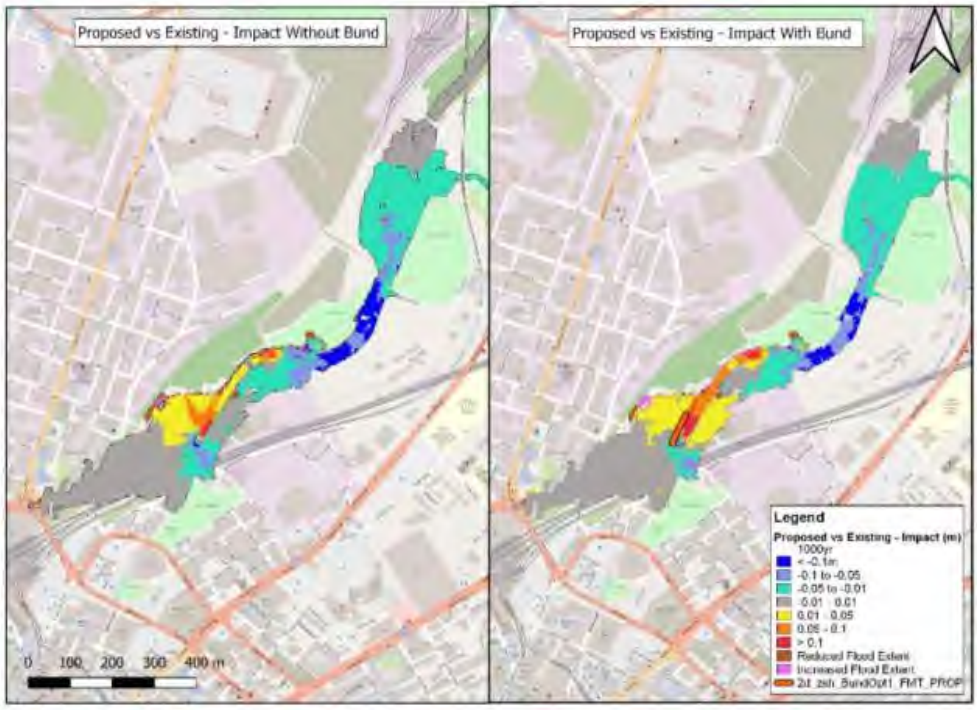


Figure 20 Interim model flood extents proposed mitigation bund comparison 1 in 1000 year event

Figure 17 shows that for the 1 in 100 year plus climate change event that with the bund in place that although flood risk remains increased within the plots over the existing case, there is no increase in flood risk off site. Figure 19 shows that mitigation proposal is effective at reducing the offsite increase in flood risk in comparison to the extents without the bund.

Figure 18 shows that the proposed mitigation has a significant impact on reducing the increase in flood extent for the 1 in 1000 year event. However, there is a small area on Roger Street into Plot RB09 where propagation of flood water remains. The model suggests that the increase in level will be up to +0.012m.

It should also be noted that there is an increase to the flood level within Dantzic Street of +0.02 to +0.04m (compared to the flood depth of 1 metre in the existing) and also an increase within the Travis Island site of approx. +0.015 m (compared to the flood depth of 0.7m in the existing). These increases are considered to not be significantly adverse when compared to the existing flood depths.

Union Plaza and Plots RB06 and RB07

As shown above in section 5.1 the proposed works increase the flows on to the area of the proposed Union Plaza and the plots RB06-08. This is due to the removal of an existing wall which is considered to reduce the flows passing from the river on to this area during flood events.

To mitigate for the loss of the wall, as discussed above a bund is proposed on Union Plaza. As shown in figures 19 and 20 the bund reduces the flood level increases within the plots RB06-08 during all events when compared to the scenario with no mitigation. However it should be noted that using the interim 2021 model these plots are shown to be within flood zone 3 due to the 'precautionary approach' hydrology when the current EA flood maps show them as flood zone 2.

The HIF scheme will not include development of on-plot infrastructure or any groundwork for the proposed plots. The development of these plots will be covered by a separate FRA as discussed above.

During the works for the HIF infrastructure the areas of RB06 and 07 will be at risk of flood. It is therefore proposed that the contractor will sign up to the EA flood warning scheme to ensure that any works within the area can be controlled in the event of a flood event. The contractor will also produce an evacuation plan so that should a flood event occur during the works on site there is a clear strategy for egress and access. Based upon the flood models there are safe routes off site to the north and the south of the site where the topography of the land raises above the flood extents.

As discussed above the proposed river works (aimed at reducing flood risk in this area) are scheduled to be complete within the same horizon as the HIF Infrastructure Works. Although the final modelling and design have not yet been completed for this future river works package it is anticipated that the design will be completed prior to the start of works on site for the HIF Infrastructure Works. It is likely that the proposed mitigation bund will therefore not be required to be built as the scenario that creates the increased flood risk will not occur. However

to ensure that in the unlikely scenario that the works in the river are delayed, a sound and robust solution is available for HIF Infrastructure Works and has therefore been included in this application.

6.2 Surface water

The following measures will be undertaken to reduce the risk of the proposed development to surface water flooding:

- Existing overland flow paths will be maintained to prevent additional flood risk outside the site boundary and to existing buildings.
- On-plot and off-plot levels will be designed to fall away from existing or proposed buildings and thresholds.
- A suitable surface water strategy will be adopted for both on-plot and off-plot development to capture and store surface water. This will incorporate SuDS to attenuate flow where infiltration is limited due to ground conditions. Surface water will be controlled at source wherever possible to reduce the risk of surface water flooding.
- Consideration of the impact of construction activities on the drainage system should be made, an adequate maintenance plan will be developed to prevent the proposed drainage and SuDS from becoming blocked due to construction debris.
- All new development will be drained to a new surface water sewer and discharged directly to the River Irk to reduce the strain on the existing combined sewer network.
- The impact of climate change on surface water risk will be considered as 40% for the 100-year return period in line with NPPF guidance.

7 Conclusion

This FRA has assessed all potential sources of flooding for the Victoria North HIF site. The primary flooding mechanisms are identified as fluvial and surface water. The site is also classified as a Critical Drainage Area which indicates historical cases of surface water flooding, this could be a result of sewers in the area having low capacity and so flooding from public sewers is also identified as a risk.

The fluvial flood risk varies across the site as a result of the topography. The Plateau area sits wholly in flood zone 1, and so does most of the park. The lower zones to the south of the river and North of Union Bridge are in areas of flood zones 2 and 3a. The HIF works will not include any work within plot boundaries in areas of flood zones 2 or 3, these will be progressed by future developers.

The impacts of the proposed development on flood risk have been shown by the interim 2021 “precautionary approach” hydraulic model to generally have a negligible effect, however there are localised issues which will require mitigation. Increased flood depths and extents, originating from the removal of a river wall to the upstream right bank of Union Bridge, are identified both on and off the site. A bund within the proposed Union Plaza area has been proposed to reduce the flow from the River Irk during extreme events and prevent additional flooding beyond the site boundary. Modelling has been undertaken to demonstrate that the proposed bund provides sufficient mitigation of the flood extents.

The HIF works are considered water compatible development. An integrated surface water management strategy will restrict the discharge from the site to greenfield rates and will discharge all surface water to the River Irk. SuDS features will be implemented to achieve the required discharge rate in order to mitigate the risk of worsening fluvial flood risk.

Consultation is ongoing with United Utilities to achieve a foul strategy which considers the capacity of existing sewers to reduce the risk of flooding from combined sewers. This FRA also outlines measures to mitigate surface water flood risk, which will be implemented in the surface water strategy to reduce the risk of localised flooding across the site.

Appendix A – Hydraulic assessment of HIF infrastructure proposals

Technical Note

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Project title	Victoria North River and Flood Alleviation Works	Job number	281943
cc		File reference	4-05-02
Prepared by	Louise O'Regan / Emma Cecil / Rob Parry	Date	31 March 2022
Subject	Hydraulic Assessment of HIF Infrastructure Proposals – Rev 3		

1 Introduction

The Victoria North HIF Infrastructure Works propose to undertake some changes to riverbank (including ground levels/profiles) and river wall features along the extent of their works. The timing of these works requires approval through Planning Application process and EIA assessment work, but in advance of the precise details of the HIF River & Flood Works downstream being confirmed. Consequently, an assessment of any changes in flood risk or extreme river level is required as part of the Infrastructure Works application, sufficient to demonstrate that there is no adverse impact to flood risk within the site (resulting from HIF Infrastructure Works Proposals in isolation), and more importantly upstream and downstream of the proposed works site since there are several operational businesses in the vicinity of the River Irk.

This note documents the hydraulic impact of this advanced piece of work to assess these proposals in isolation, and compare them back to a baseline (Existing Condition) situation.

This has been assessed for the HIF Infrastructure Works Application using the most developed version of the hydraulic river model of the Irk, as described below.

2 Methodology

2.1 Overview

The Environment Agency flood model used for flood mapping purposes dates back to 2009 and has already undergone significant development, both in 2019 for the HIF application, and more recently with updates to hydrology and model geometry/detail as an early phase of this Victoria North project.

This work has been carried out using the most current version of this model (termed '**Interim 2021**' Model) using a precautionary approach 2021 hydrology (refer to Section 2.3.2), so that recent updates are captured to represent the best understanding of flood risk at this time. However, it is recognised that this model still requires development for use in the river works design in 2022, including the incorporation of new topographical survey and a further update to hydrology.

Consequently, this work will not seek to define final flood levels or flood extents, but will report relative differences as a result of **Proposed** HIF Infrastructure Works relating to flood regime, flows and levels, compared back to the **Existing** situation using the **Interim 2021** model.

2.2 Method

In 2019, Arup utilised three existing EA models as the basis to develop a more detailed 'combined' baseline River Irk hydraulic model to aid our river restoration and optioneering. This process is summarised below and discussed in more detail in Report MNG-ARP-SW-FN-GX-0021:

In May 2021, the EA undertook an initial review of this 2019 baseline model and provided a series of comments to be actioned. Many of these have been incorporated (where possible) in this Interim 2021 model, where new information has been available to do so. A summary of the responses to the EA actions can be found in **Appendix B**, with detailed comments recorded in the EA standard reporting log ref '*EANon-real time Hydraulic Model Review - Victoria North Baseline _Arupreply03feb22.xlsm*.'

2.2.1 Interim 2021 Model Updates

1D in-channel roughness in the Interim 2021 model was reviewed against satellite imagery and online images, and compared against Manning's n Chow tables[1]. A review of spill weir coefficients in the model was also carried out, with coefficients for spills representing structures changed to 1.2, spills representing weirs changed to 1.5, and spills representing confluences changed to 1.5.

Sections on Moston Brook were removed for stability and the 1D sections extended. These exist in an isolated valley section so would have negligible impact elsewhere on levels or flood extent. Sections on the River Irk that relate to the left bank wall of the rail bridge overpass immediately upstream of Victoria Station that do not overtop, even in extreme events, were omitted from the existing EA model and left out for this study too.

2D floodplain roughness in the Interim 2021 model is defined using Manning's n values attributed to mapping polygons, using a TMF (TUFLOW Materials File); the polygons used were updated for the Interim 2021 model, based on OS OpenMap – Local, and satellite imagery.

Following the updates made to create the Interim 2021 Model, the warnings below remain, however are not considered to impact model results:

- Warning W2010: Poor interpolation
- Warning W2044: Different values (+/- 20 %) for Manning's n encountered within one panel
- Warning W2238: Panel at offset

[1] http://www.fsl.orst.edu/geowater/FX3/help/8_Hydraulic_Reference/Mannings_n_Tables.htm

J:\280000\281943-00\4 INTERNAL PROJECT DATA\4-05 REPORTS\4-05-02 CIVIL\HYDRAULICMODELLINGOFINFRA\VNIF-ARP-ZZ-RIV-RP-DF-0002_HYDRMODELLINGOFINFRAPROPOSALS_ISSUE3.DOCX

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- Warning W2229: Value of trash screen height is set to 0
- Warning: Backflow encountered at CULVERT OUTLET unit.
- Warning: Bridge downstream of IRK_1.04bu is surcharged
- Poor model convergence

Remaining EA actions will be concluded for the 2022 HIF Rivers Planning Application, to test the future engineering river works, including anticipated weir removal.

Consequently, the proposed HIF Infrastructure soft landscaping modifications have been modelled using the Interim 2021 model, and 'precautionary approach' 2021 hydrology. Although this model does not have formal EA sign off, it is deemed that proposed modifications to the watercourse are limited to local enhancements around the centre of the Victoria North project (St Catherine's Wood and Union Bridge area) and so a like-for-like comparison has been undertaken to assess overall impacts as a result of the HIF Infrastructure proposals.

The proposed HIF Infra Model has been developed by modifying the cross section and 2D levels to represent the HIF Infrastructure proposals set out in **Appendix A**.

There are limitations with this approach, including the model instability seen in the 1000-year results.

2.3 Sources of data

2.3.1 EA Hydraulic Models

Several models have been combined and used to create the latest model, as shown in **Figure 1**.

- 2009 EA Irk model (by JBA) which extended from the A6010 Queens Road Bridge to the Irwell confluence, immediately downstream of Victoria Station culvert (blue).
- 2004 EA Irk model (by Atkins) for approx. 1.5km extent upstream of Queens Road Bridge (red).
- 2007 1D EA model of Moston Brook (purple).
- 2015 EA model of River Irwell.



Figure 1 - Extents of existing EA models used

2.3.2 Hydrology

In Nov 2021, Arup carried out an update to the hydrology to be used in the Irk model. This has been developed in discussions with the Environment Agency, with the output Report **VNR-ARP-00-YYY-RP-CH-0001** reviewed by the EA. This work drew on gauged data from the Collyhurst Weir and concluded that there is some uncertainty in which rating curve best fits the data, since there are very few historical measurements taken around QMED flows, which are then used to extrapolate flood flow estimates for the higher return periods.

Consequently, it was agreed with the Environment Agency that the Proposed Infrastructure works are assessed using the higher flow estimates, termed 'precautionary approach', since these would allow any change in flood risk to be assessed against the worst-case scenario.

A summary of the range of estimated flows is given below in **Table 1**. A second round of comments have been also been incorporated in Issue 2 of this note and are documented in *'EA Hydrology Review Victoria North - 28.01.22_Arup_responses31.01.22.xls'*

The impact of on flood extents resulting from using this hydrology is considerable since flows are generally 15 to 20% higher than those previously adopted by earlier studies (but effects are not discussed further in this report).

On agreement with the Environment Agency, the downstream boundary for the Interim 2021 model was scaled in both peak and shape to the existing Manchester Ship Canal Model boundary, for each return period, so that the 20-year downstream boundary is scaled to the 20-year Manchester Ship Canal Model results.

		Peak Flow Estimate in Irk Flow at Collyhurst Weir (Irk_003) m^3/s		
Return Period (Years)	Comment	2004 Hydrology	2021 Hydrology (NFRA Rating)	2021 Hydrology Used in Interim Model (Precautionary Approach Rating)
5		38	37.8	43.5
10		45	44.2	50.8
20			50.9	58.6
50		62	60.6	69.7
75		63	65.2	75.0
100	Flood Zone 3	66	68.7	79.0
100+CC (2080 Epoch)				106.6
1000	Flood Zone 2		112.5	131.8

Table 1 - Hydrology Summary of Peak Flow Estimates

2.3.3 Survey Information

- A watercourse survey was commissioned and undertaken (January 2019), including a number of river cross sections.
- BAM have undertaken a wider topographical survey of the HIF site on behalf of HIF Infrastructure Works. This has been used to confirm bank levels and generate a 2D surface of the existing condition floodplain.
- Volker Stevin have recently completed a topographical survey of the river channel in December 2021 but the finding have not been incorporated into this work (planned for 2022 update).

3 Summary of Works Assessed

A set of design proposals have been received from the HIF Infrastructure team, showing proposed river wall alterations, changes in cross section and river extents - these include any riverbed modifications and proposed changes to ground level/channel wall top levels. These are shown on drawings **VNIF-PLA-ZZ-YYY-SK-L-0001** & **VNIF-PLA-ZZ-YYY-DR-L-1000**) received 22nd November 2021.

A high level summary of these proposals include:-

- Within two discrete areas of St Catherine's Wood, the existing northern channel wall (river right) has been removed and the bank reprofiled.

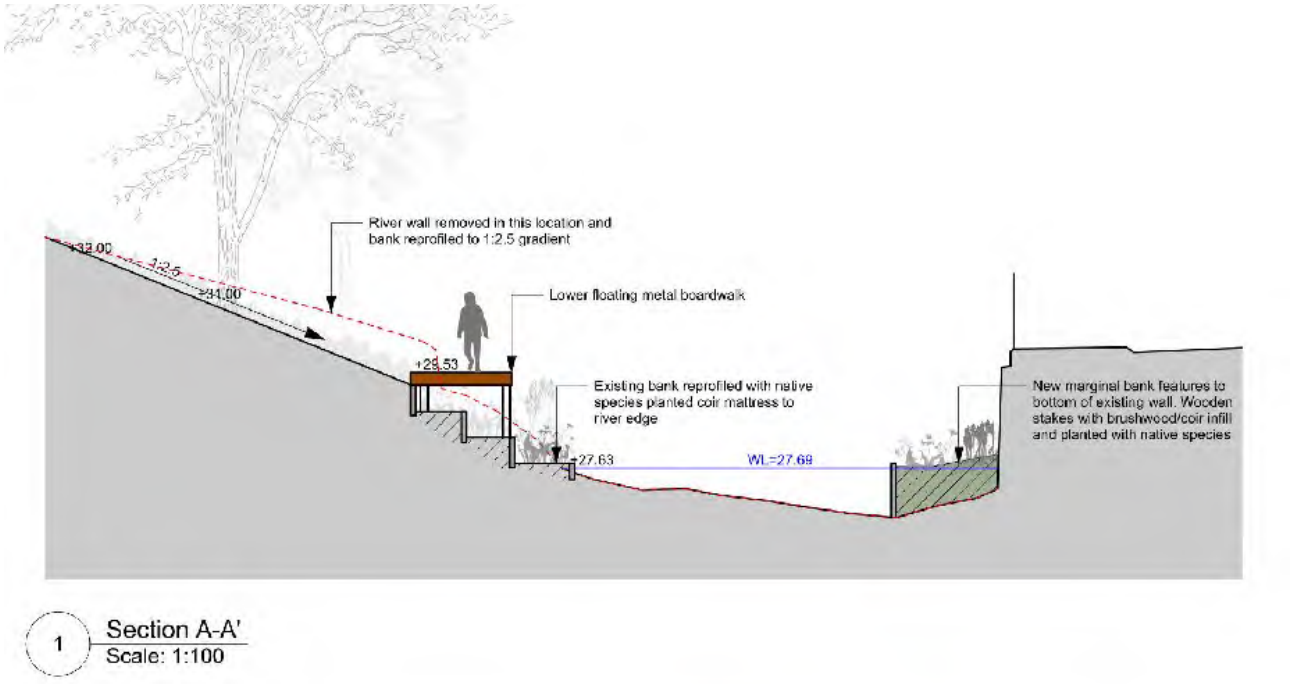


Figure 2 - St Catherine's Wood Typical X-Section

- Flow deflectors created from staked logs and gravel bars with boulders within the channel, located near St Catherine's Wood.
- Marginal bank features introduced along bottom of existing river walls along Dantzic Street/Collyhurst Road.
- Union Walk (northern/right bank) stepped back as hard landscaped public realm, with the existing channel wall removed.

A 2D surface of the proposed ground levels has been used in the model to represent the out of bank areas / floodplain.

Table 6 in **Appendix A** documents how the changes proposed by the HIF Infrastructure Works have been incorporated within the Hydraulic Model.

4 Model Results

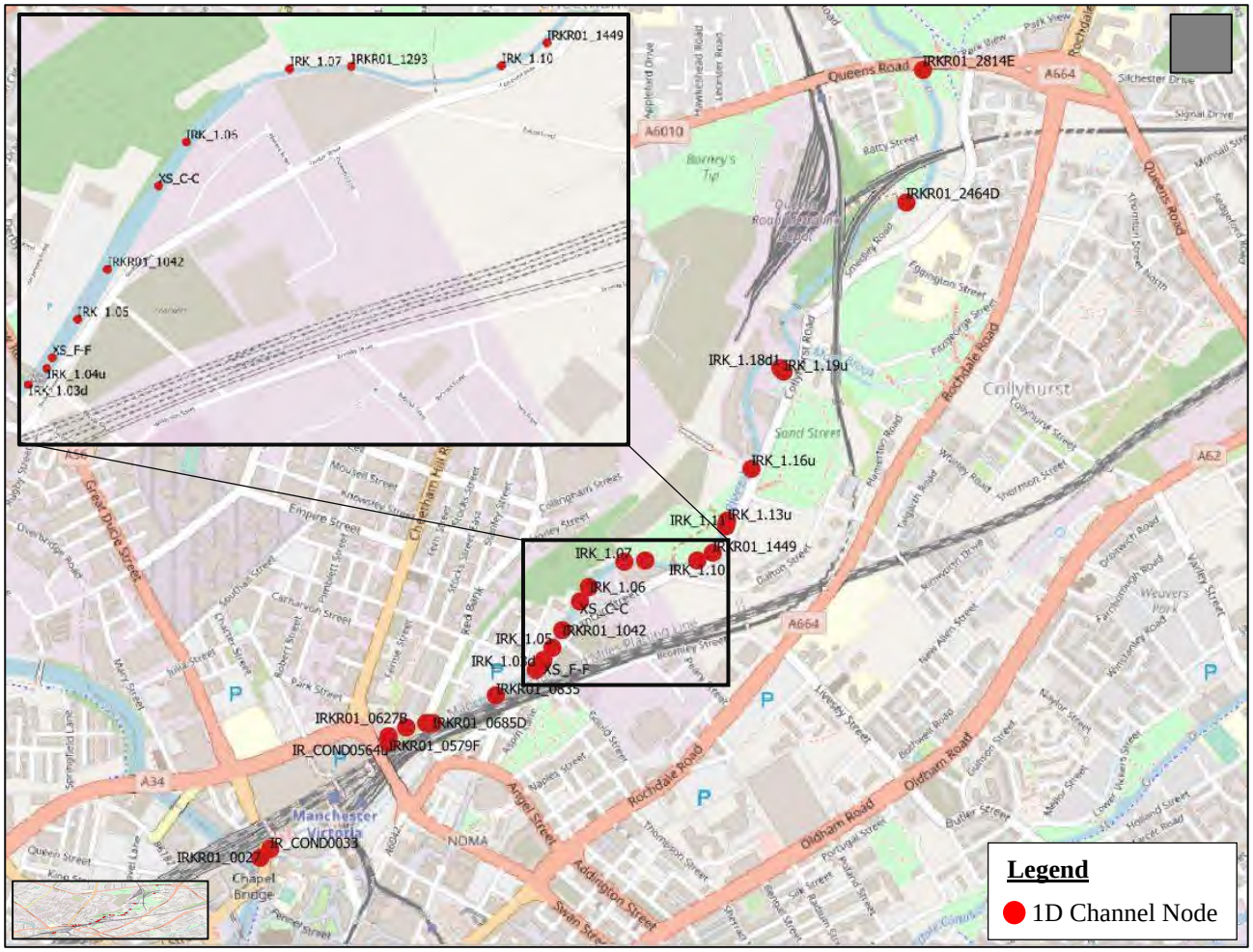


Figure 3 - Model Node Location Plan

Figure 3 shows the location of 1D modelling nodes assessed in **Table 2** and **Table 3**. While these are not all the 1D sections in the model, these nodes have been selected at key locations for review purposes here and give a good representation of the mechanisms within the model.

4.1 Existing Condition vs HIF Infrastructure Proposals

The tables below show the flow and stage for each of the 1D channel nodes shown, with **Table 2** showing the difference in flood level resulting from the proposed works, and **Table 3** showing the difference in flow.

Table 2: Results table (stage) for Existing Condition (EXIST) vs with HIF Infrastructure Proposals (PROP).

Location	Label	20 Year Stage (mAOD)			100 Year Stage (mAOD)			100 Year + CC (2020) Stage (mAOD)			100 Year + CC (2050) Stage (mAOD)			100 Year + CC (2080) Stage (mAOD)			1000 Year Stage (mAOD)		
		EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff
Queens Road U/S	IRKR01_2814E	36.63	36.63	0.00	37.07	37.07	0.00	37.67	37.67	0.00	37.84	37.84	0.00	38.29	38.29	0.00	39.02	39.02	0.00
Smedley Rd D/S	IRKR01_2464E	35.09	35.09	0.00	35.87	35.87	0.00	36.25	36.25	0.00	36.41	36.41	0.00	36.84	36.83	0.00	37.72	37.71	-0.01
HMG Paints Weir U/S	IRK_1.19u	32.93	32.93	0.00	33.64	33.64	0.00	33.85	33.84	-0.01	33.95	33.94	-0.01	34.18	34.16	-0.01	34.51	34.51	0.00
HMG Paints Weir D/S	IRK_1.18d1	32.77	32.77	0.00	33.51	33.50	-0.01	33.75	33.74	-0.01	33.85	33.84	-0.01	34.08	34.07	-0.01	34.44	34.44	0.00
P&P Bridge U/S	IRK_1.16u	31.44	31.43	-0.01	32.46	32.43	-0.03	32.83	32.80	-0.03	32.96	32.92	-0.04	33.28	33.22	-0.06	34.01	33.95	-0.06
Collyhurst Weir U/S	IRK_1.13u	31.13	31.11	-0.02	31.61	31.54	-0.07	31.82	31.74	-0.08	31.90	31.82	-0.08	32.14	31.99	-0.15	32.41	32.32	-0.09
Collyhurst Weir D/S	IRK_1.11	31.10	31.08	-0.02	31.57	31.51	-0.07	31.78	31.70	-0.08	31.86	31.78	-0.08	32.10	31.94	-0.16	32.36	32.26	-0.10
Location of Planit Cross-section A-A	IRKR01_1449	31.04	31.05	0.00	31.54	31.49	-0.05	31.74	31.68	-0.06	31.83	31.77	-0.06	32.01	31.94	-0.07	32.32	32.23	-0.09
	IRK_1.10	31.01	31.00	-0.01	31.50	31.42	-0.08	31.69	31.55	-0.14	31.75	31.61	-0.13	31.86	31.71	-0.15	32.12	31.96	-0.16
Location of Planit Cross-section B-B	IRKR01_1293	30.65	30.67	0.02	31.13	31.12	0.00	31.33	31.31	-0.03	31.43	31.40	-0.03	31.60	31.56	-0.05	31.98	31.90	-0.08
	IRK_1.07	30.49	30.53	0.04	30.91	30.97	0.06	31.07	31.14	0.06	31.16	31.23	0.07	31.28	31.38	0.10	31.59	31.71	0.12
	IRK_1.06	30.41	30.45	0.04	30.82	30.87	0.04	30.97	31.01	0.04	31.04	31.08	0.04	31.14	31.19	0.05	31.41	31.47	0.05
Location of Planit Cross-section C-C	XS_C-C		30.44			30.86			31.00			31.07			31.17			31.43	
	IRKR01_1042	30.38	30.43	0.05	30.80	30.86	0.06	30.95	31.00	0.05	31.03	31.07	0.04	31.12	31.17	0.05	31.37	31.44	0.06

Location of Planit Cross-section D-D	**IRK_1.05**	30.34	30.36	0.01	30.74	30.80	0.05	30.88	30.95	0.07	30.96	31.03	0.06	31.04	31.13	0.09	31.19	31.40	0.21
Location of Planit Cross-section F-F	**XS_F-F**		30.33			30.63			30.75			30.87			30.92			31.12	
Union Bridge U/S	**IRK_1.04u**	30.37	30.37	0.00	30.92	30.89	-0.03	31.12	31.07	-0.04	31.21	31.17	-0.04	31.35	31.30	-0.05	31.68	31.60	-0.07
Union Bridge D/S	**IRK_1.03d**	29.57	29.57	0.00	30.54	30.53	-0.01	30.82	30.80	-0.01	30.87	30.85	-0.02	31.03	31.01	-0.01	31.33	31.32	-0.01
	IRKR01_0835	29.07	29.07	0.00	29.94	29.94	0.00	30.21	30.20	-0.01	30.28	30.27	-0.01	30.45	30.45	0.00	31.07	31.08	0.01
Aspin Lane U/S	**IRKR01_0685D**	28.66	28.66	0.00	29.65	29.65	-0.01	30.02	30.00	-0.01	30.12	30.10	-0.02	30.40	30.39	-0.01	31.04	31.04	0.00
Aspin Lane D/S	**IRKR01_0685E**	28.49	28.49	0.00	28.93	28.93	0.00	29.26	29.25	0.00	29.38	29.37	-0.01	29.72	29.72	0.00	30.62	30.62	0.00
	IRKR01_0627B	28.19	28.19	0.00	28.63	28.63	0.00	28.90	28.89	-0.01	29.00	28.99	-0.01	29.29	29.28	0.00	30.27	30.27	0.01
Scotland Weir U/S	**IRKR01_0579F**	28.06	28.06	0.00	28.46	28.46	0.00	28.70	28.69	-0.01	28.78	28.78	-0.01	29.02	29.02	0.00	29.93	29.94	0.00
Scotland Weir D/S	**IRKR01_0579G**	25.54	25.54	0.00	26.39	26.39	0.00	26.71	26.70	0.00	26.87	26.86	0.00	27.26	27.26	0.00	29.42	29.42	0.00
Irk Culvert U/S Face	**IR_COND0564u**	25.46	25.46	0.00	26.35	26.35	0.00	26.67	26.67	0.00	26.83	26.83	0.00	27.23	27.23	0.00	29.40	29.41	0.00
Irk Culvert D/S Face	**IR_COND0033**	25.22	25.22	0.00	26.08	26.08	0.00	26.36	26.36	0.00	26.51	26.51	0.00	26.87	26.87	0.00	28.92	28.92	0.00
Irk/Irwell Confluence	**IRKR01_0027**	25.17	25.17	0.00	26.03	26.03	0.00	26.29	26.29	0.00	26.45	26.45	0.00	26.80	26.80	0.00	28.87	28.87	0.00

Red = increase in peak water level compared with existing (worsening) of >100mm.
Yellow = nominal increase in peak water level compared with existing (worsening) of less than 100mm.
Green = reduction in peak water level compared with existing (betterment)

[Note: Nodes XS_C-C and XS_F-F were created for the proposed run only and hence, no corresponding level exists in the existing run]

Table 3: Results table (flow) for Existing Condition (EXIST) vs with HIF Infrastructure Proposals (PROP).

Location	Label	20 Year Flow (m3/s)			100 Year Flow (m3/s)			100 Year + CC (2020) Flow (m3/s)			100 Year + CC (2050) Flow (m3/s)			100 Year + CC (2080) Flow (m3/s)			1000 Year Flow (m3/s)		
		EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff
Queens Road U/S	IRKR01_2814E	37.9	37.9	0.0	51.4	51.4	0.0	60.6	60.6	0.0	64.9	65.0	0.0	77.8	77.7	-0.1	99.6	99.8	0.2
Smedley Rd D/S	IRKR01_2464E	44.9	44.9	0.0	64.8	64.8	0.0	76.5	76.5	0.0	81.3	81.3	0.0	95.6	95.6	-0.1	118.2	118.1	-0.2
HMG Paints Weir U/S	IRK_1.19u	44.8	44.8	0.0	57.5	57.7	0.3	57.9	58.4	0.5	58.1	58.8	0.7	59.2	60.0	0.7	60.2	60.4	0.2
HMG Paints Weir D/S	IRK_1.18d1	44.8	44.8	0.0	57.5	57.7	0.3	57.9	58.4	0.5	58.1	58.8	0.7	59.2	60.0	0.7	60.2	60.4	0.2
P&P Bridge U/S	IRK_1.16u	58.7	58.7	0.0	76.1	76.3	0.2	86.4	86.6	0.3	89.4	89.9	0.4	98.2	96.9	-1.3	120.4	119.0	-1.5
Collyhurst Weir U/S	IRK_1.13u	58.7	58.7	0.0	77.3	77.7	0.4	90.0	89.5	-0.5	95.3	94.4	-0.9	110.7	107.8	-2.9	145.8	145.7	-0.1
Collyhurst Weir D/S	IRK_1.11	58.7	58.7	0.0	77.3	77.7	0.4	90.0	89.5	-0.5	95.3	94.4	-0.9	110.7	107.8	-2.9	145.8	145.7	-0.1
Location of Planit Cross-section A-A	IRKR01_1449	51.8	53.4	1.6	66.3	69.8	3.6	76.5	80.5	4.0	80.8	84.8	4.1	94.8	97.2	2.4	126.6	131.0	4.4
	IRK_1.10	51.5	50.8	-0.7	65.4	67.4	2.0	76.4	81.7	5.3	83.3	87.8	4.5	101.9	103.7	1.8	131.0	136.2	5.2
Location of Planit Cross-section B-B	IRKR01_1293	59.5	59.4	-0.1	78.5	78.8	0.2	89.2	89.9	0.7	92.7	93.7	1.0	103.8	104.4	0.6	120.9	123.5	2.6
	IRK_1.07	59.5	59.0	-0.5	78.9	76.8	-2.1	90.0	87.1	-2.8	93.8	90.5	-3.3	105.3	100.3	-5.0	124.3	117.7	-6.6
	IRK_1.06	59.4	59.4	0.0	79.0	78.0	-1.0	91.2	89.4	-1.8	95.8	93.9	-1.9	108.0	106.2	-1.8	129.1	126.1	-3.0
Location of Planit Cross-section C-C	XS_C-C		59.1			78.0			89.6			94.2			106.8			127.9	
	IRKR01_1042	59.4	59.4	0.0	78.7	78.0	-0.8	90.0	89.9	0.0	93.7	94.6	1.0	106.7	107.6	0.9	129.8	129.5	-0.4
Location of Planit Cross-section D-D	IRK_1.05	59.4	59.4	0.0	78.8	73.0	-5.7	90.0	80.4	-9.6	93.7	83.7	-9.9	106.0	93.3	-12.7	136.2	109.0	-27.2

Location of Planit Cross-section F-F	**XS_F-F**		59.6			90.6			100.5			103.4			113.6			134.3	
Union Bridge U/S	**IRK_1.04u**	52.2	52.2	0.0	52.5	52.5	0.0	52.6	52.6	0.0	52.6	52.6	0.0	53.0	53.0	0.0	47.0	47.0	0.0
Union Bridge D/S	**IRK_1.03d**	52.2	52.2	0.0	52.5	52.5	0.0	52.6	52.6	0.0	52.6	52.6	0.0	53.0	53.0	0.0	47.0	47.0	0.0
	IRKR01_0835	59.3	59.2	-0.1	78.0	77.5	-0.6	84.7	83.9	-0.8	85.8	85.0	-0.9	88.8	87.5	-1.3	85.1	83.8	-1.4
Aspin Lane U/S	**IRKR01_0685D**	59.3	59.2	-0.1	76.6	76.1	-0.5	78.4	77.7	-0.8	78.9	78.2	-0.8	80.1	79.3	-0.8	72.0	71.5	-0.5
Aspin Lane D/S	**IRKR01_0685E**	59.3	59.2	-0.1	76.6	76.1	-0.5	78.4	77.7	-0.8	78.9	78.2	-0.8	80.1	79.3	-0.8	72.0	71.5	-0.5
	IRKR01_0627B	59.3	59.2	-0.1	78.3	78.2	0.0	89.8	89.6	-0.3	93.7	93.3	-0.4	104.0	103.9	-0.1	115.4	115.4	0.0
Scotland Weir U/S	**IRKR01_0579F**	59.3	59.2	-0.1	78.3	78.2	0.0	90.3	90.1	-0.3	94.7	94.3	-0.4	107.6	107.5	-0.1	133.1	133.5	0.5
Scotland Weir D/S	**IRKR01_0579G**	59.3	59.2	-0.1	78.3	78.2	0.0	90.3	90.1	-0.3	94.7	94.3	-0.4	107.6	107.5	-0.1	133.1	133.5	0.5
Irk Culvert U/S Face	**IR_COND0564u**	59.3	59.2	-0.1	78.3	78.2	0.0	90.3	90.1	-0.3	94.7	94.3	-0.4	107.6	107.5	-0.1	133.1	133.6	0.4
Irk Culvert D/S Face	**IR_COND0033**	59.2	59.2	-0.1	78.2	78.2	-0.1	90.3	90.0	-0.3	94.6	94.3	-0.4	107.5	107.4	-0.1	133.2	133.5	0.3
Irk/Irwell Confluence	**IRKR01_0027**	59.2	59.2	-0.1	78.2	78.2	0.0	90.3	90.0	-0.3	94.6	94.3	-0.4	107.5	107.4	-0.1	133.2	133.5	0.3

Red = increase in peak flow compared with existing (worsening) of >0.1m^3/s.
Yellow = nominal increase in peak flow compared with existing (worsening) of less than 0.1m^3/s.
Green = reduction in peak flow compared with existing (betterment)

[Note: Nodes XS_C-C and XS_F-F were created for the proposed run only and hence, no corresponding level exists in the existing run]

4.2 Flood extents

Figure 4 shows the flooding extents for the 20 year, 100 year and 1000 year events for the updated 2021 Existing model

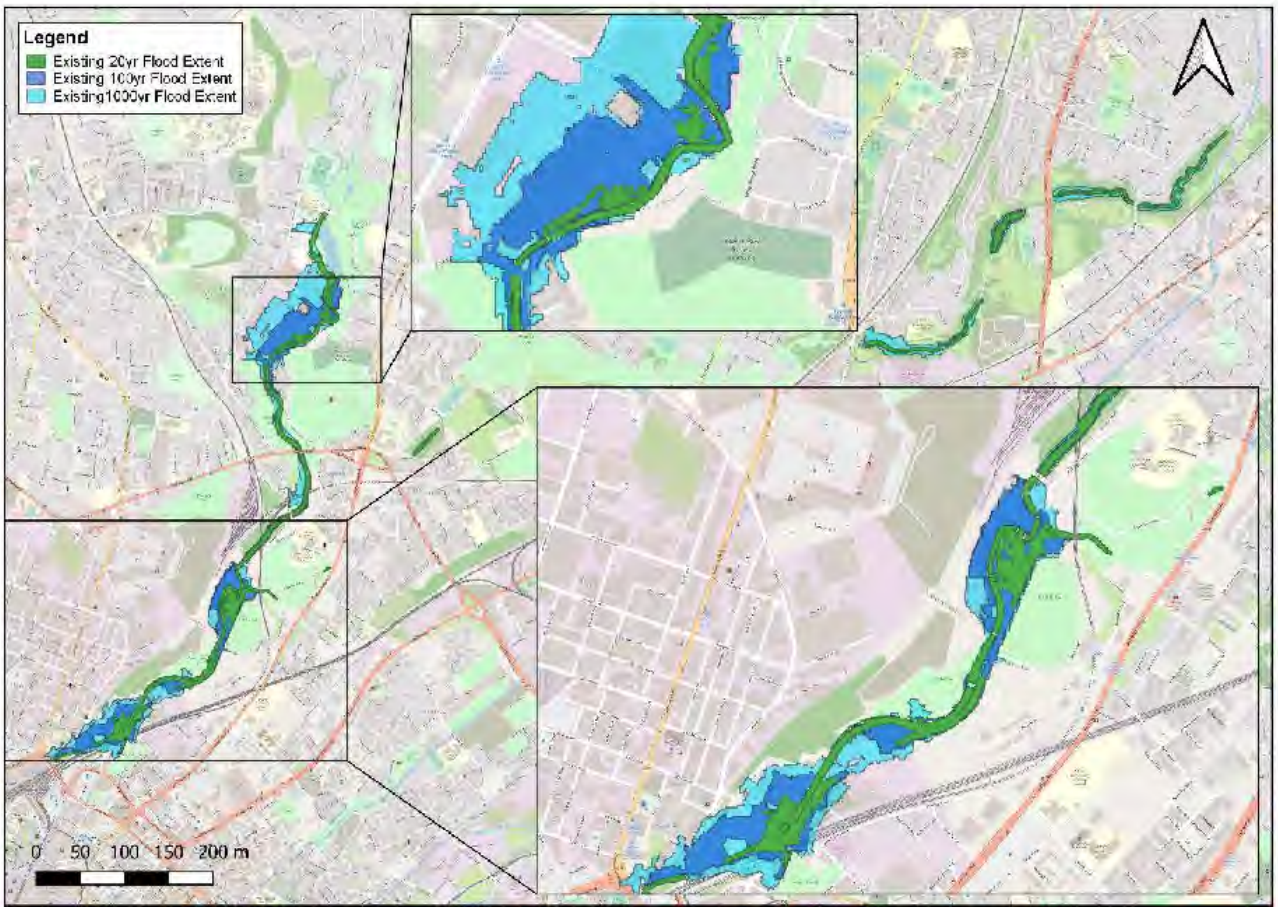


Figure 4: 20 year, 100 year and 1000 year events for the Existing Condition Interim 2021 model.

Figure 5 shows the change in levels for the 100 year event when comparing the Proposed HIF Infrastructure Works to the Existing using the Interim 2021 model.

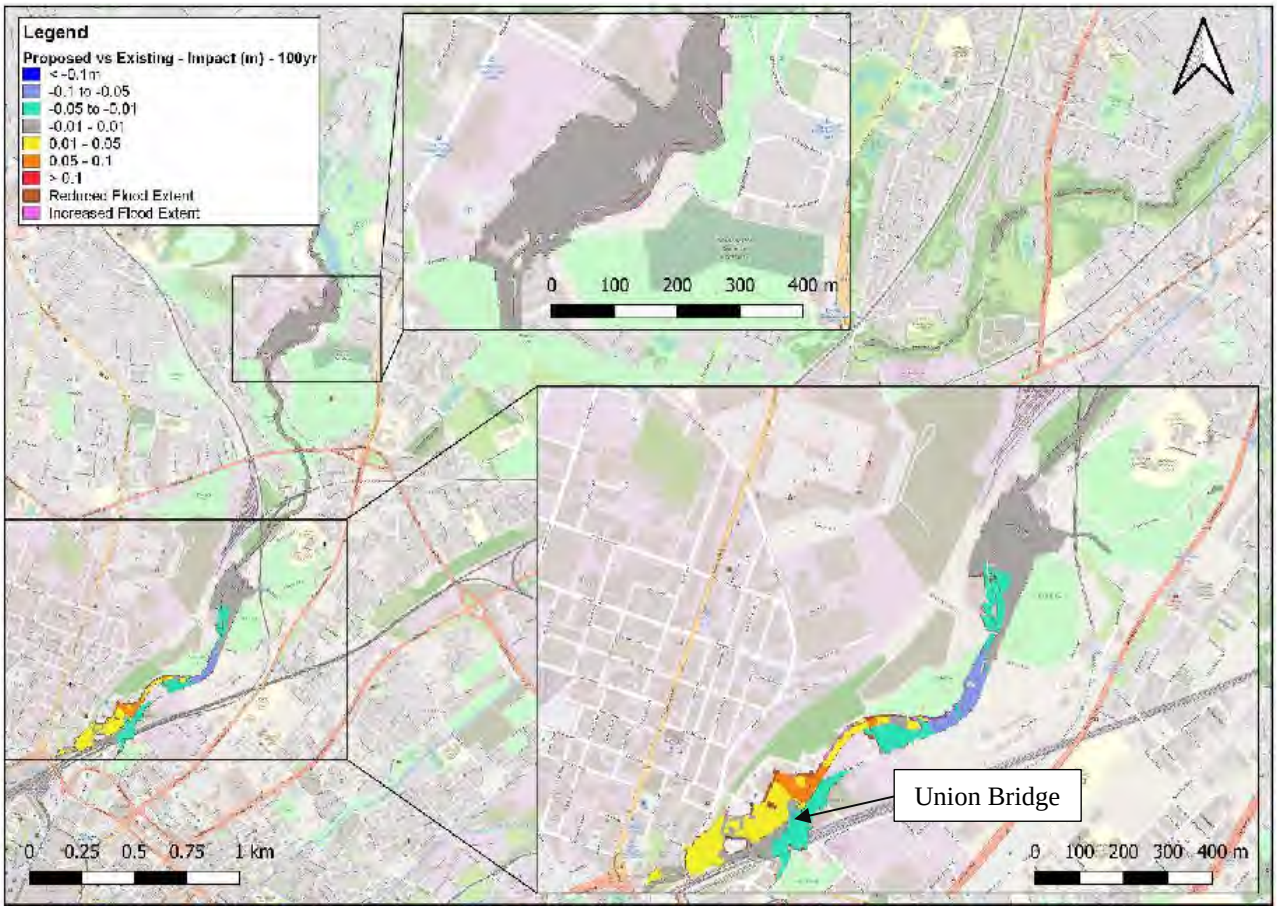


Figure 5: 100 year event Proposed vs Existing

Figure 6 shows the change in levels for the 100 year event plus climate change (2080) when comparing the Proposed HIF Infrastructure Works to the Existing using the Interim 2021 model.

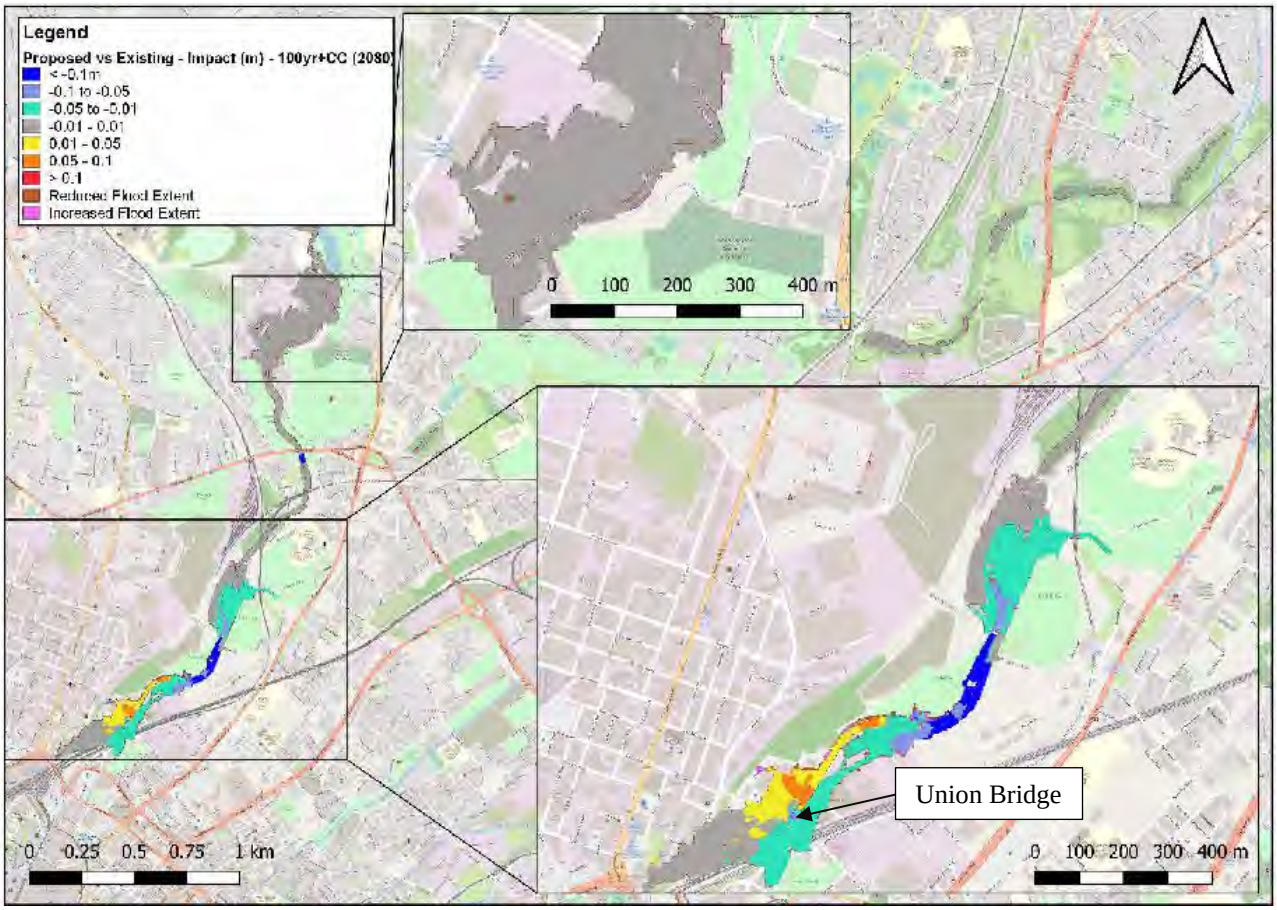


Figure 6: 100 year plus climate change (2080) event Proposed vs Existing

Figure 7 shows the change in levels for the 1000 year event comparing the Proposed HIF Infrastructure Works to the Existing using the Interim 2021 model.

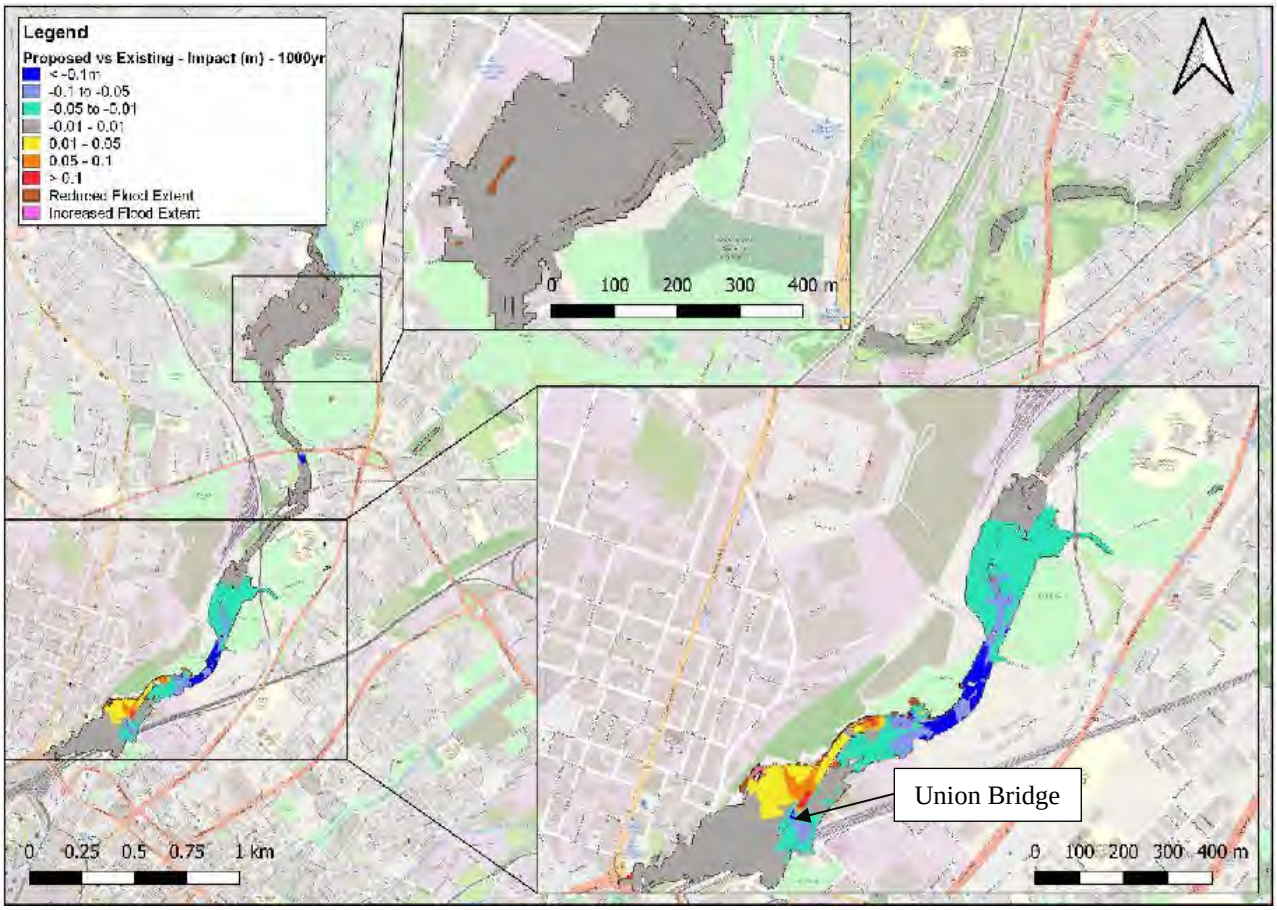


Figure 7: 1000 year Proposed vs Existing

4.3 Existing Condition vs HIF Works with Flood Mitigation Bund Inclusion

Due to the impact seen in **Figure 5**, **Figure 6** and **Figure 7** immediately west and south of Roger Street (Plot RB09), mitigation was modelled in the form of a flood bund immediately behind the proposed terracing upstream of Union Bridge. The bund was modelled as to not overtop and to mitigate changes in flood risk which resulted from the removal of the existing wall on the north bank. More information on the flood bund can be found in the HIF Infrastructure FRA (Document VNIF-ARP-ZZ-YYY-RP-CD-0002) and its location and orientation are shown in **Figure 8**.

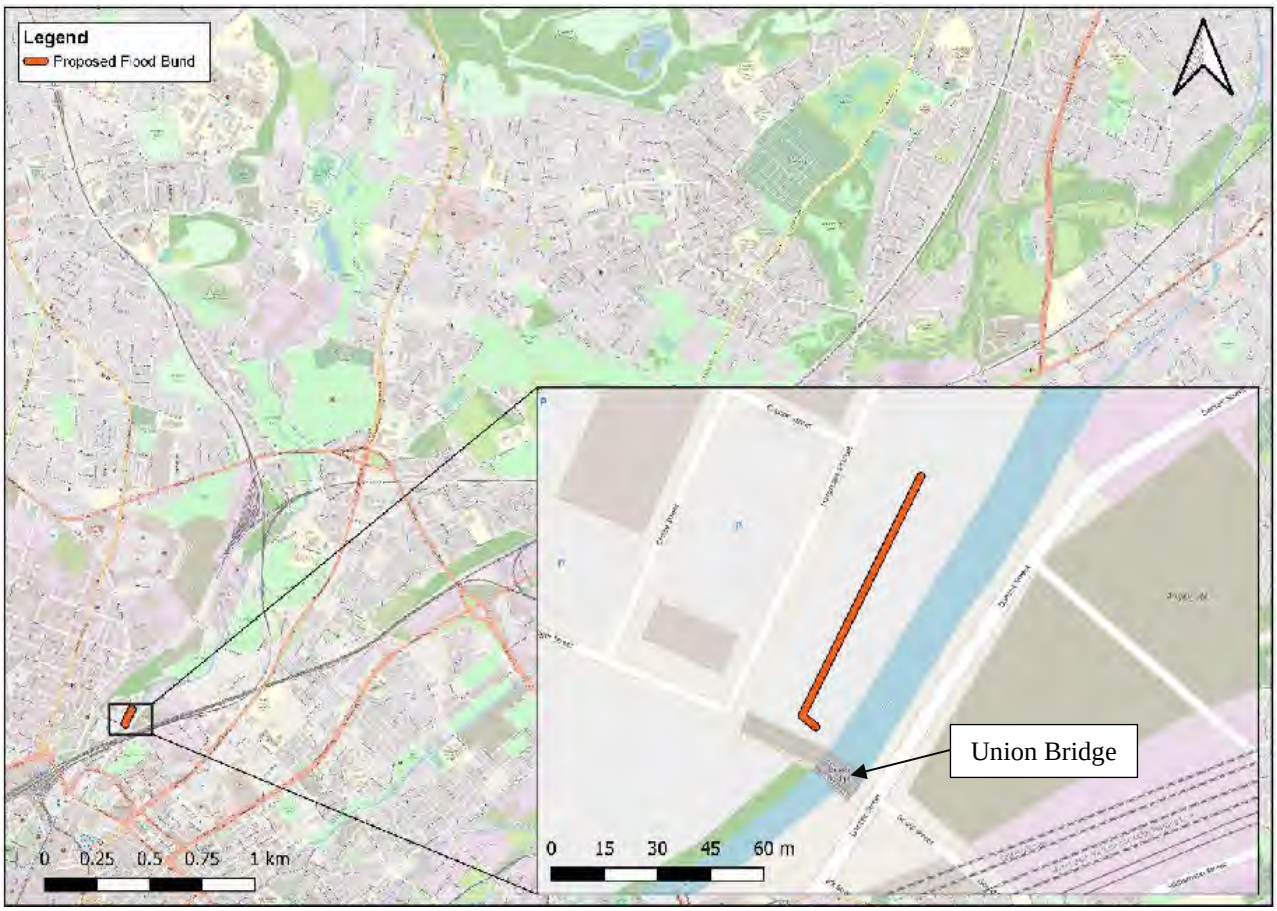


Figure 8: Location of proposed flood bund

The tables below show the stage and flow for each of the 1D channel nodes shown in **Figure 3**, with **Table 4** showing the difference in flood level resulting from the proposed works, and **Table 5** showing the difference in flow.

Table 4: Results table (stage) for Existing Condition (EXIST) vs with HIF Infrastructure Proposals (PROPM) with flood mitigation bund.

Location	Label	20 Year Stage (mAOD)			100 Year Stage (mAOD)			100 Year + CC (2020) Stage (mAOD)			100 Year + CC (2050) Stage (mAOD)			100 Year + CC (2080) Stage (mAOD)			1000 Year Stage (mAOD)		
		EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff
Queens Road U/S	IRKR01_2814E	36.63	36.63	0.00	37.07	37.07	0.00	37.67	37.68	0.00	37.84	37.84	0.00	38.29	38.29	0.00	39.02	39.02	0.00
Smedley Rd D/S	IRKR01_2464E	35.09	35.09	0.00	35.87	35.87	0.00	36.25	36.25	0.00	36.41	36.41	0.00	36.84	36.83	0.00	37.72	37.72	0.00
HMG Paints Weir U/S	IRK_1.19u	32.93	32.93	0.00	33.64	33.64	0.00	33.85	33.85	-0.01	33.95	33.94	-0.01	34.18	34.16	-0.01	34.51	34.52	0.01
HMG Paints Weir D/S	IRK_1.18d1	32.77	32.77	0.00	33.51	33.50	0.00	33.75	33.74	-0.01	33.85	33.84	-0.01	34.08	34.07	-0.01	34.44	34.44	0.01
P&P Bridge U/S	IRK_1.16u	31.44	31.43	-0.01	32.46	32.43	-0.03	32.83	32.81	-0.02	32.96	32.93	-0.03	33.28	33.23	-0.05	34.01	33.98	-0.03
Collyhurst Weir U/S	IRK_1.13u	31.13	31.11	-0.02	31.61	31.55	-0.06	31.82	31.78	-0.04	31.90	31.84	-0.06	32.14	32.01	-0.13	32.41	32.34	-0.07
Collyhurst Weir D/S	IRK_1.11	31.10	31.08	-0.02	31.57	31.52	-0.06	31.78	31.74	-0.04	31.86	31.80	-0.06	32.10	31.97	-0.14	32.36	32.28	-0.07
Location of Planit Cross-section A-A	IRKR01_1449	31.04	31.05	0.00	31.54	31.50	-0.04	31.74	31.73	-0.02	31.83	31.79	-0.04	32.01	31.96	-0.05	32.32	32.25	-0.07
	IRK_1.10	31.01	31.00	-0.01	31.50	31.43	-0.07	31.69	31.59	-0.10	31.75	31.64	-0.11	31.86	31.73	-0.13	32.12	31.98	-0.14
Location of Planit Cross-section B-B	IRKR01_1293	30.65	30.67	0.02	31.13	31.14	0.02	31.33	31.38	0.05	31.43	31.44	0.01	31.60	31.61	0.00	31.98	31.93	-0.05
	IRK_1.07	30.49	30.53	0.04	30.91	30.99	0.08	31.07	31.23	0.16	31.16	31.28	0.13	31.28	31.44	0.16	31.59	31.74	0.15
	IRK_1.06	30.41	30.45	0.04	30.82	30.89	0.07	30.97	31.12	0.15	31.04	31.14	0.10	31.14	31.25	0.11	31.41	31.51	0.10
Location of Planit Cross-section C-C	XS_C-C		30.44			30.88			31.09			31.13			31.22			31.46	
	IRKR01_1042	30.38	30.43	0.05	30.80	30.88	0.08	30.95	31.09	0.15	31.03	31.13	0.10	31.12	31.23	0.11	31.37	31.48	0.10

Location of Planit Cross-section D-D	**IRK_1.05**	30.34	30.36	0.01	30.74	30.81	0.07	30.88	31.05	0.17	30.96	31.09	0.13	31.04	31.18	0.15	31.19	31.44	0.25
Location of Planit Cross-section F-F	**XS_F-F**		30.33			30.70			30.92			30.93			30.97			31.14	
Union Bridge U/S	**IRK_1.04u**	30.37	30.37	0.00	30.92	30.92	0.00	31.12	31.17	0.05	31.21	31.22	0.01	31.35	31.35	0.00	31.68	31.64	-0.04
Union Bridge D/S	**IRK_1.03d**	29.57	29.57	0.00	30.54	30.54	0.00	30.82	30.82	0.00	30.87	30.87	0.00	31.03	31.03	0.00	31.33	31.33	0.00
	IRKR01_0835	29.07	29.07	0.00	29.94	29.95	0.00	30.21	30.21	0.00	30.28	30.28	0.00	30.45	30.46	0.01	31.07	31.08	0.02
Aspin Lane U/S	**IRKR01_0685D**	28.66	28.66	0.00	29.65	29.65	0.00	30.02	30.01	0.00	30.12	30.12	0.00	30.40	30.40	0.00	31.04	31.05	0.00
Aspin Lane D/S	**IRKR01_0685E**	28.49	28.49	0.00	28.93	28.93	0.00	29.26	29.26	0.00	29.38	29.38	0.00	29.72	29.73	0.01	30.62	30.62	0.01
	IRKR01_0627B	28.19	28.19	0.00	28.63	28.63	0.00	28.90	28.90	0.00	29.00	29.00	0.00	29.29	29.29	0.01	30.27	30.28	0.01
Scotland Weir U/S	**IRKR01_0579F**	28.06	28.06	0.00	28.46	28.46	0.00	28.70	28.70	0.00	28.78	28.78	0.00	29.02	29.03	0.01	29.93	29.94	0.00
Scotland Weir D/S	**IRKR01_0579G**	25.54	25.54	0.00	26.39	26.39	0.00	26.71	26.71	0.00	26.87	26.87	0.00	27.26	27.26	0.00	29.42	29.42	0.00
Irk Culvert U/S Face	**IR_COND0564u**	25.46	25.46	0.00	26.35	26.35	0.00	26.67	26.67	0.00	26.83	26.83	0.00	27.23	27.23	0.00	29.40	29.41	0.00
Irk Culvert D/S Face	**IR_COND0033**	25.22	25.22	0.00	26.08	26.08	0.00	26.36	26.36	0.00	26.51	26.51	0.00	26.87	26.87	0.00	28.92	28.92	0.00
Irk/Irwell Confluence	**IRKR01_0027**	25.17	25.17	0.00	26.03	26.03	0.00	26.29	26.29	0.00	26.45	26.45	0.00	26.80	26.80	0.00	28.87	28.87	0.00

Red = increase in peak water level compared with existing (worsening) of >100mm.
Yellow = nominal increase in peak water level compared with existing (worsening) of less than 100mm.
Green = reduction in peak water level compared with existing (betterment)

[Note: Nodes XS_C-C and XS_F-F were created for the proposed run only and hence, no corresponding level exists in the existing run]

Table 5: Results table (flow) for Existing Condition (EXIST) vs with HIF Infrastructure Proposals (PROP) with applied flood bund.

Location	Label	20 Year Flow (m3/s)			100 Year Flow (m3/s)			100 Year + CC (2020) Flow (m3/s)			100 Year + CC (2050) Flow (m3/s)			100 Year + CC (2080) Flow (m3/s)			1000 Year Flow (m3/s)		
		EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff	EXIST	PROP	Diff
Queens Road U/S	IRKR01_2814E	37.9	37.9	0.0	51.4	51.4	0.0	60.6	60.8	0.2	64.9	65.0	0.1	77.8	77.7	-0.1	99.6	100.1	0.4
Smedley Rd D/S	IRKR01_2464E	44.9	44.9	0.0	64.8	64.8	0.0	76.5	76.5	0.0	81.3	81.3	0.0	95.6	95.6	-0.1	118.2	118.3	0.0
HMG Paints Weir U/S	IRK_1.19u	44.8	44.8	0.0	57.5	58.1	0.6	57.9	58.7	0.8	58.1	59.1	1.0	59.2	60.2	0.9	60.2	60.9	0.7
HMG Paints Weir D/S	IRK_1.18d1	44.8	44.8	0.0	57.5	58.1	0.6	57.9	58.7	0.8	58.1	59.1	1.0	59.2	60.2	0.9	60.2	60.9	0.7
P&P Bridge U/S	IRK_1.16u	58.7	58.7	0.0	76.1	76.3	0.2	86.4	86.7	0.3	89.4	89.8	0.3	98.2	96.8	-1.4	120.4	120.0	-0.5
Collyhurst Weir U/S	IRK_1.13u	58.7	58.7	0.0	77.3	77.7	0.4	90.0	89.9	0.0	95.3	94.7	-0.6	110.7	108.2	-2.5	145.8	147.7	2.0
Collyhurst Weir D/S	IRK_1.11	58.7	58.7	0.0	77.3	77.7	0.4	90.0	89.9	0.0	95.3	94.7	-0.6	110.7	108.2	-2.5	145.8	147.7	2.0
Location of Planit Cross-section A-A	IRKR01_1449	51.8	53.4	1.6	66.3	69.9	3.6	76.5	80.9	4.4	80.8	85.1	4.4	94.8	97.6	2.8	126.6	132.7	6.1
	IRK_1.10	51.5	50.8	-0.7	65.4	67.3	1.9	76.4	82.5	6.1	83.3	87.9	4.6	101.9	105.1	3.2	131.0	138.6	7.6
Location of Planit Cross-section B-B	IRKR01_1293	59.5	59.4	-0.1	78.5	78.8	0.3	89.2	90.5	1.3	92.7	93.5	0.7	103.8	104.1	0.3	120.9	123.4	2.5
	IRK_1.07	59.5	59.0	-0.5	78.9	76.8	-2.1	90.0	87.5	-2.4	93.8	90.0	-3.8	105.3	99.7	-5.6	124.3	117.6	-6.7
	IRK_1.06	59.4	59.4	0.0	79.0	78.0	-1.0	91.2	90.1	-1.1	95.8	93.7	-2.0	108.0	107.0	-1.0	129.1	125.9	-3.2
Location of Planit Cross-section C-C	XS_C-C		59.1		0.0	78.5			91.0			94.3			108.5			128.3	
	IRKR01_1042	59.4	59.4	0.0	78.7	78.0	-0.8	90.0	90.7	0.7	93.7	94.5	0.9	106.7	108.0	1.3	129.8	130.0	0.2
Location of Planit Cross-section D-D	IRK_1.05	59.4	59.4	0.0	78.8	73.8	-4.9	90.0	83.0	-7.0	93.7	84.2	-9.4	106.0	94.0	-12.0	136.2	107.7	-28.5

Location of Planit Cross-section F-F	**XS_F-F**	0.0	59.5			86.5			98.8			101.4			115.4			137.1	
Union Bridge U/S	**IRK_1.04u**	52.2	52.2	0.0	52.5	52.6	0.1	52.6	52.8	0.2	52.6	52.9	0.2	53.0	53.0	0.1	47.0	47.0	0.0
Union Bridge D/S	**IRK_1.03d**	52.2	52.2	0.0	52.5	52.6	0.1	52.6	52.8	0.2	52.6	52.9	0.2	53.0	53.0	0.1	47.0	47.0	0.0
	IRKR01_0835	59.3	59.2	0.0	78.0	78.1	0.0	84.7	84.9	0.2	85.8	86.1	0.3	88.8	88.7	-0.1	85.1	84.9	-0.2
Aspin Lane U/S	**IRKR01_0685D**	59.3	59.2	0.0	76.6	76.5	0.0	78.4	78.4	0.0	78.9	78.9	0.0	80.1	80.1	0.0	72.0	71.9	-0.1
Aspin Lane D/S	**IRKR01_0685E**	59.3	59.2	0.0	76.6	76.5	0.0	78.4	78.4	0.0	78.9	78.9	0.0	80.1	80.1	0.0	72.0	71.9	-0.1
	IRKR01_0627B	59.3	59.2	0.0	78.3	78.3	0.0	89.8	89.8	-0.1	93.7	93.7	0.1	104.0	104.3	0.3	115.4	115.5	0.1
Scotland Weir U/S	**IRKR01_0579F**	59.3	59.2	0.0	78.3	78.3	0.0	90.3	90.3	-0.1	94.7	94.8	0.1	107.6	107.8	0.3	133.1	133.8	0.7
Scotland Weir D/S	**IRKR01_0579G**	59.3	59.2	0.0	78.3	78.3	0.0	90.3	90.3	-0.1	94.7	94.8	0.1	107.6	107.8	0.3	133.1	133.8	0.7
Irk Culvert U/S Face	**IR_COND0564u**	59.3	59.2	0.0	78.3	78.3	0.0	90.3	90.3	-0.1	94.7	94.8	0.1	107.6	107.8	0.2	133.1	133.8	0.6
Irk Culvert D/S Face	**IR_COND0033**	59.2	59.2	0.0	78.2	78.2	0.0	90.3	90.2	-0.1	94.6	94.7	0.1	107.5	107.8	0.3	133.2	133.7	0.5
Irk/Irwell Confluence	**IRKR01_0027**	59.2	59.2	0.0	78.2	78.2	0.0	90.3	90.2	-0.1	94.6	94.7	0.1	107.5	107.8	0.3	133.2	133.7	0.5

Red = increase in peak flow compared with existing (worsening) of >0.1m^3/s.
Yellow = nominal increase in peak flow compared with existing (worsening) of less than 0.1m^3/s.
Green = reduction in peak flow compared with existing (betterment)

[Note: Nodes XS_C-C and XS_F-F were created for the proposed run only and hence, no corresponding level exists in the existing run]

Figure 9 shows the change in levels for the 100 year event when comparing the Proposed HIF Infrastructure Works (with mitigation bund) vs the Existing, using the Interim 2021 model.

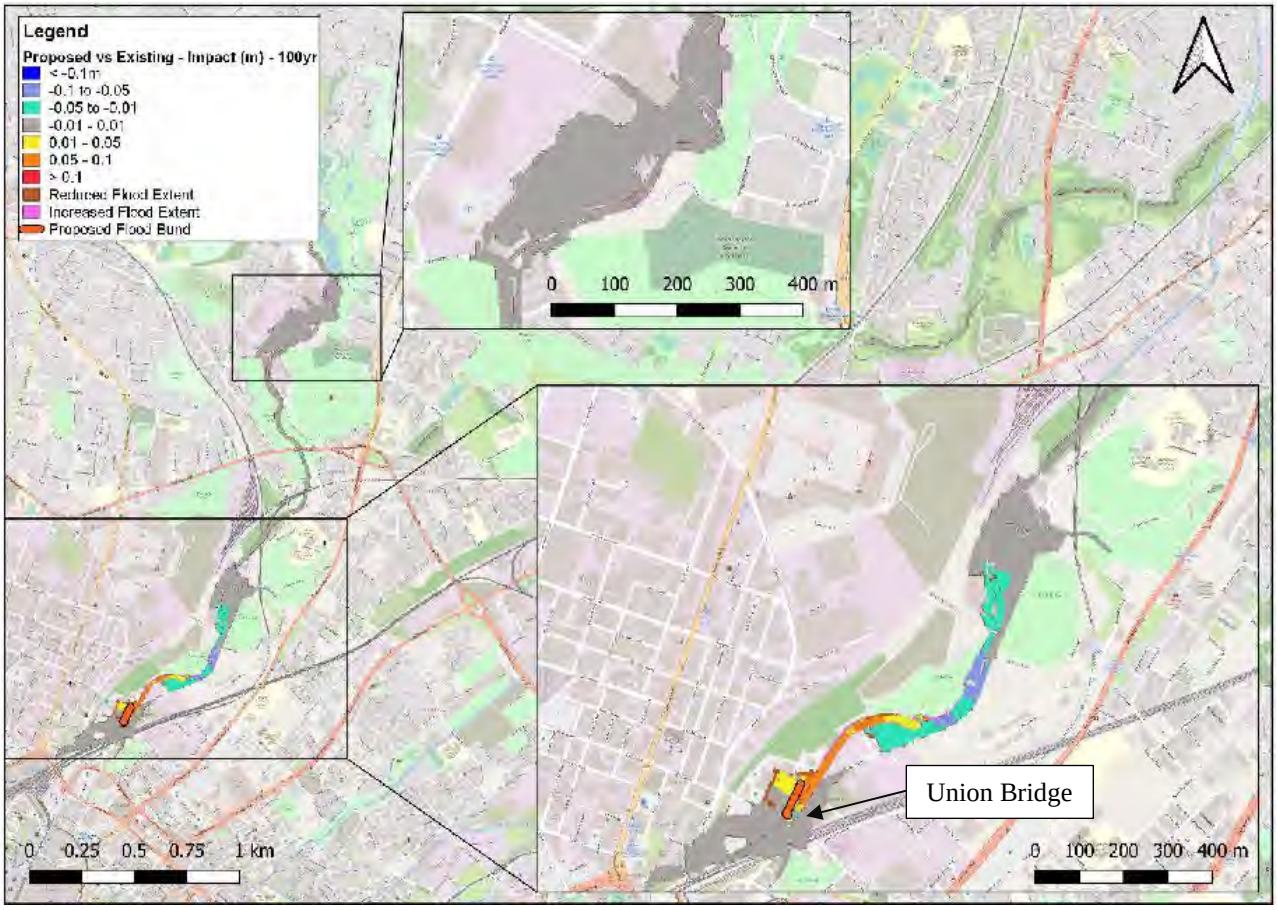


Figure 9: 100 year event HIF with flood bund vs Existing

Figure 11 shows the change in levels for the 100 year plus climate change (2080) event comparing the Proposed HIF Infrastructure Works (with mitigation bund) vs Existing, using the Interim 2021 model.

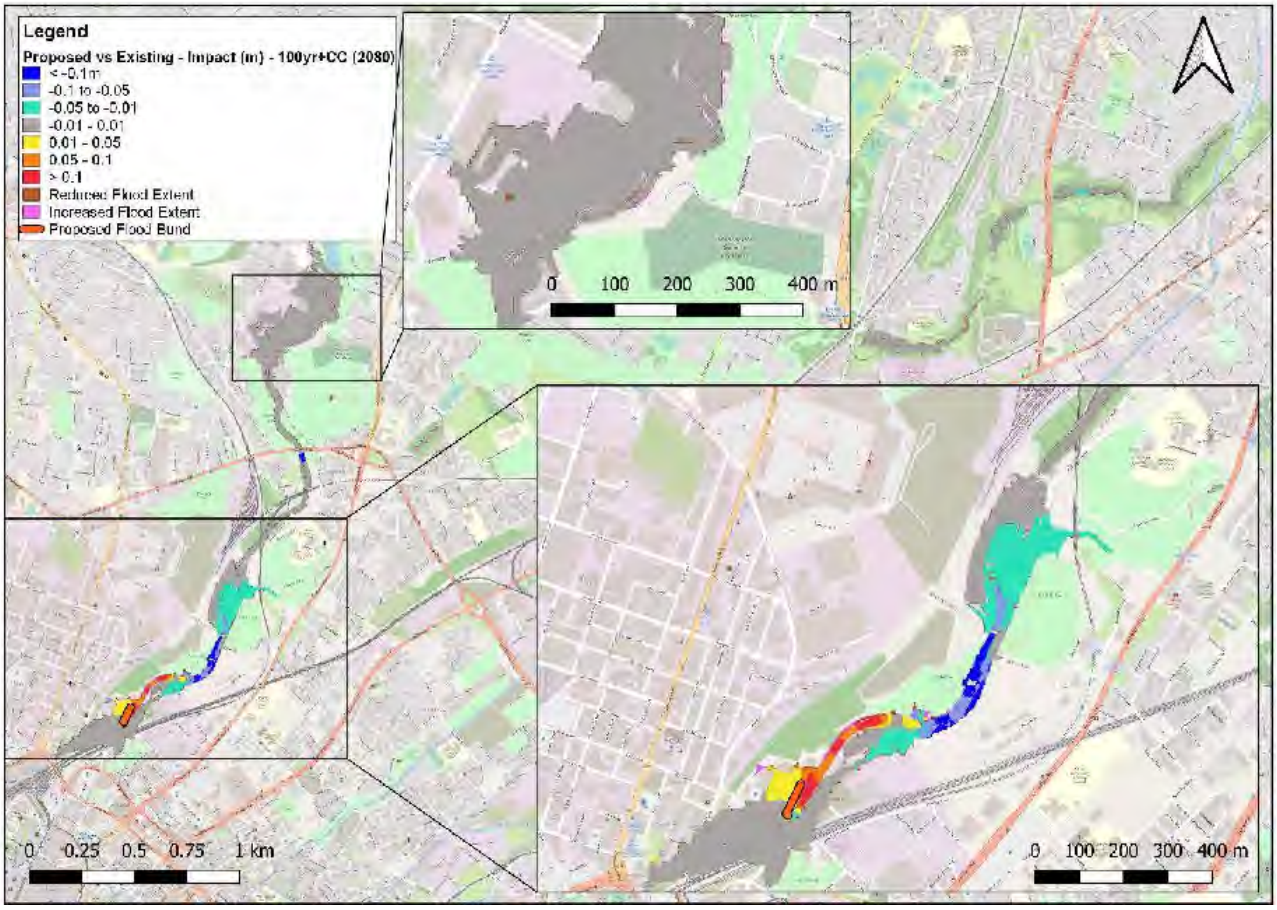


Figure 10: 100 year plus climate change (2080) event HIF with flood bund vs Existing

Figure 11 shows the change in levels for the 1000 year event comparing the Proposed HIF Infrastructure Works (with mitigation bund) vs Existing, using the Interim 2021 model.

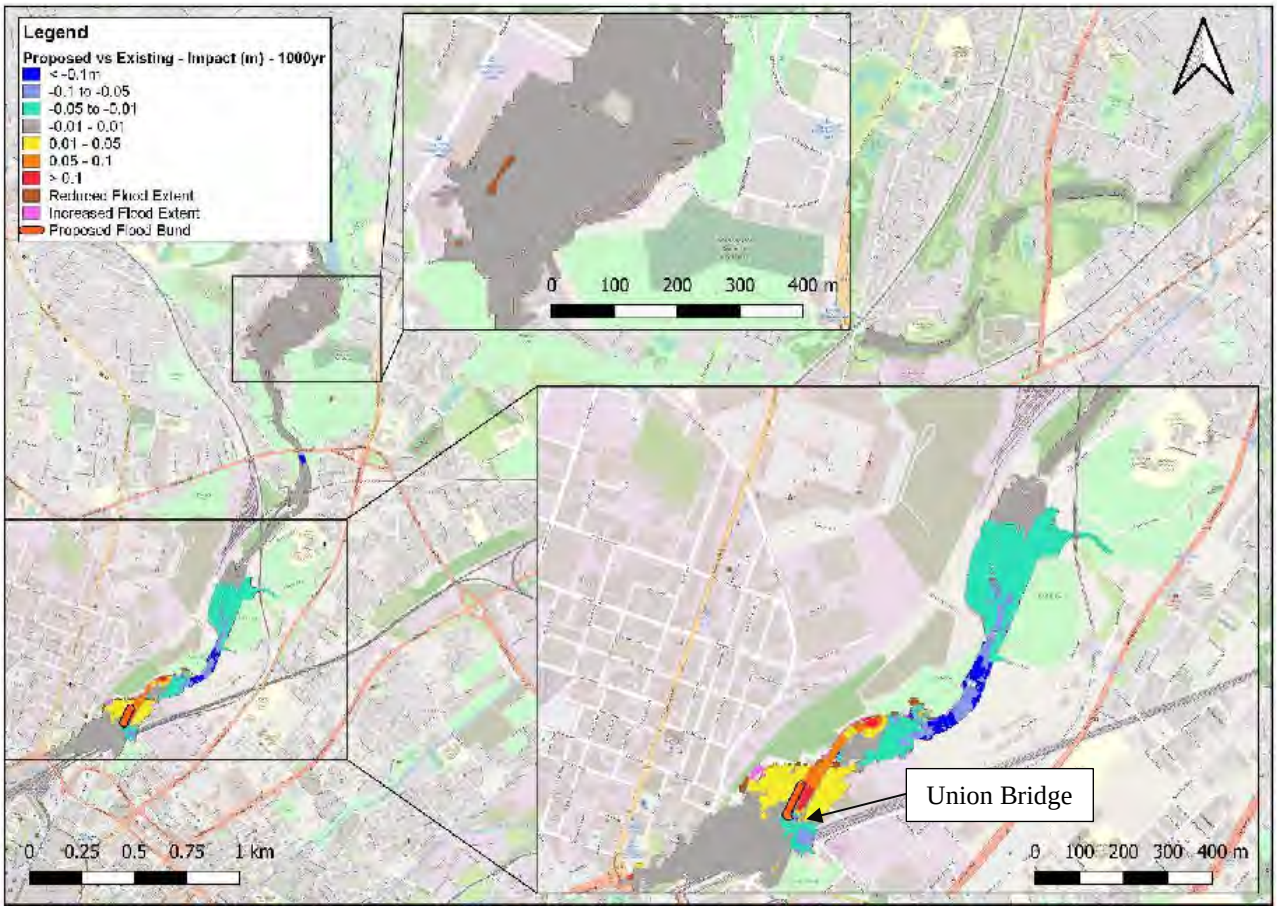


Figure 11: 1000 year event HIF with flood bund vs Existing

5 Discussion and Conclusions

A comparison has been made between Existing Conditions vs HIF Infrastructure Proposals below, using the Interim 2021 hydraulic model.

5.1 Pre Flood Bund (HIF Works)

5.1.1 Overview

Figure 5, **Figure 6**, **Figure 7** and **Table 2** all show that there is a general decrease in peak flood levels upstream of the proposed HIF Infrastructure works as a result of the proposed works.

Downstream of the proposed HIF works, there are generally negligible changes to flood levels in-channel, as shown in **Table 2**.

There are no changes in flood level at the confluence with the River Irwell as the larger river is dominant here.

Table 3 shows small increases in flow of 0.3m^3/s for the 1000 year event (<1% change of the overall flow) passing forward to the River Irwell. However, the 1000 year event model is subject to some in-channel oscillations and instabilities for both existing and proposed model runs, particularly immediately south of HMG Paints due to steepness of Moston Brook Channel and limitation due to high magnitude of flow under this extreme return period. Reasonable attempts were made to reduce the instabilities using one and/or a combination of 'a' flags on bank lines, using viscosity boundary factors and roughness patches. However, these only slightly reduced the oscillations at the expense of producing an unrealistic schematisation. These additions were therefore discarded and as such, the 1000 year results should be not be interrogated in fine detail and considered with caution.

5.1.2 Location specific comments

At Collyhurst Weir, there is a small reduction in flood level by approximately 0.07m in channel and in the floodplain (reducing from a floodplain depth of 0.89m to 0.82m) for a 100 year event. This reduction continues upstream towards HMG Paints, after which the difference is deemed negligible.

As a result of the proposals, there are small instances of both increases in flood extent at St. Catherine's Wood and decreases in extent on the right bank around the northern edge of Red Bank.

Within the boundaries of the HIF Infrastructure proposals, **Figure 5, Figure 6**and **Figure 7** show localised increases in flood levels in the out of bank areas around St Catherine's Wood and to the right bank (north side) of Union Bridge. This is due to the removal of an existing wall and introduction of terracing along the bank as shown in Section D-D, E-E and F-F in **Table 6** in **Appendix A**. The removal of this wall allows more flow to propagate into the floodplain on the right (north) bank as shown in **Figure 17**, due to proposed localised changes in topography. The removal of the wall also explains the large decreases in in-channel flow observed upstream of Union Bridge, as noted in **Table 3**, as more water is able to propagate onto the floodplain rather than stay within the channel.

Table 3 shows a significant reduction in flows up to the 1000 year event around cross-section Irk_1.05 then a swift increase in at the next section, cross-section XS_F-F for the proposed scenario. The reduction in flows at section IRK_1.05 is due to more flow being in the floodplain due to the terracing allowing more out of bank flow. Then, as **Figure 12** shows, depicting the direction of flow, the increase in flows at section XS_F-F is due to overland flow re-entering the channel at section XS_F-F.

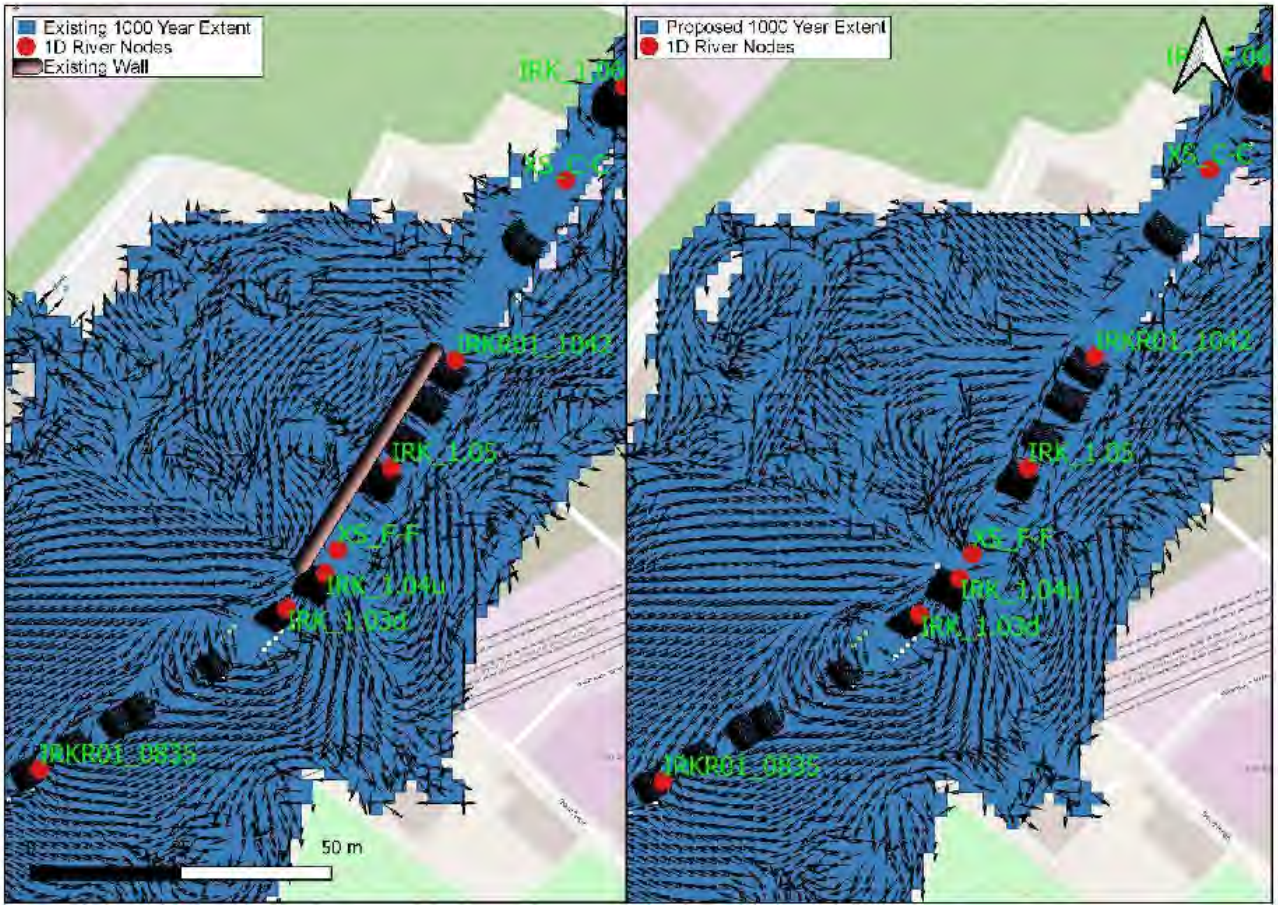


Figure 12: Direction of flow (1000 year event) Existing vs Proposed

Increases in flood heights in the floodplain are seen on the right (north) bank, immediately west of Union Bridge on Roger Street up to a maximum of +0.035m (from existing condition depth of 0.45m) for the 100 year and up to a maximum of +0.015m (from existing condition depth of 1m) for the 1000 year event.

In all return periods except for the 1000 year, levels and extent are increased downstream and to the right bank of Union Bridge. This isn't increased in the 1000 year scenario since flows are comparable and already entering Roger Street and continuing south in the existing situation. In the 100 year event, there is generally an increase in flood levels of approximately 0.01-0.02m, (from existing depths of up to 0.63m) immediately south of Roger Street (Plot RB09) with small increases in extent. Since overland flows are in a SW direction, further south-west of the HIF site (along Scotland Street), there are general increases in depths of approximately 0.01m as a result of overland flow beneath the railway sidings viaduct (which have originated from the drop in wall height and stepped nature of the bank Union Bridge Plot RB07).

It should be noted that although the source of these additional overland flows result from the terracing and proposed removal of the wall upstream of Union Bridge, it is questionable if, in reality, the existing wall could withstand hydraulic loading during extreme events in the existing condition and consequently, may occur anyway.

5.2 HIF Works With Flood Mitigation Bund

5.2.1 Overview

Figure 9, **Figure 11** and **Table 4** all show that there is a general decrease in peak flood levels upstream of the proposed HIF Infrastructure works as a result of the proposed works.

Downstream of the proposed HIF works, there are generally negligible changes to flood levels in-channel, as shown in **Table 4**.

There are no changes in flood level at the confluence with the River Irwell as the larger river is dominant here.

Table 5 shows small increases in flow of 0.5m^3/s for the 1000 year event (0.37% of the overall flow) passing forward to the River Irwell. However, as described in **Section 5.1** the 1000 year event is still subject to some in-channel oscillations and instabilities.

5.2.2 Location specific comments

Figure 13 illustrates a comparison of the 100 year impact without and with the mitigation bund in place, compared to existing.

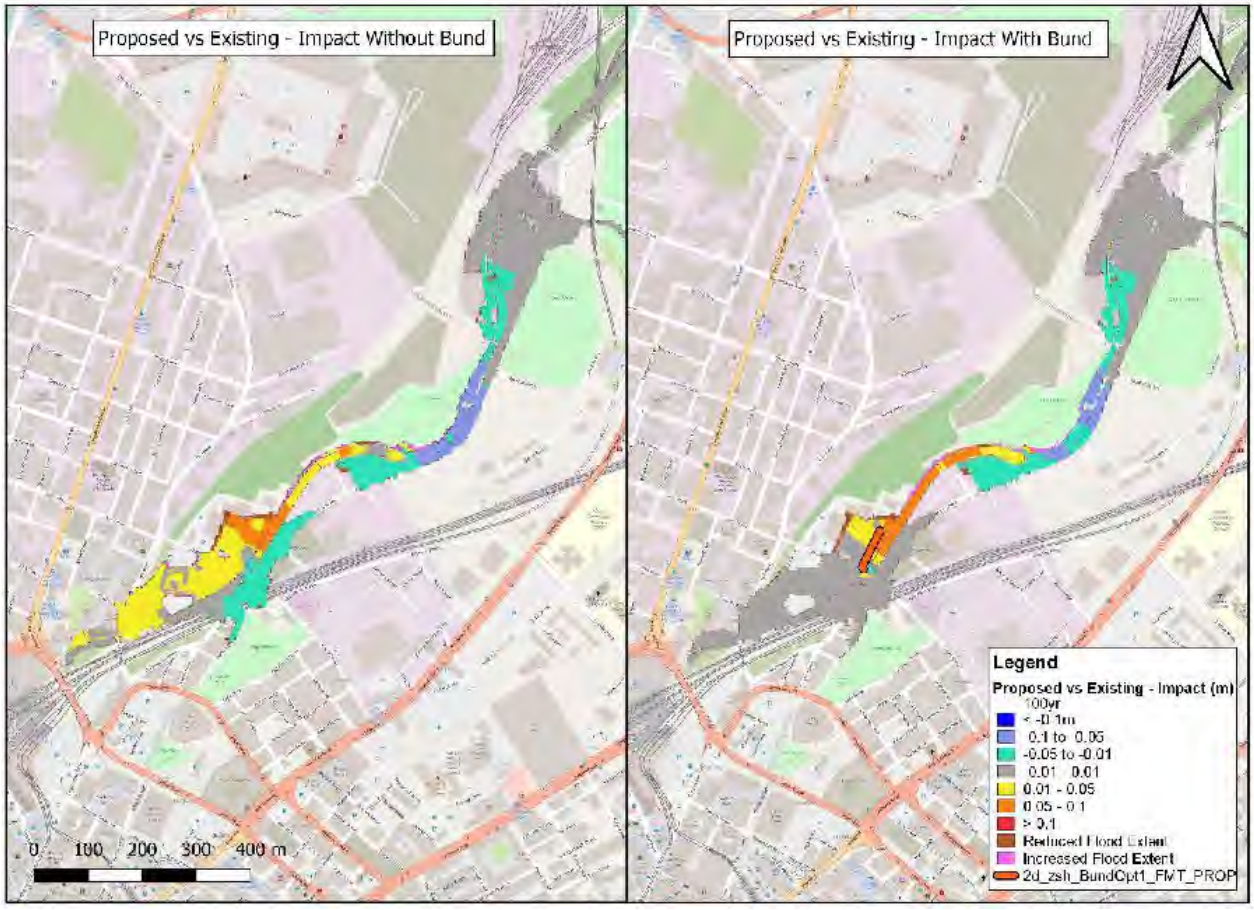


Figure 13: Impact comparison – with and without the flood bund – 100 year

Figure 13 shows that by implementing the flood bund, the increase in flood depth off site (to the south of Roger Street (Plot RB09)), is now mitigated for the 100 year event. The impact on flood depth along Dantzic Street is negligible comparing the bunded solution compared to the existing scenario.

Within the channel, in the area of the proposed works, there is a slight increase in stage. There is an increase in level along the bank, within the floodplain, at Travis Island of up to 0.035m (from an average depth of 0.7m), however the majority of the flood depths at Travis Land remain unchanged by the proposed works. Further upstream, at St Catherine's Wood, Collyhurst Road and HMG Paints, there is a reduction in channel stage of up to approximately 0.03m.

There is also no increase in flood extent here when implementing the flood bund, whereas without the bund modelling showed minimal increases.

Figure 14 shows the increase in flood depth off site (to the south of Roger Street (Plot RB09)), is still mitigated for the 100 year plus climate change (2080) event. Within the channel, in the area of the proposed works, there is a slight increase in stage. There is an increase in level along the bank, within the floodplain, at Travis Island of up to 0.03m (from an average depth of 1m), however the majority of the flood depths at Travis Land remain unchanged or reduced by the proposed works. Further upstream, at St Catherine's Wood, Collyhurst Road and HMG Paints, there is a reduction in channel stage of up to approximately 0.135m.

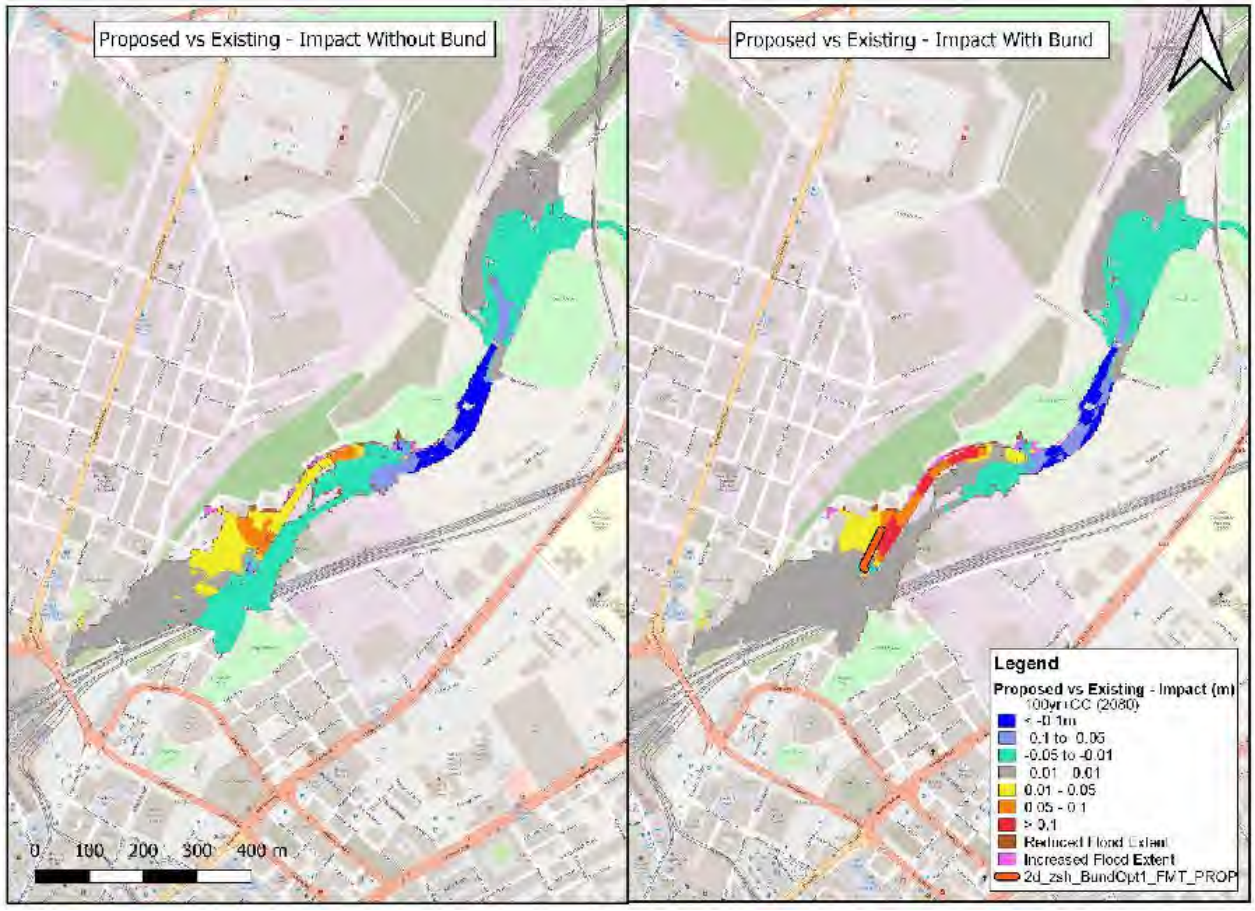


Figure 14: Impact comparison – with and without the flood bund – 100 year plus climate change (2080)

At the confluence with the River Irk downstream, as shown in **Table 5**, there is a Negligible change to pass forward flows for 100 year event and a small increase in pass forward flow of 0.3 to 0.5m^3/s for the 100 year + CC 2080 and 1000 year events (100 +CC 2028 Year flow changes from 107.5 to 107.8 m^3/s), which is less than 0.5% change.

The bund predominately mitigates the changes flood risk predicted for the proposed HIF Infra works, however **Figure 15** shows that the impact for the 1000 year event does still marginally propagate (up to 0.012m increase) south of Roger Street (into Plot RB09) but to a lesser extent than without the bund.

There is also a small increase in flood level on the eastern side of the river on Dantzic Street, with an increase in flood depth in the region of 0.02-0.04m (compared to an average flood depth prediction of approximately 1.0m in existing situation).

There is a marginal increase in predicted flood depths at Travis Island of 0.015m (from an average depth of approximately 0.7m in existing situation) illustrated in yellow, although the majority of this area has negligible impact or a reduction of up to approximately 0.06m.

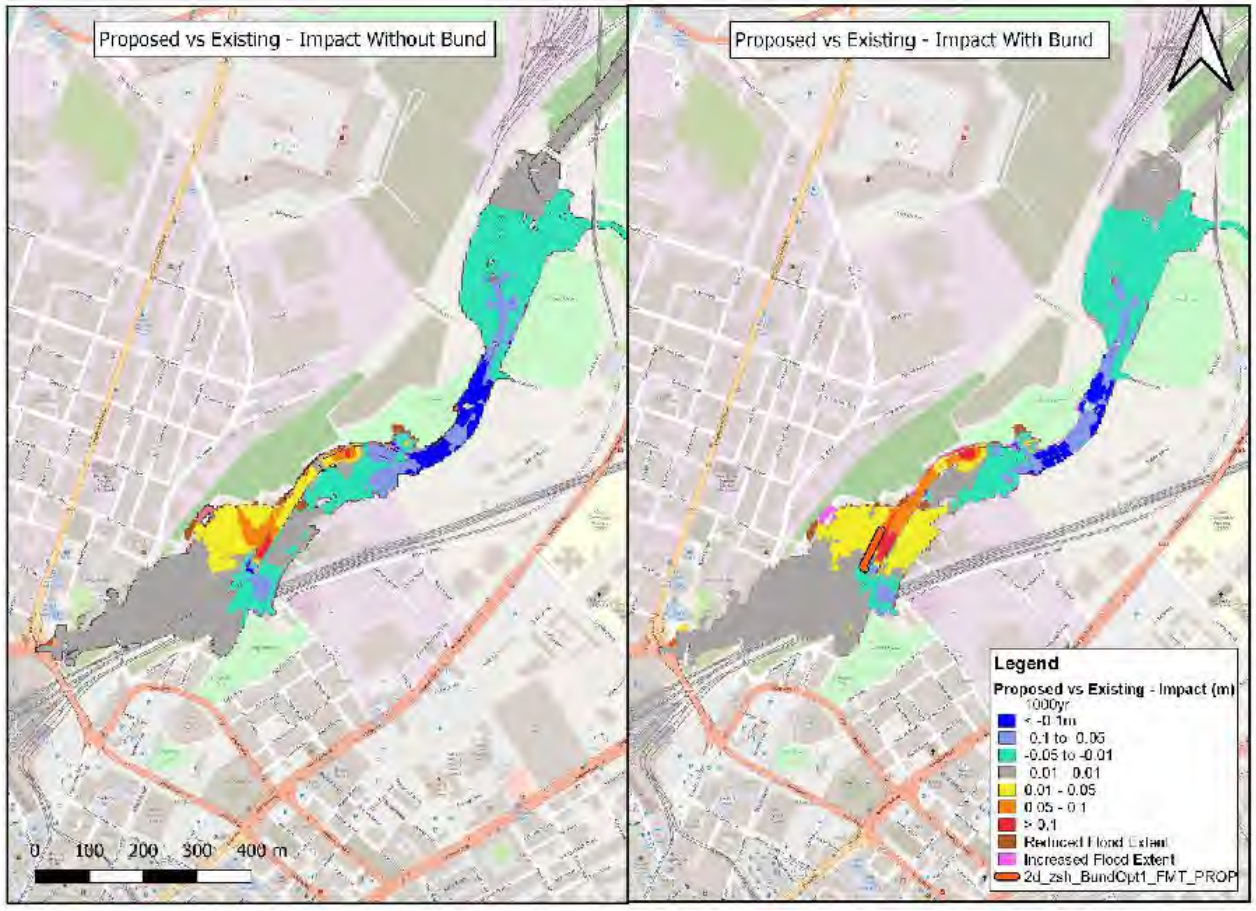


Figure 15: Impact comparison – with and without the flood bund – 1000 year

APPENDICES

A. Proposed HIF Infrastructure Works

Planit Drawings

To undertake the Flood Risk Assessment for the proposed HIF Infra works, including landscaping and river modifications, it is necessary to represent the proposed works in the model. Arup have received cross-sections highlighting the proposed changes to the channel geometry, in addition to a plan drawing of proposed changes to the floodplain (ref. **VNIF-PLA-ZZ-YYY-SK-L-0001** & **VNIF-PLA-ZZ-YYY-DR-L-1000**).



Figure 16: Location of the cross-sections representing the proposed works, in the context of the Victoria North site. Provided to Arup by Planit.

Depending on the landscaping works proposed, the ID cross-sections were updated to represent the updated river channel. Proposed updates to 1D cross-sections are detailed in **Table 6**.

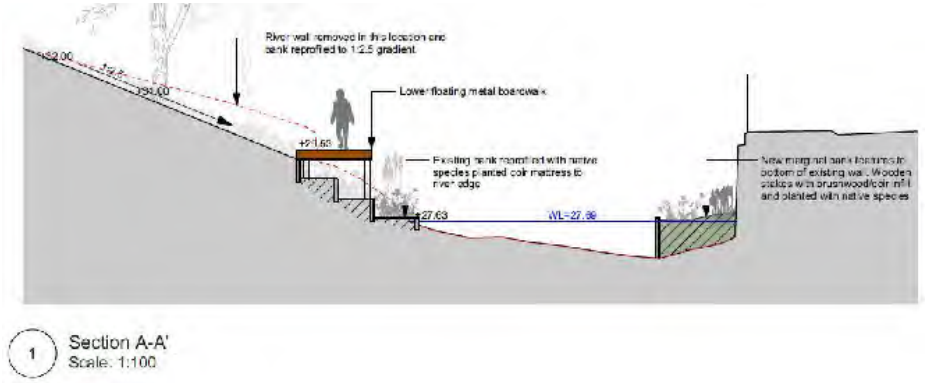
Changes include the addition of sections to provide an upstream and downstream bound to the proposed modifications.

Where out of bank changes were also proposed, or where the channel wall removed and bank stepped back, this was reflected in corresponding changes to the 2D domain. This included updating roughness values, defining the addition of paths and vegetation, and the use of z-shapes to represent changes to the topography.

An ASC layer was generated of the proposed level changes to the 2D floodplain and was read in over the existing DTM in the study area. The left hand image of **Figure 17** shows a comparison of the existing and proposed levels within the study area.



Figure 17: Comparison of the existing and proposed topography within the study area

Proposed in-channel works	1D model cross-sections impacted	Proposed changes to cross-sections
A – A’  	IRKR01_1449	Channel manually edited to include steps noted in cross-section A-A. Wooden stakes with brushwood/coir infill modelled as a constriction in the channel with level corresponding to the flow at Q95, as defined by NRFA[2], with roughness also increased to 0.07 as per 1g in Chow tables. Pathway not physically represented, rather with an increase in roughness, to 0.1, as per 1h in Chow tables[3]. Roughness increased where vegetation is shown in the infills. An ASC layer was generated of the proposed level changes to the 2D floodplain and was read in over the existing DTM in the study area. The levels in the 2D ASC were made to tie in with the 1D node levels. To account for the terrain changes shown in **Figure 16**, a new Mastermap layer was created to assign current roughness values.

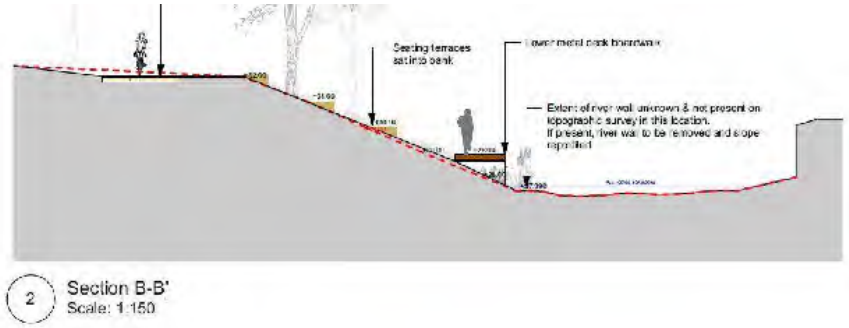
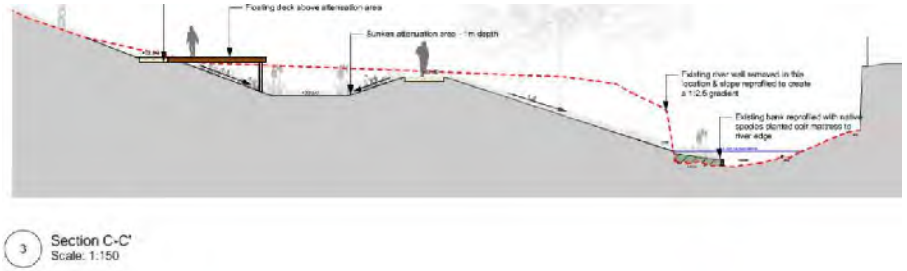
[2] https://nrfa.ceh.ac.uk/data/station/meanflow/69043

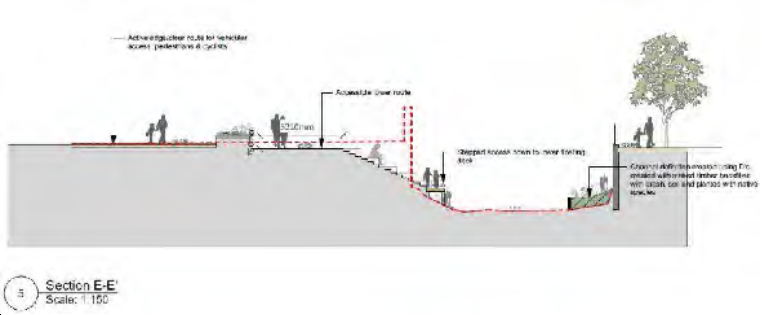
[3] http://www.fsl.orst.edu/geowater/FX3/help/8_Hydraulic_Reference/Mannings_n_Tables.htm

J:\280000\281943-00\4 INTERNAL PROJECT DATA\4-05 REPORTS\4-05-02 CIVIL\HYDRAULICMODELLINGOFINFRA\VNIF-ARP-ZZ-RIV-RP-DF-0002_HYDRMODELLINGOFINFRAPROPOSALS_ISSUE3.DOCX

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Proposed in-channel works	1D model cross-sections impacted	Proposed changes to cross-sections
B – B’ 	IRKR01_1293	Right bank slope amended to represent cross-section B-B and tie in with amended 2D DTM levels. Metal boardwalk not physically represented, rather with an increase in roughness to 0.1, as per 1h in Chow tables. Roughness increased where vegetation is shown on the right bank. An ASC layer was generated of the proposed level changes to the 2D floodplain and was read in over the existing DTM in the study area. The levels in the 2D ASC were made to tie in with the 1D node levels. To account for the terrain changes shown in **Figure 16**, a new Mastermap layer was created to assign current roughness values.
C – C’ 	Intermediary cross-section, between IRK_1.06 and IRKR01_1042 introduce, named XS_C-C.	New cross-section introduced, a copy of IRK_1.06. Right bank edited to remove the bank and introduce a slope of 1:3. Coir mattress modelled as a constriction in the channel with level corresponding to the flow at Q95, as defined by NRFA. Roughness increased for the coir mattress. A value of 0.07 used as per 1g in Chow tables. An ASC layer was generated of the proposed level changes to the 2D floodplain and was read in over the existing DTM in the study area. The levels in the 2D ASC were made to tie in with the 1D node levels. To account for the terrain changes shown in **Figure 16**, a new Mastermap layer was created to assign current roughness values.

Proposed in-channel works	1D model cross-sections impacted	Proposed changes to cross-sections
D – D’  	IRKR01_1042 & IRK_1.05	Channel manually edited to include steps noted in cross-section D-D. Wooden Staked timber backfilled with brash modelled as a constriction in the channel with level corresponding to the flow at Q95, as defined by NRFA, with roughness increased to 0.07 as per 1g in Chow tables. Floating deck not physically represented, rather with an increase in roughness, to 0.1, as per 1h in Chow tables. Roughness increased where vegetation is shown on both sides of the bank. An ASC layer was generated of the proposed level changes to the 2D floodplain and was read in over the existing DTM in the study area. The levels in the 2D ASC were made to tie in with the 1D node levels. To account for the terrain changes shown in **Figure 16**, a new Mastermap layer was created to assign current roughness values.
E – E’  	IRKR01_1042, IRK_1.05 and XS_F-F	New cross-section introduced, a copy of IRK_1.06. Channel manually edited to include steps noted in cross-section E-E. Wooden Staked timber backfilled with brash modelled as a constriction in the channel with level corresponding to the flow at Q95, as defined by NRFA, with roughness also increased to 0.07, as per 1g in Chow tables. Floating deck not physically represented, rather with an increase in roughness, to 0.1 (1h in Chow tables). Roughness increased where vegetation is shown on both sides of the bank. An ASC layer was generated of the proposed level changes to the 2D floodplain and was read in over the existing DTM in the study area. The levels in the 2D ASC were made to tie in

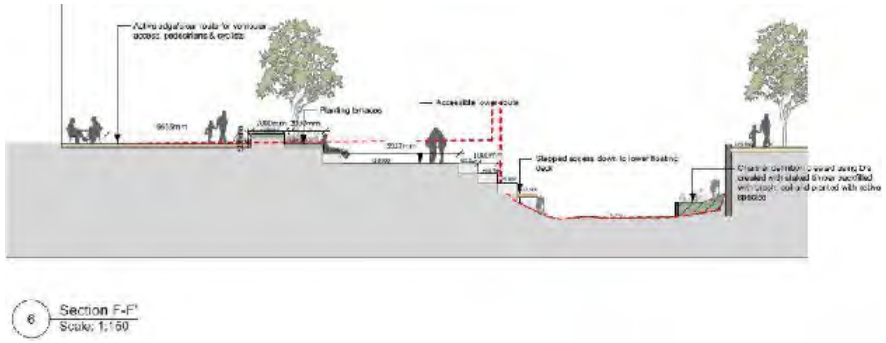
Proposed in-channel works	1D model cross-sections impacted	Proposed changes to cross-sections
		with the 1D node levels. To account for the terrain changes shown in **Figure 16**, a new Mastermap layer was created to assign current roughness values.
F – F’ 	IRK_1.05 and XS_F-F	Channel manually edited to include steps noted in cross-section F-F. Wooden Staked timber backfilled with brash modelled as a constriction in the channel with level corresponding to the flow at Q95, as defined by NRFA, with roughness also increased to 0.07, from 1h in Chow tables. Floating deck not physically represented, rather with an increase in roughness to 0.1, from 1h in Chow tables. Roughness increased where vegetation is shown on both sides of the bank. An ASC layer was generated of the proposed level changes to the 2D floodplain and was read in over the existing DTM in the study area. The levels in the 2D ASC were made to tie in with the 1D node levels. To account for the terrain changes shown in **Figure 16**, a new Mastermap layer was created to assign current roughness values.

Table 6 - Summary of HIF Infrastructure Works modelled



Figure 18 - Plot Boundaries

B. Responses to EA Model Review Actions

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
Flood Modeller and TUFLOW versions: Flood Modeller version 4.3 single precision, TUFLOW 2017-09-AC-iSP-w64	Use most up-to-date software. Currently this is: FMP version - version 5.0 TUFLOW - 2020-10-AA Ideally, double precision version of software will be used.	Completed – model updated to FMP version 5.0, and TUFLOW version 2020-10-AA
Return periods simulated: Q100, Q100+CC and Q1000 and have been run. Bare minimum of runs required, a fuller range of return periods may help to sensitivity check model outputs in the absence of validation/verification information.	Consider simulating a larger range of events. Although the wider suite of events are expected in the next stage, for this FRA we will require a comparison for the 2020 and 2050 climate change epochs to ensure the model is stable and results look sound. The results have not been provided with this submission or discussed in the report.	20 year added. More to be added for the full modelling exercise in 2022 2020 and 2050 climate change epochs added for the 100yr event
Sensitivity runs and uncertainty: Sensitivity runs have been undertaken but no analysis of these in reporting.	Quantify uncertainty of the modelling by analysing the sensitivity test results and include this in the reporting.	A full suite of SEN runs will be completed at next stage
Georeferencing: FMP gxy a bit of a mess. This won't impact model results, but makes working with and reviewing the model more difficult!	Please georeference the FMP nodes.	Minimal georeferencing so difficult to identify exact location of sections, but all have been moved to general location, based on structures. Original source EA model was not georeferenced.
Review cross-section and bed profiles: Model is based on survey from before 2004 (survey date unclear from reporting) and from Jan 2019. On Moston Brook, several cross sections are low resolution with only a few data points. This is likely attributed to the survey information available, but is	Give further detail on the survey used for the hydraulic model in the reporting. Review cross section widths on Moston Brook. Review deactivation markers for IRKR01_1788D, MOST01_5400 and MOST01_5337.	Completed – deactivation markers for IRKR01_1788D, MOST01_5400 and MOST01_5337 set to top of bank

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
considered a limitation. There are also large changes in cross section width - some sections ~10m wide, other >50m. This should be reviewed. Two sections had points on the right bank where it went down in elevation - IRKR01_1788D, MOST01_5400 and MOST01_5337. Was this intentional? The initial approach should be to deactivate at the bank crest.	There still seems to be an issue at MOST01_5400 with the right bank continuing down into the floodplain due to inappopriate bank location. There are also a handful other sections identified using a GIS tool where the bank may not be trimmed to an appropriate location, please see screenshot to the right. Action: ensure banks are trimmed at appropriate locations, especially the sections on Moston Brook. The cross sections highlighted at the d/s limit of the Irk are unlikely to have an impact and are not connected to 2d. ---------- Proposed model. Appendix A describes the amended cross sections as part of the proposed works. One source of confusion notes is that the report states that sections D-D and E-E both influence overlapping baseline units of IRK01_1042 and IRK 1.05, whilst proposed sections E-E and F-F influence IRK_1.05 and XS_F-F. Action: this is confusing, so please clarify if the drawings overlap several cross sections? Additionally, the drawings were compared to amended cross sections with the following issues noted:	Updates made to the 1D sections flagged in the screenshot to the right, ensuring the section is deactivated at the bank level. B-B - one point set to 0.07 on the LB has been removed. D-D - Given the progression of the numbers down the steps (from 30.0 to 27.5 as seen in the screenshot added opposite), the first step in the model is at 28m, not 27.5m. 27.5m would be the deck level, which is not being modelled. No changes made. E-E - represented between IRK_1.05 and F-F. deck level is 27.5m for all sections in the area, so it's not felt an individual section is necessary

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
	A-A (IRK01_1449): All OK aside. 2d elevations appear to tie in with design on right bank and are lower than baseline. B-B (IRK01_1293): High roughness used on LB in the model but nothing is indicated there on the drawing - please clarify. C-C (XS_C-C): All OK D-D (IRK01_1042 and IRK_1.05): Expected to see the first step on the right bank at 27.5m (28m in the model) although the arrow in the design drawing does obscure the value - please clarify. Wall successfully removed and 1d-2d boundary elevations have been altered to reflect the change. E-E: Hard to tell what cross section this is reflected in - is it IRK_1.05 i.e. same as D-D? F-F (XS_F-F): Amendments look OK and RB wall removed successfully.	
Chainage: This check was not undertaken.	Limited checks have been possible using the 2019 survey data. New cross sections have been added between existing nodes, and this has caused some discrepancies. E.g. CS 1.25 to 1.24 in the dwg file is 56m, but total chainage between corresponding sections in DAT file is 45m. There is also a difference betwen 1.18 and 1.17 from a spot check. Action: Please check where new survey has been added that 1d chainage matches.	A comparison was made between the chainage measured in the .DAT file, and the 2019 survey and aerial imagery. The difference between sections 1.25 and 1.24 mentioned is due to the Smedley Road Bridge not being accounted for - the section downstream of the bridge was ammended to account for this. Chainage in the model between sections 1.18 and 1.17 was compared to aerial imagery and survey, and values were adjusted accordingly.
Conveyance: Generally smooth. A handful of sections have minor	Review sections and add panel markers as appropriate.	Completed – all addressed

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
"wobbles" in conveyance - IRKR01_3652, IRKR01_3520, IRKR01_1188A, MOST01_5900, MOST01_5892A, MOST01_5270, MOST01_4212A and MOST02_0000H.	MOST02_0000 has a conveyance issue at the higher end of flows but unlikely to impact results significantly. Action: Please investigate - the conveyance issue probably only affects the highest water level for the Q1000 flow but may impact out of bank flow.	Addition of panel markers to cross-section MOST02_0000 to improve conveyance
Review flow gauge: Gauge available within study area - Irk @ Collyhurst Weir (NRFA 69043). Not mentioned in reporting at all.	Make use of gauge data for both hydrology and validation of modelled flows.	Hydrology inflows scaled to match gauge records
Channel roughness: No mention of 1D roughness in the report.	Add detail on how roughness values were calculated, along with example photos of the channel to verify the values used. Thank you for clarifying, please summarise in future reporting for wider stakeholders.	Existing values appraised for appropriateness. Aerial photography and online images reviewed against the values noted in Chow tables. Added to reporting
Manning's n values: For many of the cross sections, we have bank roughness 0.06 and channel roughness 0.04. This is suspiciously close to usual survey values. For several other cross section, possibly from the 2019 survey (as the node label was a different format), several different values are used, very low values are used (0.015-0.020) and the channel roughness is significantly higher than the bank roughness. This need review and justification. Checked against the raw survey values and they are	Review all manning's values, describe and justify values in the reporting along with example photos. As above, please summarise in report e.g. range of values in different reaches. Proposed model Roughness has been increases where channel interventions include vegetation with a value of 0.1	Review of low roughness values was completed; these values appear to correspond to the location of walls lining the channel so Chow values, as documented in the Roughness Values tab in the EA model review spreadsheet document. No changes applied Roughness values of vegetated areas outside of boardwalks in the proposed model have been dropped to 0.07, as per Chow item 1g (normal).

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
the same, so suspicious that this was not checked during the baseline model development.	being selected. As per email discussion this is ok for some areas given the expectation for piers associated with walkways along with wooden stakes where vegetation is being held, and 0.1 would represent the obstruction to flow. However where the FMP cross section panel only includes vegetation, please consider carefully if in reality this vegetation will be dense to justify the high value. If not please undertake a sensitivity test. It would be appreciated if further detail could be provided in the report justifying the high roughness.	
Roughness estimation method: Unclear if any method has been used.	Describe the process for assigning roughness values in the reporting.	Aerial photography and online images reviewed and compared against the values noted in Chow tables
Inflows: Hydrological estimates, dated 2004, not updated for this hydraulic model. 1 flow time boundary at the upstream extent. 3 FEHBDY for lateral inflows on river Irk, 7 FEHBDY used as upstream and lateral inflows on Moston Brook.	As discussed previously, hydrology needs updating as considered very out of date.	Hydrology has been updated – 20 year, 100 year (including climate change allowances) and 1000 year events modelled; subsequent updates to be made in the next modelling exercise.
Downstream boundary: Downstream boundary taken from 2017 Lower Irwell hydraulic model. Applied as a head-time boundary, with peak matching Irk peak flow, although unclear if the peak inflow or water level just upstream of boundary is taken. Sensitivity testing show that the downstream boundary has limited impact upstream of culvert. This is stated in the reporting text, but results from	Confirm whether the peak matches the Irk peak inflow, the Moston Brook peak inflow, or the peak water level near to the downstream of the model. Reviewer would consider the latter option to be most appropriate. Present downstream boundary sensitivity test results in the report - both maps and long sections.	Downstream boundary taken from the Manchester Ship Canal 2018 model. As agreed with Nick Prebble on 15/12/2021: •The shape of the head-time boundary from the previous modelling stage will be retained •The shape will be scaled to match the peak stage from the updated Ship Canal model •The peak is shifted to match the peak on the Irk at the downstream boundary

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
sensitivity test not actually presented within the report. Mention of using the Manchester Ship Canal model for the downstream boundary data is included in the reporting in the Recommendations section, without being mentioned anywhere else in the reporting.	Confirm if the MSC model is required and add detail to the justification within the main report Please also confirm the return period used from 2018 model for the downstream boundary in reporting.	•The shape will be further scaled to cover 16hrs as opposed to the previous 10hrs •This approach will be revised for the full modelling exercise in the new year. Return periods varied for each run (i.e. 20yr used for 20yr), added to report
Missing structures (bridge and viaduct along the Irk): Checked FMP against 10km OS mapping. Two missing structures noted: - possible bridge downstream of IRKR01_3652 shown on OS map, cannot see in survey photos or satellite imagery. - viaduct downstream of IRKR01_2271. survey shows very high soffit and comment in model states no constriction to flow. What about piers?	Any structures not included in the model should be investigated and exclusion should be justified in reporting.	Unsure of first structure. Looks to possibly be pipes over the river given the industrial location. This would not be modelled. Conservative approach to omit so as not to underestimate flow travelling downstream to study area. Flow at 2271 is completely within channel for all AEPs
Invert levels of 1D structures: New survey (2019) checked for all structures. All match surveyed geometries with one exception - weir IRK_1.12wu where breadth of crest in model 19.427, surveyed 16.77. Comment says "Exponent adjusted to parabolic". Not sure what this means. Old survey (2003) checked for all structures. Minor discrepancies at:	Check and address comments for structures highlighted. If not changed, need full justification in reporting. NB - no one issue causes the "red" RAG status, but lots of smaller issues together does.	Completed: Weir in new survey amended Structures in old survey amended Note in existing model states – “RAIL VIADUCT AT IRKR01_2271- NOT MODELLED AS VIADUCT REPRESENTS NO CONSTRICTION TO FLOWS”. In the absence of survey to add in, and the nature of the

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
- IRKR01_2770D - modelled springing 36.94, rather than 36.69 surveyed - IRKR01_1903D - modelled soffit 32.5 rather than 31.69 surveyed - IRKR01_1788D modelled soffit 32.03 rather than 31.67 surveyed Other comments on Irk structures: - piers for viaduct downstream of IRKR01_2271 not represented in model. - bridge and upstream cross section widths should match. This was not the case for the following bridges - Irkr01_3311A, IRKR01_2814. IRK_1.16bu. IRK_1.09bu. IRK_1.04bu. - all weir structures have spills in the same location. No description what these spills are representing. - Culvert IRK_1.01cu very low Manning's (0.015). Did not have survey for Moston Brook so structures not compared to survey here. However, the following issues were noted: - Culvert MOST01_5712J - orifice unit instead of culvert inlet, no culvert outlet. Manning's 0.02 (low) - culverts starting atMOST01_5270J, MOST01_3820, MOST01_1349, MOST01_0605J, MOST01_0177 - manual topslot in culvert, roughness 0.01-0.015 (very low), no culvert outlet. - culvert at MOST01_4980A, MOST01_4268A, represented as orifice unit. Generally conduit units preferred.	2019 survey suggests IRK_1.12wu starts at 0.27m and finishes at 22.6, giving a breadth of 22.33. Comment in survey states section observed along crest (not perpendicular), so does this account for the	surrounding topography, it's believed the flows are well represented here U/S of bridges or bridges amended so they match Spill at weir at IRK 1.23 shortened to represent the RB flow. Spill at IRK_1.18 removed Culvert at IRK_1.01cu Manning's n unchanged as brick closed conduit. 0.015 is appropriate based on roughness tab in this doc Inlet and outlet added to MOST01_5712J - roughness not changed, appropriate Culvert outlets applied to MOST01_0605J and MOST01_0177. Topslots in all added for stability Breadth of weir in section IRK_1.12wu increased to 22.33, from survey. Addition of culvert outlets on all Moston Brook culverts will be run as a sensitivity test at the next stage of modelling.

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
- stability spills used, not necessarily unacceptable, but needs highlighting in report.	curve shape? Please clarify since breadth of 21.3m is used in the model. Irk bridges look OK now - no action. Regarding IRKR01_2271, a photo is evident within Appendix D of the Irk 2004 data which indicates no piers enter the channel. No action. U/S width issues at bridges resolved. No action. Weirs/spills ok .No action. IRK_1.01cu accepted. No action. Acknowledged that some Moston Brook culverts now have outlet units, but others still don't have outlets. Confirm if this was intention and how any outlet losses can be accounted for. General comment requested such details in the report in the original review comment.	
Orifice flow on surcharging bridges: The following bridges surcharge with orifice flow not enabled: IRKR01_2770A, IRKR01_2464A, IRKR01_2123D, IRKR01_2024D, IRKR01_1930D, IRK_1.09bu, IRK_1.04bu, IRKR01_0685D, MOST01_5892D, MOST01_4212D	Enable orifice flow for the sections highlighted. If this is not suitable, justification is required in the reporting.	Completed – orifice flow enabled on all noted
Spill coefficients: Range of different spill coefficients (1.0 to 1.5) used for in line spills and overtopping spills. For example,	Review spill coefficients and ensure consistent across study area. Justification for values used should be included in reporting.	Spill at HMG paints reduced to 1.0

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
spill IRK_1.20su represents overtopping of bridge at HMG Paints site where the spill level is at windows. However, the spill coefficient used is 1.2 (default). A lower spill coefficient should be considered. All spill coefficients require justification.	Reduction at HMG Paints location is appreciated, but the wider point of justifying the coefficients is expected in model report. Values may be inherited from older models but judgement should be used in ongoing appropriateness.	Spill coefficients in the model were reviewed, and updated where necessary. Justification of spill coefficients added to the model report.
Non-default run parameters: Several parameters have been changed from default. These include: Dflood = 15 (default 6), Qtol = 0.001 (default 0.01), Maxitr = 47 (default 11), Dfloodb = 15 (default 10), Matrix dummy coefficient = 1E-6 (default 0),	Investigate the extent to which these parameters can be relaxed to their default values. If not, then justify the non-default values used in the reporting.	DFlood set to 3m for 20yr, 6m for 100yr and 100yrCC and to 8m for 1000yr – required for model to run. Dfloodb required to remain at 15 for all runs. Model doesn't initiate without it. All other parameters set back to default.
Grid size sensitivity: Was a smaller grid cell size considered? Was a sensitivity test with a smaller grid cell size undertaken to ensure that all flow routes in the urban area are represented with 4m grid?	Confirm whether a smaller grid cell size was considered and tested. Ideally, we would ensure that all flow routes are represented by completing a sensitivity test.	Given the industrial nature of the land. 4m would be sufficient for this exercise. SEN tests will be performed on cell size for the main modelling exercise in 2022
DTM rotation: Flood plain flow predominantly NE-SW.	Consider rotated DTM and grid to better represent flow routes.	Not addressed at this stage. A full suite of SEN runs will be completed for the main modelling exercise
Building representation: "Stubby buildings" approach used with 0.3m added to all building footprints. Several building polygons do not match with full building footprint as seen on OS mapping - see figures below with purple showing 2d_zsh_building_threshold_FMT_NorthernGateway	Ensure that all buildings are represented, including their full footprint. The combination of two 2d_mat layers appears to provide acceptable coverage. However for the '2022' model we recommend fully updating the floodplain with Mastermap land use with one single mat layer. (consider this item as GREEN colouration)	Completed – buildings now represented The 2d_mat layers will be combined at the next stage of modelling. Figure 8 shows plots, not buildings; each of these plots will have future modelling for individual planning

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
_007_R.shp. It looks as if the polygons were cropped to the previous domain boundary, but have not been reinstated for a larger 2D domain.	Regarding the proposed buildings, a 2d_mat_Buildings layer has been used but only represents three buildings. Looking at Figure 8 of the report there are several more buildings. Confirm if all the other buildings as part of the design should have been included in the additional shapefile. Also just a general query from Figure 9 is that the proposed buildings appear to give significant (up to 4m) reduction in ground levels, is this correct?	permissions. Only the ones included in the model now are applicable to this application
Defences/embankments/banks: Zlines and points representing bank crests, based on surveyed cross section extremes. TGC also states that additional points were taken from the LiDAR used. It is unclear which are surveyed and which are from LiDAR. Z line read in as THICK as appropriate. In some locations, there are buildings right on the bank. It is unclear how the bank crest elevations tie in with the building polygons. More justification is required here to explain the representation of the buildings in the model.	More careful thought needs to be taken on how buildings on the banks have been represented. Currently it does not appear that the bank crest elevations used tie in with the building thresholds. This will have a significant effect on flow paths through and near to the buildings. A check of 2d Z points against 1d bank limit reveals poor match up in places. Action Amend or explain the 1d-2d bank elevation differences. These have been primarily checked through the proposed VN development site reach but may be apparent elsewhere. Risk of early or late spilling from 1d to 2d.	Completed: Survey shows where buildings are. These levels have been used in the river bank levels. Anything past Queens Road that is not on a cross-section has been taken from LiDAR (generally if it's to 3dp it's from LiDAR). These are to be separated out to a separate file to avoid confusion. While a mismatch between 1d and 2d bank levels will have no implication on model results, 1d sections were trimmed where possible to better match to the 2d bank levels. In some cases, for instance section 1.04u, the difference remains as the surveyed cross-section does not contain a wall, which is represented by surveyed levels along the right bank (and so the wall is included in the 2d rather than 1d domain)

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
	E.g. IRK01_0564 right bank 31.13m in 2d, 33.76m in 1d. (it is acknowledged here that extreme events are kept in bank) IRK01_0676 right bank 30.38m in 2d, 30.765m in 1d, Q1000 max water level 30.551m. IRK_1.04u right bank 31.32m in 2d, 30.12m in 1d, Q1000 max water level 31.907m. IRK01_1188B 1d-2d match up correct in baseline with 31.59m on right bank, but in 2d proposed Z point it is 29.8m. IRK_1.07 1d-2d match up in proposed model is correct but in baseline model the 2d elevation on the right bank is 29.67m. IRK_1.10 1d-2d match up in baseline model is correct at 30.05m but in proposed model the 2d elevation on the right bank is 29.27m. IRK_1.11 the left bank 32.39m in 2d, 30.48m in 1d, Q1000 max water level 32.38m.	
Methods to estimate 2D roughness areas: Assumed to be Manning's n roughness values attributed to mapping polygons	Clarify in the reporting how roughness values have been chosen. Outstanding action for improved reporting.	Manning's n values attributed to polygons using .TMF. Will be updated in corresponding reporting. Added to reporting
Representation of different 2D roughness areas: As with 7.8, the previous model's polygons do not match the 2D domain boundary.	Use up to date mapping to create polygons for 2D roughness across all of 2D domain.	Completed – in the absence of OS MasterMap of the area upstream of Queens Road Bridge, roughness polygons

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
Up to date mapping has been used for roughness near to the Victoria North study area. Is there a reason why this wasn't extended over the entire 2D domain?	Just to confirm, is the OS Open Map use due to the lack of availability of MasterMap? If so action for Item 7.8 can be discounted.	were updated based on OS Open Map – Local, and satellite imagery upstream of Queens Road Yes. OS MasterMap will be used at the next stage - OpenMap was used here as it was considered to be proportionate to the interim 2021 work
Defence representation: According to EA AIMS database, there is an EA maintained flood risk management wall near to Vale Park Industrial Estate (asset number 78624). Unclear if this has been represented in the bank crest elevations used.	Ensure that this defence has been represented appropriately. If a flood map update is required, then an undefended model scenario should be developed.	Wall is now explicitly represented in the model, using 2d_zln and 2d_zpt features, with location and levels from received EA AIMS data
1D/2D links: FMP and TUFLOW coupled using 2d BC HX lines along the bank crests as appropriate. Some HX missing between MOST01_0653 to MOST01_0605, MOST01_5087 to MOST01_4789, left bank upstream of IRK_1.01u, and left bank from IRK_1.01cud to IRKR01_0.564. Some 2D spills only have HX line on upstream/downstream, for example IRKR01_3311 doesn't have a spill on the upstream.	Justify missing HX lines, and as far as possible, add HX lines to connect 1D and 2D domains at locations highlighted. Justify representation of 2D overtopping using HX lines.	Completed: Sections on Moston Brook removed for stability and the 1D section extended. These exist in an isolated valley section so would have no meaningful impact elsewhere on levels or extent. Sections on River Irk relate to the left bank wall of the rail bridge overpass, that would never overtop in any event, were omitted from the existing EA model and left out for this study too. IRKR01_3311 already has a spill on u/s and d/s
1D/2D channel widths: A sample of cross section widths were compared to 2D river representation widths: 1d 2d Diff IRKR01_4091 - 28.12 - 28.60 - 0.48	There are some large differences between 1D and 2D widths in the sample of sections checked. These include IRK_1.25, IRKR01_1878, IRKR01_0627, MOST01_4950 and MOST01_0645.	Completed: Amendments made to the following sections to ensure they match between 1d and 2d: IRKR02_0229E, IRKR02_0000H, IRKR02_0000I, IRKR01_3876, IRKR01_3822, IRKR01_3652, IRKR01_3520, IRKR01_2464E, IRK_1.22,

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
IRKR01_2888 - 19.16 - 20.42 - 1.26 IRKR01_2612 - 29.07 - 32.88 - 3.81 IRK_1.25 - 27.31 - 26.21 - 1.1 IRK_1.21 - 24.90 - 34.72 - 9.82 IRKR01_1878 - 10.10 - 14.78 - 4.68 IRKR01_1449 - 22.64 - 20.31 - 2.33 IRKR01_0627 - 17.13 - 08.84 - 8.29 MOST01_6250 - 15.80 - 13.80 - 2.00 MOST01_5850 - 12.26 - 10.95 - 1.31 MOST01_5300 - 09.02 - 10.16 - 1.14 MOST01_4950 - 57.20 - 08.80 - 48.4 MOST01_4500 - 12.02 - 10.48 - 1.54 MOST01_3830 - 21.45 - 22.11 - 0.66 MOST01_1400 - 39.16 - 41.65 - 2.49 MOST01_0645 - 25.00 - 11.25 - 13.75	All cross section widths need to be checked and corrected. The current version of the model is an improvement for 1d-2d widths but some issues still remain - see screenshot to the right. The tolerance for the comparison has been set at the 2d grid size so please address where discrepancies remain, especially where the difference is more significant.	IRKR01_2419, IRKR01_2360, IRK_1.21, IRKR01_2123E, IRK_1.18d1, IRK_1.18d2, IRKR01_1930A, IRKR01_1878, IRKR01_1826, IRKR01_1810B, IRK_1.14, IRK_1.13, IRK_1.13u, IRK_1.11, IRK_1.09u, IRK_1.08d, IRKR01_1293, IRK_1.07, IRKR01_1188A, IRKR01_1188B, IRK_1.06 The 1d-2d widths in the baseline and proposed works models were altered for the nodes identified in the screenshot to the right to provide a better match in channel widths
Water level lines: WLL lines used although missing at some 1D nodes, therefore coverage looks patching - see figure below.	Add WLL lines at all 1D nodes to ensure full coverage. There appear to be a number of cross sections not included in the 1d_x1d_nodes layer e.g. IRKR01_0027, IRKR01_0030I, IRKR01_0030H, IRKR01_0627A, IRKR01_0685E, IRKR01_0685D, IRK01_1188A, IRK01_1778A, IRKR01_2204A, IRKR01_2529A, IRKR01_2603E, IRKR01_2770A, MOST02_0000H, MOST02_0000 (confluence with the Irk).	Completed – added throughout After discussion with Nick (07/02/2022) updates were made to the water level lines in the baseline and proposed models to "fill in" the channel in 2d results. Missing nodes also added.

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
	Action: please include or explain absence.	
1D Comments and warnings: zzd checked for Q1000 event. The following warnings and errors: W2054 - urban extent not recommended to exceed 0.5. this is related to hydrology and will likely change with a hydrology update. W2302 - Time to peak is not an integer multiple of the data interval. this is related to hydrology and will likely change with a hydrology update. W2532 - model start time is not t=0. Why is the start time not t=0? W2044 - different values for Manning's n encountered within one panel add panel markers at locations highlighted. W2238 - panel at offset has very small width. Review cross sections highlighted. W2229 - value of trash screen height is set to 0, areas will be calculated using piezometric head. This warning can be ignored.	Review warnings and make updates as appropriate. W2010 - poor interpolation W2044 - mannings +/- 20% W2238 - panel at offset has small width. (This appears to be at locations where the section is small due to a wall bordering the channel). W2229 - trash screen height set to 0 W2262 - backflow encountered at culvert outlet. (This is evident at most of the culvert units undernath Victoria station, where the influence of the Irwell boundary causes negative flow early in the simulation). W2204 - Bridge downstream of IRK_1.04bu is surcharged. (Orifice flow is enabled here). W2058 - convergence issues. These warnings are not judged to be significant enough to impact results, but please include a section in the main report detailing the issues.	Modelling/hydrology updated so original warnings not relevant. Updated model checked and warnings addressed where possible. Added to the reporting - after model has been run with updates

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
W2204 - bridge downstream of XX is surcharged. Afflux calculation may be inaccurate. Review this location. W2205 - extrapolating base curves, base coefficient may not be reliable. Review this warning. W2058 - model convergence criteria were not met for one or more timesteps during the run. Review model stability. W2019 - water level rose beyond the max level of the section data. 1D domain connected to 2D, therefore this warning can be ignored.		
1D convergence: Some non-convergence related to culverts surcharging. See Q1000 bitmap below.	1D stability could be better in terms of convergence. Investigate how much improvements can be made. Include a section in reporting describing model stability and any measures undertaken to reduce instability. There are oscillations in Q1000 flow and stage that begin around the vicinity of IRK_1.17 and continue quite markedly through the upstream reach of the proposed VN development site, with peak flow oscillating in the order of 0.5-1m. Given the proximity to development and the uncertainty this brings around peak flow, the stability needs to be improved or at least demonstrated to not have an impact on results. It is our view that some of the peak stage results in Table 1 of the report may be too	Increase of boundary viscosity factor to 3 in the 1000yr event. Testing around the use of roughness patches carried out to attempt to slow cyclical flow patterns seen in the 1000yr events. Oscillations in flow and stage in the 1000yr event are due to circulation of flow in the floodplain (screenshot to the right shows oscillations in the baseline event).

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
	high given oscillating peak stage spikes and are therefore unreliable.	
1D/2D instability: Some visible instability in long section water level animation near to IRK_1.13u and MOST01_0605J.	Look at stability measures near to areas highlighted. Include a section in reporting describing model stability and any measures undertaken to reduce instability. Dvol appears to be more unstable compared to previous submission, see screenshot to the right. Please improve the oscillating nature of the signature. Can you please expand on the review response? dVol signature for several events still appears jumpy and discussion has not been provided in the reporting.	Increase of boundary viscosity factor to 3 in the 1000yr event. Testing around the use of roughness patches carried out to attempt to slow cyclical flow patterns seen in the 1000yr events. Initial conditions have been redefined to reduce the cases of poor model convergence at the start of the model run which were associated with the culvert at the downstream extent of the model. Orifice transitions have been added at IRK_1.04bu and IRKR01_2770D to remove instances of poor model convergence associated with rising and falling water levels reaching the soffit of the structures. Embankment markers have been added/adjusted at structures IRKR01_2770D, IRKR01_2603D and MOST01_5892D to improve model stability. Boundary Viscosity Factor == 3 command has been activated for all modelled events. Previously this was only set for the Q1000 event.. Improvements to the dVol curves for the baseline and proposed scenario during the 100 year 2080 event are shown in XLS file.

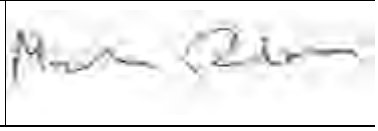
EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
2D Comments and warnings: Warning's from Q1000 tlf. W0305 - Projection of .shp file is different to that specified by the SHP Projection == command. Minor, ideally projections should match for all model files. Warning 2218 - Manning's n value of 1 for Material 2 is unusually low or high. Represented buildings, accepted although ideally would be ~0.3. Warning 2236 - XF file is an old version or wrong format. XF file not read. Warning 2235 - Unknown error reading XF file [Loc C]. XF file not read. Investigate these warnings. Warning1317 - WLL does not cross (2 point WLL only) or snap to 1D channel See comment 12.4.	Review warnings and make updates as appropriate.	Model and hydrology updates changed warnings slightly Water level lines causing Warning 1317 were edited/removed where necessary Building representation using Manning's n value of 1 retained
Calibration: Calibration runs have not been completed. It is unclear whether any previous historic flood event data is available.	Investigate any previous flooding and data there may be available. Clearly state whether calibration or verification was possible in the reporting. Confirm whether any updates have been made to reduce uncertainty in the modelled outputs.	To be investigated for the full modelling exercise in 2022. Flows scaled to gauge records at Collyhurst Weir Updates were made to the schematisation of Collyhurst Weir to produce a better calibration

EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
It is unclear if any changes have been made to the model in response to validation or verification of outputs.		
Comparison of hydrograph peaks: There is a gauge in the modelled study reach. No comparison between modelled and recorded peaks has been included.	Compare modelled and gauged data to increase confidence in modelled results.	Flows scaled to match gauge records at Collyhurst Weir
Sensitivity testing: Some sensitivity test model files and outputs have been provided, although it is unclear which tests have been undertaken. The report mentions a downstream boundary sensitivity test, however, the results are not presented in detail. In the absence of any previous flood event information, sensitivity test are more important to understand uncertainty of modelled outputs.	Add a sensitivity test section to the reporting and describe and present the outputs from the sensitivity tests undertaken.	A full suite of model sensitivity tests will be completed for the next stage of modelling, in 2022
Confidence limits: Not provided	Comment on model uncertainty limits in the reporting. Please ensure this is undertaken at any modelling stage.	Confidence limits will be calculated for the next stage of modelling in 2022. Initial findings from sensitivity tests on roughness, downstream boundaries and inflows are shown in the full model comments and review log.

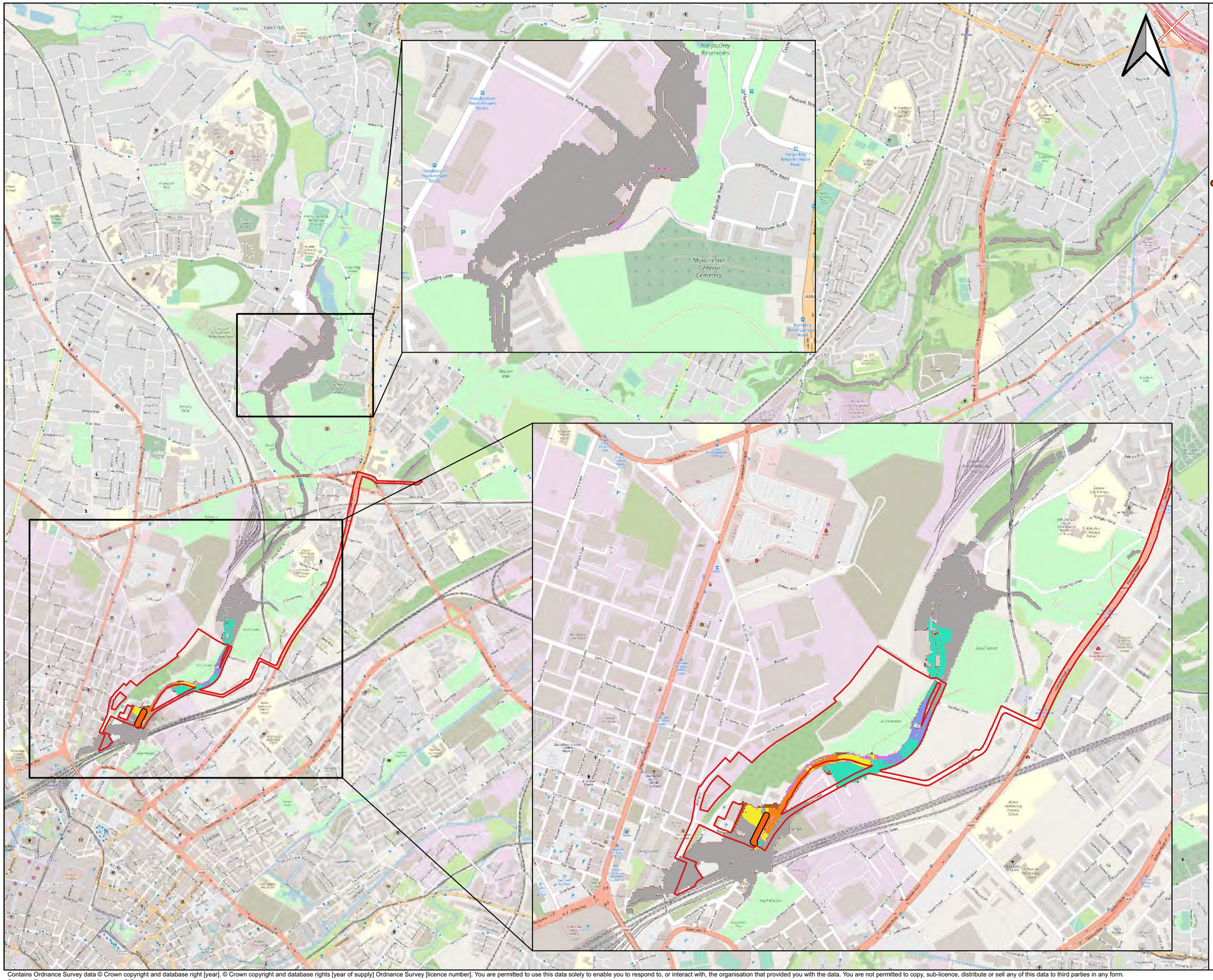
EA Model Review Comments	EA Model Review Actions	Addressed in the HIF Infrastructure Assessment model?
Audit trail comments: Not obvious what sensitivity tests were undertaken. Majority of comments in the 1D dat file are out of date (from the previous model). Model history was not detailed in the model log. Report quality is ok, focusses a lot on the outputs, but little detail on model decisions and justification, calibration/verification/sensitivity testing, or model stability.	Update comments. Add model history to log. Add detail on model performance to the reporting. Comment on accuracy of model and its ability to represent reality. Add detail in response to issues raised in this review. Several issues in the review could have been resolved with better reporting. The technical note received was very useful for the specific discussion of application stage 2 proposals but was still limited in the wider modelling detail.	Updates will be made to corresponding reporting Reporting was updated based on the changes made in response to this review

Table 7 - Hydraulic modelling review commentary. Updated to include EA comments received in January and March 22, and the Arup responses in February and Mar 22.

DOCUMENT CHECKING (not mandatory for File Note)

	Prepared by	Checked by	Approved by
Name	Louise O'Regan / Emma Cecil / Rob Parry	Rob Parry / Tom Saville	Mike Wilton
Signature	R Parry		

Appendix B – Extracted figures from flood model



Legend

Proposed vs Existing - Impact (m) 100yr with Bund

- < -0.1m
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.1
- > 0.1
- Reduced Flood Extent
- Increased Flood Extent
- Proposed Flood Bund
- Red Line Boundary

Notes:
1. Flood extents are based on Existing Condition 2021 Interim Hydraulic Modelling using Precautionary Approach Hydrology.
2. To be read in conjunction with Technical Note VNIF-ARP-ZZ-RIV-RP-DF-0002

ARUP

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Victoria North River and Flood Alleviation Works

0 100 200 300 400 500

Metres

Proposed vs Existing - Impact (m) 100yr with Bund

Drawing Number

Scale at A3
1:18,000

Arup Job No	Drawing Status
281943-02	**DRAFT**

Rev	Author	Check	Approve
001	**RP**	**TS**	**TS**

13/04/2022 10:56:58

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13/04/2022 10:55:24

Legend

Proposed vs Existing - Impact (m) 100yr+CC (2080) with Bund

- < -0.1m
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.1
- > 0.1
- Reduced Flood Extent
- Increased Flood Extent
- Proposed Flood Bund
- Red Line Boundary

Notes:
1. Flood extents are based on Existing Condition 2021 Interim Hydraulic Modelling using Precautionary Approach Hydrology.
2. To be read in conjunction with Technical Note VNIF-ARP-ZZ-RIV-RP-DF-0002

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Victoria North River and Flood Alleviation Works

0 100 200 300 400 500

Metres

Proposed vs Existing - Impact (m) 100yr+CC (2080) with Bund

Drawing Number

Scale at A3
1:18,000

Arup Job No	Drawing Status
281943-02	**DRAFT**

Rev	Author	Check	Approve
001	**RP**	**TS**	**TS**

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Legend

Proposed vs Existing - Impact (m) 100yr+CC (2080)

- < -0.1m
- -0.1 to -0.05
- -0.05 to -0.01
- -0.01 - 0.01
- 0.01 - 0.05
- 0.05 - 0.1
- > 0.1
- Reduced Flood Extent
- Increased Flood Extent
- Red Line Boundary

Notes:
1. Flood extents are based on Existing Condition 2021 Interim Hydraulic Modelling using Precautionary Approach Hydrology.
2. To be read in conjunction with Technical Note VNIF-ARP-ZZ-RIV-RP-DF-0002

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0 100 200 300 400 500

Metres

Proposed vs Existing - Impact (m) 100yr+CC (2080)

Drawing Number

Scale at A3
1:18,000

Arup Job No	Drawing Status
281943-02	**DRAFT**

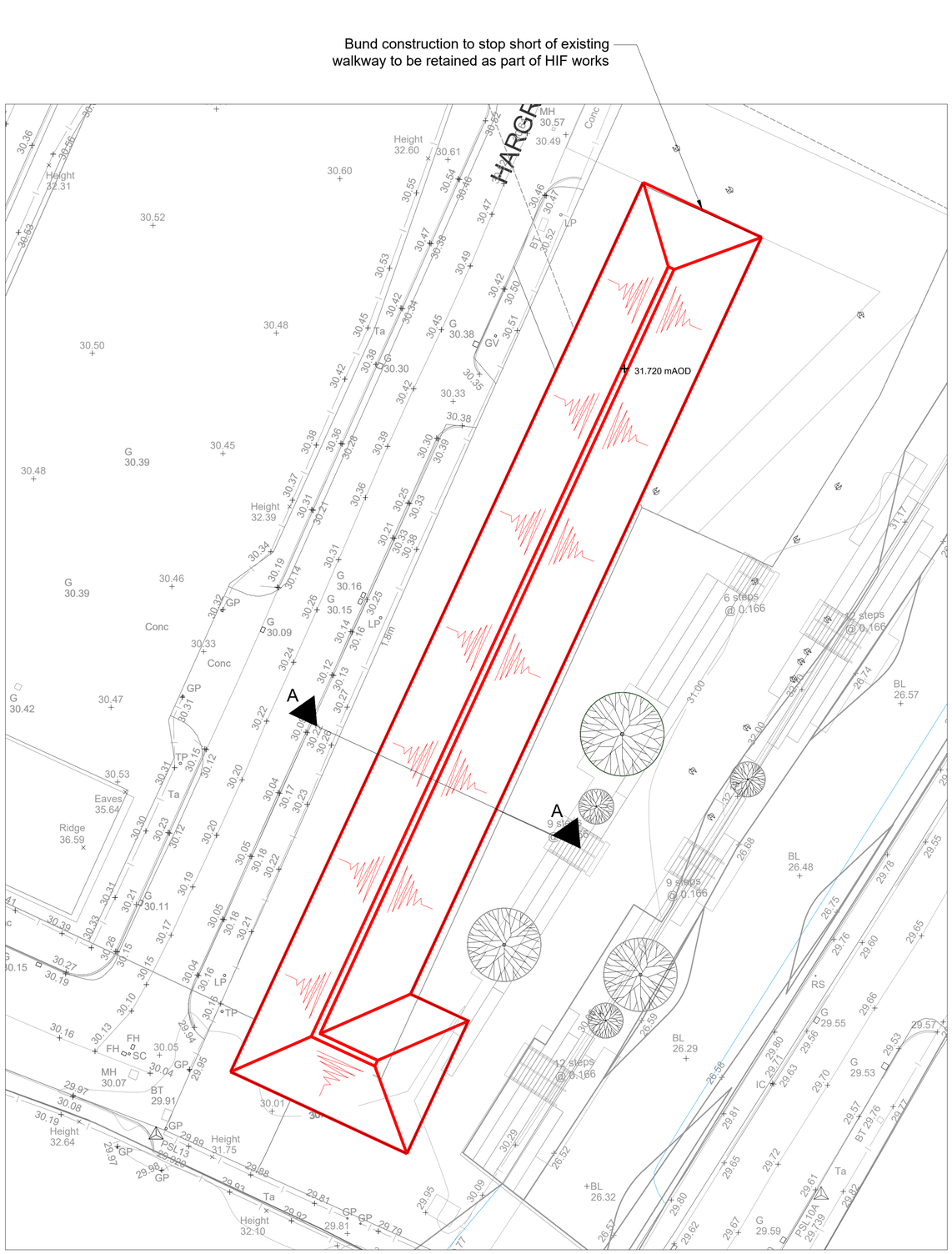
Rev	Author	Check	Approve
001	**RP**	**TS**	**TS**

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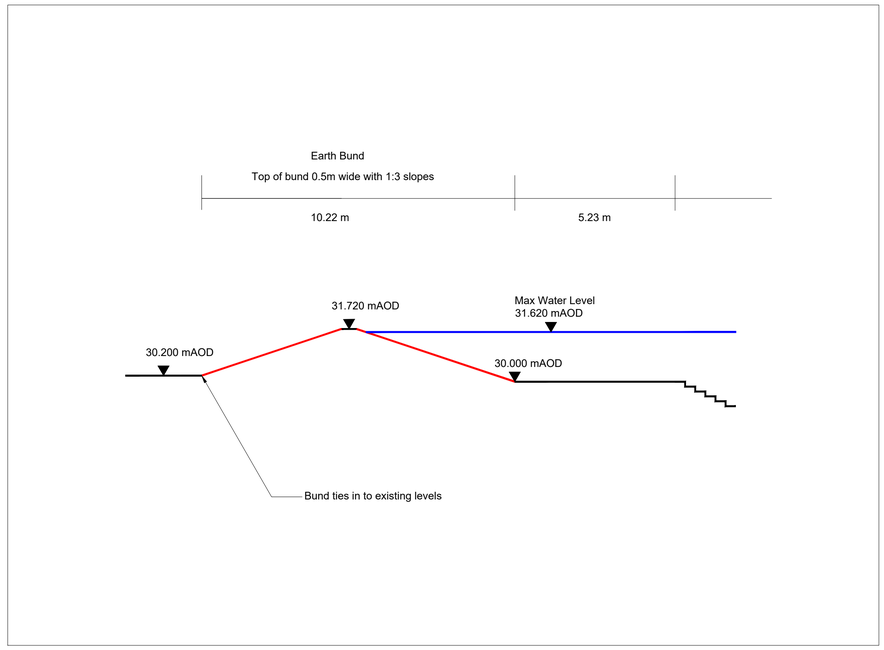
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Appendix C – Proposed mitigation bund drawing

A1



Bund Plan View
1:200



Section A-A
1:100

Notes

1. To be read in conjunction with all relevant project drawings and specifications.
2. Do not scale from this drawing or the digital data. Only figured dimensions are to be used.
3. All dimensions are in millimetres (mm), unless noted otherwise. All elevations are in metres above ordnance datum (mAOD), unless noted otherwise.
4. Bund to be constructed from site won material and to remain in position until river works have been fully undertaken.
5. This drawing has been issued for informative purposes within the Flood Risk Assessment document only. This drawing shall not be used for any other purposes.

Key

Proposed Bund

N

0 1000 2000 3000 4000 5000 mm
SCALE 1:100

0 2 4 6 8 10 m
SCALE 1:200

Rev	Date	By	Chkd	Appd
P02	10 /03/22	ES	DH	RG
Updated to reflect hydraulic modelling				
P01	10 /02/22	AM	DH	RG
Issued for Information				

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Client
Manchester City Council
BAM

Project Title
Victoria North HIF Infrastructure and Enabling Works

Drawing Title
Bund Location and Details

Scale at A1: As shown
Role: Civils
Suitability: - S2- For Information
Arup Job No: 282022
Rev: P02
Name: VNIF-ARP-00-YYY-SK-CE-0001

Do not scale

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Appendix D – HIF Infrastructure Drainage Strategy

Manchester City Council

Victoria North HIF

Drainage Strategy

VNIF-ARP-ZZ-YYY-RP-CD-0003

P03 | 18 February 2022

This report takes into account the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 282022

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Document verification

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Job title		Victoria North HIF		Job number 282022
Document title		Drainage Strategy		File reference
Document ref		VNIF-ARP-ZZ-YYY-RP-CD-0003		
Revision	**Date**	**Filename**	VNIF-ARP-ZZ-YYY-RP-CD-0003 - Drainage Strategy.docx	
P01	17 Dec 2021	Description	First draft	
			Prepared by	Checked by	Approved by
		Name	Drew Hunter/Emily Stoddart	Ryan Griffiths	Michael Wilton
		Signature			
P02	28 Jan 2022	Filename	VNIF-ARP-ZZ-YYY-RP-CD-0003 - Drainage Strategy.docx	
		Description	Issued for Planning	
			Prepared by	Checked by	Approved by
		Name	Emily Stoddart/Drew Hunter	Ryan Griffiths	Michael Wilton
		Signature			
P03	18 Feb 2022	Filename	VNIF-ARP-ZZ-YYY-RP-CD-0003 - Drainage Strategy.docx	
		Description	Updated for Planning	
			Prepared by	Checked by	Approved by
		Name	Emily Stoddart/Drew Hunter	Ryan Griffiths	Michael Wilton
		Signature			
P04	27/04/22	Filename	VNIF-ARP-ZZ-YYY-RP-CD-0003 - Drainage Strategy.docx	
		Description	Updated for Planning	
			Prepared by	Checked by	Approved by
		Name	Drew Hunter	Ryan Griffiths	Michael Wilton
		Signature			
			Issue Document verification with document		✓

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1 Introduction

Arup have been commissioned by BAM on behalf of Manchester City Council (MCC) to provide design services for the 'Design and Build' Infrastructure Works for the Victoria North HIF[1] masterplan (see Figure 1). This is funded under Homes England for the development of a 14.3ha site within the Lower Irk Valley in Manchester. Infrastructure works are being carried out to support a subsequent residential led development being planned for Victoria North by a Joint Venture between MCC and FEC. This development is part of a wider Victoria North masterplan redevelopment to the North of Manchester centre. This report provides an overview to the Drainage Strategy to be inputted into the Environmental Impact Assessment, the Planning Application and the Stage 3 report.



Figure 1 Proposed Victoria North Masterplan

2 Site overview

2.1 Site description

The Site comprises an area of circa 14.3 hectares within the Lower Irk Valley, predominately within the Red Bank and New Town neighbourhoods, which form

[1] Housing Infrastructure Funding

part of the extended Manchester City Centre. The Site location and proposed redline boundary is provided in Figure 2.

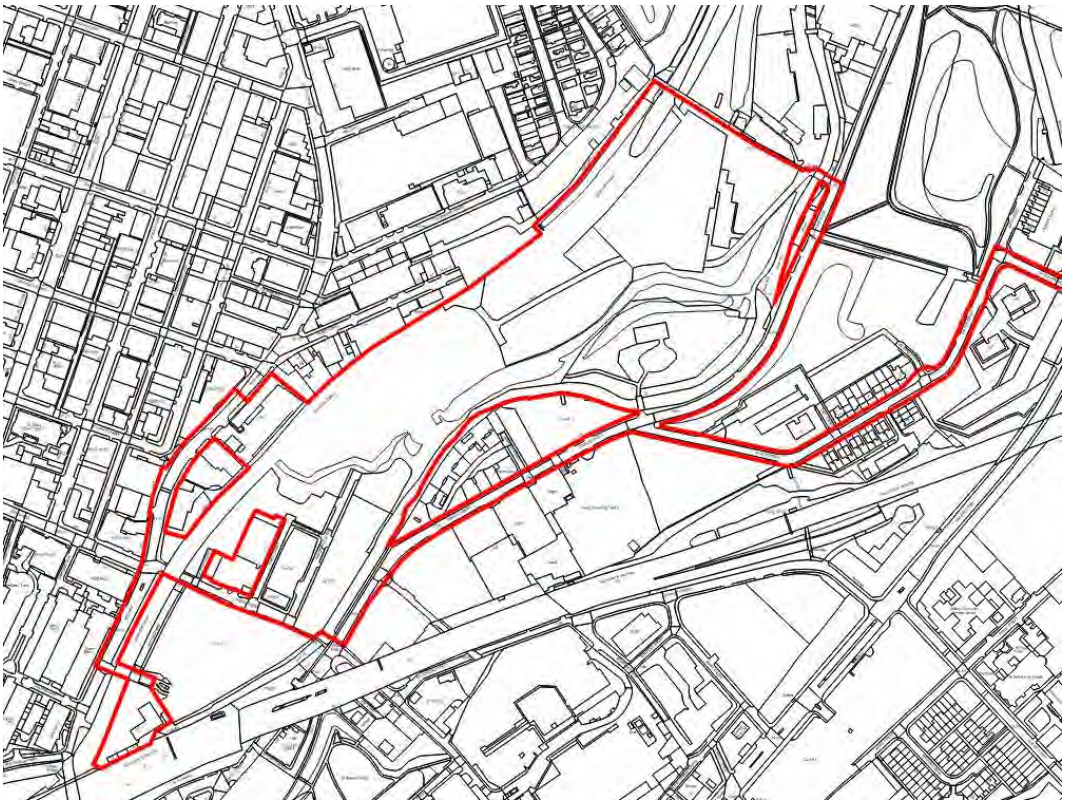


Figure 2 Victoria North site location and boundary

The site comprises features that represent more than 150 years of industrial history and infrastructure. Features include; modified waterways, significant operational and redundant rail infrastructure, utilities infrastructure and contaminated sites associated with textile manufacturing and other heavy industries. These features may present constraints and influence future development proposals.

2.1.1 Historic development of the Victoria North masterplan area

Development of the site is shown on the earliest available Ordnance Survey maps (c. 1850)[2]. At that time, areas to the south of the River Irk had been developed for housing, with several larger industrial premises shown. The railway viaduct outside of the site boundary to the south (that remains active today) is shown on this earliest map. North of the river, the eastern half of the site was largely undeveloped in 1850, however, the western half of the site contained both residential and industrial properties. A mill race is identified to the north of the river, serving several mills.

Industrial development continued across the site throughout the second half of the 1800s, often displacing areas of housing. Most notably this development involved

[2] Groundsure (2017) Northern Gateway EnviroInsight Report.

the construction of extensive railway sidings and rail infrastructure across previously undeveloped areas of the site north of the river (in the NW area of the site). These were connected to Victoria Station by a railway viaduct (Red Bank) along the southern part of the western site boundary. The need for level ground for this rail infrastructure led to extensive cut and fill operations across the area north of the River Irk, with the infilling of a former meander bend on the river and the eastern section of the mill race.

The various maps and aerial photographs that are available show that industrial activity has continued to the present. Rail infrastructure at the site continued to expand until the 1940s.

2.2 Scope of works

2.2.1 Victoria North HIF infrastructure works

The masterplan for the Victoria North Works RIBA Stage 3 review is presented in Figure 1. The Infrastructure works comprise preparation of the existing landscape for the development of new plots, to be accessed by new and existing highways. Existing access points will be maintained across the River Irk, one additional bridge is also proposed. The works also include development of a central park area.

The proposed drainage strategy for the Infrastructure Works will take account of connections and diversions of existing drainage infrastructure required for the future development of the plots within the site.

The joint venture (MCC/FEC) have stated an aspiration for a net zero carbon development for the Victoria North masterplan in line with MCC strategy on sustainable development and carbon management. It should be noted that the HIF Victoria North Infrastructure Works delivery is aiming to be carbon positive due to the nature of the work and will only be 'part' of the wider environmental strategy of the Victoria North Masterplan (an overall net zero carbon target).

2.2.2 River works

As part of the HIF scheme, there is a separate commission which includes works to the River Irk with the aim of reducing flood risk and increasing the water quality of the river. These works are being delivered under a separate project and are not covered in this report. However, there are multiple interfaces between this project and the infrastructure scheme, as all surface water is proposed to drain directly to the River Irk. Coordination with the river works team is ongoing to ensure that an integrated drainage strategy is achieved between both work packages. The extent of the river works scheme is shown in Figure 3.

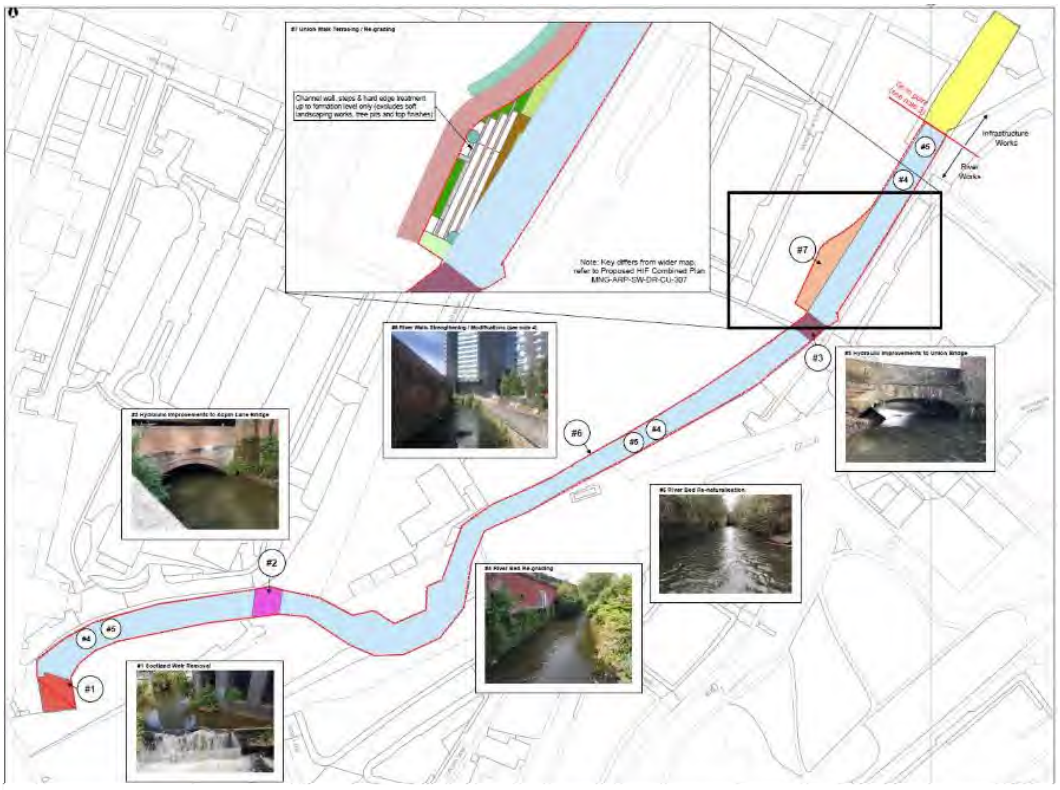


Figure 3 River Works scope as defined by the HIF river works package

3 Existing Drainage

3.1 Combined sewer network

The existing network within the HIF Red Bank and New Town areas consists of combined sewers with overflows into the River Irk. The site sits within multiple existing drainage catchments as identified in the site wide drainage strategy (MNG-ARP-SW-FN-GX-0008). Drawing VNIF-ARP-ZZ-YYY-DR-CD-0001 in Appendix A shows the existing catchments.

The existing drainage network on site consists of combined public sewers, owned by United Utilities who are the statutory undertaker. The features of the existing network have been identified from statutory records provided by United Utilities, these are summarised below and shown on Figure 4:

- 380x480mm box culvert, circa 5m deep and flowing South beneath Red Bank at the North of site
- 1500mm diameter sewer pipe, circa 5m deep and flowing South beneath Dantzic street at the South of site
- 550mmx640mm box culvert, circa 5m deep, flowing South running through the centre of the site, with an overflow into, and passage under the River Irk. There is a storage tank at the head of this culvert
- A small network of sub-carriageway box culverts between Brighton street and Hargreaves street, circa 3m deep, ranging from 375mmx500mm to 550mmx750mm in cross section

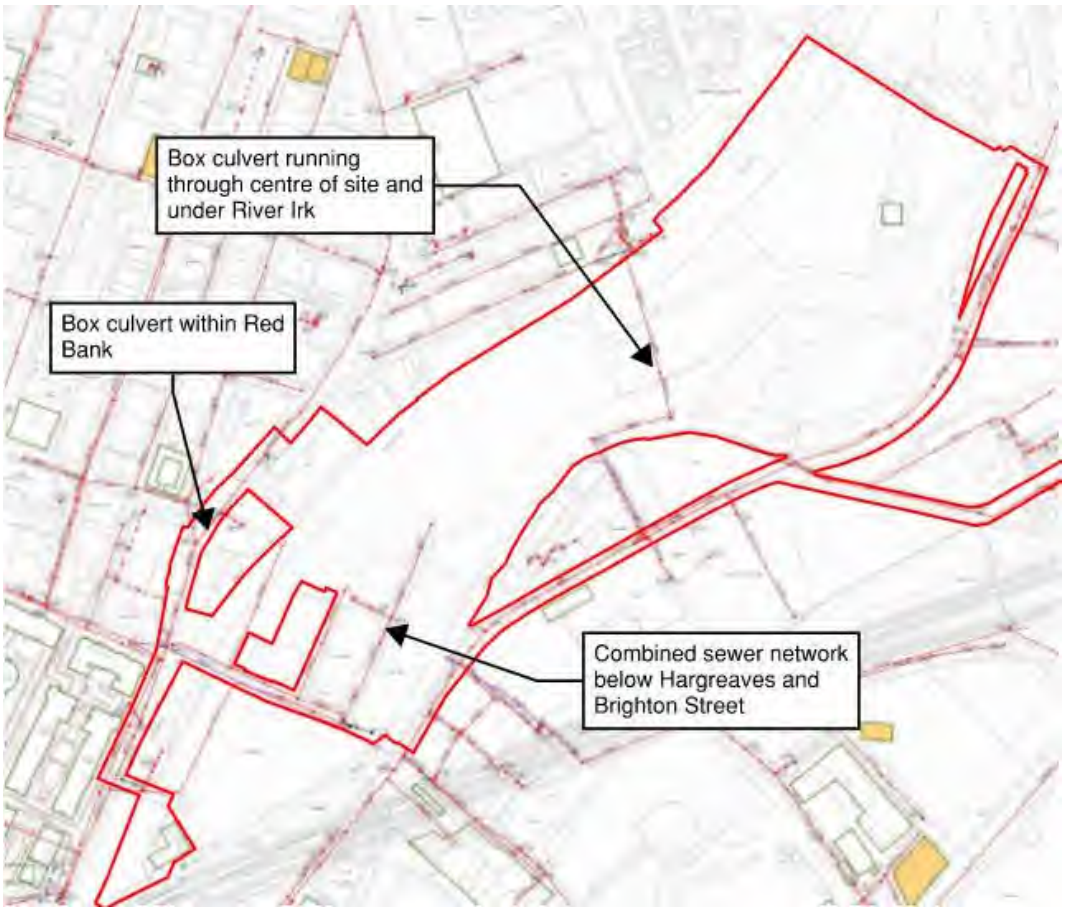


Figure 4 Existing sewer networks

There are several Combined Sewer Overflows (CSOs) to the river within the site boundary, these act as strategic contingency overflows when the capacity of the connected sewer is surcharged in periods of extreme precipitation or due to back-up from blockages. These prevent flooding from sewers in populated areas and can prevent damage to the sewer network and allow efficient design of sewers. The CSOs on the Victoria North site outfall into the River Irk. The details of the CSOs are as follows:

- 2 overflows which outfall on opposite riverbanks, North of Warford Street;
- an overflow from Roger Street, which outfalls on the North bank of the River Irk;
- an overflow perpendicular to Dantzic Street, from underneath the proposed NT01 plot, which outfalls from the South bank of the River Irk;
- an overflow on the South bank of the river South of Collyhurst Weir, underneath Dantzic Street.

In 2020 the CSOs within the site boundary spilled a total of 108 times for a total of 660 hours[3], with the most spills occurring at the Dantzic Street/Warford Street CSO. This indicates that there may be reduced capacity in the combined sewers, potentially as a result of blockages.

Passing through the centre of site is an existing watercourse, the River Irk. Historic records indicate that historically a mill race ran from the River Irk to the north east of site and reconnected to the River Irk towards the south west of the site. Records suggest that this channel was infilled following the creation of the rail sidings within the site. This can be seen in Figure 5.

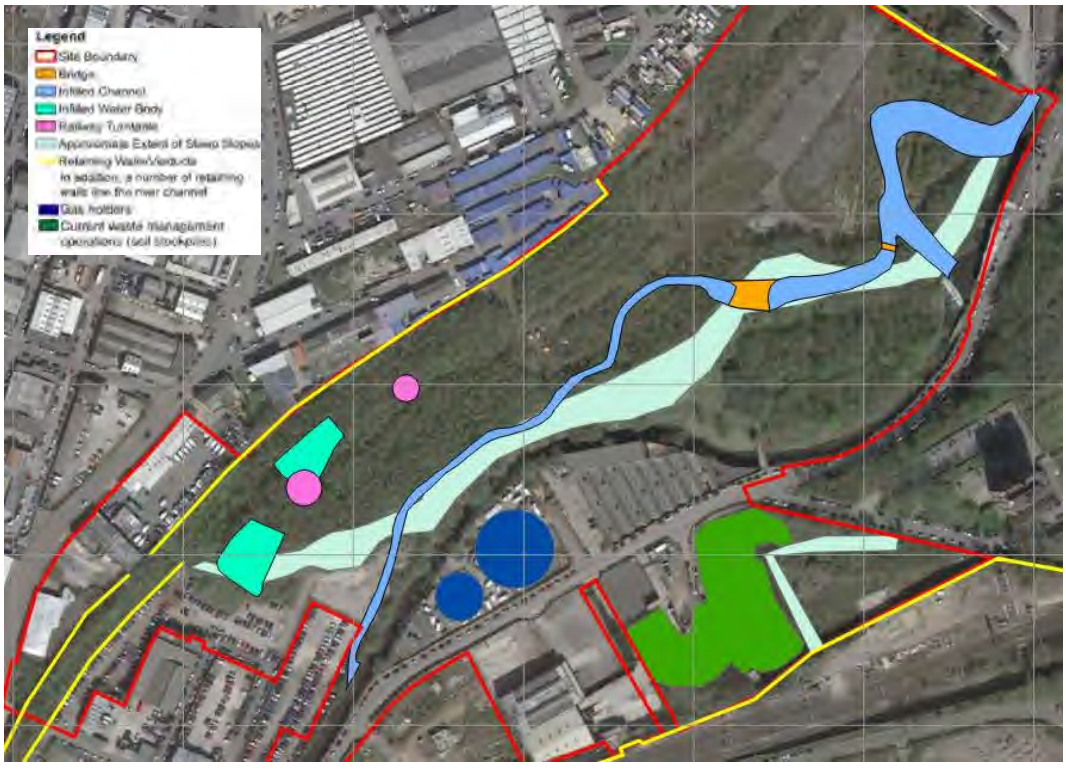


Figure 5 Historic site profile (note: plan shows outdated site boundary)

[3] The Rivers Trust: https://www.theriverstrust.org/key-issues/sewage-in-rivers

3.2 Surface water drainage regime

There are no known existing surface water drains in or around the site. All surface water is assumed to either infiltrate, drain to the River Irk or to the combined sewer network. There are three surface water catchments within the site boundary, these are indicated on Drawing VNIF-ARP-ZZ-YYY-DR-CD-0001 in Appendix A, note that greenfield extents shown relate to areas which are not actively drained, rather than previously undeveloped land.

Based on the site topography and location of existing sewers, it is likely that catchment 4 (Plateau East and St Catherine's Wood) does not drain to the combined sewer and instead is drained through infiltration or directly to the river. Catchment 1 (Plateau West down to Satnam) is likely to be at least partially drained by the combined sewers in Roger Street and Red Bank, infiltration is also likely in some areas of catchment 1.

3.3 Cheetham Hill Culvert

Based on a historic 1984 map provided and annotated on by MCC LLFA, Figure 6, the Cheetham Hill Culvert is assumed to pass through site. As part of the works being undertaken prior to the Enabling Works, the exact location of the ordinary watercourse will be identified and also the requirement for a diversion will be assessed. If a diversion is required, this will be discussed and agreed with the LLFA.



Figure 6 - Historic 1984 Map with Culvert Annotated

4 Geotechnics and Geo-Environmental

This section presents a high-level review of the key geotechnical and geo-environmental considerations relating to the Victoria North Infrastructure Works site.

Further Ground Investigations (GI) have been undertaken and are in the process of being analysed and the results being consolidated and put into the Stage 3 Geotechnical report. The findings will be found in report – VNIF-ARP-00-YY-RP-CG-0001.

4.1.1 Overview of site topography

The site occupies the north-east/south-west orientated valley of the River Irk. Areas of the site are characterised by steep slopes. North of the river, ground levels fall from approximately 50m AOD in the north to approximately 30m AOD along the river channel. South of the river, ground levels rise from river level to approximately 40m AOD at the southern site boundary. Levels are based off a Topographical Survey received 29-09-21.

4.1.2 Overview of ground conditions

Existing GI data suggests that made ground (associated with historic development) covers most of the site. North of the river, made ground varies in thickness, locally being in excess of 10m thick and is generally associated with filling undertaken in the late 1800s to enable the development of railway sidings. South of the river, the thickest made ground deposits are likely to be in plots NT03 and NT04.

Existing GI data suggests that glacial till deposits are present underlying made ground in areas north of the river. Close to the river in areas to the south of the river channel, glacial till appears to be generally absent. Limited alluvial deposits have been identified associated with the River Irk. According to published geological maps, bedrock underlying most of the site consists of sandstones of the Chester Pebble Beds Formation, with coal measures strata (Manchester Marl and Collyhurst Sandstone Formations) sub-cropping below superficial deposits in the north eastern area of the site. Published geological maps indicate that two north west to south east oriented faults are present within or close to the site.

4.1.3 Overview of Groundwater conditions

The main aquifers beneath the site are the Chester Pebble Beds and Collyhurst formations (Principal Aquifers) with the Manchester Marl a Secondary B Aquifer. Available GI data suggests groundwater is present at between 40m AOD in the north east and 28m AOD in the south west of the site and appears to be associated with both made ground and Glacial Till, though groundwater is also likely to be encountered in alluvial deposits. The principal groundwater level is anticipated as

being below most proposed structures and excavations (except for piled foundations). However, localised perched groundwater is anticipated within the made ground (along with the relatively high water table to the north east of site) and this may limit the potential for infiltration to be used in certain areas within site.

4.1.4 Potential for contamination

Key historical features shown on Figure 5 may represent geo-environmental constraints to future development. For example:

- Gas works and gas holders are associated with a range of contaminants that are likely to present risks to human health and/or controlled waters;
- Existing buildings and the remains of buildings that have been demolished may contain asbestos;
  Stockpiled soils associated with licensed recovery operations (plots NT03 and NT04) may contain potentially hazardous materials and/or elevated concentrations of contaminants that may present risks to human health and/or controlled waters.

All the above are likely sources of contamination. Contaminated soils provide a high risk to the groundwater. Infiltration can only be utilised where the risk of transferring contamination to water bodies is mitigated by an adequate depth of soil between the SuDS and the groundwater.

Areas of potential contamination have been previously assessed in 2017 through soil and water sampling and analysis, the outcome of this assessment is shown in Figure 7. Both Plateau East and Plateau West are considered at least moderately contaminated. With the high risk of contamination on Plateau East it is unlikely that infiltration will be possible. Moderate risk is indicated on Plateau West, further investigation is required to confirm the infiltration potential and depth to groundwater to inform the type of SuDS which can be used. In addition, several historic landfill sites have been identified, adjacent to the northern site boundaries.

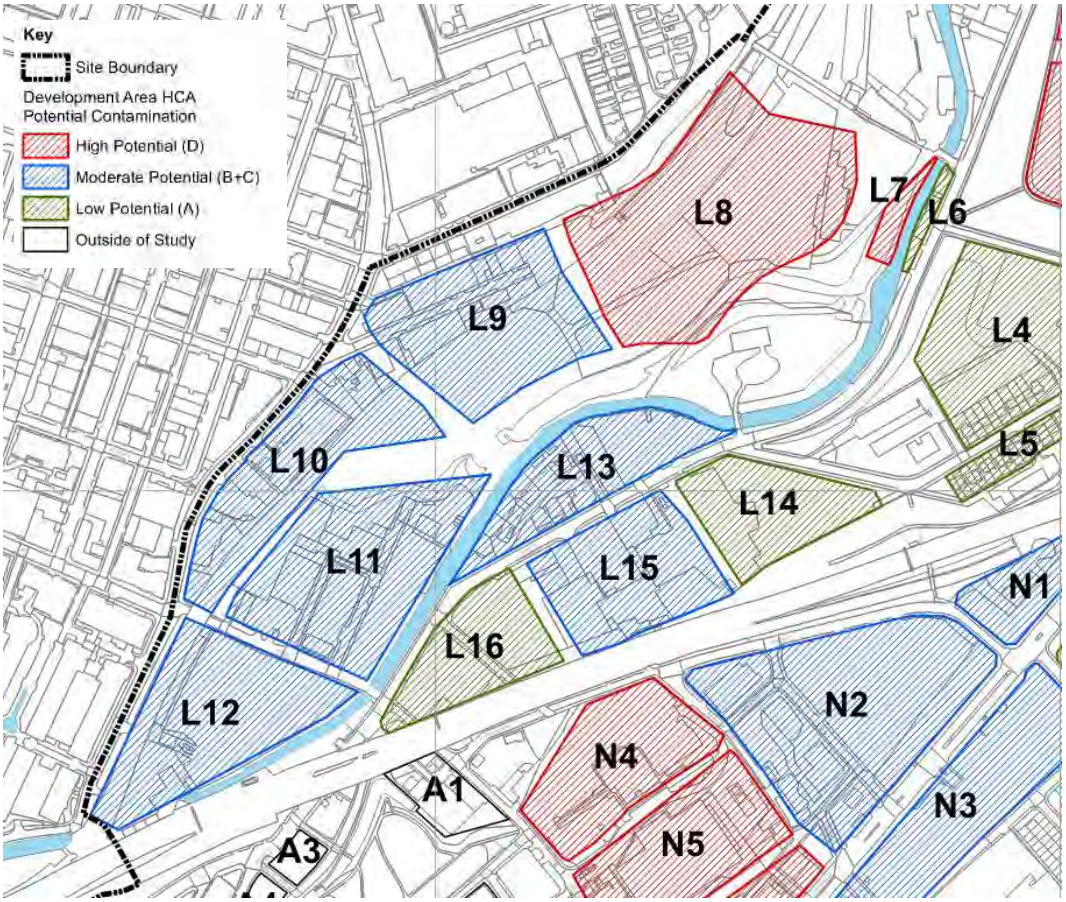


Figure 7 Extract from NGA-ARP-SW-DR-CG-100 showing current understanding of contamination levels within Victoria North site

5 Surface water hierarchy

The surface water hierarchy is summarised below, discharge mechanisms should be prioritised with 1 being most favourable to 4 being least favourable.

> (1) Infiltration > (2) Discharge to surface water body > (3) Discharge to surface water sewer > (4) Discharge to combined sewer

Following the discharge hierarchy, infiltration will be utilised where possible. Due to the contamination status of the site as summarised in section 4.1.4, infiltration is not feasible across the whole site.

Areas where infiltration is possible will be explored during the next stage of design. Where land is currently parkland and will remain as parkland, infiltration will remain the drainage mechanism and it is not proposed that these areas are actively drained.

All surface water will be discharged to the River Irk which passes through the site. A discharge restriction rate has been agreed with the LLFA (MCC) and the EA. This strategy will prevent the new outfalls to the River Irk from worsening fluvial flood risk.

Due to the types of contamination present on the site, relatively high water table in areas, and close proximity steep slopes – where it is later identified infiltration is a possible discharge mechanism the rate will be controlled such that it mimics the existing greenfield conditions.

6 Flood Risk Assessment

Arup have produced a Site Specific Flood Risk Assessment (SSFRA) – VNIF-ARP-ZZ-YYY-RP-CD-0002. The SSFRA shall be referred to in full for information.

7 Proposed drainage strategy

7.1 Discharge restrictions

All surface water runoff will discharge directly to the River Irk. All connections to the river will be new connections, therefore greenfield discharge rate restrictions have been specified by the LLFA in line with ambitions set out in the Manchester, Salford and Trafford SFRA. The discharge rate for the site has been agreed with the LLFA and is summarised later in the section.

Restrictions have been calculated based on the catchments shown by the drawing in Appendix A. Catchments 3 and 4 are included in the sitewide discharge calculations as the outfalls from these catchments will be progressed in future planning applications for the site. The restricted discharge rates are calculated as a wholly greenfield rate with an urbanisation factor of 0.75 applied to account for the existing urban nature of the site. The resulting restrictions will reduce discharge from the site by between 73% and 85% compared to existing. This excludes the park area which will continue to drain through infiltration as it does currently. Further reductions in discharge rates may be achievable if further investigation shows that infiltration is feasible, this will be confirmed at the next design stage.

The calculation of runoff rates is shown in Appendix C and summarised below:

- 1:100 year + 40% CC storm restricted to 22 l/s/ha (all catchments)
- 1:30 year storm restricted to 14 l/s/ha (Qbar) (catchments 1, 3 and 4)
- 1:30 year storm restricted to 13.3 l/s/ha (Qbar) (catchment 5)

These restrictions will also be applied to all plot connections into the network.

7.2 Climate change

In accordance with NPPF, runoff for the 100-year storm will include a 40% allowance for climate change.

7.3 Surface water strategy

7.3.1 Development plots

The arrangement of the surface water network and related details are shown in Appendix D. To provide flexibility for the connections from the future development plots the surface water network has been designed with a depth of 2.0-2.5m below cover level. Plots will be drained through connections to carrier pipes within the highway and public realm; one connection will be allowed per plot. Development plot surface water flow rates will be in line with the site wide discharge restrictions and the management of this will be the responsibility of the plot developer.

7.3.2 Infrastructure strategy

The carrier drain network downstream of plot connections is proposed to be adopted by United Utilities. Flow control devices will be applied at the outfall to the River Irk for each catchment, which will restrict flows to the following:

- Outfall 1 restricts part of Red Bank terraces and public realm zone to 11.9 l/s for the 100 year event
- Outfall 2 restricts Plateau road west zone, and part of Red Bank Terraces to 86.7 l/s for the 100 year event
- Outfall 3 restricts Plateau road east zone to 56 l/s for the 100 year event
- Outfall 4 restricts Dantzic Street to 86.2 l/s for the 100 year event.

These restrictions are calculated based on the area of each and the per ha restriction outlined in section 7.1.

The current proposal assumes no infiltration through the ground. All storm water is therefore proposed to discharge into the River Irk. This represents the worst case from a flow perspective and will be reviewed following updated geotechnical investigation. The strategy has been split into multiple drainage zones which also relate to the drainage catchments shown in Appendix A. The zones are shown in Figure 8.



Figure 8 Drainage zones

Outfalls to the river are assumed to discharge under surcharged conditions for the 1:100 year event due to high river levels. Exact river levels have not been modelled for the 1:30 year event but it is assumed that outfalls will discharge freely for this return period; due to the large upstream river catchment of the Irk, it is anticipated that the river hydrograph and the site hydrograph will not coincide for the 30-year storm.

Exceedance flow routes have been considered in the design for the drainage solution (Refer to Appendix F). The exceedance flow route in the event of system failure or larger storms will pass down Plateau Road and down Red Bank Terraces towards the River Irk. The on-plot developer should ensure buildings levels are raised from the surrounding levels to encourage water away from the proposed developments, and that plot levels route water away from steep slopes to reduce the risk of soil erosion.

7.3.3 Plateau Road East

The Plateau Road East will be drained through 2850m^2 of permeable paving which stores runoff before discharging to carrier pipes within the carriageway. The permeable layer will be lined to prevent infiltration. Flow controls at the inlet to carrier drains will allow water to be stored in the permeable road layer in order to achieve the proposed discharge restrictions. After the carrier pipes pass away

from the highway to the south-west, it will pass through a storage tank of 125m^3 before heading off towards the outfall.

The carrier system will convey runoff towards the outfall to the north east, which discharges to the River Irk as shown in Appendix D. All runoff from the Plateau Road will be discharged directly to the River Irk.

7.3.4 Plateau Road West

The drainage mechanism for Plateau Road West mirrors the mechanism for Plateau Road East. Highway runoff will be captured and stored in 3900m^2 of permeable paving and discharged to carrier pipes within the highway. This system is lined to prevent infiltration and flow control devices restrict the flow to allow water to be stored within the permeable layer. Plots will be drained into the carrier drain system.

The network passes under Red Bank Square and Red Bank Terraces and through a detention basin. The detention basin is an online feature which will provide approximately 108m^3 of storage. Flow controls are included at the outlet to provide storage within the basin and restrict the whole catchment to the agreed discharge rate. The network then outfalls to the River Irk as shown in Appendix D.

7.3.5 Red Bank Terraces and public realm

The Red Bank Terraces zone will be drained through two networks. The terraces are drained through a series of gullies feeding into a carrier drain down the slope and passing through a 55m3 storage tank. Plots RB06 and RB08 are collected in a separate carrier system which is proposed to be adopted by United Utilities. This system also picks up discharge from two sections of permeable paving (105m^2 and 321m^2). Both carrier systems combine and are discharged along the northern edge of RB06 and to the outfall downstream of the Plateau West detention basin.

The public realm area to the south of RB06 and RB07 is drained through two sections of permeable paving (220m^2 and 442m^2). The carrier drain which picks up drainage from RB07 collects the discharge from the permeable paving and discharges to the river.

7.3.6 Dantzic Street

Dantzic Street will be drained through a series of swales which provide 208m^3 of storage and feed into a carrier drain system within the highway. This carrier system also collects drainage from the plots and is proposed to be adopted by United Utilities. A hydrobrake restricts the whole system to the proposed discharge rate before outfalling to the river.

The drainage within Dantzic Street is proposed to be constructed prior to further landscaping and highways works which will be progressed at a later date. Therefore, the existing highway drainage system will remain operational until such time as the additional works are completed, at which point the highway will

drain to the new system. Above ground elements such as swales will not be able to be constructed prior to landscaping works being undertaken. Maintenance operations during the interim should take account of this, as outlined in section 9.

7.3.7 River Park

The River Park replaces an existing area with no active drainage mechanism; therefore, this area will continue to naturally drain, and no drainage infrastructure is proposed within the park. The proposed active travel route across the top edge of the park will be drained through filter drains which convey the surface water runoff to the proposed networks on Plateau East and West. The wet play area within the park will be drained through a small separate outfall to the river which will be privately adopted. The treatment requirements at this outfall will be further assessed during the next stage of design when more is understood about the intended use of the wet play area.

7.3.8 Summary

Surface water drainage infrastructure will be delivered under 6no. independent networks which all discharge to the river through 5no. outfalls (4no. adopted outfalls, plus 1no. private for the wet play outfall). Across the site a strategy has been adopted which collects highway drainage and plot drainage separately to provide the required storage to restrict flows to the proposed rates.

The available storage across the site is approximately 11014m^2 of permeable paving, which equates to 1652m^3 of storage at 30% porosity. Swales along Dantzic Street will provide 208m^3 of storage for this network. There is an additional 256m^2 for a detention basin, providing 108m^3 storage, which forms part of the Plateau Road West network.

7.3.9 Stage 3 Calculation Summary

As part of the Stage 3 surface water design, a set of calculations were produced. These can be found in Appendix C. In summary:

- In a 1 in 30-year storm, the system does not flood at any part of the system as required by United Utilities.
- In a 1 in 100-year storm, the system floods very minorly in a couple of areas but the flood water is controlled and kept within site as required by United Utilities.

7.4 Foul water strategy

Foul water from the plots will be connected to proposed foul water sewers, which will discharge to the existing combined sewer network which surrounds the site. The connection depth from plots has been agreed with the on-plot developers as 1.5m minimum depth to cover. The foul drainage arrangement can be seen in Appendix E. The foul network has been modelled based on the unit numbers provided by FEC on 23/09/2021 with an assumed split between 1, 2 and 3 bed

dwellings based on the Northern Gateway Strategic Regeneration Framework (SRF).

The expected foul peak flows from each plot are shown in Table 1. In line with the Sewers Design and Construction Guidance, these are calculated based on a peak rate of 0.05l/s per dwelling and 0.6l/s/ha for non-residential land uses

Table 1 Foul Generation per plot

Block ID	Residential Total	Non-residential total	Peak Foul Generation
	units	sqm	l/s
RB06	190	1402.6	9.6
RB07	406	2981.7	20.5
RB10*	282	1995.8	14.2
Park	0	0	0
NT02*	583	1743.1	29.3
NT03*	392	1775.8	19.7
NT04*	432	0	21.6
RB16*	137	1003.0	6.9
RB17*	171	1256.2	8.6
RB01	166	930.6	8.4
RB02	261	491.5	13.1
RB03	256	481.6	12.8
RB04a	388	2413.2	19.5
RB04b	403.5	819.0	20.2
RB05a	201.75	409.5	10.1
RB05b	201.75	409.5	10.1
RB12(b)	204	791.5	10.2
RB08	149.814	0	7.5
RB09*	384.5548	0	19.2
RB11&12(a)	123.5806	2265.1	6.3
Total			267.9

(* red cells denote plots within the wider masterplan which are not considered under the HIF Infrastructure works planning application)

Plots outside of the HIF boundary in immediate proximity to the existing combined system are assumed to connect into the existing system directly and do not connect to the proposed foul network.

Consultation is ongoing with United Utilities to understand the capacity of the existing sewers. A CCTV survey of the sewers has also been commissioned to advise on their current condition. Existing surface water connections from the site

to the combined sewer will be re-routed directly to the river, so the overall flow rate in the combined sewer will be reduced, this will be considered when assessing the sewer's capacity. Collaboration with United Utilities will be maintained to achieve a design which is adoptable by them.

8 Sustainable drainage systems (SuDS)

Sustainable drainage systems will be utilised across the site to treat and attenuate surface water runoff to the agreed flow rates. The SuDS which will be applied at each area of site (off-plot) are summarised below. The on-plot developer is responsible for developing attenuation on-plot to meet the required restrictions.

8.1 Plateau Road and Red Bank Square

Permeable Paving will be utilised for the Plateau Road and areas of public realm within the masterplan, including on-street car parking spaces and footways. This will provide a large volume for storage of storm water as well as wider benefits for water quality; permeable paving provides some treatment by trapping pollutants through adsorption and settlement within the permeable layer. Evapotranspiration is also a potential benefit of permeable paving due to the shallow depth of storage. Oversized pipes are used for storage on the entrance from Red Bank, as steep slopes make permeable paving unsuitable in this area.

The permeable paving is designed so that water infiltrates through voids in the paving and is stored in the voids in the sub-base. The sub-base will be lined to ensure there is no infiltration to the ground, potential for infiltration will be explored at the next stage. Surface water will exit through a filter pipe at the bottom of the sub-base to drain to the carrier system. A typical section of the permeable paving is shown in Figure 9, the sub-base will be shallower under the footways as there is less loading.

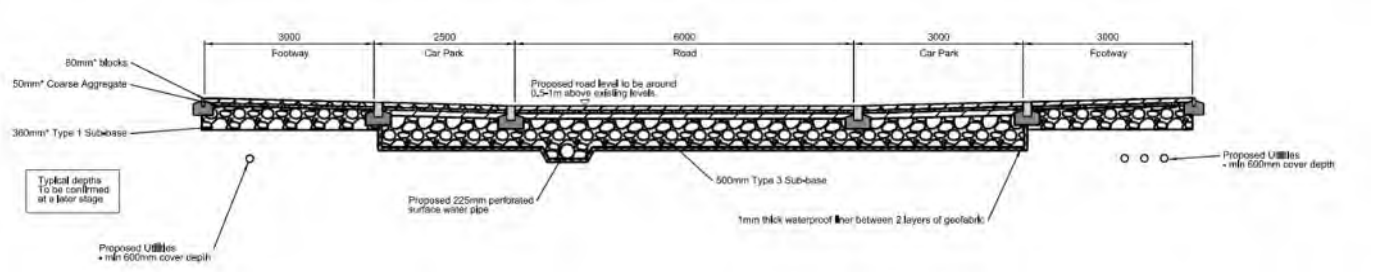


Figure 9 Typical permeable paving section

8.2 Dantzic Street Swales

Swales are proposed along Dantzic Street which will provide up to 208m^3 of storage, this will be achieved by implementing flow controls at the outlet of each swale. Swales will also be lined to prevent infiltration. Surface vegetation will provide filtration of coarse to medium sediments and associated pollutants, improving water quality at swale outlets.

8.3 Detention basin

The detention basin will store up to 108m^3 of water during storm events and will provide an area of amenity during prolonged periods of dry weather when flows will be lower. This will store runoff collected in the Plateau West network and a complex control will restrict outflow from the basin to provide the required storage for the 30 and 100-year storms. Infiltration from the basin will be prevented using impermeable lining. The basin will be an online feature and is proposed to be adopted by United Utilities.

The basin will be vegetated, which will provide filtration along the base, settling of particulate pollutants within the basin will also provide water treatment. The outfall will be designed to prevent the resuspension of solids before water outfalls to the river.

8.4 Water treatment capabilities and the Simple Index Approach

The Simple Index Approach (SIA) as defined in the CIRIA C753 SuDS manual has been used to determine the treatment efficiency of the proposed Sustainable drainage systems across the site.

Under the SIA, the site use has been designated as *'low traffic roads'* or *' Non-residential parking with infrequent change'* which are the site uses with the highest Pollution Hazard Indices of all proposed land uses within the development. The Pollution Hazard Indices for this land use are shown in Table 2.

Table 2 Land Use Pollution Hazard Indices

		Pollution Hazard Indices		
Runoff Area Land Use Description	Pollution Hazard Level	Total Suspended Solids	Metals	Hydrocarbons
Low traffic roads (e.g. residential roads and general access roads, < 300 traffic movements/day)	Low	0.5	0.4	0.4
Non-residential parking with infrequent change (e.g. schools, offices, < 300 traffic movements a day)	Low	0.5	0.4	0.4

The Pollution Mitigation Indices of the proposed SuDS features are shown in Table 3.

Table 3 Proposed SuDS Pollution Mitigation Indices

	Pollution Mitigation Indices		
	Total Suspended Solids	Metals	Hydrocarbons
Detention basin	0.5	0.5	0.6
Swale	0.5	0.6	0.6
Pervious pavement (where the pavement is not designed as an infiltration component)	0.7	0.6	0.7

Groundwater protection will be provided for all SuDS features through the use of lining to prevent infiltration to the ground.

As the pollution mitigation indices for each of the proposed SuDS elements are greater than the pollution hazard index, the proposed components are considered sufficient to provide pollution risk mitigation in isolation. Additionally, the SuDS features have been designed so that most of the surface water flows will pass through multiple SuDS elements before they are discharged. This will provide a robust treatment train and treat a broad range of pollutants; the proposed features will provide interception, primary and secondary treatment to most of the surface water flows as defined by the Ciria C753 SuDS Manual 2015.

9 Phased development and maintenance

The Victoria North site is to be developed in multiple different phases. The infrastructure works will form part of the first stage of development, on-plot development will be undertaken in subsequent phases. The construction phase will therefore continue after the completion of the HIF works, with the last plot being completed in 2032 according to the current phasing plan.

For both the surface and foul water network, construction activity in subsequent phases to their delivery could lead to increased sedimentation due to reduced flows which may result in blockages in the system. Blockages within the SuDS systems will reduce their storage and treatment capabilities which could lead to increased flood risk and pollution of surface water or other environmental receptors. Similarly, blockages within the foul network would exacerbate current capacity issues, likely leading to increased CSO spill rates and potential flooding. Construction debris may also cause erosion to pipe networks, particularly where

backdrops are included due to steep slopes. Construction traffic may induce higher highway loading on the network than it has been designed to carry, temporary traffic routes should be developed with consideration of the cover depths and load classes of the drainage network to prevent damage.

As the drainage networks will be installed prior to plots connecting to the system, self-cleansing velocities may not be achieved during all phases of the development in the foul system. The current proposed phasing plan indicates a seven-year gap between the completion of the first plot to the last one. Assuming that occupancy of the plots will follow a similar timeline to their completion, flow rates may be lower than the designed full flow rate for a number of years before all plots come online.

9.1 Interim construction phase maintenance regime

A sufficient maintenance plan should be developed in line with Ciria 753 which includes all phases of the development prior to eventual handover, including the interim period between HIF works delivery and full plot occupation, and prior to highways works on Dantzic Street. The frequency of maintenance activities should be increased during construction phases to prevent the need for remedial actions. Additional maintenance requirements of the system during the interim period will include:

- Visual inspection of all networks quarterly and following large storms
- Camera surveys prior to plot build outs to ensure the system is clear of debris and construction waste
- Rodding and jetting of drainage pipes and regular inspection/ sediment removal from chambers as needed following inspection
- Sweeping of permeable paving using a brush and suction cleaner twice yearly, after leaf fall and as required following inspection
- Monthly inspection and sediment removal from flow controls, inlets and outlets
- Mowing, vegetation management and debris removal in detention basin monthly or as required (less frequent during winter), regular inspection should inform the need for sediment excavation during subsequent construction and use phases

United Utilities will adopt the drainage mentioned above formally once the Section 104 has been agreed and the occupancy of the plots is 51% minimum. Before this point, the whole drainage system will need to be maintained privately by the Developer. The Developer should consider separate S104 applications in order to achieve adoption status sooner.

9.2 Post site completion maintenance regime

Upon completion of the wider site, the maintenance of drainage systems will be the responsibility of the asset owners. It is anticipated, that once the whole site has

been developed, the whole foul water system as well as the surface water system where plots are connected will be adopted by United Utilities; this also includes the online detention basin. The highway will be un-adopted and so maintenance of the highway drainage up to the connection with the carrier system will be the responsibility of the private owner. The maintenance regime once the site is completed should align with Ciria 753 and is summarised in Table 4.

Table 4 Basin typical Maintenance Regime

Basin - Maintenance Task	**Frequency**
Visually inspect inlet and outlet for blockages, remove silt and debris	Monthly
Mow and manage vegetation	Monthly (seasonal)
Re-seed areas of poor vegetation	As required

Table 5 Permeable Paving typical maintenance regime

Permeable Paving - Maintenance Task	**Frequency**
Visually inspect for blockages, remove silt and debris	Monthly
Mow and manage vegetation in areas adjacent to permeable paving	Monthly (seasonal)
Sweep using a brush and suction cleaner	Annually after leaf fall or as needed
Weed removal in permeable paving using glyophosphate	Annually or as required

Table 6 Swales typical maintenance regime

Swales - Maintenance Task	**Frequency**
Visually inspect inlet and outlet for blockages, remove silt and debris	Monthly
Mow and manage vegetation	Monthly (seasonal)
Re-seed areas of poor vegetation	As required

Table 7 Pipe network typical maintenance regime

Pipe Network - Maintenance Task	Frequency
Visually inspect access covers for structural damage and remove litter or debris	Monthly
Lift access covers to visually inspect condition of access chambers and presence of silt or debris, remove as necessary	Annually
Visually inspect flow control chambers, remove sediment. Maintain flow controls in accordance with manufacturers' recommendations	Biannually

10 Conclusions

The existing drainage on and around site consists of combined sewers as well as infiltration and runoff to the River Irk in the non-developed areas. In line with the drainage hierarchy, and with consideration of the potential for contamination, the proposed surface water drainage strategy is to discharge to the River Irk as the primary mechanism.

Discussions to agree discharge restrictions are ongoing with the LLFA and the EA. The site is proposed to be restricted to Qbar up to the 30-year event (14l/s/ha and 13.3l/s/ha) and will be restricted to the 100-year storm flow rate for the 100 year + 40% climate change event (22l/s/ha). To achieve these restrictions, SuDS are proposed across the site including permeable paving, swales and a detention basin to provide storage.

As a result of the site's industrial history, areas of potential contamination have been identified, further investigation is required to confirm the contamination levels within site – this will then govern our ability to introduce infiltration into the design at the next stage. Due to this, all SuDS features are designed with impermeable lining to prevent infiltration. Under the Simple Index Approach, the proposed SuDS are shown to be sufficient to mitigate pollution potential of the site to environmental receptors. The sitewide SuDS will drain highways and public realm only, attenuation for the plots will be achieved on-plot.

The SuDS features will drain to a carrier pipe system, which also connects with the plot surface water drainage. The carrier drains will convey all surface water to 5no. outfalls to the River Irk. Flow controls will be installed at each outfall to control the discharge in line with the sitewide restrictions for the 1:30 and 1:100+CC return periods.

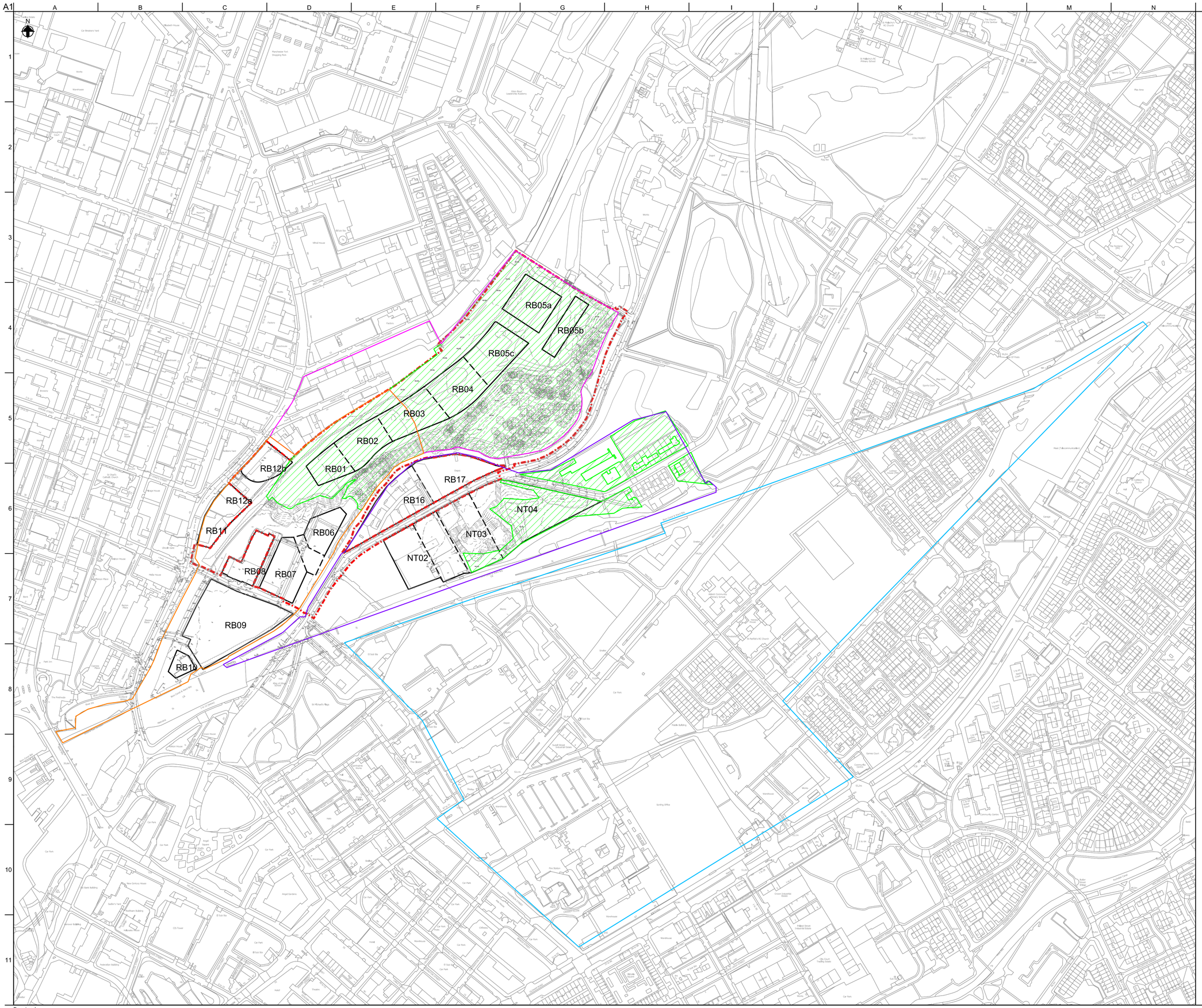
A new foul network will be installed to drain the plots, this will connect to the existing combined sewers in and around the site. Foul water generation has been calculated based on the proposed building uses, and a peak flow rate is applied for both residential and non-residential land uses. Consultation with United Utilities is ongoing to understand the capacity of existing sewers which the site will discharge to.

Maintenance of the proposed drainage systems should be prioritised during all phases to prevent blockages which could lead to the system not functioning as designed, causing potential flooding and pollution. This should particularly be considered during the construction of plots which are due to progress after the infrastructure works delivery.

Appendix A

Existing Drainage Catchments

A1



Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.
2. This map is reproduced from Ordnance Survey Material with the permission of the Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office (c) Crown Copyright. License Number 100019568 (2021).
3. Layout is based on:
   - Landscape Architect masterplan drawing 2700-PLA-ZZ-YYY-DR-L-1011 Rev P01.01 dated 07/12/2021 by Planit.
   - Topographical Survey drawing PS-2158-TS by Paragon Surveys dated September 2021.
4. No guarantee is given for the accuracy of the information contained herein, which is provided for general guidance only and must not be relied upon for excavation or detailed design until apparatus locations are verified / validated through further site investigation works.
5. This drawing should be read with reference to VNIF-ARP-ZZ-YYY-CS-CD-0001 stage 3 drainage calculations
6. Greenfield assumed as areas which are not positively drained.
7. Greenfield extents are shown to catchment boundaries only.

Key

- HIF Site Boundary
- Plot Boundary
- Greenfield Extents
- Drainage Catchment 1
- Drainage Catchment 3
- Drainage Catchment 4
- Drainage Catchment 5

Rev	Date	Description	By	Chkd	Appd	Auth
P01	26/08/21		AS	AS	AS	---
P02	17/12/21		ES	DH	RG	---

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Client

MANCHESTER CITY COUNCIL

bam nuttall

Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

HIF Existing Surface Water Catchments

Scale at A1	1:1250	Arup Job No	282022-00
Role	Civil - Drainage		
Suitability	S0 - Initial Status or WIP		

Rev	By	Chkd	Appd	
P02	---	---	---	---
	Date	Date	Date	
	---	---	---	---

Name

VNIF	- ARP -	00	- YYY -	DR	- CD -	0001
Project	Orlginator	Volume	Location	Type	Role	Number

Do not scale

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Appendix C

Drainage Calculations

Technical Note

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Project title	Victoria North HIF Infrastructure Works	Job number	282022
cc		File reference	VNIF-ARP-ZZ-YYY-CS-CD-0001
Prepared by	Emily Stoddart Drew Hunter	Date	17 February 2022
Subject	Work Stage 3 drainage calculations		

This technical note has been prepared to summarise the calculations which support the work stage 3 drainage design for the Victoria North Infrastructure Works project.

1 Surface water

The surface water calculations are split into catchments which have been taken from the sitewide drainage strategy (MNG-ARP-SW-FN-GX-0008). The catchments are shown in . Note that greenfield extents indicated in refer only to land which is not actively drained and do not indicate previously undeveloped land.

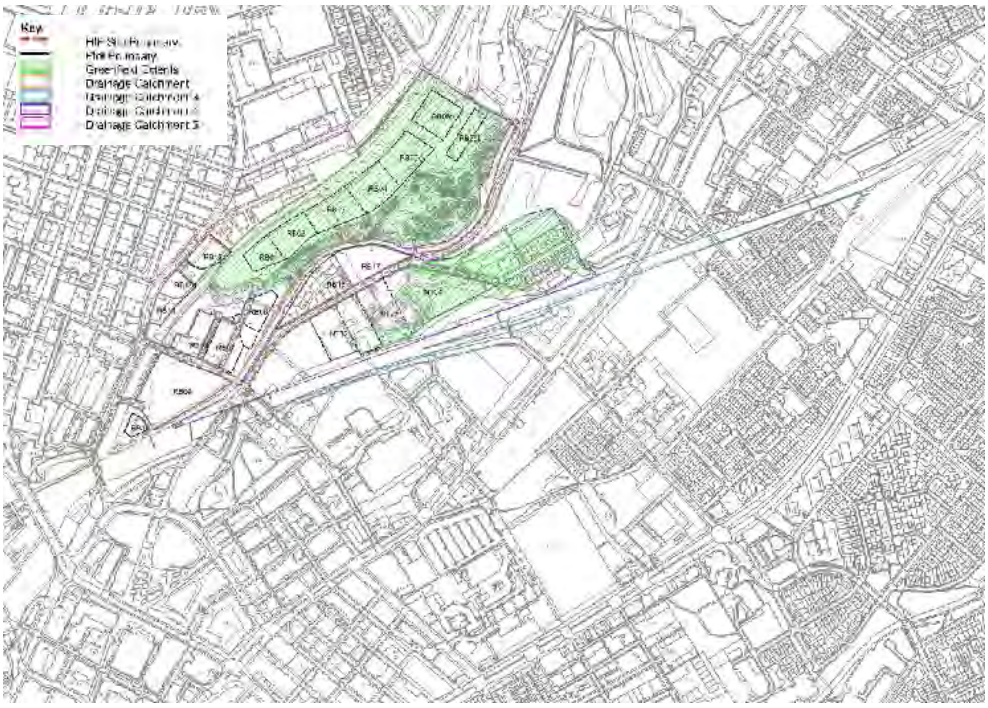


Figure 1 Existing drainage catchments

1.1 Discharge restrictions

Discharge restrictions have been calculated in consultation with the LLFA (MCC), the EA and the on-plot developer. MCC have indicated during previous engagement that greenfield discharge rates would be required for the site as all outfalls to the river are considered as new connections. This has been agreed in principle, the resulting discharge rates are still to be formally agreed by the LLFA.

The discharge restrictions are specified as a sitewide restriction per hectare. These restrictions will also be applied to the highways, footways, public spaces and development plots.

1.2 Catchment areas

Catchment areas have been calculated from the areas shown in . Areas which are not currently actively drained and will not be so under the proposed development (St Catherine's Wood) have not been included.

Table 1 - Areas Summary

Catchment	Area Total	Area Greenfield	Area Brownfield	Total area - Unchanged greenfield
	(ha)	(ha)	(ha)	(ha)
1	7.0	1.5	5.5	6.6
3	31.8	5.3	26.6	31.8
4	8.0	1.8	6.2	8.0
5	7.1	3.5	3.6	5.2
Total	**53.9**	**12.1**	**41.9**	**51.6**

1.3 Discharge rates (Existing)

As stated in the "SC030219 – Rainfall Management for Developments" EA document, QBar runoff rate has been calculated using the IH124 method through source control in Micro Drainage, based on the varying urbanisation factors (as stated in the guidance, the area is calculated for the larger catchment and interpolated for the smaller individual catchments) – the summary can be seen in the Appendix A. The 30-year and 100-year runoff rates are then calculated using the FSSR coefficients derived from Figure 2.

Based on the existing catchments shown in Figure 1 the urbanisation factors for each catchment have been calculated. The urbanisation factor has been calculated as a percentage of brownfield to the total area (minus the areas of greenfield remaining unchanged throughout the design). This percentage will be different for each catchment, but it is worth noting that the maximum recommended Urbanization Factor is 0.75. This means that for Catchments 1,3 and 4 – the urbanization factor has been reduced down to 0.75 for the simulation (providing an increased betterment to the River Irk).

Table 2 - Existing Data

	Qbar	Storm Event	FSSR Co-efficient
IH124 urban greenfield runoff rate (l/s) (0.70 Urbanization)	688.3	30 Yr	1.4
IH124 urban greenfield runoff rate (l/s) (0.75 Urbanization)	722.8	100 Yr	1.68

Table 3 - Existing Discharge/Volume Data

Outfall	Proposed Outfall Path	Catchment	Urbanization Factor	Existing Greenfield Run-Off (l/s/ha)			Existing Greenfield 6-hour Volume (m3)		
			Brownfield/(Total area - unchanged area)	Qbar	30 Year	100 Year	Qbar	30 Year	100 Year
1	River Irk (new outfall)	1	0.83	14	19.5	23.4	2000.26	2800.36	3360.43
3	River Irk (new outfall)	3	0.83	14	19.5	23.4	9595.80	13434.12	16120.95
4	River Irk (new outfall)	4	0.77	14	19.5	23.4	2397.90	3357.05	4028.46
5	River Irk (new outfall)	5	0.7	13.3	18.6	22.3	1487.59	2082.63	2499.16

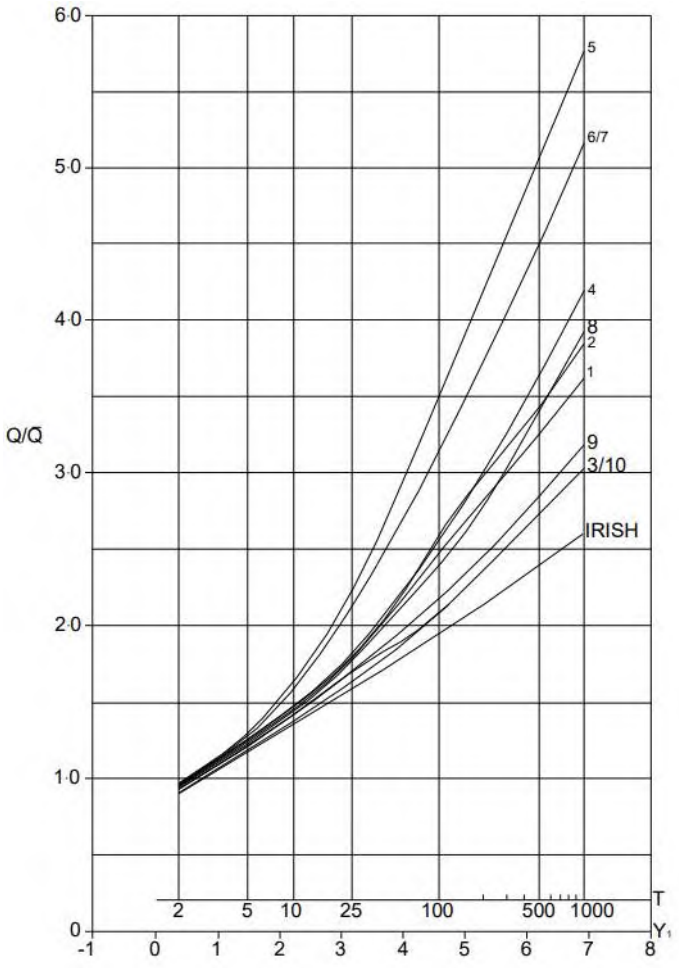


Figure 2 – Peak flow growth curves of UK (from FSSR 14)

1.4 Proposed restrictions

The proposed restrictions for the site are as follows:

- 30-year storm = **14 l/s/ha** (catchments 1, 3 and 4)
- 30-year storm = **13.3 l/s/ha** (catchment 5)
- 100-year storm = **22 l/s/ha** (all catchments)

Based on the values above, the 6-hour storm values and discharge volume reduction are as follows:

Table 4 – Proposed Discharge/Volume Data

Outfall	Proposed Outfall Path	Catchment	Urbanization Factor	Proposed Flow Rate (l/s/ha)			Proposed 6-hour Volume (m3)		Proposed Volume Reduction from Existing (%)	
			Brownfield/(Total area - unchanged area)	1 Year	30 Year	100 Year	30 Year	100 Year	30 Year	100 Year
1	River Irk (new outfall)	1	0.83	14.0	14.0	22.0	2008.3	3153.0	28.6	6.6
3	River Irk (new outfall)	3	0.83	14.0	14.0	22.0	9634.5	15125.6	28.6	6.6
4	River Irk (new outfall)	4	0.77	14.0	14.0	22.0	2407.6	3779.7	28.6	6.6
5	River Irk (new outfall)	5	0.70	13.3	13.3	22.0	1487.6	2452.5	28.6	1.9

As can be seen in the final 2 columns, the volume of water in a 6-hour event is reduced in the 30-year and the 100-year storm. This in turn complies with the EA guidance to have the developed discharge rate at no greater volume to the undeveloped discharge volume.

1.5 Network modelling

The storm water networks have been modelled to achieve the discharge restrictions presented above. The network is designed with minimum cover of 0.9m for non-trafficked areas, 1.2m for trafficked areas and 2.0 - 2.5m connections (to FFL) from the development plots, as agreed with the on-plot developer. A maximum backdrop height of 1.5m has been applied.

Vortex flow controls are included in the site wide model for all plot connections to the network. Plot specific restrictions are shown in Table 4 and are based on the current sitewide masterplan. Plots have also been modelled with an indicative storage structure equivalent to the required storage volume, this represents the storage which will be applied on-plot to restrict discharge. Vortex flow controls are also applied at the connections from online storage structures to control the volume stored in each structure, as well as at all outfalls to the river to ensure each catchment meets the required discharge restriction.

Table 4 Modelled plot restrictions

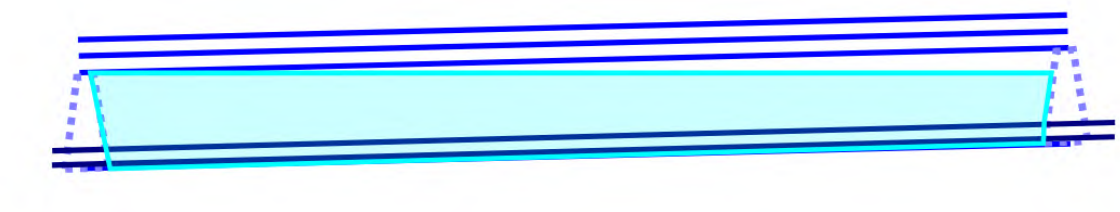
Plot	Area (ha)	Catchment	30 year restriction (l/s)	100 year restriction (l/s)
RB06	0.247	1	3.4	5.4
RB07	0.376	1	5.2	8.3
RB10	Drained to separate network			
NT02	0.771	4	10.8	16.9
NT03	0.537	4	7.5	11.8
NT04	1.012	4	14.1	22.2
RB16	0.537	4	7.5	11.8
RB17	0.461	4	6.4	10.1
RB01	0.288	1	4.0	6.3
RB02	0.326	1	4.5	7.2
RB03	0.403	5	5.4	8.9
RB04	0.415	5	5.5	9.1
RB05a	0.369	5	4.9	8.1
RB05b	0.237	5	3.2	5.2
RB05c	0.410	5	5.5	9.0
RB12(b)	0.235	1	3.3	5.2
RB08	0.444	1	6.2	9.8
RB09	Drained to separate network			
RB11	0.156	1	2.2	3.4
RB12a	0.163	1	2.3	3.6

The network has been designed to minimise flooding during the 100-year storm as much as possible, and any flooding is designed such that it will stay within the site boundary. No flooding occurs within the network for the 30-year storm event. The model network results are split into 4no. surface water catchments and are shown in Appendix 1 – Appendix 4. Note that layouts shown provide a representation of the network for modelling purposes only, for full proposed layouts refer to drainage strategy VNIF-ARP-ZZ-YYY-RP-CD-0003.

1.6 Permeable Paving Calcs

Current working assumptions are as follows:

- Permeable paving depth – 500mm
- For Stage 3 permeable paving has been modelled as 4 separate storage units. During Stage 4 a more detailed model will be produced breaking down each storage unit to reflect the bund spacing.
- Permeable paving sub-base porosity – 30%
- Smaller localised areas of permeable paving to have a slope factor of 0.9. To be detailed further at Detailed Design Stage.



Plateau West

For Plateau Avenue the current slope is designed to be 1:150 and using the area method as shown below the sloping factor is calculated to be 0.83.
Available Storage – 3900m2 (area) x 0.5m (depth) x 0.3 (porosity) x 0.83 (slope factor)
= 485.55m3
MD Storage – (215x0.5)+(350x0.5)+(200x0.5)+(200x0.5)
= 482.5m3 < 485.55m3 (**OK**)

Plateau East

Available Storage (1) – 2850m2 (area) x 0.5m (depth) x 0.3 (porosity) x 0.83 (slope factor)
= 354.825m3
Available Storage (2) – 140m2 (area) x 0.8m (depth) x 0.95 (porosity)
= 106.4m3
Available Storage (1+2) = 461.225m3
MD storage – (225x0.5) + (62.5x0.5) + (175x0.5) + (62.5x0.5) + (255x0.5)
= 390m3 < 461.225m3 (**OK**)

Red Bank Avenue

Red Bank Avenue has been split into two separate storage areas. North of Plot RB06 and South of RB06.

North of Plot RB06

The storage in this section is broken down into a storage tank and 2 permeable paving areas.
The tank has been modelled with the dimensions 9mx8mx0.8m (95% porosity).
Permeable paving available storage (1) – 321.262m2 (area) x 0.5m (Depth) x 0.3 (porosity) x 0.9 (sloping factor)
= 43.37m3
Permeable paving available storage (2) – 104.642m2 (area) x 0.5m (depth) x 0.3 (porosity) x 0.9 (sloping factor)
= 14.40m3

Available storage (1+2) – 57.77m3
MD provided storage 57.50m3 < 57.77m3 (**OK**)

South of Plot RB06

The storage in this section is broken down into 2 permeable paving areas
Permeable paving available storage (1) – 442.490m2 (area) x 0.5m (depth) x 0.3 (porosity) x 0.9 (sloping factor)
= 59.74m3
Permeable paving available storage (2) –218.738m2 (area) x 0.5m (depth) x 0.3 (porosity) x 0.9 (sloping factor)
= 29.53m3
Available storage (1+2) – 89.27m3
MD provided storage – 89m3 < 89.27m3 (**OK**)

2 Foul water

The foul network has been modelled based on the unit numbers provided by FEC on 23/09/2021 with an assumed split between 1, 2 and 3 bed dwellings based on the Northern Gateway Strategic Regeneration Framework (SRF).

2.1 Foul water generation

In line with the Sewerage Sector Design and Construction Guidance v2-1, a peak flow rate of 0.05l/s/dwelling and 0.6l/s/ha for non-residential land use have been applied, giving the flow rates shown in Table 6.

Table 6 Foul water flows

Block ID	Residential	Non-residential	Foul generation
	units	**sqm**	**l/s**
RB06	179	1403	9.1
RB07	457	2982	22.8
RB10	Drained to separate network		
NT02	583	1743	29.1
NT03	392	1776	19.6
NT04	432	0	21.6
RB16	137	1003	6.9
RB17	172	1256	8.6
RB01	166	931	8.3
RB02	261	492	13.1
RB03	256	482	12.8
RB04	388	2413	19.4
RB05a	404	819	20.2
RB05b	202	409	10.1
RB05c	202	409	10.1
RB12(b)	204	792	10.2
RB08	150	2265	7.5
RB09	Drained to a separate network		
RB11&12(a)	124	480	6.2
Total	**5335**	**24039**	**267**

2.2 Network modelling

Details of the foul network are shown in Appendix 5. The network has been designed to carry the flows shown above and discharge to existing combined sewers. Plot connections are set at a minimum of 1.5m deep, as agreed with the on-plot developer. Minimum depths for trafficked areas are set as 1.2m and for non-trafficked areas is 0.9m. A minimum self-cleansing velocity of 0.75m/s at 1/3 design flow has been achieved across the foul network in line with the Sewerage Sector Design and Construction Guidance.

A1 Appendix 1 Catchment 1 (north) surface network report

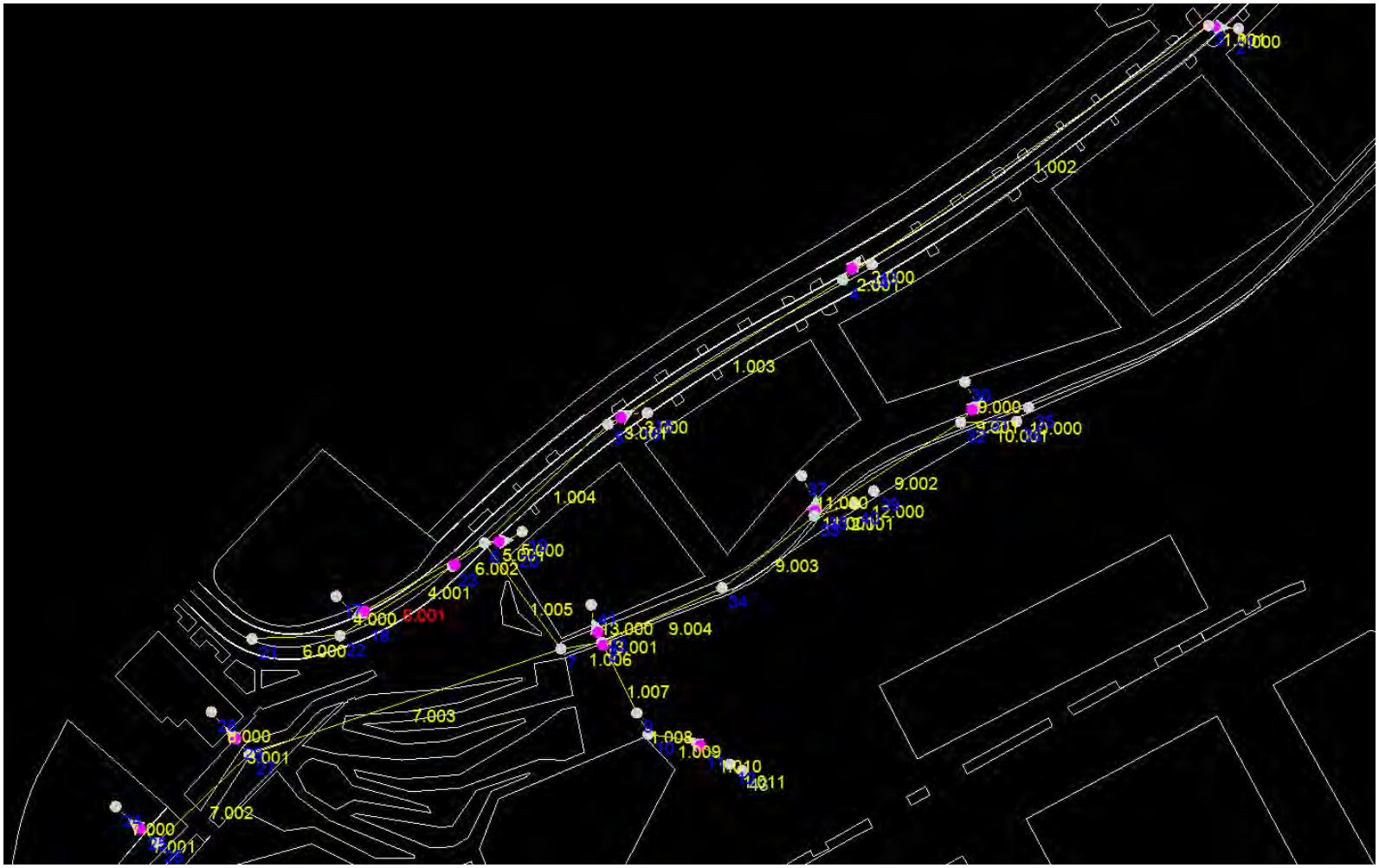


Figure 4 Catchment 1 north model layout

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.357	Minimum Backdrop Height (m)	0.000
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	0.000
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	0.900
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	100

Designed with Level Soffits

Network Design Table for Storm

- Indicates pipe length does not match coordinates

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	5.088	0.051	99.8	0.000	5.00	0.0	0.600	o	225	Pipe/Conduit	
1.001	4.385	0.044	99.7	0.283	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	140.566	1.017	138.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	10.000#	0.102	98.0	0.000	15.00	0.0	0.600	o	225	Pipe/Conduit	
2.001	6.945	0.061	113.9	0.304	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	87.000	0.580	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	10.000#	0.100	100.0	0.000	15.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	7.128	0.240	29.7	0.192	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.004	54.011	0.360	150.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
4.000	10.000#	0.200	50.0	0.000	15.00	0.0	0.600	o	150	Pipe/Conduit	

Dummy pipe upstream of permeable paving

Dummy pipe upstream of permeable paving

Dummy pipe upstream of permeable paving

Dummy pipe upstream of indicative plot storage/flow control

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	46.36	5.06	41.351	0.000	0.0	0.0	0.0	1.31	52.0	0.0
1.001	46.14	5.12	41.300	0.283	0.0	0.0	0.0	1.31	52.1	35.3
1.002	39.46	7.23	41.256	0.283	0.0	0.0	0.0	1.11	44.1	35.3
2.000	26.63	15.13	40.402	0.000	0.0	0.0	0.0	1.32	52.5	0.0
2.001	26.53	15.22	40.300	0.304	0.0	0.0	0.0	1.22	48.7	21.8
1.003	25.48	16.35	40.239	0.587	0.0	0.0	0.0	1.28	90.6	40.5
3.000	26.59	15.17	40.000	0.000	0.0	0.0	0.0	1.00	17.8	0.0
3.001	26.52	15.23	39.900	0.192	0.0	0.0	0.0	1.85	32.8	13.8
1.004	24.87	17.05	39.510	0.778	0.0	0.0	0.0	1.28	90.6	52.4
4.000	26.64	15.12	38.500	0.000	0.0	0.0	0.0	1.43	25.2	0.0

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
4.001	46.084	0.307	150.1	0.235	0.00	0.0	0.600	o	225	Pipe/Conduit	
5.000	5.650	0.038	148.7	0.000	15.00	0.0	0.600	o	150	Pipe/Conduit	
5.001	7.050	0.807	8.7	0.107	0.00	0.0	0.600	o	225	Pipe/Conduit	
6.000	27.739	0.055	504.3	0.090	5.00	0.0	0.600	o	900	Pipe/Conduit	
6.001	41.740	0.083	502.9	0.056	0.00	0.0	0.600	o	900	Pipe/Conduit	
6.002	12.475	0.114	109.4	0.072	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.005	41.216	0.724	56.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	10.000#	0.100	100.0	0.000	15.00	0.0	0.600	o	225	Pipe/Conduit	
7.001	10.000#	0.100	100.0	0.156	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.002	40.188	0.241	166.8	0.040	0.00	0.0	0.600	o	450	Pipe/Conduit	
8.000	10.000#	0.699	14.3	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
8.001	10.000#	2.439	4.1	0.163	0.00	0.0	0.600	o	150	Pipe/Conduit	
7.003	103.792	0.622	166.9	0.035	0.00	0.0	0.600	o	450	Pipe/Conduit	
1.006	13.057	0.526	24.8	0.073	0.00	0.0	0.600	o	450	Pipe/Conduit	
9.000	10.000#	0.400	25.0	0.000	15.00	0.0	0.600	o	150	Pipe/Conduit	
9.001	7.831	1.144	6.8	0.403	0.00	0.0	0.600	o	150	Pipe/Conduit	
10.000	10.000#	0.313	31.9	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
10.001	17.659	1.262	14.0	0.038	0.00	0.0	0.600	o	150	Pipe/Conduit	

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of permeable paving

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
4.001	25.94	15.84	38.225	0.235	0.0	0.0	0.0	1.06	42.3	16.5
5.000	26.64	15.11	40.413	0.000	0.0	0.0	0.0	0.82	14.5	0.0
5.001	26.61	15.14	40.300	0.107	0.0	0.0	0.0	4.45	177.1	7.7
6.000	45.35	5.33	38.200	0.090	0.0	0.0	0.0	1.39	883.2	11.0
6.001	43.60	5.83	38.145	0.146	0.0	0.0	0.0	1.39	884.5	17.3
6.002	43.15	5.97	38.062	0.218	0.0	0.0	0.0	1.50	106.2	25.5
1.005	24.59	17.38	37.918	1.338	0.0	0.0	0.0	2.09	147.6	89.1
7.000	26.63	15.13	37.000	0.000	0.0	0.0	0.0	1.31	52.0	0.0
7.001	26.50	15.25	36.900	0.156	0.0	0.0	0.0	1.31	52.0	11.2
7.002	26.09	15.68	36.800	0.196	0.0	0.0	0.0	1.57	249.9	13.8
8.000	46.37	5.06	39.723	0.000	0.0	0.0	0.0	2.68	47.3	0.0
8.001	46.24	5.10	39.024	0.163	0.0	0.0	0.0	5.01	88.6	20.4
7.003	25.10	16.78	36.285	0.394	0.0	0.0	0.0	1.57	249.9	26.8
1.006	24.55	17.44	35.663	1.805	0.0	0.0	0.0	4.09	651.1	120.0
9.000	26.67	15.08	38.500	0.000	0.0	0.0	0.0	2.02	35.7	0.0
9.001	26.64	15.12	38.100	0.403	0.0	0.0	0.0	3.88	68.5	29.1
10.000	46.25	5.09	40.106	0.000	0.0	0.0	0.0	1.79	31.6	0.0
10.001	45.83	5.20	39.793	0.038	0.0	0.0	0.0	2.71	47.8	4.7

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
9.002	54.826	0.372	147.4	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
11.000	10.000#	0.156	64.1	0.000	15.00	0.0	0.600	o	150	Pipe/Conduit	
11.001	4.209	0.071	59.3	0.326	0.00	0.0	0.600	o	225	Pipe/Conduit	
12.000	10.000#	0.074	135.1	0.029	5.00	0.0	0.600	o	150	Pipe/Conduit	
12.001	13.164	1.000	13.2	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
9.003	36.816	0.326	112.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
9.004	41.714	0.226	184.6	0.020	0.00	0.0	0.600	o	450	Pipe/Conduit	
13.000	10.000#	0.085	117.6	0.000	15.00	0.0	0.600	o	150	Pipe/Conduit	
13.001	5.861	0.550	10.7	0.288	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.007	24.884	1.945	12.8	0.020	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.008	10.000#	1.000	10.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.009	14.381	0.144	99.9	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.010	13.612	0.972	14.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.011	4.000#	0.021	190.5	0.000	0.00	20.7	0.600	o	450	Pipe/Conduit	

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of permeable paving

Dummy pipe upstream of indicative plot storage/flow control

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
9.002	25.96	15.82	36.956	0.441	0.0	0.0	0.0	1.29	91.4	31.0
11.000	26.62	15.13	37.507	0.000	0.0	0.0	0.0	1.26	22.2	0.0
11.001	26.58	15.17	37.351	0.326	0.0	0.0	0.0	1.70	67.7	23.5
12.000	45.87	5.19	38.938	0.029	0.0	0.0	0.0	0.86	15.2	3.6
12.001	45.57	5.27	38.864	0.029	0.0	0.0	0.0	2.79	49.3	3.6
9.003	25.66	16.14	36.359	0.796	0.0	0.0	0.0	1.91	304.2	55.3
9.004	25.25	16.61	36.033	0.816	0.0	0.0	0.0	1.49	237.5	55.8
13.000	26.57	15.18	37.735	0.000	0.0	0.0	0.0	0.93	16.4	0.0
13.001	26.54	15.21	37.650	0.288	0.0	0.0	0.0	3.10	54.9	20.7
1.007	24.48	17.52	35.137	2.929	0.0	0.0	0.0	5.09	562.1	194.2
1.008	24.46	17.55	32.211	2.929	0.0	0.0	0.0	5.76	635.9	194.2
1.009	24.35	17.68	31.211	2.929	0.0	0.0	0.0	1.81	200.3	194.2
1.010	24.32	17.73	30.000	2.929	0.0	0.0	0.0	4.86	537.2	194.2
1.011	24.28	17.77	27.431	2.929	20.7	0.0	0.0	1.47	233.7	213.3

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.000	0.000	0.000
1.001	User	-	100	0.283	0.283	0.283
1.002	-	-	100	0.000	0.000	0.000
2.000	-	-	100	0.000	0.000	0.000
2.001	User	-	100	0.304	0.304	0.304
1.003	-	-	100	0.000	0.000	0.000
3.000	-	-	100	0.000	0.000	0.000
3.001	User	-	100	0.192	0.192	0.192
1.004	-	-	100	0.000	0.000	0.000
4.000	-	-	100	0.000	0.000	0.000
4.001	User	-	100	0.235	0.235	0.235
5.000	-	-	100	0.000	0.000	0.000
5.001	User	-	100	0.107	0.107	0.107
6.000	User	-	100	0.090	0.090	0.090
6.001	User	-	100	0.056	0.056	0.056
6.002	User	-	100	0.072	0.072	0.072
1.005	-	-	100	0.000	0.000	0.000
7.000	-	-	100	0.000	0.000	0.000
7.001	User	-	100	0.156	0.156	0.156
7.002	User	-	100	0.040	0.040	0.040
8.000	-	-	100	0.000	0.000	0.000
8.001	User	-	100	0.163	0.163	0.163
7.003	User	-	100	0.035	0.035	0.035
1.006	User	-	100	0.073	0.073	0.073
9.000	-	-	100	0.000	0.000	0.000
9.001	User	-	100	0.403	0.403	0.403
10.000	-	-	100	0.000	0.000	0.000
10.001	User	-	100	0.038	0.038	0.038
9.002	-	-	100	0.000	0.000	0.000
11.000	-	-	100	0.000	0.000	0.000
11.001	User	-	100	0.326	0.326	0.326
12.000	User	-	100	0.029	0.029	0.029
12.001	-	-	100	0.000	0.000	0.000
9.003	-	-	100	0.000	0.000	0.000
9.004	User	-	100	0.020	0.020	0.020
13.000	-	-	100	0.000	0.000	0.000
13.001	User	-	100	0.288	0.288	0.288
1.007	User	-	100	0.020	0.020	0.020
1.008	-	-	100	0.000	0.000	0.000
1.009	-	-	100	0.000	0.000	0.000
1.010	-	-	100	0.000	0.000	0.000
1.011	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				2.929	2.929	2.929

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.011	43	30.000	27.410	27.160	0	0

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.840	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	240
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	4

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	13	Number of Storage Structures	11	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Winter
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	120
Ratio R	0.357		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 2, DS/PN: 1.001, Volume (m³): 0.9

Flow control for permeable paving

Unit Reference	MD-SHE-0130-7200-0700-7200
Design Head (m)	0.700
Design Flow (l/s)	7.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	130
Invert Level (m)	41.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	7.2	Kick-Flo®	0.499	6.1
Flush-Flo™	0.228	7.2	Mean Flow over Head Range	-	6.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.7	0.800	7.7	2.000	11.8	4.000	16.4	7.000	21.5
0.200	7.2	1.000	8.5	2.200	12.3	4.500	17.4	7.500	22.1
0.300	7.1	1.200	9.3	2.400	12.9	5.000	18.2	8.000	22.8
0.400	6.9	1.400	10.0	2.600	13.4	5.500	19.1	8.500	23.6
0.500	6.2	1.600	10.6	3.000	14.3	6.000	19.9	9.000	24.2
0.600	6.7	1.800	11.2	3.500	15.4	6.500	20.7	9.500	24.9

Hydro-Brake® Optimum Manhole: 14, DS/PN: 2.001, Volume (m³): 1.1

Flow control for permeable paving

Unit Reference	MD-SHE-0128-7000-0700-7000
Design Head (m)	0.700
Design Flow (l/s)	7.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	128
Invert Level (m)	40.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	7.0	Kick-Flo®	0.496	6.0
Flush-Flo™	0.225	7.0	Mean Flow over Head Range	-	5.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.6	0.600	6.5	1.600	10.3	2.600	13.0	5.000	17.7
0.200	7.0	0.800	7.5	1.800	10.9	3.000	13.9	5.500	18.6
0.300	6.9	1.000	8.3	2.000	11.5	3.500	15.0	6.000	19.4
0.400	6.7	1.200	9.0	2.200	12.0	4.000	16.0	6.500	20.1
0.500	6.0	1.400	9.7	2.400	12.5	4.500	16.9	7.000	20.9

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Hydro-Brake® Optimum Manhole: 14, DS/PN: 2.001, Volume (m³): 1.1

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.500	21.5	8.000	22.2	8.500	22.9	9.000	23.6	9.500	24.2

Hydro-Brake® Optimum Manhole: 16, DS/PN: 3.001, Volume (m³): 0.9

Flow control for permeable paving

Unit Reference	MD-SHE-0104-4400-0700-4400
Design Head (m)	0.700
Design Flow (l/s)	4.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	104
Invert Level (m)	39.900
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	4.4	Kick-Flo®	0.480	3.7
Flush-Flo™	0.214	4.4	Mean Flow over Head Range	-	3.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.5	0.800	4.7	2.000	7.2	4.000	9.9	7.000	13.0
0.200	4.4	1.000	5.2	2.200	7.5	4.500	10.5	7.500	13.4
0.300	4.3	1.200	5.6	2.400	7.8	5.000	11.1	8.000	13.8
0.400	4.1	1.400	6.1	2.600	8.1	5.500	11.6	8.500	14.3
0.500	3.8	1.600	6.5	3.000	8.7	6.000	12.1	9.000	14.7
0.600	4.1	1.800	6.8	3.500	9.3	6.500	12.5	9.500	15.1

Hydro-Brake® Optimum Manhole: 18, DS/PN: 4.001, Volume (m³): 3.3

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0099-5200-1600-5200
Design Head (m)	1.600
Design Flow (l/s)	5.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	99
Invert Level (m)	38.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.600	5.2	Kick-Flo®	0.880	3.9
Flush-Flo™	0.432	4.9	Mean Flow over Head Range	-	4.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.2	0.300	4.8	0.500	4.9	0.800	4.4	1.200	4.5
0.200	4.5	0.400	4.9	0.600	4.8	1.000	4.2	1.400	4.9

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Hydro-Brake® Optimum Manhole: 18, DS/PN: 4.001, Volume (m³): 3.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.600	5.2	2.400	6.3	4.000	8.0	6.000	9.7	8.000	11.1
1.800	5.5	2.600	6.5	4.500	8.4	6.500	10.1	8.500	11.4
2.000	5.8	3.000	7.0	5.000	8.9	7.000	10.4	9.000	11.7
2.200	6.0	3.500	7.5	5.500	9.3	7.500	10.8	9.500	12.1

Hydro-Brake® Optimum Manhole: 20, DS/PN: 5.001, Volume (m³): 0.9

Flow control for permeable paving

Unit Reference	MD-SHE-0080-2500-0700-2500
Design Head (m)	0.700
Design Flow (l/s)	2.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	80
Invert Level (m)	40.300
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	2.5	Kick-Flo®	0.456	2.1
Flush-Flo™	0.207	2.5	Mean Flow over Head Range	-	2.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.3	0.800	2.7	2.000	4.1	4.000	5.6	7.000	7.3
0.200	2.5	1.000	2.9	2.200	4.2	4.500	5.9	7.500	7.5
0.300	2.4	1.200	3.2	2.400	4.4	5.000	6.2	8.000	7.8
0.400	2.3	1.400	3.4	2.600	4.6	5.500	6.5	8.500	8.0
0.500	2.1	1.600	3.7	3.000	4.9	6.000	6.8	9.000	8.3
0.600	2.3	1.800	3.9	3.500	5.3	6.500	7.0	9.500	8.5

Hydro-Brake® Optimum Manhole: 23, DS/PN: 6.002, Volume (m³): 35.4

Flow control for oversized pipe

Unit Reference	MD-SHE-0187-2000-1800-2000
Design Head (m)	1.800
Design Flow (l/s)	20.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	187
Invert Level (m)	38.062
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1800

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.800	20.0	Kick-Flo®	1.126	16.0
Flush-Flo™	0.522	20.0	Mean Flow over Head Range	-	17.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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Hydro-Brake® Optimum Manhole: 23, DS/PN: 6.002, Volume (m³): 35.4

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.5	0.800	19.3	2.000	21.0	4.000	29.3	7.000	38.4
0.200	17.0	1.000	17.9	2.200	22.0	4.500	31.0	7.500	39.7
0.300	19.0	1.200	16.5	2.400	22.9	5.000	32.6	8.000	40.9
0.400	19.7	1.400	17.7	2.600	23.8	5.500	34.1	8.500	42.1
0.500	20.0	1.600	18.9	3.000	25.5	6.000	35.6	9.000	43.3
0.600	19.9	1.800	20.0	3.500	27.5	6.500	37.0	9.500	44.5

Hydro-Brake® Optimum Manhole: 25, DS/PN: 7.001, Volume (m³): 3.2

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0074-3400-2155-3400
Design Head (m)	2.155
Design Flow (l/s)	3.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	74
Invert Level (m)	36.900
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.155	3.4	Kick-Flo®	0.656	2.0
Flush-Flo™	0.319	2.5	Mean Flow over Head Range	-	2.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.0	0.800	2.2	2.000	3.3	4.000	4.5	7.000	5.9
0.200	2.4	1.000	2.4	2.200	3.4	4.500	4.8	7.500	6.1
0.300	2.5	1.200	2.6	2.400	3.6	5.000	5.0	8.000	6.3
0.400	2.4	1.400	2.8	2.600	3.7	5.500	5.3	8.500	6.5
0.500	2.4	1.600	3.0	3.000	4.0	6.000	5.5	9.000	6.6
0.600	2.2	1.800	3.1	3.500	4.3	6.500	5.7	9.500	6.8

Hydro-Brake® Optimum Manhole: 29, DS/PN: 8.001, Volume (m³): 1.3

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0092-3600-0900-3600
Design Head (m)	0.900
Design Flow (l/s)	3.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	92
Invert Level (m)	39.024
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.900	3.6	Kick-Flo®	0.574	2.9
Flush-Flo™	0.267	3.6	Mean Flow over Head Range	-	3.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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Hydro-Brake® Optimum Manhole: 29, DS/PN: 8.001, Volume (m³): 1.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.9	0.800	3.4	2.000	5.2	4.000	7.2	7.000	9.4
0.200	3.5	1.000	3.8	2.200	5.4	4.500	7.6	7.500	9.7
0.300	3.6	1.200	4.1	2.400	5.7	5.000	8.0	8.000	10.0
0.400	3.5	1.400	4.4	2.600	5.9	5.500	8.4	8.500	10.3
0.500	3.3	1.600	4.7	3.000	6.3	6.000	8.7	9.000	10.6
0.600	3.0	1.800	5.0	3.500	6.8	6.500	9.1	9.500	10.9

Hydro-Brake® Optimum Manhole: 31, DS/PN: 9.001, Volume (m³): 3.4

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0119-8900-2300-8900
Design Head (m)	2.300
Design Flow (l/s)	8.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	38.100
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.300	8.9	Kick-Flo®	1.068	6.2
Flush-Flo™	0.524	7.8	Mean Flow over Head Range	-	7.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.2	0.800	7.5	2.000	8.3	4.000	11.6	7.000	15.1
0.200	6.7	1.000	6.7	2.200	8.7	4.500	12.2	7.500	15.6
0.300	7.4	1.200	6.6	2.400	9.1	5.000	12.9	8.000	16.1
0.400	7.7	1.400	7.0	2.600	9.4	5.500	13.5	8.500	16.6
0.500	7.8	1.600	7.5	3.000	10.1	6.000	14.0	9.000	17.0
0.600	7.8	1.800	7.9	3.500	10.9	6.500	14.6	9.500	17.5

Hydro-Brake® Optimum Manhole: 38, DS/PN: 11.001, Volume (m³): 3.3

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0108-7200-2200-7200
Design Head (m)	2.200
Design Flow (l/s)	7.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	108
Invert Level (m)	37.351
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.200	7.2	Kick-Flo®	0.963	4.9
Flush-Flo™	0.468	6.2	Mean Flow over Head Range	-	5.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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Hydro-Brake® Optimum Manhole: 38, DS/PN: 11.001, Volume (m³): 3.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	0.800	5.7	2.000	6.9	4.000	9.5	7.000	12.4
0.200	5.5	1.000	5.0	2.200	7.2	4.500	10.1	7.500	12.9
0.300	6.0	1.200	5.4	2.400	7.5	5.000	10.6	8.000	13.3
0.400	6.1	1.400	5.8	2.600	7.8	5.500	11.1	8.500	13.7
0.500	6.2	1.600	6.2	3.000	8.3	6.000	11.6	9.000	14.0
0.600	6.1	1.800	6.6	3.500	9.0	6.500	12.0	9.500	14.4

Hydro-Brake® Optimum Manhole: 42, DS/PN: 13.001, Volume (m³): 3.0

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0118-6300-1000-6300
Design Head (m)	1.000
Design Flow (l/s)	6.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	118
Invert Level (m)	37.650
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	6.3	Kick-Flo®	0.652	5.2
Flush-Flo™	0.299	6.3	Mean Flow over Head Range	-	5.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.2	0.800	5.7	2.000	8.7	4.000	12.1	7.000	15.8
0.200	6.1	1.000	6.3	2.200	9.1	4.500	12.8	7.500	16.3
0.300	6.3	1.200	6.8	2.400	9.5	5.000	13.4	8.000	16.8
0.400	6.2	1.400	7.4	2.600	9.8	5.500	14.1	8.500	17.3
0.500	6.0	1.600	7.8	3.000	10.5	6.000	14.7	9.000	17.8
0.600	5.6	1.800	8.3	3.500	11.3	6.500	15.2	9.500	18.3

Hydro-Brake® Optimum Manhole: 8, DS/PN: 1.007, Volume (m³): 23.5

Flow control to restrict flows down hillside

Unit Reference	MD-SHE-0305-7500-4200-7500
Design Head (m)	4.200
Design Flow (l/s)	75.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	305
Invert Level (m)	35.137
Minimum Outlet Pipe Diameter (mm)	Site Specific Design (Contact Hydro International)
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	4.200	75.0	Kick-Flo®	2.489	58.2
Flush-Flo™	1.194	74.8	Mean Flow over Head Range	-	65.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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Hydro-Brake® Optimum Manhole: 8, DS/PN: 1.007, Volume (m³): 23.5

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.3	0.800	72.7	2.000	69.7	4.000	73.2	7.000	96.1
0.200	31.3	1.000	74.4	2.200	66.3	4.500	77.5	7.500	99.4
0.300	53.5	1.200	74.8	2.400	61.2	5.000	81.6	8.000	102.5
0.400	62.0	1.400	74.5	2.600	59.4	5.500	85.4	8.500	105.6
0.500	66.0	1.600	73.5	3.000	63.7	6.000	89.1	9.000	108.6
0.600	69.0	1.800	72.0	3.500	68.6	6.500	92.7	9.500	111.5

Hydro-Brake® Optimum Manhole: 11, DS/PN: 1.010, Volume (m³): 3.1

Flow control for network outfall

Unit Reference	MD-SHE-0324-6550-1500-6550
Design Head (m)	1.500
Design Flow (l/s)	65.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	324
Invert Level (m)	30.000
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	65.5	Kick-Flo®	1.097	56.3
Flush-Flo™	0.542	65.5	Mean Flow over Head Range	-	54.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.7	0.800	63.8	2.000	75.3	4.000	105.4	7.000	138.5
0.200	33.1	1.000	60.2	2.200	78.8	4.500	111.6	7.500	143.3
0.300	58.7	1.200	58.8	2.400	82.2	5.000	117.5	8.000	147.9
0.400	64.4	1.400	63.4	2.600	85.5	5.500	123.1	8.500	152.3
0.500	65.4	1.600	67.6	3.000	91.7	6.000	128.5	9.000	156.6
0.600	65.4	1.800	71.5	3.500	98.8	6.500	133.6	9.500	160.8

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Storage Structures for Storm

Tank or Pond Manhole: 2, DS/PN: 1.001

Invert Level (m) 41.500

Depth (m)	Area (m²)
0.000	215.0

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 14, DS/PN: 2.001

Invert Level (m) 40.500

Depth (m)	Area (m²)
0.000	350.0

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 16, DS/PN: 3.001

Invert Level (m) 40.100

Depth (m)	Area (m²)
0.000	200.0

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 18, DS/PN: 4.001

Invert Level (m) 39.306

Depth (m)	Area (m²)
0.000	160.0

Tank to indicatively represent Plot storage.

Tank or Pond Manhole: 20, DS/PN: 5.001

Invert Level (m) 40.500

Depth (m)	Area (m²)
0.000	181.5

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 25, DS/PN: 7.001

Invert Level (m) 38.448

Depth (m)	Area (m²)
0.000	100.0

Tank to indicatively represent Plot storage.

Tank or Pond Manhole: 29, DS/PN: 8.001

Invert Level (m) 39.024

Depth (m)	Area (m²)
0.000	80.0

Tank to indicatively represent Plot storage.

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Tank or Pond Manhole: 31, DS/PN: 9.001

Invert Level (m) 39.772

Depth (m)	Area (m²)
0.000	217.0

Tank to indicatively represent Plot storage.

Tank or Pond Manhole: 38, DS/PN: 11.001

Invert Level (m) 39.076

Depth (m)	Area (m²)
0.000	191.0

Tank to indicatively represent Plot storage.

Tank or Pond Manhole: 42, DS/PN: 13.001

Invert Level (m) 37.650

Depth (m)	Area (m²)
0.000	142.0

Tank to indicatively represent Plot storage.

Tank or Pond Manhole: 11, DS/PN: 1.010

Invert Level (m) 31.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	178.0	0.600	0.0	1.200	0.0	1.800	0.0	2.400	0.0
0.100	193.6	0.700	0.0	1.300	0.0	1.900	0.0	2.500	0.0
0.200	209.2	0.800	0.0	1.400	0.0	2.000	0.0		
0.300	224.8	0.900	0.0	1.500	0.0	2.100	0.0		
0.400	240.4	1.000	0.0	1.600	0.0	2.200	0.0		
0.500	256.0	1.100	0.0	1.700	0.0	2.300	0.0		

Tank to represent storage basin

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	13	Number of Storage Structures	11	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	18.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.357	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	1	120 Winter	100	+40%	100/15 Summer				41.942	0.366
1.001	2	120 Winter	100	+40%	100/15 Summer				41.942	0.417
1.002	3	360 Summer	100	+40%					41.317	-0.164
2.000	13	120 Winter	100	+40%	100/15 Summer				40.812	0.185
2.001	14	120 Winter	100	+40%	100/15 Summer				40.812	0.287
1.003	4	240 Summer	100	+40%					40.324	-0.215
3.000	15	120 Winter	100	+40%	100/15 Summer				40.447	0.297
3.001	16	120 Winter	100	+40%	100/15 Summer				40.447	0.397
1.004	5	360 Winter	100	+40%					39.606	-0.204
4.000	17	120 Winter	100	+40%	100/15 Summer				39.849	1.199
4.001	18	120 Winter	100	+40%	100/15 Summer				39.849	1.399
5.000	19	120 Winter	100	+40%	100/15 Summer				40.708	0.145
5.001	20	120 Winter	100	+40%	100/15 Summer				40.708	0.183
6.000	21	60 Winter	100	+40%					39.006	-0.094
6.001	22	60 Winter	100	+40%					39.005	-0.040
6.002	23	60 Winter	100	+40%	100/15 Summer				39.003	0.641
1.005	6	60 Winter	100	+40%	100/30 Summer				38.847	0.629
7.000	24	240 Winter	100	+40%	100/15 Summer				39.021	1.796
7.001	25	240 Winter	100	+40%	100/15 Summer				39.021	1.896
7.002	26	60 Winter	100	+40%	100/15 Summer				38.815	1.565
8.000	28	120 Winter	100	+40%					39.807	-0.066
8.001	29	120 Winter	100	+40%	100/15 Summer				39.807	0.633
7.003	27	60 Winter	100	+40%	100/15 Summer				38.812	2.077
1.006	7	60 Winter	100	+40%	100/15 Summer				38.803	2.690
9.000	30	120 Winter	100	+40%	100/15 Summer				40.448	1.798
9.001	31	120 Winter	100	+40%	100/15 Summer				40.449	2.199
10.000	35	15 Summer	100	+40%					40.106	-0.150
10.001	36	15 Winter	100	+40%					39.867	-0.076
9.002	32	60 Winter	100	+40%	100/15 Summer				38.832	1.576
11.000	37	120 Winter	100	+40%	100/15 Summer				39.704	2.047
11.001	38	120 Winter	100	+40%	100/15 Summer				39.704	2.128
12.000	39	15 Winter	100	+40%	100/15 Summer				39.103	0.015
12.001	40	15 Winter	100	+40%					38.932	-0.082
9.003	33	60 Winter	100	+40%	100/15 Summer				38.812	2.003

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.00			0.0	FLOOD RISK	
1.001	2	0.000	0.24			7.2	FLOOD RISK	
1.002	3	0.000	0.16			7.2	OK	
2.000	13	0.000	0.00			0.0	FLOOD RISK	
2.001	14	0.000	0.20			7.0	FLOOD RISK	
1.003	4	0.000	0.18			14.1	OK	
3.000	15	0.000	0.00			0.0	FLOOD RISK	
3.001	16	0.000	0.15			4.3	FLOOD RISK	
1.004	5	0.000	0.23			18.4	OK	
4.000	17	0.000	0.00			0.0	SURCHARGED	
4.001	18	0.000	0.12			5.0	SURCHARGED	
5.000	19	0.000	0.00			0.0	FLOOD RISK	
5.001	20	0.000	0.02			2.5	FLOOD RISK	
6.000	21	0.000	0.04			23.8	OK	
6.001	22	0.000	0.03			23.7	OK	
6.002	23	0.000	0.24			20.0	SURCHARGED	
1.005	6	0.000	0.33			45.4	SURCHARGED	
7.000	24	0.000	0.00			0.0	SURCHARGED	
7.001	25	0.000	0.08			3.3	SURCHARGED	
7.002	26	0.000	0.07			14.0	SURCHARGED	
8.000	28	0.000	0.00			0.0	FLOOD RISK	
8.001	29	0.000	0.05			3.6	FLOOD RISK	
7.003	27	0.000	0.10			23.3	SURCHARGED	
1.006	7	0.000	0.16			65.5	SURCHARGED	
9.000	30	0.000	0.00			0.0	SURCHARGED	
9.001	31	0.000	0.15			8.8	SURCHARGED	
10.000	35	0.000	0.00			0.0	OK	
10.001	36	0.000	0.48			21.6	OK	
9.002	32	0.000	0.25			19.1	SURCHARGED	
11.000	37	0.000	0.00			0.0	SURCHARGED	
11.001	38	0.000	0.24			7.2	SURCHARGED	
12.000	39	0.000	1.10			15.0	SURCHARGED	
12.001	40	0.000	0.41			15.2	OK	
9.003	33	0.000	0.11			29.9	SURCHARGED	

Any exceedance will flow down Plateau Road and pass into downstream permeable paving.

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
9.004	34	60 Winter	100	+40%	100/15 Summer				38.802	2.319
13.000	41	120 Winter	100	+40%	100/15 Summer				38.637	0.752
13.001	42	120 Winter	100	+40%	100/15 Summer				38.637	0.837
1.007	8	60 Winter	100	+40%	100/15 Summer				38.787	3.275
1.008	9	120 Summer	100	+40%					32.321	-0.265
1.009	10	480 Winter	100	+40%					31.436	-0.150
1.010	11	480 Winter	100	+40%	100/15 Summer				31.397	1.022
1.011	12	360 Winter	100	+40%					27.711	-0.170

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
9.004	34	0.000	0.15			25.4	SURCHARGED	
13.000	41	0.000	0.00			0.0	SURCHARGED	
13.001	42	0.000	0.19			6.3	SURCHARGED	
1.007	8	0.000	0.17			72.4	SURCHARGED	
1.008	9	0.000	0.19			72.9	OK	
1.009	10	0.000	0.54			72.9	OK	
1.010	11	0.000	0.23			65.5	FLOOD RISK	
1.011	12	0.000	0.71			86.2	OK	

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A4 Appendix 5 Catchment 5 surface network report

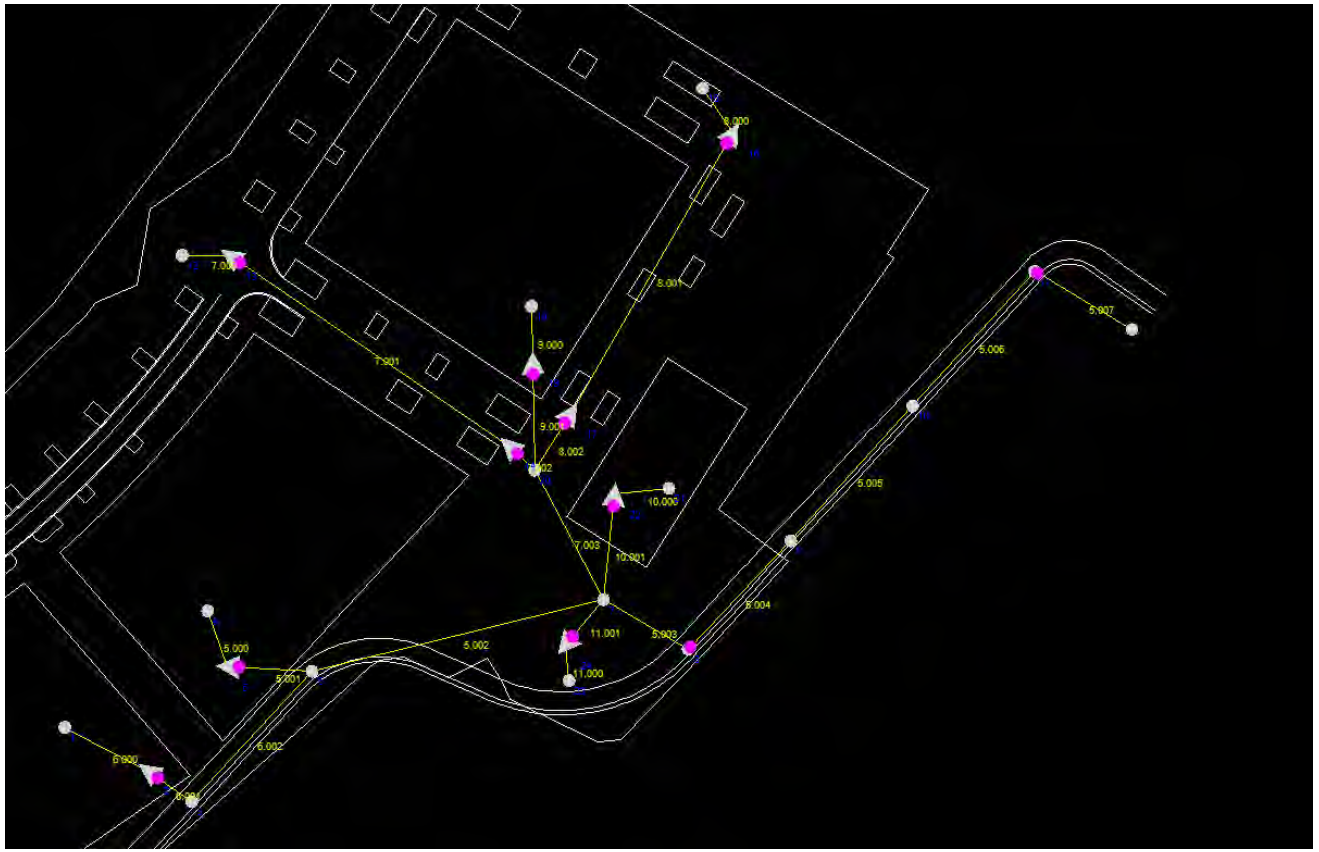


Figure 7 Catchment 5 model layout

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	40
Ratio R	0.357	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	150

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
5.000	12.576	0.080	157.2	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
5.001	18.098	0.300	60.3	0.410	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	20.031	0.200	100.2	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.001	11.360	0.113	100.5	0.415	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.002	37.779	0.252	149.9	0.034	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.002	63.874	0.386	165.5	0.045	0.00	0.0	0.600	o	375	Pipe/Conduit	
7.000	10.216	0.100	102.2	0.000	15.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	71.762	0.478	150.1	0.215	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.002	7.570	0.076	99.6	0.139	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.000	11.511	0.115	100.1	0.000	15.00	0.0	0.600	o	150	Pipe/Conduit	
8.001	68.841	0.459	150.0	0.171	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.002	14.379	0.144	99.9	0.129	0.00	0.0	0.600	o	225	Pipe/Conduit	

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of permeable paving

Dummy pipe upstream of permeable paving

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.000	45.61	5.26	39.778	0.000	0.0	0.0	0.0	0.80	14.1	0.0
5.001	45.07	5.41	39.548	0.410	0.0	0.0	20.0	2.03	143.3	70.1
6.000	45.35	5.33	39.963	0.000	0.0	0.0	0.0	1.00	17.7	0.0
6.001	44.91	5.45	39.613	0.415	0.0	0.0	20.2	1.57	110.8	70.6
6.002	43.24	5.94	39.500	0.448	0.0	0.0	21.0	1.28	90.6	73.5
5.002	40.91	6.70	39.173	0.904	0.0	0.0	40.1	1.41	155.3	140.2
7.000	26.58	15.17	42.475	0.000	0.0	0.0	0.0	0.99	17.6	0.0
7.001	25.53	16.29	42.300	0.215	0.0	0.0	6.0	1.06	42.3	20.8
7.002	25.44	16.39	41.822	0.355	0.0	0.0	9.8	1.31	52.1	34.2
8.000	26.56	15.19	42.490	0.000	0.0	0.0	0.0	1.00	17.7	0.0
8.001	25.55	16.27	42.300	0.171	0.0	0.0	4.7	1.07	42.4	16.6
8.002	25.39	16.45	41.841	0.300	0.0	0.0	8.3	1.31	52.0	28.9

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
9.000	11.979	0.120	99.8	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
9.001	22.901	0.303	75.6	0.369	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.003	31.225	1.488	21.0	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
10.000	11.653	0.117	99.6	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
10.001	22.543	0.300	75.1	0.237	0.00	0.0	0.600	o	225	Pipe/Conduit	
11.000	7.501	0.075	100.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
11.001	12.683	1.212	10.5	0.260	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.003	20.862	0.298	70.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
5.004	31.740	0.212	149.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.005	38.687	0.258	149.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.006	38.687	0.258	149.9	0.026	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.007	24.121	0.500	48.2	0.024	0.00	0.0	0.600	o	450	Pipe/Conduit	

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of permeable paving

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
9.000	45.85	5.20	40.923	0.000	0.0	0.0	0.0	1.01	17.8	0.0
9.001	45.07	5.41	40.653	0.369	0.0	0.0	18.0	1.81	128.0	63.0
7.003	25.25	16.60	40.350	1.023	0.0	0.0	28.0	3.45	243.7	98.0
10.000	45.87	5.19	40.420	0.000	0.0	0.0	0.0	1.01	17.8	0.0
10.001	44.96	5.44	40.228	0.237	0.0	0.0	11.5	1.51	60.0	40.3
11.000	46.13	5.12	41.500	0.000	0.0	0.0	0.0	1.00	17.8	0.0
11.001	45.87	5.19	41.425	0.260	0.0	0.0	12.9	3.13	55.4	45.3
5.003	25.12	16.76	38.787	2.424	0.0	0.0	65.9	2.17	239.5	230.8
5.004	24.84	17.08	38.414	2.424	0.0	0.0	65.9	1.66	263.9	230.8
5.005	24.52	17.47	36.728	2.424	0.0	0.0	65.9	1.66	263.7	230.8
5.006	24.21	17.86	34.996	2.450	0.0	0.0	65.9	1.66	263.7	230.8
5.007	24.10	18.00	33.265	2.474	0.0	0.0	65.9	2.93	466.5	230.8

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
5.000	-	-	100	0.000	0.000	0.000
5.001	User	-	100	0.410	0.410	0.410
6.000	-	-	100	0.000	0.000	0.000
6.001	User	-	100	0.415	0.415	0.415
6.002	User	-	100	0.034	0.034	0.034
5.002	User	-	100	0.045	0.045	0.045
7.000	-	-	100	0.000	0.000	0.000
7.001	User	-	100	0.215	0.215	0.215
7.002	User	-	100	0.139	0.139	0.139
8.000	-	-	100	0.000	0.000	0.000
8.001	User	-	100	0.171	0.171	0.171
8.002	User	-	100	0.129	0.129	0.129
9.000	-	-	100	0.000	0.000	0.000
9.001	User	-	100	0.369	0.369	0.369
7.003	-	-	100	0.000	0.000	0.000
10.000	-	-	100	0.000	0.000	0.000
10.001	User	-	100	0.237	0.237	0.237
11.000	-	-	100	0.000	0.000	0.000
11.001	User	-	100	0.260	0.260	0.260
5.003	-	-	100	0.000	0.000	0.000
5.004	-	-	100	0.000	0.000	0.000
5.005	-	-	100	0.000	0.000	0.000
5.006	User	-	100	0.026	0.026	0.026
5.007	User	-	100	0.024	0.024	0.024
				Total	Total	Total
				2.474	2.474	2.474

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
5.007		33.500	32.765	29.500	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 11	Number of Storage Structures 9	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.357		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 5, DS/PN: 5.001, Volume (m³): 3.0

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0139-9000-1000-9000
Design Head (m)	1.000
Design Flow (l/s)	9.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	139
Invert Level (m)	39.548
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	9.0	Kick-Flo®	0.668	7.5
Flush-Flo™	0.301	9.0	Mean Flow over Head Range	-	7.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	0.800	8.1	2.000	12.5	4.000	17.4	7.000	22.7
0.200	8.7	1.000	9.0	2.200	13.1	4.500	18.4	7.500	23.5
0.300	9.0	1.200	9.8	2.400	13.6	5.000	19.3	8.000	24.2
0.400	8.9	1.400	10.5	2.600	14.1	5.500	20.2	8.500	24.9
0.500	8.6	1.600	11.2	3.000	15.1	6.000	21.1	9.000	25.6
0.600	8.2	1.800	11.9	3.500	16.3	6.500	21.9	9.500	26.3

Hydro-Brake® Optimum Manhole: 2, DS/PN: 6.001, Volume (m³): 3.0

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0132-9100-1500-9100
Design Head (m)	1.500
Design Flow (l/s)	9.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	132
Invert Level (m)	39.613
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	9.1	Kick-Flo®	0.931	7.3
Flush-Flo™	0.443	9.1	Mean Flow over Head Range	-	7.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.8	0.600	9.0	1.600	9.4	2.600	11.8	5.000	16.1
0.200	8.2	0.800	8.3	1.800	9.9	3.000	12.6	5.500	16.9
0.300	8.9	1.000	7.5	2.000	10.4	3.500	13.6	6.000	17.6
0.400	9.1	1.200	8.2	2.200	10.9	4.000	14.5	6.500	18.3
0.500	9.1	1.400	8.8	2.400	11.4	4.500	15.3	7.000	18.9

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Hydro-Brake® Optimum Manhole: 2, DS/PN: 6.001, Volume (m³): 3.0

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.500	19.6	8.000	20.2	8.500	20.8	9.000	21.3	9.500	21.9

Hydro-Brake® Optimum Manhole: 13, DS/PN: 7.001, Volume (m³): 1.0

Flow control for permeable paving

Unit Reference	MD-SHE-0111-5100-0700-5100
Design Head (m)	0.700
Design Flow (l/s)	5.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	42.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	5.1	Kick-Flo®	0.482	4.3
Flush-Flo™	0.214	5.1	Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.8	0.800	5.4	2.000	8.3	4.000	11.6	7.000	15.1
0.200	5.1	1.000	6.0	2.200	8.7	4.500	12.2	7.500	15.6
0.300	5.0	1.200	6.6	2.400	9.1	5.000	12.9	8.000	16.1
0.400	4.8	1.400	7.0	2.600	9.4	5.500	13.5	8.500	16.6
0.500	4.4	1.600	7.5	3.000	10.1	6.000	14.0	9.000	17.1
0.600	4.7	1.800	7.9	3.500	10.9	6.500	14.6	9.500	17.6

Hydro-Brake® Optimum Manhole: 14, DS/PN: 7.002, Volume (m³): 4.1

Flow control for permeable paving

Unit Reference	MD-SHE-0132-8400-1200-8400
Design Head (m)	1.200
Design Flow (l/s)	8.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	132
Invert Level (m)	41.822
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	8.4	Kick-Flo®	0.768	6.8
Flush-Flo™	0.357	8.4	Mean Flow over Head Range	-	7.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.7	0.300	8.3	0.500	8.2	0.800	6.9	1.200	8.4
0.200	7.9	0.400	8.4	0.600	8.0	1.000	7.7	1.400	9.0

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Hydro-Brake® Optimum Manhole: 14, DS/PN: 7.002, Volume (m³): 4.1

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.600	9.6	2.400	11.6	4.000	14.8	6.000	18.0	8.000	20.7
1.800	10.2	2.600	12.1	4.500	15.7	6.500	18.7	8.500	21.3
2.000	10.7	3.000	12.9	5.000	16.5	7.000	19.4	9.000	21.9
2.200	11.2	3.500	13.9	5.500	17.3	7.500	20.1	9.500	22.5

Hydro-Brake® Optimum Manhole: 16, DS/PN: 8.001, Volume (m³): 1.0

Flow control for permeable paving

Unit Reference	MD-SHE-0097-3800-0700-3800
Design Head (m)	0.700
Design Flow (l/s)	3.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	42.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	3.8	Kick-Flo®	0.469	3.2
Flush-Flo™	0.210	3.8	Mean Flow over Head Range	-	3.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.1	0.800	4.0	2.000	6.2	4.000	8.6	7.000	11.2
0.200	3.8	1.000	4.5	2.200	6.5	4.500	9.1	7.500	11.5
0.300	3.7	1.200	4.9	2.400	6.7	5.000	9.5	8.000	11.9
0.400	3.5	1.400	5.2	2.600	7.0	5.500	10.0	8.500	12.3
0.500	3.3	1.600	5.6	3.000	7.5	6.000	10.4	9.000	12.6
0.600	3.5	1.800	5.9	3.500	8.0	6.500	10.8	9.500	13.0

Hydro-Brake® Optimum Manhole: 17, DS/PN: 8.002, Volume (m³): 4.0

Flow control for permeable paving

Unit Reference	MD-SHE-0120-6900-1200-6900
Design Head (m)	1.200
Design Flow (l/s)	6.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	120
Invert Level (m)	41.841
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	6.9	Kick-Flo®	0.760	5.6
Flush-Flo™	0.356	6.9	Mean Flow over Head Range	-	6.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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Hydro-Brake® Optimum Manhole: 17, DS/PN: 8.002, Volume (m³): 4.0

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.2	0.800	5.7	2.000	8.8	4.000	12.2	7.000	15.9
0.200	6.5	1.000	6.3	2.200	9.2	4.500	12.9	7.500	16.4
0.300	6.9	1.200	6.9	2.400	9.5	5.000	13.5	8.000	16.9
0.400	6.9	1.400	7.4	2.600	9.9	5.500	14.2	8.500	17.4
0.500	6.8	1.600	7.9	3.000	10.6	6.000	14.8	9.000	17.9
0.600	6.5	1.800	8.3	3.500	11.4	6.500	15.3	9.500	18.4

Hydro-Brake® Optimum Manhole: 19, DS/PN: 9.001, Volume (m³): 2.8

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0125-8100-1500-8100
Design Head (m)	1.500
Design Flow (l/s)	8.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	125
Invert Level (m)	40.803
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	8.1	Kick-Flo®	0.922	6.4
Flush-Flo™	0.437	8.1	Mean Flow over Head Range	-	7.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.5	0.800	7.3	2.000	9.3	4.000	12.9	7.000	16.8
0.200	7.3	1.000	6.7	2.200	9.7	4.500	13.6	7.500	17.4
0.300	7.9	1.200	7.3	2.400	10.1	5.000	14.3	8.000	17.9
0.400	8.1	1.400	7.8	2.600	10.5	5.500	15.0	8.500	18.5
0.500	8.1	1.600	8.3	3.000	11.2	6.000	15.6	9.000	19.0
0.600	7.9	1.800	8.8	3.500	12.1	6.500	16.2	9.500	19.5

Hydro-Brake® Optimum Manhole: 22, DS/PN: 10.001, Volume (m³): 3.3

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0108-5200-1000-5200
Design Head (m)	1.000
Design Flow (l/s)	5.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	108
Invert Level (m)	40.230
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.2	Kick-Flo®	0.641	4.2
Flush-Flo™	0.296	5.2	Mean Flow over Head Range	-	4.5

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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Hydro-Brake® Optimum Manhole: 22, DS/PN: 10.001, Volume (m³): 3.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.7	0.800	4.7	2.000	7.2	4.000	10.0	7.000	13.0
0.200	5.1	1.000	5.2	2.200	7.5	4.500	10.5	7.500	13.4
0.300	5.2	1.200	5.7	2.400	7.8	5.000	11.1	8.000	13.9
0.400	5.1	1.400	6.1	2.600	8.1	5.500	11.6	8.500	14.3
0.500	4.9	1.600	6.5	3.000	8.7	6.000	12.1	9.000	14.7
0.600	4.5	1.800	6.8	3.500	9.4	6.500	12.6	9.500	15.1

Hydro-Brake® Optimum Manhole: 24, DS/PN: 11.001, Volume (m³): 1.3

Flow control for permeable paving

Unit Reference	MD-SHE-0119-6500-1000-6500
Design Head (m)	1.000
Design Flow (l/s)	6.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	41.425
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	6.5	Kick-Flo®	0.649	5.3
Flush-Flo™	0.296	6.5	Mean Flow over Head Range	-	5.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.2	0.800	5.9	2.000	9.0	4.000	12.5	7.000	16.3
0.200	6.3	1.000	6.5	2.200	9.4	4.500	13.2	7.500	16.9
0.300	6.5	1.200	7.1	2.400	9.8	5.000	13.9	8.000	17.4
0.400	6.4	1.400	7.6	2.600	10.2	5.500	14.5	8.500	17.9
0.500	6.2	1.600	8.1	3.000	10.9	6.000	15.2	9.000	18.4
0.600	5.8	1.800	8.6	3.500	11.7	6.500	15.7	9.500	18.9

Hydro-Brake® Optimum Manhole: 8, DS/PN: 5.004, Volume (m³): 8.2

Flow control to restrict flows down hillside

Unit Reference	MD-SHE-0267-4750-2484-4750
Design Head (m)	2.484
Design Flow (l/s)	47.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	267
Invert Level (m)	38.414
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.484	47.3	Kick-Flo®	1.561	37.8
Flush-Flo™	0.727	47.2	Mean Flow over Head Range	-	41.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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Hydro-Brake® Optimum Manhole: 8, DS/PN: 5.004, Volume (m³): 8.2

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.5	0.800	47.1	2.000	42.6	4.000	59.5	7.000	78.1
0.200	27.5	1.000	46.4	2.200	44.6	4.500	63.0	7.500	80.7
0.300	41.6	1.200	44.9	2.400	46.5	5.000	66.3	8.000	83.3
0.400	44.5	1.400	42.1	2.600	48.3	5.500	69.4	8.500	85.8
0.500	46.1	1.600	38.3	3.000	51.8	6.000	72.4	9.000	88.2
0.600	46.9	1.800	40.5	3.500	55.8	6.500	75.3	9.500	90.6

Hydro-Brake® Optimum Manhole: 11, DS/PN: 5.007, Volume (m³): 9.1

Flow control for network outfall

Unit Reference	MD-SHE-0299-5600-1808-5600
Design Head (m)	1.808
Design Flow (l/s)	56.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	299
Invert Level (m)	33.265
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.808	56.0	Kick-Flo®	1.248	46.8
Flush-Flo™	0.575	56.0	Mean Flow over Head Range	-	47.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.2	0.800	55.1	2.000	58.8	4.000	82.2	7.000	107.9
0.200	30.8	1.000	53.2	2.200	61.5	4.500	87.0	7.500	111.6
0.300	52.2	1.200	48.8	2.400	64.2	5.000	91.6	8.000	115.2
0.400	54.7	1.400	49.5	2.600	66.7	5.500	96.0	8.500	118.7
0.500	55.8	1.600	52.8	3.000	71.5	6.000	100.1	9.000	122.0
0.600	56.0	1.800	55.8	3.500	77.0	6.500	104.1	9.500	125.3

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Storage Structures for Storm

Tank or Pond Manhole: 5, DS/PN: 5.001

Invert Level (m) 39.548

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	180.0	1.000	180.0	1.001	0.0

Tank to indicatively represent Plot storage.

Tank or Pond Manhole: 2, DS/PN: 6.001

Invert Level (m) 39.613

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	170.0	1.000	170.0	1.001	0.0

Tank to indicatively represent Plot storage.

Tank or Pond Manhole: 13, DS/PN: 7.001

Invert Level (m) 42.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	225.0	0.500	225.0

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 14, DS/PN: 7.002

Invert Level (m) 42.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	62.5	0.500	62.5

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 16, DS/PN: 8.001

Invert Level (m) 42.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	175.0	0.500	175.0

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 17, DS/PN: 8.002

Invert Level (m) 42.500

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	62.5	0.500	62.5

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 19, DS/PN: 9.001

Invert Level (m) 40.728

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	150.0	1.000	150.0	1.001	0.0

Tank to indicatively represent Plot storage.

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Tank or Pond Manhole: 22, DS/PN: 10.001

Invert Level (m) 40.230

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	180.0	1.000	180.0	1.001	0.0

Tank to indicatively represent Plot storage.

Tank or Pond Manhole: 24, DS/PN: 11.001

Invert Level (m) 42.000

Depth (m)	Area (m²)
0.000	255.0

Tank to represent 0.5m deep permeable paving

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	11	Number of Storage Structures	9	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	18.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.357	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
5.000	4	240 Winter	100	+40%	100/15 Summer				41.677	1.749
5.001	5	240 Winter	100	+40%	100/15 Summer				41.677	1.829
6.000	1	240 Winter	100	+40%	100/15 Winter				41.942	1.829
6.001	2	240 Winter	100	+40%	100/15 Summer				41.942	2.029
6.002	3	240 Winter	100	+40%	100/15 Summer				40.868	1.068
5.002	6	240 Winter	100	+40%	100/15 Summer				40.856	1.308
7.000	12	120 Winter	100	+40%	100/15 Summer				42.939	0.314
7.001	13	120 Winter	100	+40%	100/15 Summer				42.939	0.414
7.002	14	60 Winter	100	+40%	100/15 Summer				42.939	0.892
8.000	15	120 Winter	100	+40%	100/15 Summer				42.951	0.311
8.001	16	120 Winter	100	+40%	100/15 Summer				42.952	0.427
8.002	17	60 Winter	100	+40%	100/15 Summer				42.937	0.871
9.000	18	240 Winter	100	+40%	100/15 Summer				42.365	1.292
9.001	19	240 Winter	100	+40%	100/15 Summer				42.365	1.412
7.003	20	240 Winter	100	+40%	100/120 Winter				40.866	0.216
10.000	21	240 Winter	100	+40%	100/30 Summer				40.868	0.298
10.001	22	240 Winter	100	+40%	100/15 Summer				40.868	0.415
11.000	23	120 Winter	100	+40%	100/15 Summer				42.350	0.700
11.001	24	120 Winter	100	+40%	100/15 Summer				42.350	0.775
5.003	7	240 Winter	100	+40%	100/15 Summer				40.839	1.677
5.004	8	240 Winter	100	+40%	100/15 Summer				40.811	1.947
5.005	9	360 Winter	100	+40%					36.865	-0.313
5.006	10	15 Winter	100	+40%					35.152	-0.294
5.007	11	30 Winter	100	+40%	100/15 Summer				35.081	1.366

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
5.000	4	0.000	0.10			1.3	SURCHARGED	
5.001	5	0.000	0.07			9.0	SURCHARGED	
6.000	1	0.000	0.08			1.3	FLOOD RISK	
6.001	2	0.000	0.11			9.1	FLOOD RISK	

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.002	3	0.000	0.14			12.0	SURCHARGED	
5.002	6	0.000	0.16			22.9	SURCHARGED	
7.000	12	0.000	0.00			0.0	FLOOD RISK	
7.001	13	0.000	0.12			5.1	FLOOD RISK	
7.002	14	0.000	0.22			8.4	FLOOD RISK	
8.000	15	0.000	0.00			0.0	FLOOD RISK	
8.001	16	0.000	0.09			3.8	FLOOD RISK	
8.002	17	0.000	0.15			6.9	FLOOD RISK	
9.000	18	0.000	0.06			0.9	SURCHARGED	
9.001	19	0.000	0.07			8.2	SURCHARGED	
7.003	20	0.000	0.10			22.6	SURCHARGED	
10.000	21	0.000	0.00			0.0	SURCHARGED	
10.001	22	0.000	0.09			5.2	SURCHARGED	
11.000	23	0.000	0.00			0.0	FLOOD RISK	
11.001	24	0.000	0.13			6.5	FLOOD RISK	
5.003	7	0.000	0.24			48.5	SURCHARGED	
5.004	8	0.000	0.21			47.2	SURCHARGED	
5.005	9	0.000	0.20			47.2	OK	
5.006	10	0.000	0.26			60.5	OK	
5.007	11	0.000	0.14			56.1	SURCHARGED	

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A2 Appendix 2 Catchment 1 (south) surface network report

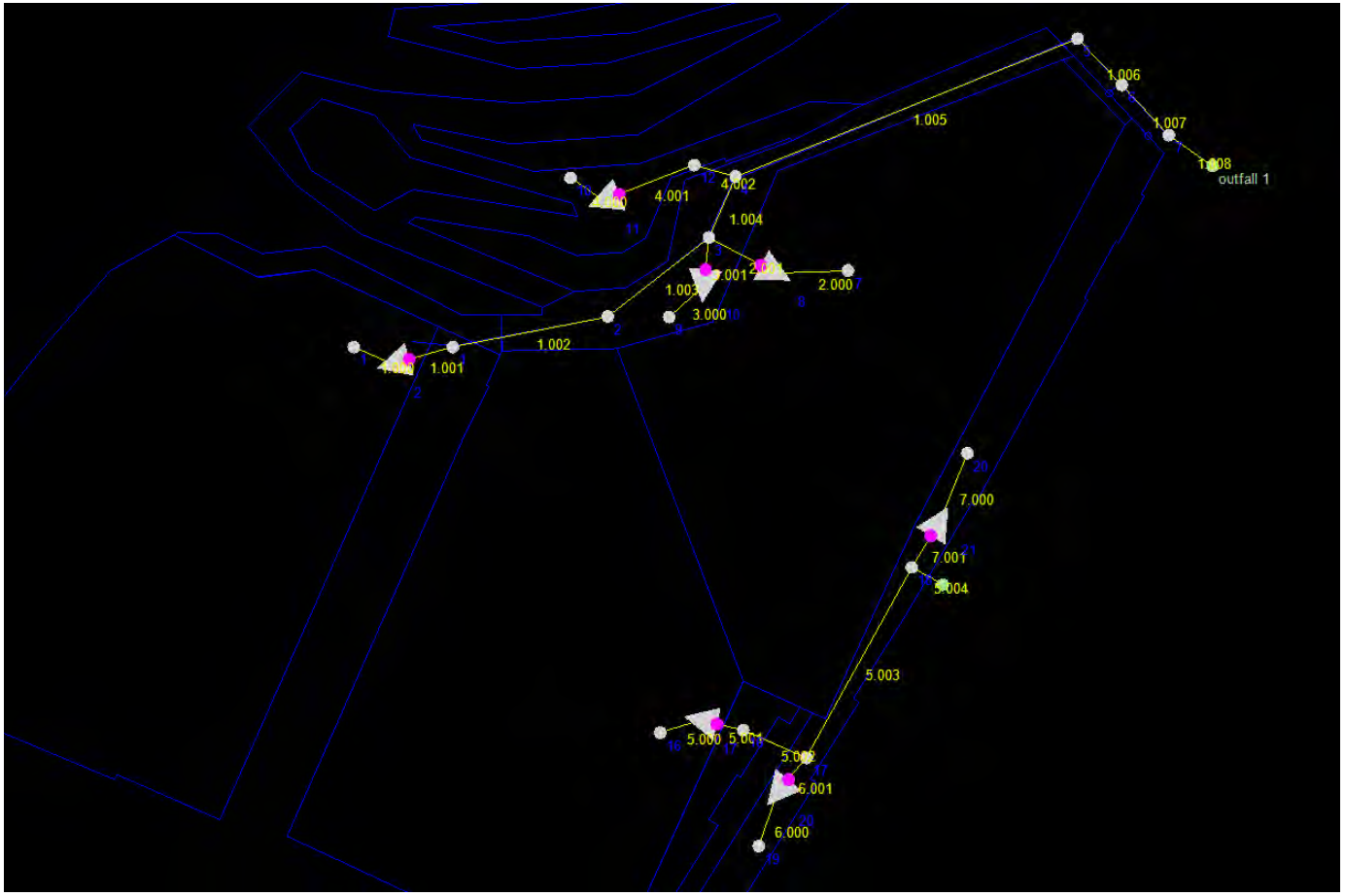


Figure 5 Catchment 1 south model layout

STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

« - Indicates pipe capacity < flow

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	6.260	0.063	99.4	0.434	5.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	9.161	0.092	99.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.002	23.298	0.155	150.3	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.003	18.884	0.126	149.9	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
2.000	10.645	0.106	100.4	0.294	5.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	11.157	0.112	99.6	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
3.000	6.836	0.068	100.5	0.109	5.00	0.0	0.600	o	225	Pipe/Conduit	
3.001	7.213	0.072	100.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.004	9.849	0.066	149.2	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
4.000	5.890	0.075	78.5	0.127	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	14.346	0.359	40.0	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.002	6.318	0.158	40.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.005	54.338	0.362	150.1	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
1.006	9.441	0.063	149.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of permeable paving

Dummy pipe upstream of attenuation tank

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	46.55	5.07	28.655	0.434	0.0	0.0	0.0	1.58	111.5	54.7
1.001	46.10	5.18	28.592	0.434	0.0	0.0	0.0	1.31	52.1«	54.7
1.002	44.76	5.55	28.500	0.434	0.0	0.0	0.0	1.06	42.3«	54.7
1.003	43.75	5.84	28.345	0.434	0.0	0.0	0.0	1.07	42.4«	54.7
2.000	46.36	5.11	28.437	0.294	0.0	0.0	0.0	1.57	110.9	36.9
2.001	45.83	5.26	28.331	0.294	0.0	0.0	0.0	1.31	52.1	36.9
3.000	46.46	5.09	30.500	0.109	0.0	0.0	0.0	1.30	51.8	13.7
3.001	46.11	5.18	30.432	0.109	0.0	0.0	0.0	1.31	51.9	13.7
1.004	43.24	6.00	28.219	0.836	0.0	0.0	0.0	1.07	42.5«	97.9
4.000	46.47	5.09	31.875	0.127	0.0	0.0	0.0	1.14	20.1	16.0
4.001	45.90	5.24	30.800	0.127	0.0	0.0	0.0	1.60	28.2	16.0
4.002	45.71	5.29	29.941	0.127	0.0	0.0	0.0	2.07	82.5	16.0
1.005	40.66	6.85	28.153	0.963	0.0	0.0	0.0	1.06	42.3«	106.1
1.006	40.31	6.97	27.791	0.963	0.0	0.0	0.0	1.28	90.6«	106.1

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STORM SEWER DESIGN by the Modified Rational Method

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.007	10.124	0.067	151.1	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
1.008	7.860	0.052	151.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.000	6.202	0.041	151.3	0.426	5.00	0.0	0.600	o	300	Pipe/Conduit	
5.001	6.459	0.043	150.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.002	10.188	0.068	149.8	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	8.345	0.083	100.5	0.065	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.001	6.617	0.066	100.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.003	32.070	0.214	149.9	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	10.856	0.186	58.4	0.054	5.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	7.929	0.136	58.3	0.000	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.004	5.255	0.053	99.2	0.000	0.00	0.0	0.600	o	300	Pipe/Conduit	

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of permeable paving

Dummy pipe upstream of permeable paving

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.007	39.95	7.10	27.653	0.963	0.0	0.0	0.0	1.28	90.2«	106.1
1.008	39.67	7.20	27.586	0.963	0.0	0.0	0.0	1.28	90.2«	106.1
5.000	46.49	5.08	27.584	0.426	0.0	0.0	0.0	1.28	90.2	53.7
5.001	46.17	5.17	27.543	0.426	0.0	0.0	0.0	1.28	90.5	53.7
5.002	45.67	5.30	27.500	0.426	0.0	0.0	0.0	1.28	90.6	53.7
6.000	46.27	5.14	28.950	0.065	0.0	0.0	0.0	1.00	17.7	8.1
6.001	45.85	5.25	28.867	0.065	0.0	0.0	0.0	1.00	17.7	8.1
5.003	44.18	5.71	27.432	0.491	0.0	0.0	0.0	1.28	90.6	58.7
7.000	46.27	5.14	30.186	0.054	0.0	0.0	0.0	1.32	23.3	6.7
7.001	45.89	5.24	30.000	0.054	0.0	0.0	0.0	1.32	23.3	6.7
5.004	43.99	5.77	27.218	0.545	0.0	0.0	0.0	1.58	111.6	64.9

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	User	-	100	0.434	0.434	0.434
1.001	-	-	100	0.000	0.000	0.000
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
2.000	User	-	100	0.294	0.294	0.294
2.001	-	-	100	0.000	0.000	0.000
3.000	User	-	100	0.099	0.099	0.099
	User	-	100	0.010	0.010	0.109
3.001	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
4.000	User	-	100	0.127	0.127	0.127
4.001	-	-	100	0.000	0.000	0.000
4.002	-	-	100	0.000	0.000	0.000
1.005	-	-	100	0.000	0.000	0.000
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
1.008	-	-	100	0.000	0.000	0.000
5.000	User	-	100	0.426	0.426	0.426
5.001	-	-	100	0.000	0.000	0.000
5.002	-	-	100	0.000	0.000	0.000
6.000	User	-	100	0.065	0.065	0.065
6.001	-	-	100	0.000	0.000	0.000
5.003	-	-	100	0.000	0.000	0.000
7.000	User	-	100	0.054	0.054	0.054
7.001	-	-	100	0.000	0.000	0.000
5.004	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				1.508	1.508	1.508

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.008	outfall 1	31.000	27.534	0.000	0	0

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
5.004		30.500	27.165	0.000	0	0

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Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Storage Structures	7
Number of Online Controls	7	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.360		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 2, DS/PN: 1.001, Volume (m³): 3.1

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0125-9500-2184-9500
Design Head (m)	2.184
Design Flow (l/s)	9.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	125
Invert Level (m)	28.592
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.184	9.5
Flush-Flo™	0.547	8.7
Kick-Flo®	1.118	6.9
Mean Flow over Head Range	-	7.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.5	1.200	7.2	3.000	11.0	7.000	16.5
0.200	7.4	1.400	7.7	3.500	11.9	7.500	17.1
0.300	8.2	1.600	8.2	4.000	12.6	8.000	17.6
0.400	8.6	1.800	8.7	4.500	13.4	8.500	18.1
0.500	8.7	2.000	9.1	5.000	14.1	9.000	18.6
0.600	8.7	2.200	9.5	5.500	14.7	9.500	19.1
0.800	8.5	2.400	9.9	6.000	15.3		
1.000	7.8	2.600	10.3	6.500	15.9		

Hydro-Brake® Optimum Manhole: 8, DS/PN: 2.001, Volume (m³): 3.7

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0100-6500-2401-6500
Design Head (m)	2.401
Design Flow (l/s)	6.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	100
Invert Level (m)	28.331
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum Manhole: 8, DS/PN: 2.001, Volume (m³): 3.7

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.401	6.5
Flush-Flo™	0.437	5.2
Kick-Flo®	0.896	4.1
Mean Flow over Head Range	-	5.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.3	1.200	4.7	3.000	7.2	7.000	10.8
0.200	4.7	1.400	5.1	3.500	7.8	7.500	11.1
0.300	5.0	1.600	5.4	4.000	8.3	8.000	11.5
0.400	5.2	1.800	5.7	4.500	8.7	8.500	11.8
0.500	5.1	2.000	6.0	5.000	9.2	9.000	12.1
0.600	5.1	2.200	6.2	5.500	9.6	9.500	12.5
0.800	4.6	2.400	6.5	6.000	10.0		
1.000	4.3	2.600	6.7	6.500	10.4		

Hydro-Brake® Optimum Manhole: 10, DS/PN: 3.001, Volume (m³): 0.9

Flow control for permeable paving

Unit Reference	MD-SHE-0081-2400-0500-2400
Design Head (m)	0.500
Design Flow (l/s)	2.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	81
Invert Level (m)	30.432
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	2.4
Flush-Flo™	0.151	2.4
Kick-Flo®	0.349	2.0
Mean Flow over Head Range	-	2.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.3	0.300	2.2	0.500	2.4	0.800	3.0
0.200	2.4	0.400	2.2	0.600	2.6	1.000	3.3

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Hydro-Brake® Optimum Manhole: 10, DS/PN: 3.001, Volume (m³): 0.9

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.200	3.6	2.400	4.9	5.000	7.0	8.000	8.8
1.400	3.9	2.600	5.1	5.500	7.3	8.500	9.1
1.600	4.1	3.000	5.5	6.000	7.6	9.000	9.4
1.800	4.3	3.500	5.9	6.500	7.9	9.500	9.6
2.000	4.5	4.000	6.3	7.000	8.3		
2.200	4.8	4.500	6.7	7.500	8.5		

Hydro-Brake® Optimum Manhole: 11, DS/PN: 4.001, Volume (m³): 2.6

Flow control for attenuation tank

Unit Reference	MD-SHE-0083-2800-0800-2800
Design Head (m)	0.800
Design Flow (l/s)	2.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	83
Invert Level (m)	31.800
Minimum Outlet Pipe Diameter (mm)	100
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.800	2.8
Flush-Flo™	0.238	2.8
Kick-Flo®	0.514	2.3
Mean Flow over Head Range	-	2.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	2.4	1.200	3.4	3.000	5.2	7.000	7.7
0.200	2.8	1.400	3.6	3.500	5.5	7.500	8.0
0.300	2.8	1.600	3.9	4.000	5.9	8.000	8.2
0.400	2.7	1.800	4.1	4.500	6.2	8.500	8.4
0.500	2.4	2.000	4.3	5.000	6.6	9.000	8.7
0.600	2.5	2.200	4.5	5.500	6.9	9.500	8.9
0.800	2.8	2.400	4.7	6.000	7.2		
1.000	3.1	2.600	4.8	6.500	7.4		

Hydro-Brake® Optimum Manhole: 17, DS/PN: 5.001, Volume (m³): 4.3

Unit Reference	MD-SHE-0142-9400-1000-9400
Design Head (m)	1.000
Design Flow (l/s)	9.4
Flush-Flo™	Calculated

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Hydro-Brake® Optimum Manhole: 17, DS/PN: 5.001, Volume (m³): 4.3

Flow control to represent flow from Plot

Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	142
Invert Level (m)	27.543
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	9.4
Flush-Flo™	0.302	9.4
Kick-Flo®	0.672	7.8
Mean Flow over Head Range	-	8.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.1	1.200	10.2	3.000	15.8	7.000	23.7
0.200	9.1	1.400	11.0	3.500	17.0	7.500	24.5
0.300	9.4	1.600	11.7	4.000	18.1	8.000	25.3
0.400	9.3	1.800	12.4	4.500	19.2	8.500	26.1
0.500	9.0	2.000	13.0	5.000	20.2	9.000	26.8
0.600	8.6	2.200	13.6	5.500	21.1	9.500	27.5
0.800	8.5	2.400	14.2	6.000	22.0		
1.000	9.4	2.600	14.8	6.500	22.9		

Hydro-Brake® Optimum Manhole: 20, DS/PN: 6.001, Volume (m³): 0.8

Flow control for permeable paving

Unit Reference	MD-SHE-0063-1400-0500-1400
Design Head (m)	0.500
Design Flow (l/s)	1.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	63
Invert Level (m)	28.867
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	1.4
Flush-Flo™	0.148	1.4
Kick-Flo®	0.334	1.2
Mean Flow over Head Range	-	1.2

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a

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Hydro-Brake® Optimum Manhole: 20, DS/PN: 6.001, Volume (m³): 0.8

Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.4	1.200	2.1	3.000	3.2	7.000	4.7
0.200	1.4	1.400	2.2	3.500	3.4	7.500	4.9
0.300	1.3	1.600	2.4	4.000	3.6	8.000	5.1
0.400	1.3	1.800	2.5	4.500	3.8	8.500	5.2
0.500	1.4	2.000	2.6	5.000	4.0	9.000	5.4
0.600	1.5	2.200	2.7	5.500	4.2	9.500	5.5
0.800	1.7	2.400	2.9	6.000	4.4		
1.000	1.9	2.600	3.0	6.500	4.6		

Hydro-Brake® Optimum Manhole: 21, DS/PN: 7.001, Volume (m³): 0.7

Flow control for permeable paving

Unit Reference	MD-SHE-0058-1200-0500-1200
Design Head (m)	0.500
Design Flow (l/s)	1.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	58
Invert Level (m)	30.000
Minimum Outlet Pipe Diameter (mm)	75
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.500	1.2
Flush-Flo™	0.148	1.2
Kick-Flo®	0.331	1.0
Mean Flow over Head Range	-	1.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	1.2	1.200	1.8	3.000	2.7	7.000	4.1
0.200	1.2	1.400	1.9	3.500	2.9	7.500	4.2
0.300	1.1	1.600	2.0	4.000	3.1	8.000	4.3
0.400	1.1	1.800	2.1	4.500	3.3	8.500	4.5
0.500	1.2	2.000	2.2	5.000	3.4	9.000	4.6
0.600	1.3	2.200	2.3	5.500	3.6	9.500	4.7
0.800	1.5	2.400	2.4	6.000	3.8		
1.000	1.6	2.600	2.5	6.500	3.9		

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Storage Structures for Storm

Tank or Pond Manhole: 2, DS/PN: 1.001

Invert Level (m) 30.000

Tank to indicatively represent Plot storage.

Depth (m)	Area (m²)
0.000	200.0

Tank or Pond Manhole: 8, DS/PN: 2.001

Invert Level (m) 30.000

Tank to indicatively represent Plot storage.

Depth (m)	Area (m²)
0.000	140.0

Tank or Pond Manhole: 10, DS/PN: 3.001

Invert Level (m) 30.432

Tank to represent 0.5m deep permeable paving

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	118.0	0.500	118.0

Tank or Pond Manhole: 11, DS/PN: 4.001

Tank to represent 0.8m deep attenuation tank.

Invert Level (m) 31.800

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	68.4	0.800	68.4	0.801	0.0

Tank or Pond Manhole: 17, DS/PN: 5.001

Invert Level (m) 27.543

Tank to indicatively represent Plot storage.

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	200.0	1.000	200.0

Tank or Pond Manhole: 20, DS/PN: 6.001

Invert Level (m) 28.867

Tank to represent 0.5m deep permeable paving

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	59.0	0.500	59.0

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Tank or Pond Manhole: 21, DS/PN: 7.001

Invert Level (m) 30.000

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	119.0	0.500	119.0

Tank to represent 0.5m deep permeable paving

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Storage Structures	7
Number of Online Controls	7	Number of Time/Area Diagrams	0
Number of Offline Controls	0	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Ratio R	0.360
Region	England and Wales	Cv (Summer)	0.750
M5-60 (mm)	18.000	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0	DVD Status	OFF
Analysis Timestep	Fine	Inertia Status	OFF
DTS Status	ON		

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.
1.000	1	15 Winter	100	+40%	100/15 Summer	100/15 Winter		
1.001	2	120 Winter	100	+40%	100/15 Summer			
1.002	1	120 Winter	100	+40%				
1.003	2	120 Winter	100	+40%				
2.000	7	120 Winter	100	+40%	100/15 Summer			
2.001	8	120 Winter	100	+40%	100/15 Summer			
3.000	9	15 Winter	100	+40%	100/15 Summer			
3.001	10	240 Winter	100	+40%	100/30 Summer			
1.004	3	120 Winter	100	+40%				
4.000	10	15 Winter	100	+40%	100/15 Summer			
4.001	11	120 Winter	100	+40%	100/15 Summer			
4.002	12	960 Winter	100	+40%				
1.005	4	120 Winter	100	+40%				
1.006	5	120 Winter	100	+40%				
1.007	6	120 Winter	100	+40%				
1.008	7	120 Winter	100	+40%				
5.000	16	15 Winter	100	+40%	100/15 Summer			
5.001	17	240 Winter	100	+40%	100/15 Summer			
5.002	16	30 Winter	100	+40%				
6.000	19	15 Winter	100	+40%	100/15 Summer			
6.001	20	240 Winter	100	+40%	100/15 Summer			
5.003	17	960 Summer	100	+40%				

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

Small amount of flooding at dummy connection to plot. Exceedance will flow towards permeable paving below Red Bank Terraces

PN	US/MH Name	Water Level (m)	Surcharged Depth (m)	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status
1.000	1	31.000	2.045	0.026	3.52			221.1	FLOOD
1.001	2	30.781	1.964	0.000	0.22			9.5	FLOOD RISK
1.002	1	28.575	-0.150	0.000	0.24			9.5	OK
1.003	2	28.421	-0.149	0.000	0.25			9.5	OK
2.000	7	30.738	2.001	0.000	0.64			52.1	FLOOD RISK
2.001	8	30.733	2.177	0.000	0.15			6.5	FLOOD RISK
3.000	9	30.816	0.091	0.000	1.56			57.2	FLOOD RISK
3.001	10	30.805	0.148	0.000	0.06			2.4	FLOOD RISK
1.004	3	28.333	-0.111	0.000	0.51			18.1	OK
4.000	10	32.982	0.957	0.000	3.54			59.1	FLOOD RISK
4.001	11	32.506	1.556	0.000	0.11			2.8	SURCHARGED
4.002	12	29.973	-0.193	0.000	0.05			2.8	OK
1.005	4	28.267	-0.111	0.000	0.51			20.7	OK
1.006	5	27.909	-0.182	0.000	0.33			20.7	OK
1.007	6	27.769	-0.184	0.000	0.32			20.7	OK
1.008	7	27.706	-0.180	0.000	0.34			20.7	OK
5.000	16	28.665	0.781	0.000	3.64			223.2	SURCHARGED
5.001	17	28.409	0.566	0.000	0.15			9.4	SURCHARGED
5.002	16	27.575	-0.225	0.000	0.14			9.4	OK
6.000	19	29.377	0.277	0.000	2.08			32.1	FLOOD RISK
6.001	20	29.291	0.274	0.000	0.09			1.4	FLOOD RISK
5.003	17	27.503	-0.229	0.000	0.13			10.8	OK

PN	US/MH Name	Level Exceeded
1.000	1	1
1.001	2	
1.002	1	
1.003	2	
2.000	7	
2.001	8	
3.000	9	
3.001	10	
1.004	3	
4.000	10	
4.001	11	
4.002	12	
1.005	4	
1.006	5	
1.007	6	
1.008	7	
5.000	16	
5.001	17	
5.002	16	
6.000	19	

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Level Exceeded
6.001	20	
5.003	17	

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Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)
7.000	20	15 Winter	100	+40%	100/15 Summer				30.471
7.001	21	240 Winter	100	+40%	100/60 Winter				30.195
5.004	18	960 Winter	100	+40%					27.307

PN	US/MH Name	Surcharged Depth (m)	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
7.000	20	0.135	0.000	1.32			27.6	SURCHARGED	
7.001	21	0.045	0.000	0.06			1.2	SURCHARGED	
5.004	18	-0.211	0.000	0.19			11.9	OK	

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A3 Appendix 3 Catchment 4 surface network report

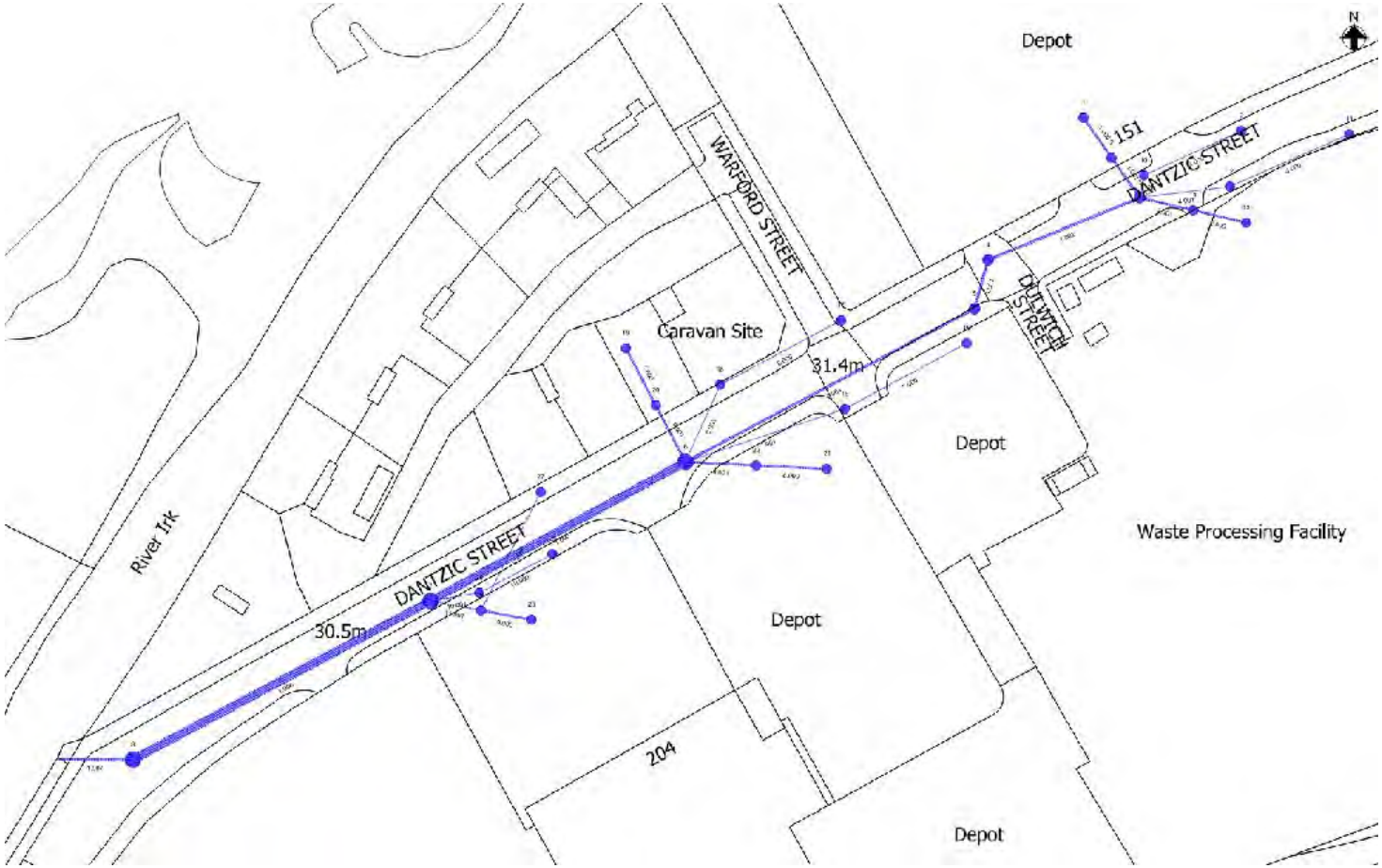


Figure 6 Catchment 4 model layout

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Refer to Plan on final page for Pipe Number reference

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	0
Ratio R	0.357	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	2.500
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	500

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
1.000	8.157	0.264	30.9	0.000	15.00	0.0	0.600	o	300	Pipe/Conduit	
1.001	8.157	0.264	30.9	0.461	0.00	0.0	0.600	o	300	Pipe/Conduit	
2.000	9.147	0.142	64.4	0.000	15.00	0.0	0.600	o	300	Pipe/Conduit	
2.001	9.147	0.142	64.4	1.012	0.00	0.0	0.600	o	300	Pipe/Conduit	
3.000	17.866	0.305	58.6	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
3.001	3.790	1.637	2.3	0.100	0.00	0.0	0.600	o	150	Pipe/Conduit	
4.000	21.795	0.367	59.4	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
4.001	15.185	2.137	7.1	0.100	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.002	27.407	0.137	200.1	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.003	8.445	0.042	201.1	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
1.004	54.682	0.273	200.3	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
5.000	10.734	0.295	36.4	0.000	15.00	0.0	0.600	o	300	Pipe/Conduit	

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of Swale

Dummy pipe upstream of indicative plot storage/flow control

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
1.000	26.70	15.05	29.066	0.000	0.0	0.0	0.0	2.84	200.7	0.0
1.001	26.66	15.10	28.802	0.461	0.0	0.0	0.0	2.84	200.7	33.3
2.000	26.68	15.08	28.822	0.000	0.0	0.0	0.0	1.96	138.7	0.0
2.001	26.60	15.16	28.680	1.012	0.0	0.0	0.0	1.96	138.7	72.9
3.000	45.74	5.23	30.630	0.000	0.0	0.0	0.0	1.32	23.3	0.0
3.001	45.71	5.24	30.325	0.100	0.0	0.0	0.0	6.68	118.0	12.4
4.000	45.55	5.28	31.192	0.000	0.0	0.0	0.0	1.31	23.1	0.0
4.001	45.31	5.34	30.825	0.100	0.0	0.0	0.0	3.80	67.2	12.3
1.002	26.25	15.51	28.463	1.673	0.0	0.0	0.0	1.28	141.1	118.9
1.003	26.14	15.62	28.326	1.673	0.0	0.0	0.0	1.27	140.7	118.9
1.004	25.49	16.34	28.284	1.673	0.0	0.0	0.0	1.28	141.0	118.9
5.000	26.68	15.07	29.101	0.000	0.0	0.0	0.0	2.61	184.8	0.0

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
5.001	10.734	0.295	36.4	0.537	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	11.845	0.208	56.9	0.000	15.00	0.0	0.600	o	300	Pipe/Conduit	
6.001	11.845	0.208	56.9	0.537	0.00	0.0	0.600	o	300	Pipe/Conduit	
7.000	23.124	0.424	54.5	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	28.083	2.189	12.8	0.100	0.00	0.0	0.600	o	150	Pipe/Conduit	
8.000	22.866	0.396	57.7	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
8.001	14.180	1.589	8.9	0.100	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.005	48.511	0.097	500.1	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
9.000	8.574	0.147	58.3	0.000	15.00	0.0	0.600	o	300	Pipe/Conduit	
9.001	8.574	0.147	58.3	0.771	0.00	0.0	0.600	o	300	Pipe/Conduit	
10.000	13.809	0.215	64.2	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
10.001	8.268	1.686	4.9	0.100	0.00	0.0	0.600	o	150	Pipe/Conduit	
11.000	19.578	0.335	58.4	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
11.001	8.665	1.286	6.7	0.100	0.00	0.0	0.600	o	150	Pipe/Conduit	
1.006	56.351	0.111	507.7	0.000	0.00	0.0	0.600	o	1200	Pipe/Conduit	
1.007	12.625	0.047	268.6	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of Swale

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of Swale

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.001	26.62	15.14	28.806	0.537	0.0	0.0	0.0	2.61	184.8	38.7
6.000	26.66	15.09	28.927	0.000	0.0	0.0	0.0	2.09	147.6	0.0
6.001	26.56	15.19	28.719	0.537	0.0	0.0	0.0	2.09	147.6	38.6
7.000	45.54	5.28	31.274	0.000	0.0	0.0	0.0	1.37	24.1	0.0
7.001	44.93	5.45	30.850	0.100	0.0	0.0	0.0	2.83	50.0	12.2
8.000	45.52	5.29	30.646	0.000	0.0	0.0	0.0	1.33	23.4	0.0
8.001	45.26	5.36	30.250	0.100	0.0	0.0	0.0	3.39	60.0	12.3
1.005	25.06	16.82	27.611	2.947	0.0	0.0	0.0	1.67	1884.3	200.0
9.000	26.68	15.07	28.707	0.000	0.0	0.0	0.0	2.06	145.8	0.0
9.001	26.61	15.14	28.560	0.771	0.0	0.0	0.0	2.06	145.8	55.6
10.000	45.91	5.18	30.465	0.000	0.0	0.0	0.0	1.26	22.2	0.0
10.001	45.79	5.21	30.250	0.100	0.0	0.0	0.0	4.58	81.0	12.4
11.000	45.66	5.25	30.185	0.000	0.0	0.0	0.0	1.32	23.3	0.0
11.001	45.53	5.28	29.850	0.100	0.0	0.0	0.0	3.91	69.0	12.3
1.006	24.59	17.39	27.514	3.918	0.0	0.0	0.0	1.65	1870.1	260.9
1.007	26.58	15.17	27.403	0.000	86.2	0.0	0.0	1.24	196.5	86.2

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
1.000	-	-	100	0.000	0.000	0.000
1.001	-	-	100	0.461	0.461	0.461
2.000	-	-	100	0.000	0.000	0.000
2.001	-	-	100	1.012	1.012	1.012
3.000	-	-	100	0.000	0.000	0.000
3.001	-	-	100	0.100	0.100	0.100
4.000	-	-	100	0.000	0.000	0.000
4.001	-	-	100	0.100	0.100	0.100
1.002	-	-	100	0.000	0.000	0.000
1.003	-	-	100	0.000	0.000	0.000
1.004	-	-	100	0.000	0.000	0.000
5.000	-	-	100	0.000	0.000	0.000
5.001	-	-	100	0.537	0.537	0.537
6.000	-	-	100	0.000	0.000	0.000
6.001	-	-	100	0.537	0.537	0.537
7.000	-	-	100	0.000	0.000	0.000
7.001	-	-	100	0.100	0.100	0.100
8.000	-	-	100	0.000	0.000	0.000
8.001	-	-	100	0.100	0.100	0.100
1.005	-	-	100	0.000	0.000	0.000
9.000	-	-	100	0.000	0.000	0.000
9.001	-	-	100	0.771	0.771	0.771
10.000	-	-	100	0.000	0.000	0.000
10.001	-	-	100	0.100	0.100	0.100
11.000	-	-	100	0.000	0.000	0.000
11.001	-	-	100	0.100	0.100	0.100
1.006	-	-	100	0.000	0.000	0.000
1.007	-	-	100	0.000	0.000	0.000
				Total	Total	Total
				3.918	3.918	3.918

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
1.007		29.600	27.356	0.000	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	12	Number of Storage Structures	11	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	1	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.357		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 2, DS/PN: 1.001, Volume (m³): 3.0

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0146-1010-1000-1010
Design Head (m)	1.000
Design Flow (l/s)	10.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	146
Invert Level (m)	28.802
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	10.1	Kick-Flo®	0.676	8.4
Flush-Flo™	0.305	10.1	Mean Flow over Head Range	-	8.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.3	0.800	9.1	2.000	14.0	4.000	19.5	7.000	25.5
0.200	9.8	1.000	10.1	2.200	14.7	4.500	20.6	7.500	26.4
0.300	10.1	1.200	11.0	2.400	15.3	5.000	21.7	8.000	27.2
0.400	10.0	1.400	11.8	2.600	15.9	5.500	22.7	8.500	28.0
0.500	9.7	1.600	12.6	3.000	17.0	6.000	23.7	9.000	28.8
0.600	9.2	1.800	13.3	3.500	18.3	6.500	24.6	9.500	29.6

Hydro-Brake® Optimum Manhole: 14, DS/PN: 2.001, Volume (m³): 3.5

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0208-2230-1000-2230
Design Head (m)	1.000
Design Flow (l/s)	22.3
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	208
Invert Level (m)	28.680
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	22.3	Kick-Flo®	0.725	19.1
Flush-Flo™	0.348	22.3	Mean Flow over Head Range	-	18.7

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	7.1	0.600	21.2	1.600	27.9	2.600	35.2	5.000	48.3
0.200	20.0	0.800	20.0	1.800	29.5	3.000	37.7	5.500	50.6
0.300	22.2	1.000	22.3	2.000	31.1	3.500	40.7	6.000	52.8
0.400	22.2	1.200	24.3	2.200	32.5	4.000	43.4	6.500	54.9
0.500	21.8	1.400	26.2	2.400	33.9	4.500	45.9	7.000	56.9

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Hydro-Brake® Optimum Manhole: 14, DS/PN: 2.001, Volume (m³): 3.5

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.500	58.8	8.000	60.7	8.500	62.5	9.000	64.3	9.500	66.0

Flow control for Swale

Orifice Manhole: 10, DS/PN: 3.001, Volume (m³): 1.1

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 30.325

Flow control for Swale

Orifice Manhole: 12, DS/PN: 4.001, Volume (m³): 1.1

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 30.825

Hydro-Brake® Optimum Manhole: 20, DS/PN: 5.001, Volume (m³): 3.6

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0157-1180-1000-1180
Design Head (m)	1.000
Design Flow (l/s)	11.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	157
Invert Level (m)	28.806
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	11.8	Kick-Flo®	0.683	9.9
Flush-Flo™	0.308	11.8	Mean Flow over Head Range	-	10.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.6	0.800	10.6	2.000	16.4	4.000	22.8	7.000	29.9
0.200	11.4	1.000	11.8	2.200	17.1	4.500	24.1	7.500	30.9
0.300	11.8	1.200	12.9	2.400	17.9	5.000	25.4	8.000	31.9
0.400	11.7	1.400	13.8	2.600	18.6	5.500	26.6	8.500	32.8
0.500	11.4	1.600	14.7	3.000	19.9	6.000	27.7	9.000	33.7
0.600	10.9	1.800	15.6	3.500	21.4	6.500	28.8	9.500	34.6

Hydro-Brake® Optimum Manhole: 22, DS/PN: 6.001, Volume (m³): 4.1

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0157-1180-1000-1180
Design Head (m)	1.000
Design Flow (l/s)	11.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	157
Invert Level (m)	28.719
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1200

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Hydro-Brake® Optimum Manhole: 22, DS/PN: 6.001, Volume (m³): 4.1

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	11.8	Kick-Flo®	0.683	9.9
Flush-Flo™	0.308	11.8	Mean Flow over Head Range	-	10.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.6	0.800	10.6	2.000	16.4	4.000	22.8	7.000	29.9
0.200	11.4	1.000	11.8	2.200	17.1	4.500	24.1	7.500	30.9
0.300	11.8	1.200	12.9	2.400	17.9	5.000	25.4	8.000	31.9
0.400	11.7	1.400	13.8	2.600	18.6	5.500	26.6	8.500	32.8
0.500	11.4	1.600	14.7	3.000	19.9	6.000	27.7	9.000	33.7
0.600	10.9	1.800	15.6	3.500	21.4	6.500	28.8	9.500	34.6

Flow control for Swale

Orifice Manhole: 16, DS/PN: 7.001, Volume (m³): 1.2

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 30.850

Flow control for Swale

Orifice Manhole: 18, DS/PN: 8.001, Volume (m³): 1.2

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 30.250

Hydro-Brake® Optimum Manhole: 24, DS/PN: 9.001, Volume (m³): 3.2

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0185-1700-1000-1700
Design Head (m)	1.000
Design Flow (l/s)	17.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	185
Invert Level (m)	28.560
Minimum Outlet Pipe Diameter (mm)	225
Suggested Manhole Diameter (mm)	1500

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	17.0	Kick-Flo®	0.711	14.4
Flush-Flo™	0.330	17.0	Mean Flow over Head Range	-	14.4

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	6.5	0.800	15.3	2.000	23.6	4.000	33.0	7.000	43.2
0.200	16.3	1.000	17.0	2.200	24.7	4.500	34.9	7.500	44.7
0.300	16.9	1.200	18.5	2.400	25.8	5.000	36.7	8.000	46.1
0.400	16.9	1.400	19.9	2.600	26.8	5.500	38.4	8.500	47.5
0.500	16.5	1.600	21.2	3.000	28.7	6.000	40.1	9.000	48.8
0.600	16.0	1.800	22.5	3.500	30.9	6.500	41.7	9.500	50.1

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Flow control for Swale

Orifice Manhole: 26, DS/PN: 10.001, Volume (m³): 1.1

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 30.250

Flow control for Swale

Orifice Manhole: 24, DS/PN: 11.001, Volume (m³): 1.2

Diameter (m) 0.150 Discharge Coefficient 0.600 Invert Level (m) 29.850

Hydro-Brake® Optimum Manhole: 8, DS/PN: 1.007, Volume (m³): 69.3

Flow control for network outfall

Unit Reference	MD-SHE-0354-8620-2297-8620
Design Head (m)	2.297
Design Flow (l/s)	86.2
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	354
Invert Level (m)	27.403
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.297	86.2	Kick-Flo®	1.548	71.2
Flush-Flo™	0.709	86.1	Mean Flow over Head Range	-	73.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	10.2	0.800	85.9	2.000	80.6	4.000	112.9	7.000	148.3
0.200	35.7	1.000	84.5	2.200	84.4	4.500	119.5	7.500	153.4
0.300	66.1	1.200	82.2	2.400	88.0	5.000	125.8	8.000	158.3
0.400	81.5	1.400	77.8	2.600	91.5	5.500	131.8	8.500	163.0
0.500	84.3	1.600	72.3	3.000	98.1	6.000	137.5	9.000	167.7
0.600	85.7	1.800	76.6	3.500	105.7	6.500	143.0	9.500	172.2

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Storage Structures for Storm

Tank or Pond Manhole: 2, DS/PN: 1.001

Tank to indicatively represent Plot storage.

Invert Level (m) 28.802

Depth (m)	Area (m²)
0.000	200.0

Tank or Pond Manhole: 14, DS/PN: 2.001

Tank to indicatively represent Plot storage.

Invert Level (m) 28.680

Depth (m)	Area (m²)
0.000	500.0

Complex Manhole: 10, DS/PN: 3.001

Complex storage to represent Swale

Bio-Retention Area

Invert Level (m) 30.250 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)
0.000	84.0	88.000

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr) 0.00000 Length (m) 42.0
Infiltration Coefficient Side (m/hr) 0.00000 Side Slope (1:X) 3.0
Safety Factor 2.0 Slope (1:X) 0.0
Porosity 1.00 Cap Volume Depth (m) 0.000
Invert Level (m) 30.750 Cap Infiltration Depth (m) 0.000
Base Width (m) 0.5 Include Swale Volume Yes

Complex Manhole: 12, DS/PN: 4.001

Complex storage to represent Swale

Bio-Retention Area

Invert Level (m) 30.750 Infiltration Coefficient Side (m/hr) 0.00000
Porosity 0.30 Safety Factor 2.0
Infiltration Coefficient Base (m/hr) 0.00000

Depth (m)	Area (m²)	Perimeter (m)
0.000	135.0	113.000

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Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	54.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	31.250	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0	Include Swale Volume	Yes

Tank or Pond Manhole: 20, DS/PN: 5.001

Tank to indicatively represent Plot storage.

Invert Level (m) 28.806

Depth (m)	Area (m²)
0.000	200.0

Tank or Pond Manhole: 22, DS/PN: 6.001

Tank to indicatively represent Plot storage.

Invert Level (m) 28.719

Depth (m)	Area (m²)
0.000	300.0

Complex Manhole: 16, DS/PN: 7.001

Complex storage to represent Swale

Bio-Retention Area

Invert Level (m)	30.850	Infiltration Coefficient Side (m/hr)	0.00000
Porosity	0.30	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000		

Depth (m)	Area (m²)	Perimeter (m)
0.000	187.5	155.000

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	75.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	31.350	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0	Include Swale Volume	Yes

Complex Manhole: 18, DS/PN: 8.001

Complex storage to represent Swale

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Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	69.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	4.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	30.250	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0	Include Swale Volume	Yes

Bio-Retention Area

Invert Level (m)	30.250	Infiltration Coefficient Side (m/hr)	0.00000
Porosity	0.30	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000		

Depth (m)	Area (m²)	Perimeter (m)
0.000	138.0	142.000

Tank or Pond Manhole: 24, DS/PN: 9.001

Tank to indicatively represent Plot storage.

Invert Level (m) 28.560

Depth (m)	Area (m²)
0.000	400.0

Complex Manhole: 26, DS/PN: 10.001

Complex storage to represent Swale

Bio-Retention Area

Invert Level (m)	30.250	Infiltration Coefficient Side (m/hr)	0.00000
Porosity	0.30	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000		

Depth (m)	Area (m²)	Perimeter (m)
0.000	60.0	53.000

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	24.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	30.750	Cap Infiltration Depth (m)	0.000
Base Width (m)	1.0	Include Swale Volume	Yes

Complex Manhole: 24, DS/PN: 11.001

Complex storage to represent Swale

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Bio-Retention Area

Invert Level (m)	29.850	Infiltration Coefficient Side (m/hr)	0.00000
Porosity	0.30	Safety Factor	2.0
Infiltration Coefficient Base (m/hr)	0.00000		

Depth (m)	Area (m²)	Perimeter (m)
0.000	74.0	78.000

Swale

Warning:- Volume should always be included unless the upstream pipe is being used for storage and/or as a carrier

Infiltration Coefficient Base (m/hr)	0.00000	Length (m)	37.0
Infiltration Coefficient Side (m/hr)	0.00000	Side Slope (1:X)	3.0
Safety Factor	2.0	Slope (1:X)	0.0
Porosity	1.00	Cap Volume Depth (m)	0.000
Invert Level (m)	30.350	Cap Infiltration Depth (m)	0.000
Base Width (m)	0.5	Include Swale Volume	Yes

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	12	Number of Storage Structures	11	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	18.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.358	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	1	15 Summer	1	+0%	100/30 Summer				29.066	-0.300
1.001	2	120 Winter	1	+0%	30/30 Summer				28.954	-0.148
2.000	13	120 Winter	1	+0%	100/15 Winter				28.839	-0.283
2.001	14	120 Winter	1	+0%	30/30 Winter				28.839	-0.141
3.000	9	15 Summer	1	+0%					30.630	-0.150
3.001	10	60 Winter	1	+0%	30/15 Summer				30.416	-0.059
4.000	11	15 Summer	1	+0%					31.192	-0.150
4.001	12	120 Winter	1	+0%	30/15 Winter				30.898	-0.077
1.002	3	120 Winter	1	+0%	100/30 Winter				28.586	-0.252
1.003	4	120 Winter	1	+0%	100/30 Winter				28.464	-0.237
1.004	5	120 Winter	1	+0%	100/30 Winter				28.403	-0.256
5.000	19	15 Summer	1	+0%	100/15 Winter				29.101	-0.300
5.001	20	120 Winter	1	+0%	30/15 Winter				28.975	-0.131
6.000	21	15 Summer	1	+0%	100/30 Winter				28.927	-0.300
6.001	22	120 Winter	1	+0%	30/60 Winter				28.854	-0.165
7.000	15	15 Summer	1	+0%					31.274	-0.150
7.001	16	60 Winter	1	+0%	30/15 Winter				30.932	-0.068
8.000	17	15 Summer	1	+0%					30.646	-0.150
8.001	18	120 Winter	1	+0%	100/30 Winter				30.307	-0.093
1.005	6	120 Winter	1	+0%	100/30 Winter				27.813	-0.998
9.000	23	120 Winter	1	+0%	100/30 Summer				28.707	-0.300
9.001	24	120 Winter	1	+0%	30/60 Summer				28.708	-0.152
10.000	25	15 Summer	1	+0%	100/15 Summer				30.465	-0.150
10.001	26	30 Winter	1	+0%	30/15 Summer				30.368	-0.032
11.000	27	15 Summer	1	+0%					30.185	-0.150
11.001	24	30 Winter	1	+0%	30/15 Summer				29.963	-0.037
1.006	7	120 Winter	1	+0%	100/30 Winter				27.764	-0.950
1.007	8	120 Winter	1	+0%	30/15 Summer				27.721	-0.132

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1 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.00			0.0	OK	
1.001	2	0.000	0.07			9.0	OK	
2.000	13	0.000	0.00			0.0	OK	
2.001	14	0.000	0.16			15.1	OK	
3.000	9	0.000	0.00			0.0	OK	
3.001	10	0.000	0.06			4.8	OK	
4.000	11	0.000	0.00			0.0	OK	
4.001	12	0.000	0.05			3.0	OK	
1.002	3	0.000	0.24			29.1	OK	
1.003	4	0.000	0.29			29.1	OK	
1.004	5	0.000	0.22			29.1	OK	
5.000	19	0.000	0.00			0.0	OK	
5.001	20	0.000	0.08			11.1	OK	
6.000	21	0.000	0.00			0.0	OK	
6.001	22	0.000	0.08			8.7	OK	
7.000	15	0.000	0.00			0.0	OK	
7.001	16	0.000	0.08		35	3.9	OK	
8.000	17	0.000	0.00			0.0	OK	
8.001	18	0.000	0.03		83	1.8	OK	
1.005	6	0.000	0.04			53.4	OK	
9.000	23	0.000	0.00			0.0	OK	
9.001	24	0.000	0.12			12.0	OK	
10.000	25	0.000	0.00			0.0	OK	
10.001	26	0.000	0.10		14	6.9	OK	
11.000	27	0.000	0.00			0.0	OK	
11.001	24	0.000	0.11		15	6.5	OK	
1.006	7	0.000	0.05			69.6	OK	
1.007	8	0.000	0.48			68.8	OK	

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	12	Number of Storage Structures	11	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	18.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.358	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	1	120 Winter	30	+0%	100/30 Summer				29.226	-0.140
1.001	2	120 Winter	30	+0%	30/30 Summer				29.226	0.124
2.000	13	120 Winter	30	+0%	100/15 Winter				29.070	-0.052
2.001	14	120 Winter	30	+0%	30/30 Winter				29.070	0.090
3.000	9	15 Summer	30	+0%					30.630	-0.150
3.001	10	30 Winter	30	+0%	30/15 Summer				30.537	0.062
4.000	11	15 Summer	30	+0%					31.192	-0.150
4.001	12	30 Winter	30	+0%	30/15 Winter				30.996	0.021
1.002	3	30 Winter	30	+0%	100/30 Winter				28.649	-0.189
1.003	4	30 Winter	30	+0%	100/30 Winter				28.538	-0.163
1.004	5	30 Winter	30	+0%	100/30 Winter				28.463	-0.196
5.000	19	120 Winter	30	+0%	100/15 Winter				29.299	-0.102
5.001	20	120 Winter	30	+0%	30/15 Winter				29.299	0.193
6.000	21	120 Winter	30	+0%	100/30 Winter				29.061	-0.166
6.001	22	120 Winter	30	+0%	30/60 Winter				29.061	0.042
7.000	15	15 Summer	30	+0%					31.274	-0.150
7.001	16	30 Winter	30	+0%	30/15 Winter				31.018	0.018
8.000	17	15 Summer	30	+0%					30.646	-0.150
8.001	18	60 Winter	30	+0%	100/30 Winter				30.355	-0.045
1.005	6	120 Winter	30	+0%	100/30 Winter				28.293	-0.518
9.000	23	120 Winter	30	+0%	100/30 Summer				28.929	-0.078
9.001	24	120 Winter	30	+0%	30/60 Summer				28.929	0.069
10.000	25	15 Winter	30	+0%	100/15 Summer				30.499	-0.116
10.001	26	15 Winter	30	+0%	30/15 Summer				30.513	0.113
11.000	27	15 Summer	30	+0%					30.185	-0.150
11.001	24	15 Winter	30	+0%	30/15 Summer				30.093	0.093
1.006	7	120 Winter	30	+0%	100/30 Winter				28.290	-0.424
1.007	8	120 Winter	30	+0%	30/15 Summer				28.285	0.432

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30 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.00			0.1	OK	
1.001	2	0.000	0.08			10.1	SURCHARGED	
2.000	13	0.000	0.00			0.0	OK	
2.001	14	0.000	0.24			22.2	SURCHARGED	
3.000	9	0.000	0.00			0.0	OK	
3.001	10	0.000	0.21		17	17.1	SURCHARGED	
4.000	11	0.000	0.00			0.0	OK	
4.001	12	0.000	0.20		27	12.7	SURCHARGED	
1.002	3	0.000	0.49			61.0	OK	
1.003	4	0.000	0.61			60.9	OK	
1.004	5	0.000	0.46			60.8	OK	
5.000	19	0.000	0.00			0.1	OK	
5.001	20	0.000	0.09			11.6	SURCHARGED	
6.000	21	0.000	0.00			0.0	OK	
6.001	22	0.000	0.10			11.8	SURCHARGED	
7.000	15	0.000	0.00			0.0	OK	
7.001	16	0.000	0.26		18	12.3	SURCHARGED	
8.000	17	0.000	0.00			0.0	OK	
8.001	18	0.000	0.11		47	5.9	OK	
1.005	6	0.000	0.06			85.6	OK	
9.000	23	0.000	0.00			0.0	OK	
9.001	24	0.000	0.18			16.9	SURCHARGED	
10.000	25	0.000	0.02			0.3	OK	
10.001	26	0.000	0.29		8	20.3	SURCHARGED	
11.000	27	0.000	0.00			0.0	OK	
11.001	24	0.000	0.32		8	19.2	SURCHARGED	
1.006	7	0.000	0.07			105.7	OK	
1.007	8	0.000	0.59			86.0	SURCHARGED	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs	0	Number of Offline Controls	0	Number of Time/Area Diagrams	0
Number of Online Controls	12	Number of Storage Structures	11	Number of Real Time Controls	0

Synthetic Rainfall Details

Rainfall Model		FSR M5-60 (mm)	18.000	Cv (Summer)	0.750
Region	England and Wales	Ratio R	0.358	Cv (Winter)	0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	1, 30, 100
Climate Change (%)	0, 0, 40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
1.000	1	120 Winter	100	+40%	100/30 Summer				29.721	0.355
1.001	2	120 Winter	100	+40%	30/30 Summer				29.721	0.619
2.000	13	240 Winter	100	+40%	100/15 Winter				29.570	0.448
2.001	14	240 Winter	100	+40%	30/30 Winter				29.570	0.590
3.000	9	30 Winter	100	+40%					30.730	-0.050
3.001	10	30 Winter	100	+40%	30/15 Summer				30.730	0.255
4.000	11	15 Summer	100	+40%					31.192	-0.150
4.001	12	30 Winter	100	+40%	30/15 Winter				31.144	0.169
1.002	3	120 Winter	100	+40%	100/30 Winter				29.460	0.622
1.003	4	120 Winter	100	+40%	100/30 Winter				29.441	0.740
1.004	5	120 Winter	100	+40%	100/30 Winter				29.431	0.772
5.000	19	120 Winter	100	+40%	100/15 Winter				29.869	0.468
5.001	20	120 Winter	100	+40%	30/15 Winter				29.869	0.763
6.000	21	240 Winter	100	+40%	100/30 Winter				29.493	0.266
6.001	22	240 Winter	100	+40%	30/60 Winter				29.494	0.475
7.000	15	15 Summer	100	+40%					31.274	-0.150
7.001	16	30 Winter	100	+40%	30/15 Winter				31.137	0.137
8.000	17	15 Summer	100	+40%					30.646	-0.150
8.001	18	60 Winter	100	+40%	100/30 Winter				30.413	0.013
1.005	6	120 Winter	100	+40%	100/30 Winter				29.404	0.593
9.000	23	240 Winter	100	+40%	100/30 Summer				29.459	0.452
9.001	24	240 Winter	100	+40%	30/60 Summer				29.459	0.599
10.000	25	15 Winter	100	+40%	100/15 Summer				30.749	0.134
10.001	26	15 Winter	100	+40%	30/15 Summer				30.750	0.350
11.000	27	15 Winter	100	+40%					30.299	-0.036
11.001	24	15 Winter	100	+40%	30/15 Summer				30.305	0.305
1.006	7	120 Winter	100	+40%	100/30 Winter				29.401	0.687
1.007	8	120 Winter	100	+40%	30/15 Summer				29.397	1.544

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
1.000	1	0.000	0.00			0.1	SURCHARGED	
1.001	2	0.000	0.08			10.1	SURCHARGED	
2.000	13	0.000	0.00			0.1	SURCHARGED	
2.001	14	0.000	0.24			22.2	SURCHARGED	
3.000	9	0.000	0.02			0.5	FLOOD RISK	
3.001	10	0.000	0.34		12	26.9	FLOOD RISK	
4.000	11	0.000	0.00			0.0	OK	
4.001	12	0.000	0.37		17	23.2	SURCHARGED	
1.002	3	0.000	0.53			65.3	SURCHARGED	
1.003	4	0.000	0.66			65.4	SURCHARGED	
1.004	5	0.000	0.50			65.3	SURCHARGED	
5.000	19	0.000	0.00			0.1	SURCHARGED	
5.001	20	0.000	0.09			11.8	SURCHARGED	
6.000	21	0.000	0.00			0.0	SURCHARGED	
6.001	22	0.000	0.10			11.8	SURCHARGED	
7.000	15	0.000	0.00			0.0	OK	
7.001	16	0.000	0.45		15	21.6	SURCHARGED	
8.000	17	0.000	0.00			0.0	OK	
8.001	18	0.000	0.21		39	11.8	SURCHARGED	
1.005	6	0.000	0.07			102.5	SURCHARGED	
9.000	23	0.000	0.00			0.0	SURCHARGED	
9.001	24	0.000	0.18			16.9	SURCHARGED	
10.000	25	0.000	0.05			0.9	FLOOD RISK	
10.001	26	0.000	0.43		8	30.4	FLOOD RISK	
11.000	27	0.000	0.03			0.7	OK	
11.001	24	0.000	0.48		8	28.8	FLOOD RISK	
1.006	7	0.000	0.08			122.5	SURCHARGED	
1.007	8	0.000	0.59			86.0	SURCHARGED	

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A4 Appendix 5 Catchment 5 surface network report

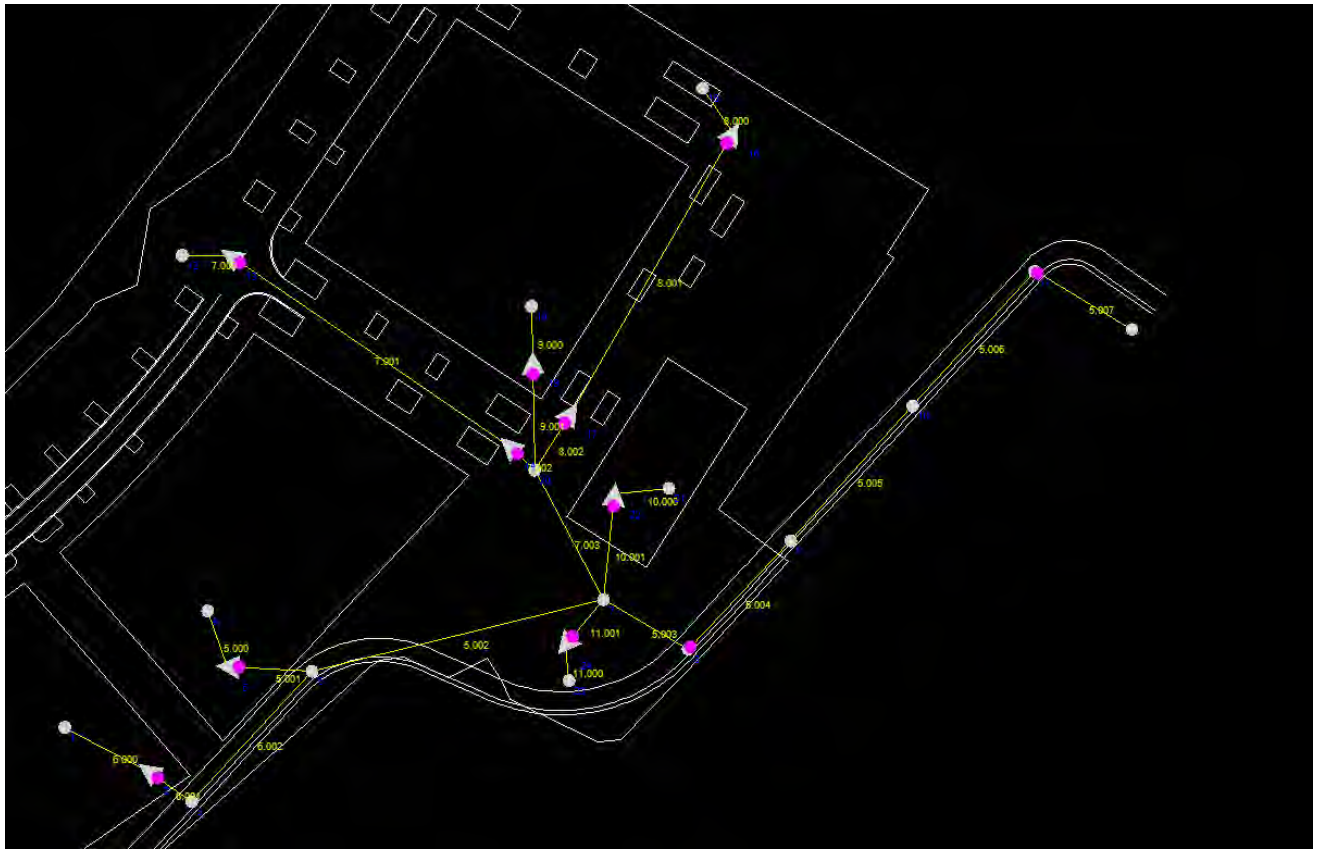


Figure 6 Catchment 5 model layout

STORM SEWER DESIGN by the Modified Rational Method

Design Criteria for Storm

Pipe Sizes STANDARD Manhole Sizes STANDARD

FSR Rainfall Model - England and Wales

Return Period (years)	1	PIMP (%)	100
M5-60 (mm)	18.000	Add Flow / Climate Change (%)	40
Ratio R	0.357	Minimum Backdrop Height (m)	0.200
Maximum Rainfall (mm/hr)	50	Maximum Backdrop Height (m)	1.500
Maximum Time of Concentration (mins)	30	Min Design Depth for Optimisation (m)	1.200
Foul Sewage (l/s/ha)	0.000	Min Vel for Auto Design only (m/s)	1.00
Volumetric Runoff Coeff.	0.750	Min Slope for Optimisation (1:X)	150

Designed with Level Soffits

Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
5.000	12.576	0.080	157.2	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
5.001	18.098	0.300	60.3	0.401	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.000	20.031	0.200	100.2	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
6.001	11.360	0.113	100.5	0.409	0.00	0.0	0.600	o	300	Pipe/Conduit	
6.002	37.779	0.252	149.9	0.034	0.00	0.0	0.600	o	300	Pipe/Conduit	
5.002	63.874	0.386	165.5	0.041	0.00	0.0	0.600	o	375	Pipe/Conduit	
7.000	10.216	0.100	102.2	0.000	15.00	0.0	0.600	o	150	Pipe/Conduit	
7.001	71.762	0.478	150.1	0.232	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.002	7.570	0.076	99.6	0.151	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.000	11.511	0.115	100.1	0.000	15.00	0.0	0.600	o	150	Pipe/Conduit	
8.001	68.841	0.459	150.0	0.175	0.00	0.0	0.600	o	225	Pipe/Conduit	
8.002	14.379	0.144	99.9	0.142	0.00	0.0	0.600	o	225	Pipe/Conduit	

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of permeable paving

Dummy pipe upstream of permeable paving

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
5.000	45.61	5.26	39.778	0.000	0.0	0.0	0.0	0.80	14.1	0.0
5.001	45.07	5.41	39.548	0.401	0.0	0.0	19.6	2.03	143.3	68.5
6.000	45.35	5.33	39.963	0.000	0.0	0.0	0.0	1.00	17.7	0.0
6.001	44.91	5.45	39.613	0.409	0.0	0.0	19.9	1.57	110.8	69.6
6.002	43.24	5.94	39.500	0.443	0.0	0.0	20.8	1.28	90.6	72.7
5.002	40.91	6.70	39.173	0.885	0.0	0.0	39.2	1.41	155.3	137.3
7.000	26.58	15.17	42.475	0.000	0.0	0.0	0.0	0.99	17.6	0.0
7.001	25.53	16.29	42.300	0.232	0.0	0.0	6.4	1.06	42.3	22.4
7.002	25.44	16.39	41.822	0.383	0.0	0.0	10.6	1.31	52.1	36.9
8.000	26.56	15.19	42.490	0.000	0.0	0.0	0.0	1.00	17.7	0.0
8.001	25.55	16.27	42.300	0.175	0.0	0.0	4.8	1.07	42.4	16.9
8.002	25.39	16.45	41.841	0.317	0.0	0.0	8.7	1.31	52.0	30.5

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Network Design Table for Storm

PN	Length (m)	Fall (m)	Slope (1:X)	I.Area (ha)	T.E. (mins)	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type	Auto Design
9.000	11.979	0.120	99.8	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
9.001	22.901	0.303	75.6	0.344	0.00	0.0	0.600	o	225	Pipe/Conduit	
7.003	31.225	1.488	21.0	0.000	0.00	0.0	0.600	o	225	Pipe/Conduit	
10.000	11.653	0.117	99.6	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
10.001	22.543	0.300	75.1	0.269	0.00	0.0	0.600	o	225	Pipe/Conduit	
11.000	7.501	0.075	100.0	0.000	5.00	0.0	0.600	o	150	Pipe/Conduit	
11.001	12.683	1.212	10.5	0.295	0.00	0.0	0.600	o	150	Pipe/Conduit	
5.003	20.862	0.298	70.0	0.000	0.00	0.0	0.600	o	375	Pipe/Conduit	
5.004	31.740	0.212	149.7	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.005	38.687	0.258	149.9	0.000	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.006	38.687	0.258	149.9	0.026	0.00	0.0	0.600	o	450	Pipe/Conduit	
5.007	24.121	0.500	48.2	0.024	0.00	0.0	0.600	o	450	Pipe/Conduit	

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of indicative plot storage/flow control

Dummy pipe upstream of permeable paving

Network Results Table

PN	Rain (mm/hr)	T.C. (mins)	US/IL (m)	Σ I.Area (ha)	Σ Base Flow (l/s)	Foul (l/s)	Add Flow (l/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
9.000	45.85	5.20	40.923	0.000	0.0	0.0	0.0	1.01	17.8	0.0
9.001	44.92	5.45	40.728	0.344	0.0	0.0	16.7	1.51	59.9	58.6
7.003	25.23	16.63	40.425	1.044	0.0	0.0	28.5	2.87	114.1	99.8
10.000	45.87	5.19	40.420	0.000	0.0	0.0	0.0	1.01	17.8	0.0
10.001	44.96	5.44	40.228	0.269	0.0	0.0	13.1	1.51	60.0	45.9
11.000	46.13	5.12	41.500	0.000	0.0	0.0	0.0	1.00	17.8	0.0
11.001	45.87	5.19	41.425	0.295	0.0	0.0	14.7	3.13	55.4	51.3
5.003	25.09	16.79	38.787	2.493	0.0	0.0	67.8	2.17	239.5	237.2
5.004	24.82	17.11	38.414	2.493	0.0	0.0	67.8	1.66	263.9	237.2
5.005	24.50	17.50	36.728	2.493	0.0	0.0	67.8	1.66	263.7	237.2
5.006	24.19	17.89	34.996	2.520	0.0	0.0	67.8	1.66	263.7	237.2
5.007	24.08	18.03	33.265	2.543	0.0	0.0	67.8	2.93	466.5	237.2

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Area Summary for Storm

Pipe Number	PIMP Type	PIMP Name	PIMP (%)	Gross Area (ha)	Imp. Area (ha)	Pipe Total (ha)
5.000	-	-	100	0.000	0.000	0.000
5.001	User	-	100	0.401	0.401	0.401
6.000	-	-	100	0.000	0.000	0.000
6.001	User	-	100	0.409	0.409	0.409
6.002	User	-	100	0.034	0.034	0.034
5.002	User	-	100	0.041	0.041	0.041
7.000	-	-	100	0.000	0.000	0.000
7.001	User	-	100	0.232	0.232	0.232
7.002	User	-	100	0.151	0.151	0.151
8.000	-	-	100	0.000	0.000	0.000
8.001	User	-	100	0.175	0.175	0.175
8.002	User	-	100	0.142	0.142	0.142
9.000	-	-	100	0.000	0.000	0.000
9.001	User	-	100	0.344	0.344	0.344
7.003	-	-	100	0.000	0.000	0.000
10.000	-	-	100	0.000	0.000	0.000
10.001	User	-	100	0.269	0.269	0.269
11.000	-	-	100	0.000	0.000	0.000
11.001	User	-	100	0.295	0.295	0.295
5.003	-	-	100	0.000	0.000	0.000
5.004	-	-	100	0.000	0.000	0.000
5.005	-	-	100	0.000	0.000	0.000
5.006	User	-	100	0.026	0.026	0.026
5.007	User	-	100	0.024	0.024	0.024
				Total	Total	Total
				2.543	2.543	2.543

Free Flowing Outfall Details for Storm

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
5.007		33.500	32.765	29.500	0	0

Simulation Criteria for Storm

Volumetric Runoff Coeff	0.750	Additional Flow - % of Total Flow	0.000
Areal Reduction Factor	1.000	MADD Factor * 10m³/ha Storage	2.000
Hot Start (mins)	0	Inlet Coeffiecient	0.800
Hot Start Level (mm)	0	Flow per Person per Day (l/per/day)	0.000
Manhole Headloss Coeff (Global)	0.500	Run Time (mins)	60
Foul Sewage per hectare (l/s)	0.000	Output Interval (mins)	1

Number of Input Hydrographs 0	Number of Offline Controls 0	Number of Time/Area Diagrams 0
Number of Online Controls 11	Number of Storage Structures 9	Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	Profile Type	Summer
Return Period (years)	100	Cv (Summer)	0.750
Region	England and Wales	Cv (Winter)	0.840
M5-60 (mm)	18.000	Storm Duration (mins)	30
Ratio R	0.357		

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Online Controls for Storm

Hydro-Brake® Optimum Manhole: 5, DS/PN: 5.001, Volume (m³): 3.0

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0137-8800-1000-8800
Design Head (m)	1.000
Design Flow (l/s)	8.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	137
Invert Level (m)	39.548
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	8.8	Kick-Flo®	0.664	7.3
Flush-Flo™	0.299	8.8	Mean Flow over Head Range	-	7.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	5.0	0.800	7.9	2.000	12.2	4.000	17.0	7.000	22.2
0.200	8.5	1.000	8.8	2.200	12.8	4.500	18.0	7.500	22.9
0.300	8.8	1.200	9.6	2.400	13.3	5.000	18.9	8.000	23.7
0.400	8.7	1.400	10.3	2.600	13.8	5.500	19.8	8.500	24.4
0.500	8.4	1.600	11.0	3.000	14.8	6.000	20.6	9.000	25.0
0.600	7.9	1.800	11.6	3.500	15.9	6.500	21.4	9.500	25.7

Hydro-Brake® Optimum Manhole: 2, DS/PN: 6.001, Volume (m³): 3.0

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0131-9000-1500-9000
Design Head (m)	1.500
Design Flow (l/s)	9.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	131
Invert Level (m)	39.613
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	9.0	Kick-Flo®	0.927	7.2
Flush-Flo™	0.440	9.0	Mean Flow over Head Range	-	7.9

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.7	0.600	8.8	1.600	9.3	2.600	11.7	5.000	15.9
0.200	8.1	0.800	8.2	1.800	9.8	3.000	12.5	5.500	16.7
0.300	8.8	1.000	7.4	2.000	10.3	3.500	13.4	6.000	17.4
0.400	9.0	1.200	8.1	2.200	10.8	4.000	14.3	6.500	18.0
0.500	9.0	1.400	8.7	2.400	11.2	4.500	15.1	7.000	18.7

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Hydro-Brake® Optimum Manhole: 2, DS/PN: 6.001, Volume (m³): 3.0

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
7.500	19.3	8.000	19.9	8.500	20.5	9.000	21.1	9.500	21.7

Hydro-Brake® Optimum Manhole: 13, DS/PN: 7.001, Volume (m³): 1.0

Flow control for permeable paving

Unit Reference	MD-SHE-0111-5100-0700-5100
Design Head (m)	0.700
Design Flow (l/s)	5.1
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	111
Invert Level (m)	42.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	5.1	Kick-Flo®	0.482	4.3
Flush-Flo™	0.214	5.1	Mean Flow over Head Range	-	4.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.8	0.800	5.4	2.000	8.3	4.000	11.6	7.000	15.1
0.200	5.1	1.000	6.0	2.200	8.7	4.500	12.2	7.500	15.6
0.300	5.0	1.200	6.6	2.400	9.1	5.000	12.9	8.000	16.1
0.400	4.8	1.400	7.0	2.600	9.4	5.500	13.5	8.500	16.6
0.500	4.4	1.600	7.5	3.000	10.1	6.000	14.0	9.000	17.1
0.600	4.7	1.800	7.9	3.500	10.9	6.500	14.6	9.500	17.6

Hydro-Brake® Optimum Manhole: 14, DS/PN: 7.002, Volume (m³): 4.1

Flow control for permeable paving

Unit Reference	MD-SHE-0132-8400-1200-8400
Design Head (m)	1.200
Design Flow (l/s)	8.4
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	132
Invert Level (m)	41.822
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	8.4	Kick-Flo®	0.768	6.8
Flush-Flo™	0.357	8.4	Mean Flow over Head Range	-	7.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.7	0.300	8.3	0.500	8.2	0.800	6.9	1.200	8.4
0.200	7.9	0.400	8.4	0.600	8.0	1.000	7.7	1.400	9.0

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Hydro-Brake® Optimum Manhole: 14, DS/PN: 7.002, Volume (m³): 4.1

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
1.600	9.6	2.400	11.6	4.000	14.8	6.000	18.0	8.000	20.7
1.800	10.2	2.600	12.1	4.500	15.7	6.500	18.7	8.500	21.3
2.000	10.7	3.000	12.9	5.000	16.5	7.000	19.4	9.000	21.9
2.200	11.2	3.500	13.9	5.500	17.3	7.500	20.1	9.500	22.5

Hydro-Brake® Optimum Manhole: 16, DS/PN: 8.001, Volume (m³): 1.0

Flow control for permeable paving

Unit Reference	MD-SHE-0097-3800-0700-3800
Design Head (m)	0.700
Design Flow (l/s)	3.8
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	97
Invert Level (m)	42.300
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	0.700	3.8	Kick-Flo®	0.469	3.2
Flush-Flo™	0.210	3.8	Mean Flow over Head Range	-	3.3

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	3.1	0.800	4.0	2.000	6.2	4.000	8.6	7.000	11.2
0.200	3.8	1.000	4.5	2.200	6.5	4.500	9.1	7.500	11.5
0.300	3.7	1.200	4.9	2.400	6.7	5.000	9.5	8.000	11.9
0.400	3.5	1.400	5.2	2.600	7.0	5.500	10.0	8.500	12.3
0.500	3.3	1.600	5.6	3.000	7.5	6.000	10.4	9.000	12.6
0.600	3.5	1.800	5.9	3.500	8.0	6.500	10.8	9.500	13.0

Hydro-Brake® Optimum Manhole: 17, DS/PN: 8.002, Volume (m³): 4.0

Flow control for permeable paving

Unit Reference	MD-SHE-0120-6900-1200-6900
Design Head (m)	1.200
Design Flow (l/s)	6.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	120
Invert Level (m)	41.841
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.200	6.9	Kick-Flo®	0.760	5.6
Flush-Flo™	0.356	6.9	Mean Flow over Head Range	-	6.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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Hydro-Brake® Optimum Manhole: 17, DS/PN: 8.002, Volume (m³): 4.0

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.2	0.800	5.7	2.000	8.8	4.000	12.2	7.000	15.9
0.200	6.5	1.000	6.3	2.200	9.2	4.500	12.9	7.500	16.4
0.300	6.9	1.200	6.9	2.400	9.5	5.000	13.5	8.000	16.9
0.400	6.9	1.400	7.4	2.600	9.9	5.500	14.2	8.500	17.4
0.500	6.8	1.600	7.9	3.000	10.6	6.000	14.8	9.000	17.9
0.600	6.5	1.800	8.3	3.500	11.4	6.500	15.3	9.500	18.4

Hydro-Brake® Optimum Manhole: 19, DS/PN: 9.001, Volume (m³): 2.8

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0121-7600-1500-7600
Design Head (m)	1.500
Design Flow (l/s)	7.6
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	121
Invert Level (m)	40.803
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.500	7.6	Kick-Flo®	0.921	6.0
Flush-Flo™	0.440	7.6	Mean Flow over Head Range	-	6.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.3	0.800	6.9	2.000	8.7	4.000	12.1	7.000	15.8
0.200	6.9	1.000	6.3	2.200	9.1	4.500	12.8	7.500	16.3
0.300	7.4	1.200	6.8	2.400	9.5	5.000	13.4	8.000	16.8
0.400	7.6	1.400	7.4	2.600	9.8	5.500	14.0	8.500	17.3
0.500	7.6	1.600	7.8	3.000	10.5	6.000	14.6	9.000	17.8
0.600	7.5	1.800	8.3	3.500	11.3	6.500	15.2	9.500	18.2

Hydro-Brake® Optimum Manhole: 22, DS/PN: 10.001, Volume (m³): 3.3

Flow control to represent flow from Plot

Unit Reference	MD-SHE-0114-5900-1000-5900
Design Head (m)	1.000
Design Flow (l/s)	5.9
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	114
Invert Level (m)	40.230
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	5.9	Kick-Flo®	0.645	4.8
Flush-Flo™	0.295	5.9	Mean Flow over Head Range	-	5.1

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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Hydro-Brake® Optimum Manhole: 22, DS/PN: 10.001, Volume (m³): 3.3

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.0	0.800	5.3	2.000	8.2	4.000	11.3	7.000	14.8
0.200	5.7	1.000	5.9	2.200	8.5	4.500	12.0	7.500	15.3
0.300	5.9	1.200	6.4	2.400	8.9	5.000	12.6	8.000	15.8
0.400	5.8	1.400	6.9	2.600	9.2	5.500	13.2	8.500	16.2
0.500	5.6	1.600	7.3	3.000	9.9	6.000	13.7	9.000	16.7
0.600	5.2	1.800	7.8	3.500	10.6	6.500	14.3	9.500	17.1

Hydro-Brake® Optimum Manhole: 24, DS/PN: 11.001, Volume (m³): 1.3

Flow control for permeable paving

Unit Reference	MD-SHE-0119-6500-1000-6500
Design Head (m)	1.000
Design Flow (l/s)	6.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	119
Invert Level (m)	41.425
Minimum Outlet Pipe Diameter (mm)	150
Suggested Manhole Diameter (mm)	1200

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.000	6.5	Kick-Flo®	0.649	5.3
Flush-Flo™	0.296	6.5	Mean Flow over Head Range	-	5.6

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	4.2	0.800	5.9	2.000	9.0	4.000	12.5	7.000	16.3
0.200	6.3	1.000	6.5	2.200	9.4	4.500	13.2	7.500	16.9
0.300	6.5	1.200	7.1	2.400	9.8	5.000	13.9	8.000	17.4
0.400	6.4	1.400	7.6	2.600	10.2	5.500	14.5	8.500	17.9
0.500	6.2	1.600	8.1	3.000	10.9	6.000	15.2	9.000	18.4
0.600	5.8	1.800	8.6	3.500	11.7	6.500	15.7	9.500	18.9

Hydro-Brake® Optimum Manhole: 8, DS/PN: 5.004, Volume (m³): 8.2

Flow control to restrict flows down hillside

Unit Reference	MD-SHE-0267-4750-2484-4750
Design Head (m)	2.484
Design Flow (l/s)	47.5
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	267
Invert Level (m)	38.414
Minimum Outlet Pipe Diameter (mm)	300
Suggested Manhole Diameter (mm)	Site Specific Design (Contact Hydro International)

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	2.484	47.3	Kick-Flo®	1.561	37.8
Flush-Flo™	0.727	47.2	Mean Flow over Head Range	-	41.0

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

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Hydro-Brake® Optimum Manhole: 8, DS/PN: 5.004, Volume (m³): 8.2

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	8.5	0.800	47.1	2.000	42.6	4.000	59.5	7.000	78.1
0.200	27.5	1.000	46.4	2.200	44.6	4.500	63.0	7.500	80.7
0.300	41.6	1.200	44.9	2.400	46.5	5.000	66.3	8.000	83.3
0.400	44.5	1.400	42.1	2.600	48.3	5.500	69.4	8.500	85.8
0.500	46.1	1.600	38.3	3.000	51.8	6.000	72.4	9.000	88.2
0.600	46.9	1.800	40.5	3.500	55.8	6.500	75.3	9.500	90.6

Hydro-Brake® Optimum Manhole: 11, DS/PN: 5.007, Volume (m³): 9.1

Flow control for network outfall

Unit Reference	MD-SHE-0299-5600-1808-5600
Design Head (m)	1.808
Design Flow (l/s)	56.0
Flush-Flo™	Calculated
Objective	Minimise upstream storage
Application	Surface
Sump Available	Yes
Diameter (mm)	299
Invert Level (m)	33.265
Minimum Outlet Pipe Diameter (mm)	375
Suggested Manhole Diameter (mm)	2100

Control Points	Head (m)	Flow (l/s)	Control Points	Head (m)	Flow (l/s)
Design Point (Calculated)	1.808	56.0	Kick-Flo®	1.248	46.8
Flush-Flo™	0.575	56.0	Mean Flow over Head Range	-	47.8

The hydrological calculations have been based on the Head/Discharge relationship for the Hydro-Brake® Optimum as specified. Should another type of control device other than a Hydro-Brake Optimum® be utilised then these storage routing calculations will be invalidated

Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)	Depth (m)	Flow (l/s)
0.100	9.2	0.800	55.1	2.000	58.8	4.000	82.2	7.000	107.9
0.200	30.8	1.000	53.2	2.200	61.5	4.500	87.0	7.500	111.6
0.300	52.2	1.200	48.8	2.400	64.2	5.000	91.6	8.000	115.2
0.400	54.7	1.400	49.5	2.600	66.7	5.500	96.0	8.500	118.7
0.500	55.8	1.600	52.8	3.000	71.5	6.000	100.1	9.000	122.0
0.600	56.0	1.800	55.8	3.500	77.0	6.500	104.1	9.500	125.3

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Storage Structures for Storm

Tank or Pond Manhole: 5, DS/PN: 5.001

Invert Level (m) 39.548

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	180.0	1.000	180.0	1.001	0.0

Tank to indicatively represent Plot storage.

Tank or Pond Manhole: 2, DS/PN: 6.001

Invert Level (m) 39.613

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	170.0	1.000	170.0	1.001	0.0

Tank to indicatively represent Plot storage.

Tank or Pond Manhole: 13, DS/PN: 7.001

Invert Level (m) 42.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	150.0	0.500	150.0

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 14, DS/PN: 7.002

Invert Level (m) 41.822

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	40.0	0.500	40.0

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 16, DS/PN: 8.001

Invert Level (m) 42.300

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	120.0	0.500	120.0

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 17, DS/PN: 8.002

Invert Level (m) 41.841

Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	40.0	0.500	40.0

Tank to represent 0.5m deep permeable paving

Tank or Pond Manhole: 19, DS/PN: 9.001

Invert Level (m) 40.728

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	150.0	1.000	150.0	1.001	0.0

Tank to indicatively represent Plot storage.

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Tank or Pond Manhole: 22, DS/PN: 10.001

Tank to indicatively represent Plot storage.

Invert Level (m) 40.230

Depth (m)	Area (m²)	Depth (m)	Area (m²)	Depth (m)	Area (m²)
0.000	180.0	1.000	180.0	1.001	0.0

Tank or Pond Manhole: 24, DS/PN: 11.001

Tank to represent 0.5m deep permeable paving

Invert Level (m) 42.000

Depth (m)	Area (m²)
0.000	255.0

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

Simulation Criteria

Areal Reduction Factor	1.000	Additional Flow - % of Total Flow	0.000
Hot Start (mins)	0	MADD Factor * 10m³/ha Storage	2.000
Hot Start Level (mm)	0	Inlet Coeffiecient	0.800
Manhole Headloss Coeff (Global)	0.500	Flow per Person per Day (l/per/day)	0.000
Foul Sewage per hectare (l/s)	0.000		

Number of Input Hydrographs 0 Number of Offline Controls 0 Number of Time/Area Diagrams 0
Number of Online Controls 11 Number of Storage Structures 9 Number of Real Time Controls 0

Synthetic Rainfall Details

Rainfall Model	FSR	M5-60 (mm) 18.000	Cv (Summer) 0.750
Region	England and Wales	Ratio R 0.357	Cv (Winter) 0.840

Margin for Flood Risk Warning (mm)	300.0
Analysis Timestep	2.5 Second Increment (Extended)
DTS Status	OFF
DVD Status	OFF
Inertia Status	OFF

Profile(s)	Summer and Winter
Duration(s) (mins)	15, 30, 60, 120, 240, 360, 480, 960, 1440
Return Period(s) (years)	100
Climate Change (%)	40

PN	US/MH Name	Storm	Return Period	Climate Change	First (X) Surcharge	First (Y) Flood	First (Z) Overflow	Overflow Act.	Water Level (m)	Surcharged Depth (m)
5.000	4	240 Winter	100	+40%	100/15 Summer				41.537	1.609
5.001	5	240 Winter	100	+40%	100/15 Summer				41.537	1.689
6.000	1	240 Winter	100	+40%	100/15 Winter				41.732	1.619
6.001	2	240 Winter	100	+40%	100/15 Summer				41.732	1.819
6.002	3	240 Winter	100	+40%	100/15 Summer				40.954	1.154
5.002	6	240 Winter	100	+40%	100/15 Summer				40.941	1.393
7.000	12	240 Winter	100	+40%	100/15 Winter				42.977	0.352
7.001	13	240 Winter	100	+40%	100/15 Summer				42.977	0.452
7.002	14	120 Winter	100	+40%	100/15 Summer				42.902	0.855
8.000	15	240 Winter	100	+40%	100/30 Summer				42.950	0.310
8.001	16	240 Winter	100	+40%	100/15 Summer				42.950	0.425
8.002	17	120 Winter	100	+40%	100/15 Summer				42.889	0.823
9.000	18	240 Winter	100	+40%	100/15 Summer				41.693	0.620
9.001	19	240 Winter	100	+40%	100/15 Summer				41.693	0.740
7.003	20	240 Winter	100	+40%	100/120 Winter				40.984	0.334
10.000	21	240 Winter	100	+40%	100/15 Winter				40.940	0.370
10.001	22	240 Winter	100	+40%	100/15 Summer				40.940	0.487
11.000	23	120 Winter	100	+40%	100/15 Summer				42.414	0.764
11.001	24	120 Winter	100	+40%	100/15 Summer				42.414	0.839
5.003	7	240 Winter	100	+40%	100/15 Summer				40.923	1.761
5.004	8	240 Winter	100	+40%	100/15 Summer				40.895	2.031
5.005	9	240 Winter	100	+40%					36.865	-0.313
5.006	10	15 Winter	100	+40%					35.152	-0.294
5.007	11	30 Winter	100	+40%	100/15 Summer				35.076	1.361

PN	US/MH Name	Flooded Volume (m³)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
5.000	4	0.000	0.06			0.8	SURCHARGED	
5.001	5	0.000	0.07			8.8	SURCHARGED	
6.000	1	0.000	0.06			1.0	FLOOD RISK	

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100 year Return Period Summary of Critical Results by Maximum Level (Rank 1) for Storm

PN	US/MH Name	Flooded Volume (m^3)	Flow / Cap.	Overflow (l/s)	Half Drain Time (mins)	Pipe Flow (l/s)	Status	Level Exceeded
6.001	2	0.000	0.11			9.0	FLOOD RISK	
6.002	3	0.000	0.14			11.9	SURCHARGED	
5.002	6	0.000	0.15			22.5	SURCHARGED	
7.000	12	0.000	0.00			0.0	FLOOD RISK	
7.001	13	0.000	0.12			5.1	FLOOD RISK	
7.002	14	0.000	0.22			8.4	FLOOD RISK	
8.000	15	0.000	0.00			0.0	FLOOD RISK	
8.001	16	0.000	0.09			3.8	FLOOD RISK	
8.002	17	0.000	0.15			6.9	FLOOD RISK	
9.000	18	0.000	0.00			0.1	SURCHARGED	
9.001	19	0.000	0.14			7.6	SURCHARGED	
7.003	20	0.000	0.21			22.8	SURCHARGED	
10.000	21	0.000	0.00			0.0	SURCHARGED	
10.001	22	0.000	0.11			5.9	SURCHARGED	
11.000	23	0.000	0.00			0.0	FLOOD RISK	
11.001	24	0.000	0.13			6.5	FLOOD RISK	
5.003	7	0.000	0.24			48.6	SURCHARGED	
5.004	8	0.000	0.21			47.2	SURCHARGED	
5.005	9	0.000	0.20			47.2	OK	
5.006	10	0.000	0.26			60.5	OK	
5.007	11	0.000	0.14			56.0	SURCHARGED	

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A5 Appendix 6 foul network report



Figure 8 Foul model layout

FOUL SEWERAGE DESIGN

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
F1.000	26.111	0.348	75.0	0.041	202	0.0	1.500	o	150	Pipe/Conduit
F1.001	59.659	0.796	75.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit
F2.000	15.749	0.870	18.1	0.041	202	0.0	1.500	o	150	Pipe/Conduit
F1.002	73.682	0.737	100.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit
F3.000	15.702	0.146	107.5	0.082	403	0.0	1.500	o	225	Pipe/Conduit
F1.003	67.321	2.324	29.0	0.000	0	0.0	1.500	o	225	Pipe/Conduit
F4.000	14.987	1.499	10.0	0.241	388	0.0	1.500	o	150	Pipe/Conduit
F5.000	13.915	0.155	89.8	0.048	261	0.0	1.500	o	225	Pipe/Conduit
F5.001	63.488	0.705	90.1	0.000	0	0.0	1.500	o	225	Pipe/Conduit
F6.000	12.048	0.142	85.0	0.049	256	0.0	1.500	o	225	Pipe/Conduit
F5.002	46.122	1.051	43.9	0.000	0	0.0	1.500	o	225	Pipe/Conduit
F1.004	64.823	0.259	250.3	0.000	0	0.0	1.500	o	375	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.000	41.829	0.041	0.0	202	0.0	81	1.04	1.01	17.9	10.1
F1.001	41.481	0.041	0.0	202	0.0	81	1.04	1.01	17.9	10.1
F2.000	41.555	0.041	0.0	202	0.0	54	1.76	2.07	36.5	10.1
F1.002	40.610	0.082	0.0	404	0.0	105	1.11	1.15	45.6	20.2
F3.000	40.899	0.082	0.0	403	0.0	107	1.08	1.11	44.0	20.2
F1.003	39.873	0.164	0.0	807	0.0	109	2.11	2.14	85.0	40.4
F4.000	40.332	0.241	0.0	388	0.0	66	2.62	2.78	49.2	19.5
F5.000	39.460	0.048	0.0	261	0.0	80	1.03	1.21	48.2	13.0
F5.001	39.305	0.048	0.0	261	0.0	80	1.03	1.21	48.1	13.0
F6.000	39.796	0.049	0.0	256	0.0	78	1.05	1.25	49.5	12.8
F5.002	38.600	0.097	0.0	517	0.0	95	1.61	1.74	69.0	25.8
F1.004	37.399	0.502	0.0	1712	0.0	246	1.11	1.01	111.8	85.7

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FOUL SEWERAGE DESIGN

Network Design Table for Foul - Main

PN	Length (m)	Fall (m)	Slope (1:X)	Area (ha)	Houses	Base Flow (l/s)	k (mm)	HYD SECT	DIA (mm)	Section Type
F1.005	17.354	0.069	251.5	0.000	0	0.0	1.500	o	375	Pipe/Conduit
F7.000	7.066	0.109	64.8	0.093	166	0.0	1.500	o	150	Pipe/Conduit
F7.001	47.754	0.735	65.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit
F7.002	19.753	0.304	65.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit
F8.000	28.892	1.860	15.5	0.048	204	0.0	1.500	o	150	Pipe/Conduit
F7.003	13.037	1.100	11.9	0.000	0	0.0	1.500	o	150	Pipe/Conduit
F7.004	8.620	0.431	20.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit
F7.005	8.620	0.575	15.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit
F7.006	14.354	0.957	15.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit
F7.007	19.249	0.962	20.0	0.000	0	0.0	1.500	o	150	Pipe/Conduit
F9.000	31.865	0.437	72.9	0.140	179	0.0	1.500	o	150	Pipe/Conduit
F10.000	6.546	0.212	30.9	0.227	150	0.0	1.500	o	150	Pipe/Conduit
F11.000	5.764	0.140	41.2	0.298	457	0.0	1.500	o	150	Pipe/Conduit

Network Results Table

PN	US/IL (m)	Σ Area (ha)	Σ Base Flow (l/s)	Σ Hse	Add Flow (l/s)	P.Dep (mm)	P.Vel (m/s)	Vel (m/s)	Cap (l/s)	Flow (l/s)
F1.005	37.140	0.502	0.0	1712	0.0	247	1.11	1.01	111.5	85.7
F7.000	39.300	0.093	0.0	166	0.0	69	1.05	1.09	19.2	8.3
F7.001	39.191	0.093	0.0	166	0.0	69	1.05	1.09	19.2	8.3
F7.002	38.456	0.093	0.0	166	0.0	69	1.05	1.09	19.2	8.3
F8.000	41.510	0.048	0.0	204	0.0	52	1.87	2.23	39.4	10.2
F7.003	38.152	0.141	0.0	370	0.0	67	2.43	2.55	45.1	18.5
F7.004	36.150	0.141	0.0	370	0.0	78	2.00	1.96	34.7	18.5
F7.005	34.219	0.141	0.0	370	0.0	72	2.23	2.27	40.1	18.5
F7.006	32.288	0.141	0.0	370	0.0	72	2.23	2.27	40.1	18.5
F7.007	30.070	0.141	0.0	370	0.0	78	2.00	1.96	34.7	18.5
F9.000	29.515	0.140	0.0	179	0.0	75	1.03	1.03	18.1	9.0
F10.000	29.761	0.227	0.0	150	0.0	54	1.34	1.58	27.9	7.6
F11.000	29.069	0.298	0.0	457	0.0	117	1.56	1.37	24.2	23.0

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Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F1.005	F26	41.659	37.071	0.000	0	0

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F7.007	F27	30.539	29.108	0.000	1200	0

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F9.000	F28	30.538	29.078	0.000	0	0

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F10.000	F29	30.899	29.549	0.000	0	0

Free Flowing Outfall Details for Foul - Main

Outfall Pipe Number	Outfall Name	C. Level (m)	I. Level (m)	Min I. Level (m)	D,L (mm)	W (mm)
F11.000	F30	30.279	28.929	0.000	0	0

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Technical Note

282022 17 February 2022

DOCUMENT CHECKING (not mandatory for File Note)

	Prepared by	Checked by	Approved by
Name	Emily Stoddart	Ryan Griffiths	Mike Wilton
Signature			

Appendix D

Surface Water General Arrangements & Details

Plot	Area (ha)	Catchment	30 year restriction (l/s)	100 year restriction (l/s)
RB06	0.247	1	3.4	5.4
RB07	0.376	1	5.2	8.3
RB10	1.011	1	14.1	22.2
NT02	0.771	4	10.8	16.9
NT03	0.537	4	7.5	11.8
NT04	1.012	4	14.1	22.2
RB16	0.537	4	7.5	11.8
RB17	0.461	4	6.4	10.1
RB01	0.288	1	4.0	6.3
RB02	0.326	1	4.5	7.2
RB03	0.403	5	5.4	8.9
RB04	0.415	5	5.5	9.1
RB05a	0.369	5	4.9	8.1
RB05b	0.237	5	3.2	5.2
RB05c	0.410	5	5.5	9.0
RB12(b)	0.235	1	3.3	5.2
RB08	0.444	1	6.2	9.8
RB09	0.009	1	0.1	0.2
RB11	0.156	1	2.2	3.4
RB12a	0.163	1	2.3	3.6

See sheet 2 of 2

Notes

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   • Topographical Survey drawing PS-2158-TS by Paragon Surveys dated September 2021.
4. No guarantee is given for the accuracy of the information contained herein, which is provided for general guidance only and must not be relied upon for excavation or detailed design until apparatus locations are verified / validated through further site investigation works.
5. Extents of road refurbishments, new roads, and street works are WIP based on WS3 Design.
6. Existing Drainage layout based on the following information:
   - Utility Search Map drawing 97079 undertaken by Atkins dated 24/06/2021.
7. For the Standard Drainage Specification refer to the "Design and Construction Guidance for foul and surface water sewers offered for adoption" - Rev 2.1 - dated 25th May 2021.
8. This drawing should be read with reference to the Arup Stage 3 Report and Drainage Strategy.
9. Utilities have been drawn to PAS128 standard. The Located Service Classification table below gives a brief overview. For further details refer to document 'PAS 128:2014 Specification for underground utility detection, verification and location'.

Located Service Classification	Certainty/Risk
Type A Verification + Visual identification	
Type B Detection + Typically GPR and EML techniques are used	Data
Type C Site reconnaissance + Physical surface features identified	
Type D Desktop utility records search	

10. A connection point has been provided for each plot within the HIF Boundary at a minimum depth of 2.0-2.5m as agreed with WSP.
11. Drainage construction materials, unless otherwise stated:
   - Drainage pipes - Polyethylene in accordance with BS 13476
   - Manholes - Precast Concrete
   - Inspection Chambers - Polypropylene in accordance with BS 7158
12. As RB09/10 are outside the HIF Red Line Boundary, it has been areed that a connection to the River Irk will be provided/constructed as part of the Plot construction. Dischare Rates are to be agreed as part of the HIF works.
13. The finalised location of trees is to be confirmed at the next design stage.

Rev	Date	Description	By	Chkd	Appd	Auth
P01	17/12/21		DH	RG	RG	---
P02	01/02/22		DH	RG	RG	---
P03.04	17/02/22		---	---	---	---

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www.arup.com

Client

MANCHESTER CITY COUNCIL

bam nuttall

Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Proposed Surface Water Drainage
Sheet 1 of 2

Scale at A1	1:500	Arup Job No	282022-00
Role	Civil - Drainage		
Suitability	S0 - Initial Status or WIP		

Rev	By	Chkd	Appd	
P03.04	---	---	---	---
	Date	Date	Date	
	---	---	---	---

Name: VNIF - ARP - 00 - YYY - DR - CD - 0010
(Project | Originator | Volume | Location | Type | Role | Number)

Do not scale

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A1

See sheet 1 of 2



Plot	Area (ha)	Catchment	30 year restriction (l/s)	100 year restriction (l/s)
RB06	0.247	1	3.4	5.4
RB07	0.376	1	5.2	8.3
RB10	1.011	1	14.1	22.2
NT02	0.771	4	10.8	16.9
NT03	0.537	4	7.5	11.8
NT04	1.012	4	14.1	22.2
RB16	0.537	4	7.5	11.8
RB17	0.461	4	6.4	10.1
RB01	0.288	1	4.0	6.3
RB02	0.326	1	4.5	7.2
RB03	0.403	5	5.4	8.9
RB04	0.415	5	5.5	9.1
RB05a	0.369	5	4.9	8.1
RB05b	0.237	5	3.2	5.2
RB05c	0.410	5	5.5	9.0
RB12(b)	0.235	1	3.3	5.2
RB08	0.444	1	6.2	9.8
RB09	0.009	1	0.1	0.2
RB11	0.156	1	2.2	3.4
RB12a	0.163	1	2.3	3.6

Key

- HIF Site Boundary
- Plot Boundary
- Provision of Utility and Drainage Infrastructure Only
- Existing Drainage Combined Sewer
- Existing Drainage Surface Water Drain (Private)
- Proposed Surface Water Pipe
- Proposed Adopted Surface Water Pipe
- Proposed Surface Water Manhole
- Proposed Adopted Surface Water Manhole
- Proposed Outfall to River
- Area of permable paving
- Area of Adopted Attenuation Basin
- Proposed Channel Drain
- Proposed Adoptable Easement (3m)

Notes

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8. This drawing should be read with reference to the Arup Stage 3 Report and Drainage Strategy.
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Located Service Classification	Certainty/Risk	
Type A Verification - Visual identification		
Type B Detection - Typically GPR and EML techniques are used	Data	
Type C Site reconnaissance - Physical surface features identified		
Type D Desktop utility records search		

10. A connection point has been provided for each plot within the HIF Boundary at a minimum depth of 2.0-2.5m as agreed with WSP.
11. Drainage construction materials, unless otherwise stated:
   - Drainage pipes - Polyethylene in accordance with BS 13476
   - Manholes - Precast Concrete
   - Inspection Chambers - Polypropylene in accordance with BS 7158
12. The finalised location of trees is to be confirmed at the next design stage.

Rev	Date	Description	By	Chkd	Appd	Auth
P01	17/12/21		DH	RG	RG	---
P02	01/02/22		DH	RG	RG	---
P03.04	17/02/22		---	---	---	---

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Client

MANCHESTER CITY COUNCIL

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Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Proposed Surface Water Drainage
Sheet 2 of 2

Scale at A1	1:500	Arup Job No	282022-00
Role	Civil - Drainage		
Suitability	S0 - Initial Status or WIP		

Rev	By	Chkd	Appd	
P03.04	---	---	---	---
	Date	Date	Date	
	---	---	---	---

Name

VNIF - ARP - 00 - YYY - DR - CD - 0011
Project | Originator | Volume | Location | Type | Role | Number

See sheet 1 of 2

Do not scale

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A1

RB04

Plot	Area (ha)	Catchment	30 year restriction (l/s)	100 year restriction (l/s)
RB06	0.247	1	3.4	5.4
RB07	0.376	1	5.2	8.3
RB10	1.011	1	14.1	22.2
NT02	0.771	4	10.8	16.9
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   - Inspection Chambers - Polypropylene in accordance with BS 7158
12. The finalised location of trees is to be confirmed at the next design stage.

RB06
RB16
RB17
NT02
NT03
NT04
Depot
Caravan Site
DANTZIC STREET
151
MSON STREET
37.2m
39.6m
Boro Const & Ward Bdy
CR
MP 0.5

Proposed outfall pipe to have non-return valve
Proposed Headwall
Proposed Outflow (1:100) - 86.2l/s
Proposed Outflow (1:30) - 53.9l/s
Proposed Outfall Level - 27.403mAOD

S7D
Hydrobrake
Design Head - 2.48m
Design Flow (1:100) - 86.2l/s
Design Flow (1:30) - 54.9l/s

S1.006 D
S11.000 D
S1.005 D
S10 D
S9.000 D
S1.004 D
S6 D
S7.000 D
S10.000 D
S8.000 D
S4.000 D
S5 D
S6.000 D
S3 D
S1.002 D
S4 D
S1.003 D
S1.001 D
S5.000 D
S1.000 D
S3.000 D
S2 D
S2.000 D

Key

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- Area of permable paving
- Area of Adopted Attenuation Basin

Rev	Date	Description	By	Chkd	Appd	Auth
P01	17/12/21		DH	RG	RG	---
P02	01/02/22		DH	RG	RG	---
P03.02	17/02/22		---	---	---	---

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Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Proposed Surface Water Drainage
Dantzic Street

Scale at A1	1:500	Arup Job No	282022-00
Role	Civil - Drainage		
Suitability	S0 - Initial Status or WIP		

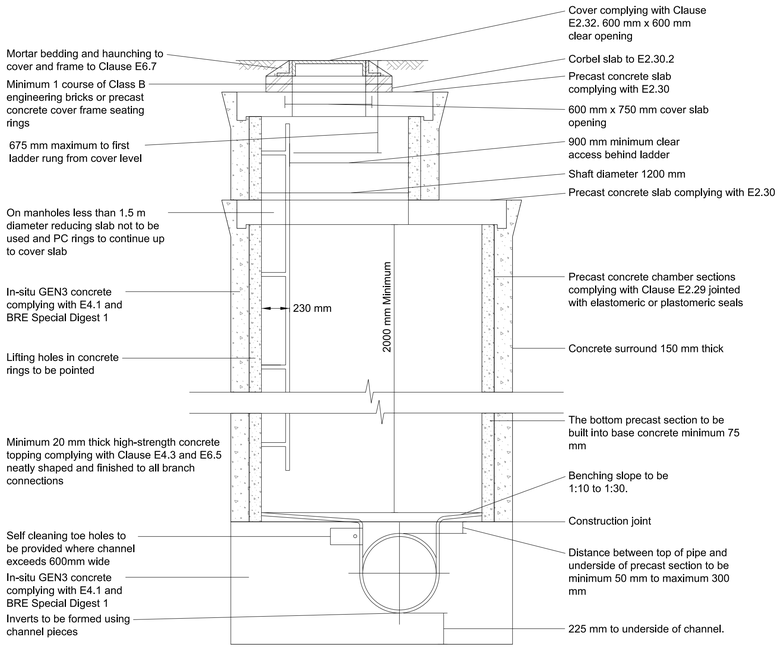
Rev	By	Chkd	Appd	
P03.02	---	---	---	---
	Date ---	Date ---	Date ---	---

Name

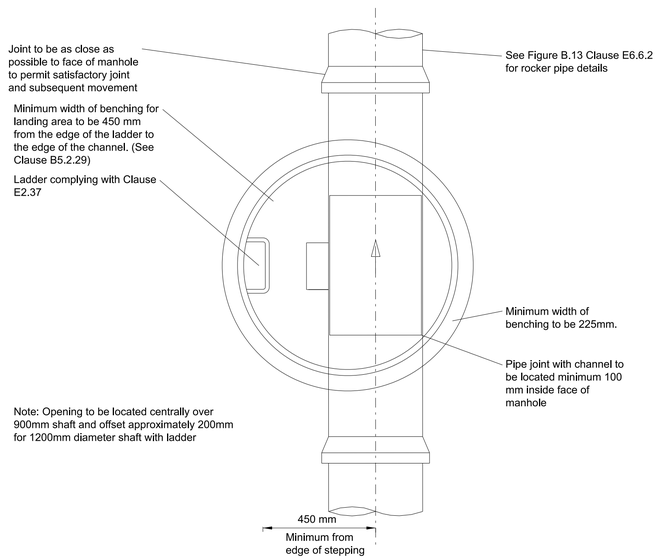
VNIF - ARP - 00 - YYY - DR - CD - 0012
Project | Originator | Volume | Location | Type | Role | Number

Do not scale

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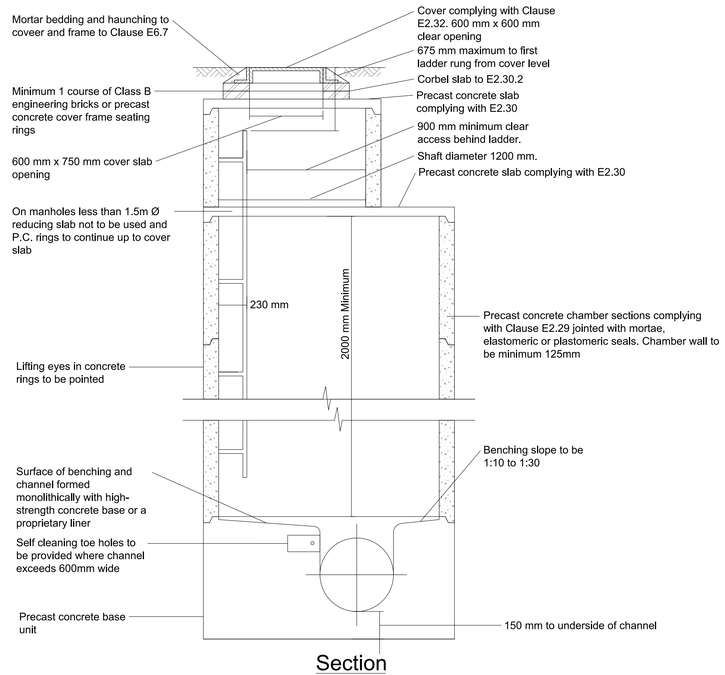
Section



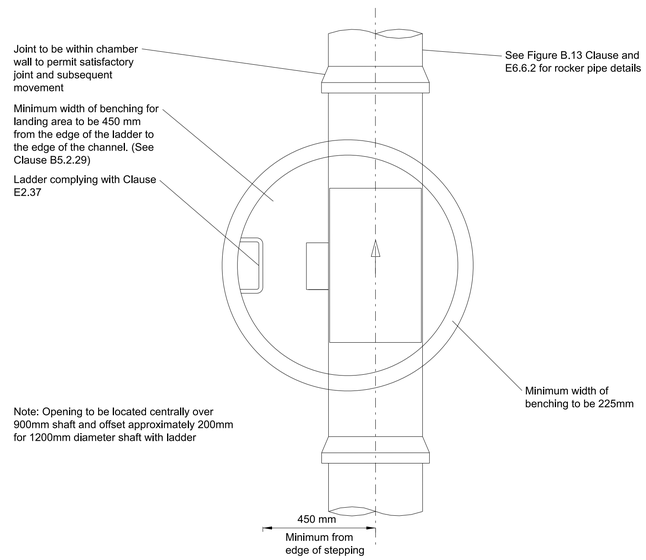
Plan

Typical manhole detail – Type A1
Depth from Cover Level to Soffit of Pipe 3 m to 6 m With Ladder and Reducing Slab
Rigid Material Construction With Concrete Surround

Scale 1:25



Section



Plan

Typical Manhole Detail Type 1A
Depth from Cover Level to Soffit of Pipe 3m to 6m with Ladder and Reduced Slab
Rigid Material Construction Without Concrete Surround

Scale 1:25

Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.

2. Do not scale from this drawing.

3. This drawing should be read in conjunction with all relevant Engineer's and Architect's drawings, reports and specifications

4. Concrete Requirements. Concrete to be in accordance with BS 8500 parts 1 and 2.
- Concrete chemcial class - DS-1 AC-1
- Blinding: GEN 0
- Bases and Surround: GEN 3.

5. Drainage construction materials, unless otherwise stated:
- Drainage pipes - Polyethylene in accordance with BS 13476
- Manholes - Precast Concrete
- Inspection Chambers - Polypropylene in accordance with BS 7158

6. For the Standard Drainage Specification refer to the "Design and Construction Guidance for foul and surface water sewers offered for adoption" - Rev 2.1 - dated 25th May 2021.

7. Bed and Surround Class A3 when:
- Cover level in trafficked areas < 1.2m
- Cover level in non-trafficked areas < 0.9m

Bed and Surround Class S when:
- Cover level in trafficked areas > 1.2m
- Cover level in non-trafficked areas > 0.9m

Rev	Date	Description	By	Chkd	Appd	Auth
P01	17/12/21		DH	RG	RG	—
P02	01/02/22		DH	RG	RG	—

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Client

MANCHESTER CITY COUNCIL

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Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Typical Drainage Details
Sheet 1 of 5

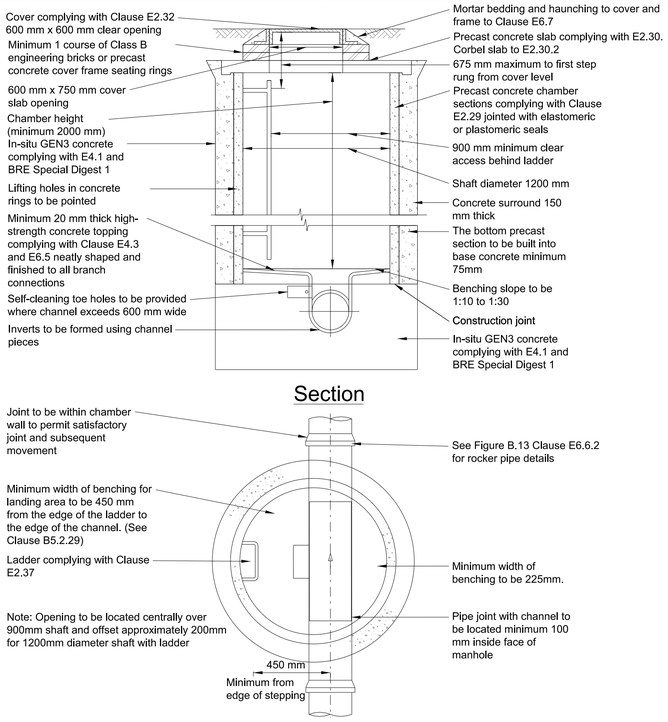
Scale at A1 1:25			Arup Job No 282022-00
Role: Civil - Drainage			
Suitability: S3 - Issued for Review and Comment			
Rev: **P02**	By: DH	Chkd: RG	Appd: RG
	Date: 01/02/22	Date: 01/02/22	Date: 01/02/22

Name

VNIF	- ARP -	00	- YYY -	DR	- CD -	0004
Project	Originator	Volume	Location	Type	Role	Number

Do not scale

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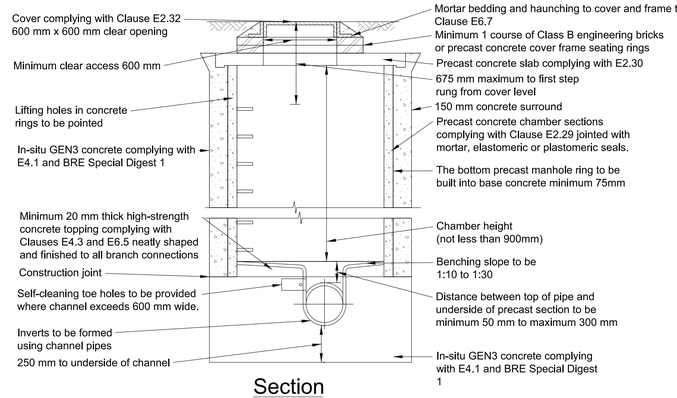


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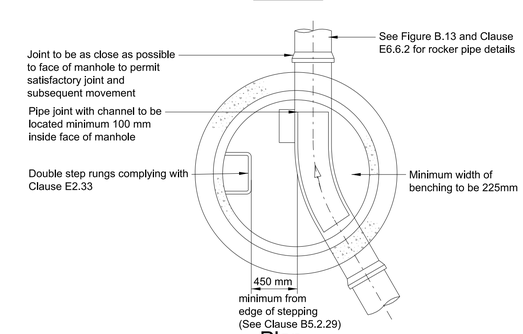
Plan

Typical Manhole Detail Type A2
Depth from Cover Level to Soffit of Pipe 3m to 6m with Ladder
Alternative Rigid Material Construction with Concrete Surround

Scale 1:25



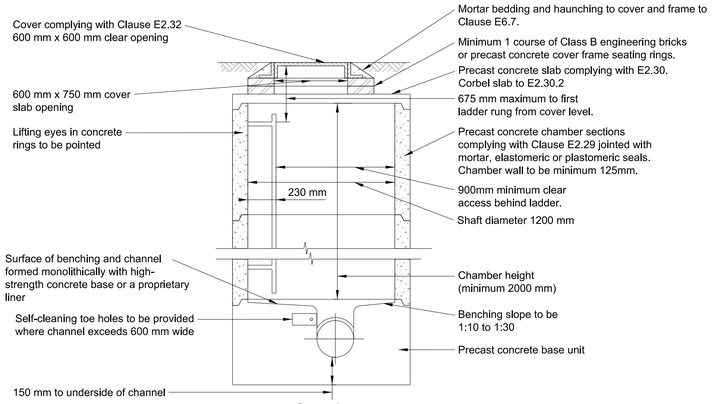
Section



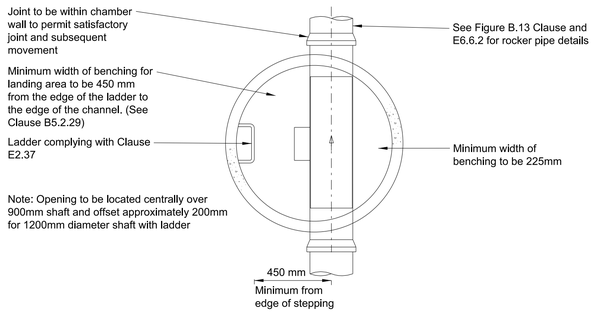
Plan

Typical Manhole Detail Type B
Depth from Cover Level to Soffit of Pipe 1.5m to 3m
Alternative Rigid Material Construction with Concrete Surround

Scale 1:25



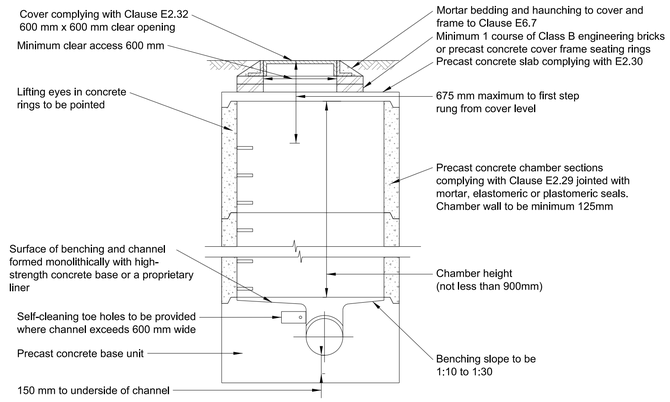
Section



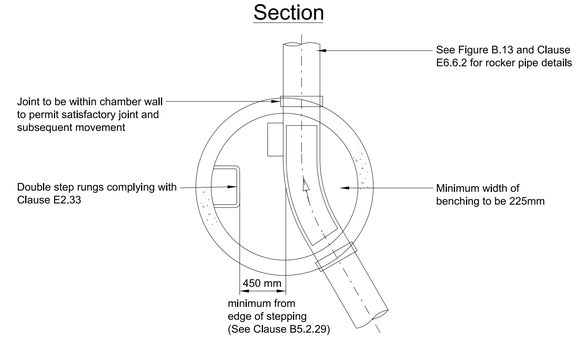
Plan

Typical Manhole Detail Type A2
Depth from Cover Level to Soffit of Pipe 3m to 6m with Ladder
Rigid Material Construction Without Concrete Surround

Scale 1:25



Section



Plan

Typical Manhole Detail Type B
Depth from Cover Level to Soffit of Pipe 1.5m to 3m
Rigid Material Construction Without Concrete Surround

Scale 1:25

Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.

2. Do not scale from this drawing.

3. This drawing should be read in conjunction with all relevant Engineer's and Architect's drawings, reports and specifications

4. Concrete Requirements. Concrete to be in accordance with BS 8500 parts 1 and 2.
- Concrete chemcial class - DS-1 AC-1
- Blinding: GEN 0
- Bases and Surround: GEN 3.

5. Drainage construction materials, unless otherwise stated:
- Drainage pipes - Polyethylene in accordance with BS 13476
- Manholes - Precast Concrete
- Inspection Chambers - Polypropylene in accordance with BS 7158

6. For the Standard Drainage Specification refer to the "Design and Construction Guidance for foul and surface water sewers offered for adoption" - Rev 2.1 - dated 25th May 2021.

7. Bed and Surround Class A3 when:
- Cover level in trafficked areas < 1.2m
- Cover level in non-trafficked areas < 0.9m

Bed and Surround Class S when:
- Cover level in trafficked areas > 1.2m
- Cover level in non-trafficked areas > 0.9m

Rev	Date	Description	By	Chkd	Appd	Auth
P01	17/12/21		DH	RG	RG	—

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Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Typical Drainage Details
Sheet 2 of 5

Scale at A1	1:25	Arup Job No	282022-00
Role	Civil - Drainage		
Suitability	S3 - Issued for Review and Comment		

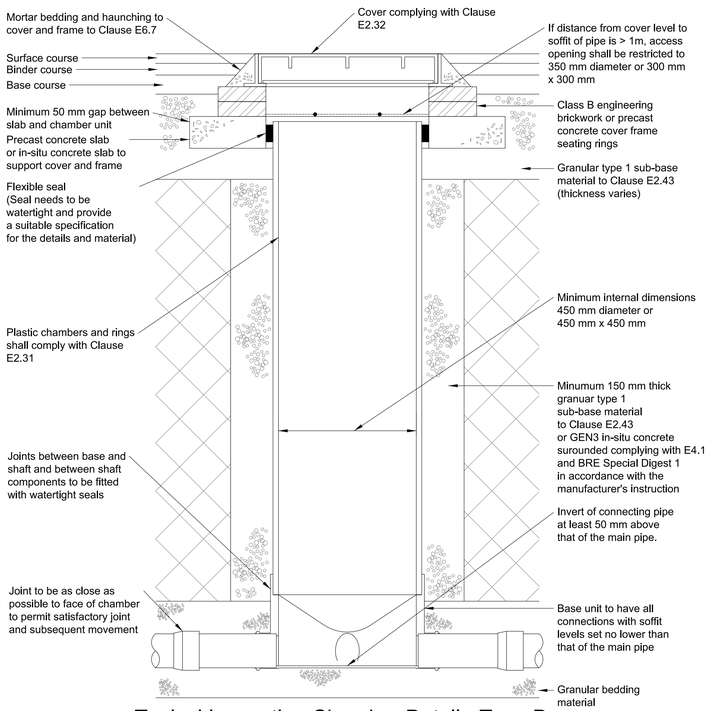
Rev	By	Chkd	Appd	
P01	DH	RG	RG	—
	Date 17/12/21	Date 17/12/21	Date 17/12/21	—

Name

VNIF	- ARP -	00	- YYY -	DR	- CD -	0005
Project	Originator	Volume	Location	Type	Role	Number

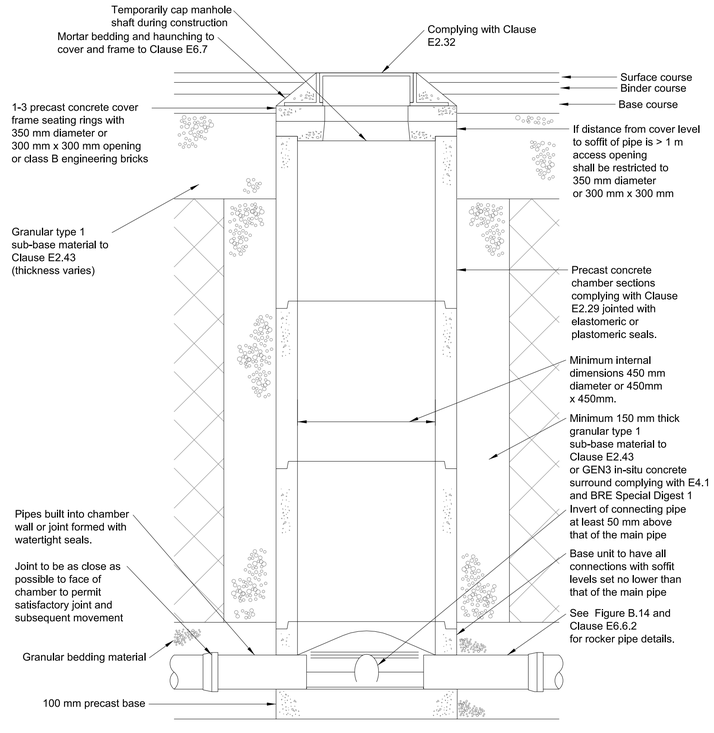
Do not scale

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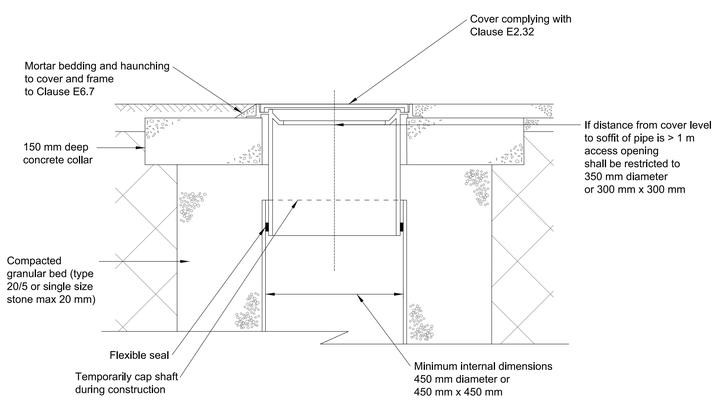
Typical Inspection Chamber Detail - Type D
Depth from Cover Level to Soffit of Pipe up to 3 m
Flexible Material Construction for use in Areas Subject to Vehicle Loading

Scale 1:10



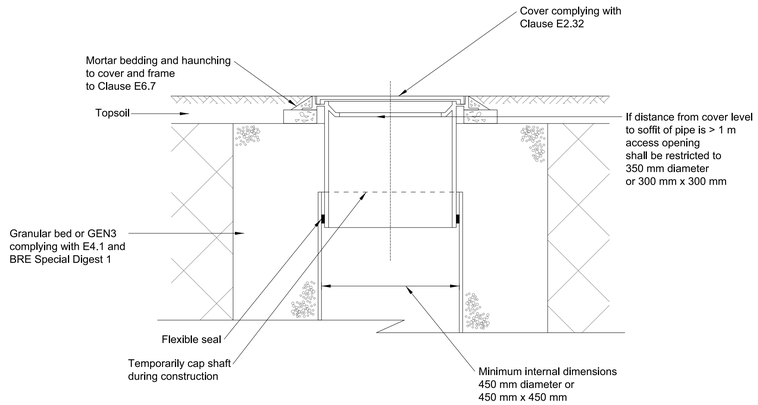
Typical Inspection Chamber Detail - Type D
Depth from Cover Level to Soffit of Pipe up to 3 m
Rigid Material Construction for use in Areas Subject to Vehicle Loading.

Scale 1:10



Alternative Top Details for Light Vehicle Loading and Landscaped Areas - Type D
Sited in domestic driveways or footways

Scale 1:10



Alternative Top Details for Light Vehicle Loading and Landscaped Areas - Type D
Sited in domestic gardens

Scale 1:10

Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.

2. Do not scale from this drawing.

3. This drawing should be read in conjunction with all relevant Engineer's and Architect's drawings, reports and specifications

4. Concrete Requirements. Concrete to be in accordance with BS 8500 parts 1 and 2.
- Concrete chemcial class - DS-1 AC-1
- Blinding: GEN 0
- Bases and Surround: GEN 3.

5. Drainage construction materials, unless otherwise stated:
- Drainage pipes - Polyethylene in accordance with BS 13476
- Manholes - Precast Concrete
- Inspection Chambers - Polypropylene in accordance with BS 7158

6. For the Standard Drainage Specification refer to the "Design and Construction Guidance for foul and surface water sewers offered for adoption" - Rev 2.1 - dated 25th May 2021.

7. Bed and Surround Class A3 when:
- Cover level in trafficked areas < 1.2m
- Cover level in non-trafficked areas < 0.9m

Bed and Surround Class S when:
- Cover level in trafficked areas > 1.2m
- Cover level in non-trafficked areas > 0.9m

Rev	Date	Description	By	Chkd	Appd	Auth
P01	17/12/21		DH	RG	RG	—

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Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Typical Drainage Details
Sheet 3 of 5

Scale at A1 1:10			Arup Job No 282022-00	
Role Civil - Drainage				
Suitability S3 - Issued for Review and Comment				
Rev P01	By DH	Chkd RG	Appd RG	—
	Date 17/12/21	Date 17/12/21	Date 17/12/21	—

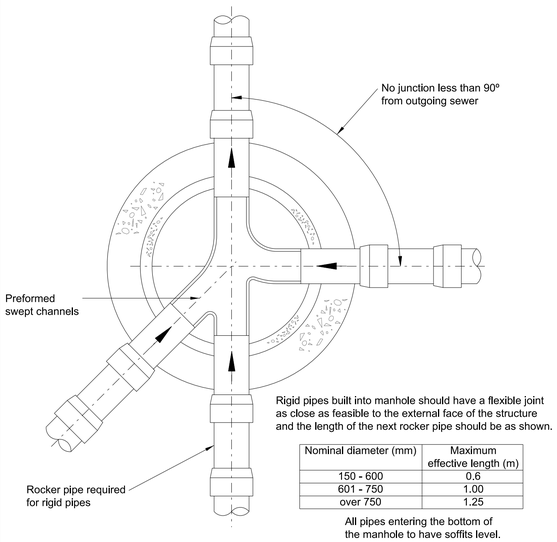
Name

VNIF - ARP - 00 - YYY - DR - CD - 0006

Project | Originator | Volume | Location | Type | Role | Number

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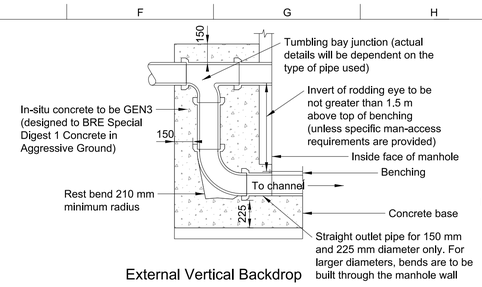
Rigid pipes built into manhole should have a flexible joint as close as feasible to the external face of the structure and the length of the next rocker pipe should be as shown.

Nominal diameter (mm)	Maximum effective length (m)
150 - 600	0.6
601 - 750	1.00
over 750	1.25

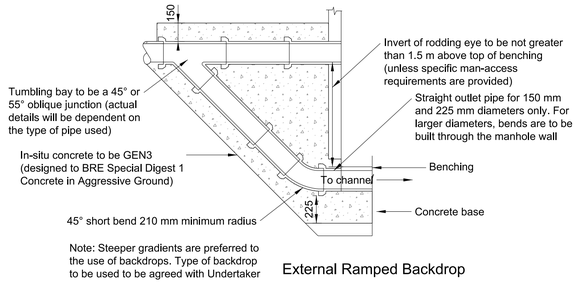
All pipes entering the bottom of the manhole to have soffits level.

Typical Arrangement of Pipe Junctions within Manholes

Scale 1:25

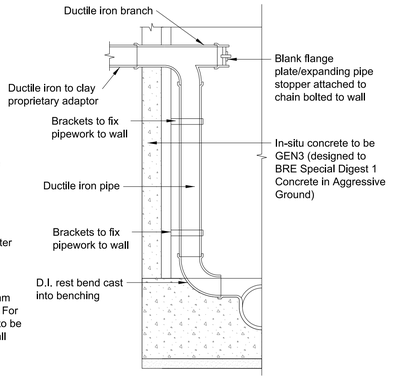


External Vertical Backdrop



Note: Steeper gradients are preferred to the use of backdrops. Type of backdrop to be used to be agreed with Undertaker

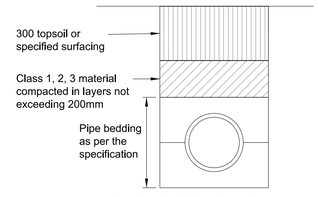
External Ramped Backdrop



Internal backdrops may only be used if agreed with the adopting authority.

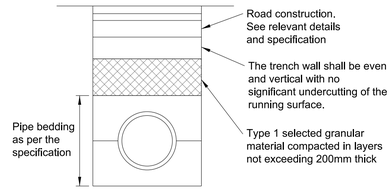
Typical Vertical and Ramped Backdrop Detail

Scale 1:25



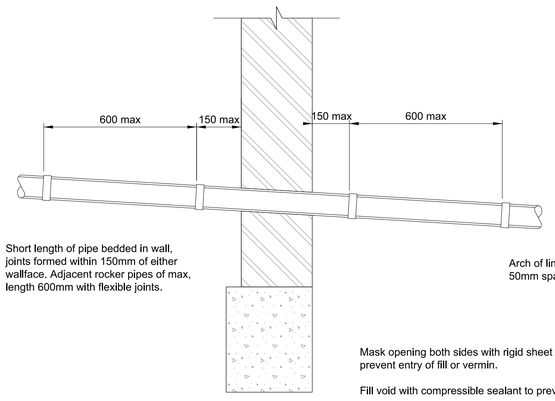
Detail D5.19 - Trench Reinstatement In Landscaped And Non Trafficked Areas

Scale 1:25

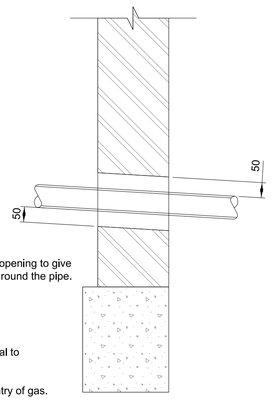


Detail D5.20 - Trench Reinstatement In Roads, Car Parks And Other Trafficked Areas

Scale 1:25



Short length of pipe bedded in wall, joints formed within 150mm of either wallface. Adjacent rocker pipes of max, length 600mm with flexible joints.



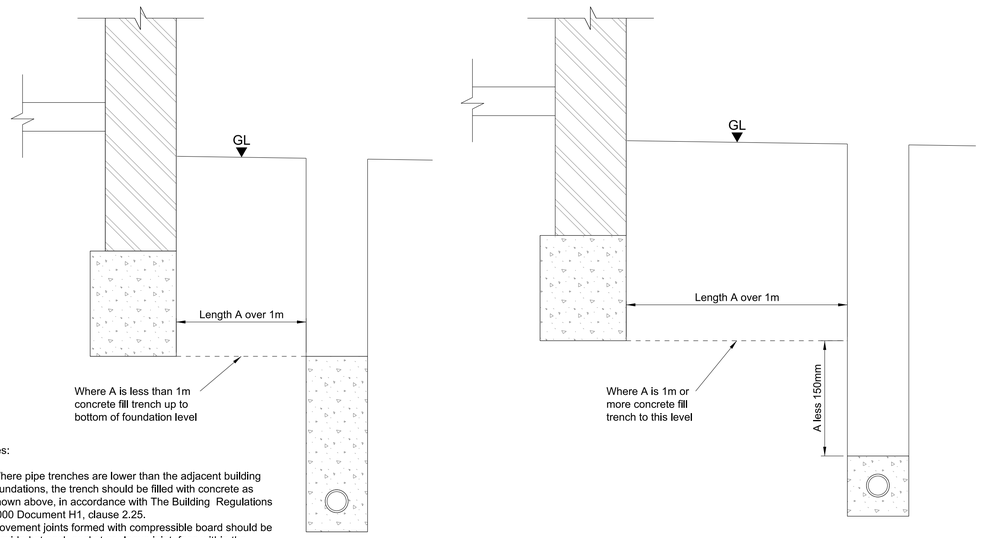
Arch of lintelled opening to give 50mm space all round the pipe.

Mask opening both sides with rigid sheet material to prevent entry of fill or vermin.

Fill void with compressible sealant to prevent entry of gas.

Detail D5.21 - Pipes Penetrating Walls

Not to scale

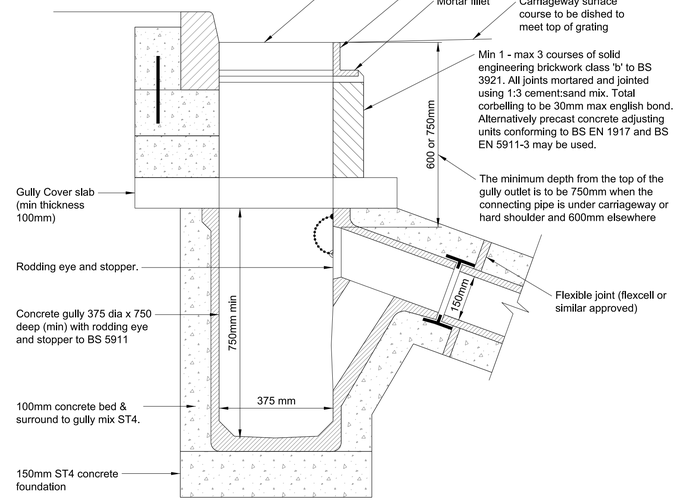


Notes:

1. Where pipe trenches are lower than the adjacent building foundations, the trench should be filled with concrete as shown above, in accordance with The Building Regulations 2000 Document H1, clause 2.25.
2. Movement joints formed with compressible board should be provided at each socket or sleeve joint face within the concrete filed trench.

Detail D5.22 - Pipe Runs Near Buildings

Not to scale



Typical Trapped Road Gully

Scale 1:10

Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.
2. Do not scale from this drawing.
3. This drawing should be read in conjunction with all relevant Engineer's and Architect's drawings, reports and specifications
4. Concrete Requirements. Concrete to be in accordance with BS 8500 parts 1 and 2.
   - Concrete chemcial class - DS-1 AC-1
   - Blinding: GEN 0
   - Bases and Surround: GEN 3.
5. Drainage construction materials, unless otherwise stated:
   - Drainage pipes - Polyethylene in accordance with BS 13476
   - Manholes - Precast Concrete
   - Inspection Chambers - Polypropylene in accordance with BS 7158
6. For the Standard Drainage Specification refer to the "Design and Construction Guidance for foul and surface water sewers offered for adoption" - Rev 2.1 - dated 25th May 2021.
7. Bed and Surround Class A3 when:
   - Cover level in trafficked areas < 1.2m
   - Cover level in non-trafficked areas < 0.9m

   Bed and Surround Class S when:
   - Cover level in trafficked areas > 1.2m
   - Cover level in non-trafficked areas > 0.9m

Rev	Date	Description	By	Chkd	Appd	Auth
P01	17/12/21		DH	RG	RG	—

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Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Typical Drainage Details
Sheet 4 of 5

Scale at A1	Arup Job No
AS SHOWN	282022-00

Role: Civil - Drainage

Suitability: S3 - Issued for Review and Comment

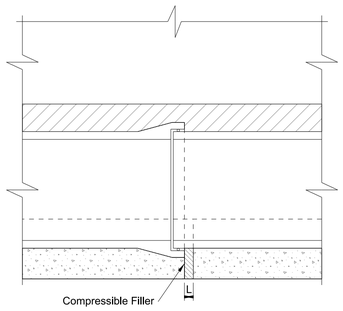
Rev	By	Chkd	Appd	
P01	DH	RG	RG	—
	Date 17/12/21	Date 17/12/21	Date 17/12/21	—

Name: VNIF - ARP - 00 - YYY - DR - CD - 0007

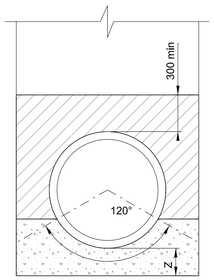
Project | Originator | Volume | Location | Type | Role | Number

Do not scale

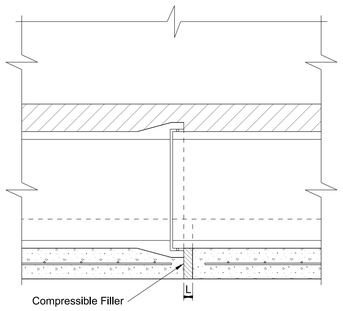
© Arup



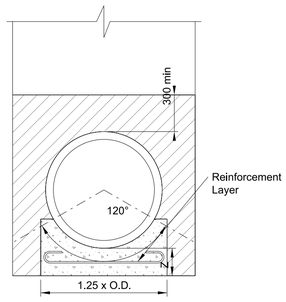
Plain Concrete Bed
Class A1
Spigot and Socket Pipes



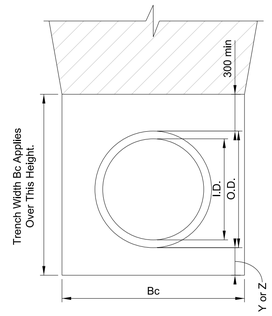
Plain Concrete Bed
Class A1
Bedding Factor 2.6



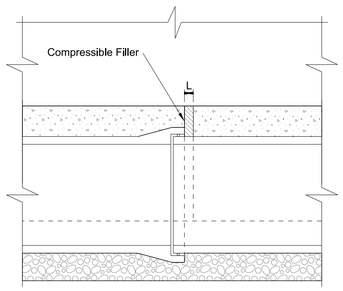
Reinforced Concrete Cradle
Class A4
Spigot and Socket Pipes



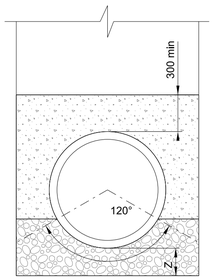
Reinforced Concrete Cradle
Class A4
Bedding Factor 3.4



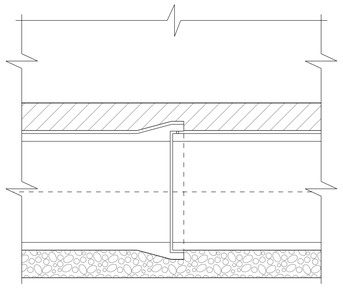
Typical Trench Section



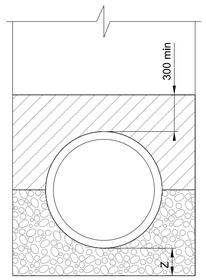
Plain Concrete Arch
Class A2
Spigot and Socket Pipes



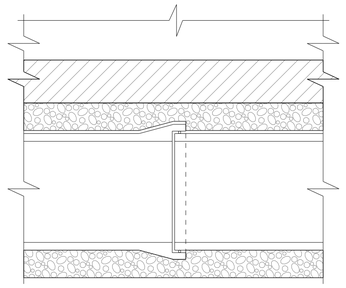
Plain Concrete Arch
Class A2
Bedding Factor 2.6



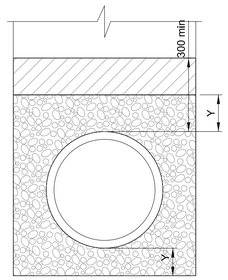
Granular Bed
Class B
Spigot and Socket Pipes



Granular Bed
Class B
Bedding Factor 1.9



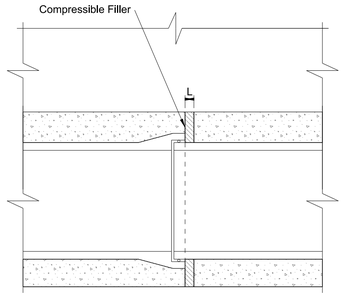
Granular Bed and Surround
Class S
Spigot and Socket Pipes



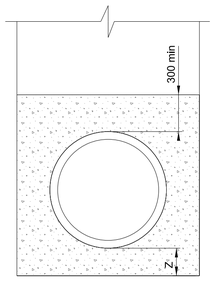
Granular Bed and Surround
Class S
Bedding Factor 2.2

PIPE DIA. (mm)	WIDTH Bc		Y		L (mm)	Z MIN
	MAX	MIN	Y1 (UNIFORM SOIL)	Y2 (ROCK) *		
100 150 225	550 600 700	450 490 580	100 100 150	200 200 200	18 36 54	100 100 100
300 375 450	750 1050 1150	680 950 1030	150 150 150	200 200 200		100 100 150
525 600 675	1200 1350 1450	1120 1240 1330	150 150 150	200 200 200		150 150 225
750 825 900	1500 1600 2100	1400 1490 1900	150 150 150	200 225 225		225 225 225
975 1050 1200	2150 2250 2500	1950 2050 2250	175 175 200	250 275 300		300 300 300
OVER 1200	O.D.+1000	O.D.+800	I.D./6	I.D./4		400

Table B
Trench Widths and Other Dimensions



Concrete Bed and Surround
Class A3
Spigot and Socket Pipes



Concrete Bed and Surround
Class A3
Bedding Factor 4.5

	Aggregate Size	
Pipe Dia (mm)	Graded (mm)	Single Sized (mm)
100	-	10
150	14-5	10 or 14
225-300	14-5 or 20-5	10,14 or 20
375-525	14-5 or 20-5	10,14 or 20
Exceeding 525	14-5 or 20-5 or 40-5	10,14,20 or 40

Table A
Granular pipe bedding material type 'A'

Legend:

Concrete Mix St4

Granular Pipe Bedding Material Type 'A'

Type 1 Granular Material

Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.

2. Do not scale from this drawing.

3. This drawing should be read in conjunction with all relevant Engineer's and Architect's drawings, reports and specifications

4. Concrete Requirements. Concrete to be in accordance with BS 8500 parts 1 and 2.
- Concrete chemcial class - DS-1 AC-1
- Blinding: GEN 0
- Bases and Surround: GEN 3.

5. Drainage construction materials, unless otherwise stated:
- Drainage pipes - Polyethylene in accordance with BS 13476
- Manholes - Precast Concrete
- Inspection Chambers - Polypropylene in accordance with BS 7158

6. For the Standard Drainage Specification refer to the "Design and Construction Guidance for foul and surface water sewers offered for adoption" - Rev 2.1 - dated 25th May 2021.

7. Bed and Surround Class A3 when:
- Cover level in trafficked areas < 1.2m
- Cover level in non-trafficked areas < 0.9m

Bed and Surround Class S when:
- Cover level in trafficked areas > 1.2m
- Cover level in non-trafficked areas > 0.9m

Rev	Date	Description	By	Chkd	Appd	Auth
P01	17/12/21		DH	RG	RG	—

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Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Typical Drainage Details
Sheet 5 of 5

Scale at A1	Arup Job No
1:25	282022-00

Role: Civil - Drainage

Suitability: S3 - Issued for Review and Comment

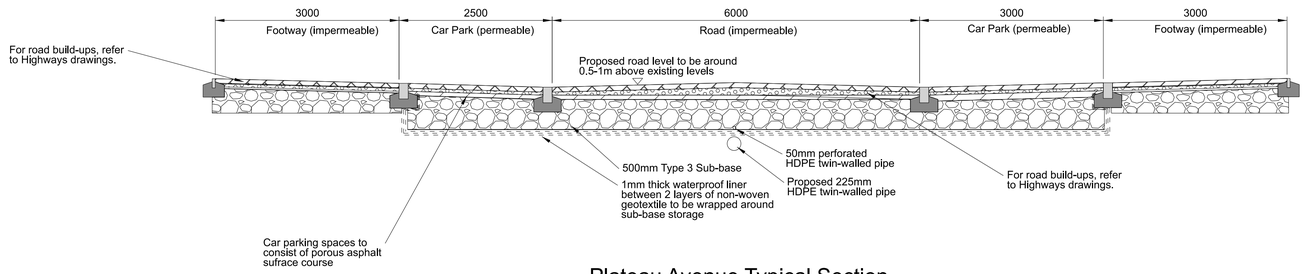
Rev	By	Chkd	Appd	
P01	DH	RG	RG	—
	Date 17/12/21	Date 17/12/21	Date 17/12/21	—

Name

VNIF	- ARP -	00	- YYY -	DR	- CD -	0008
Project	Originator	Volume	Location	Type	Role	Number

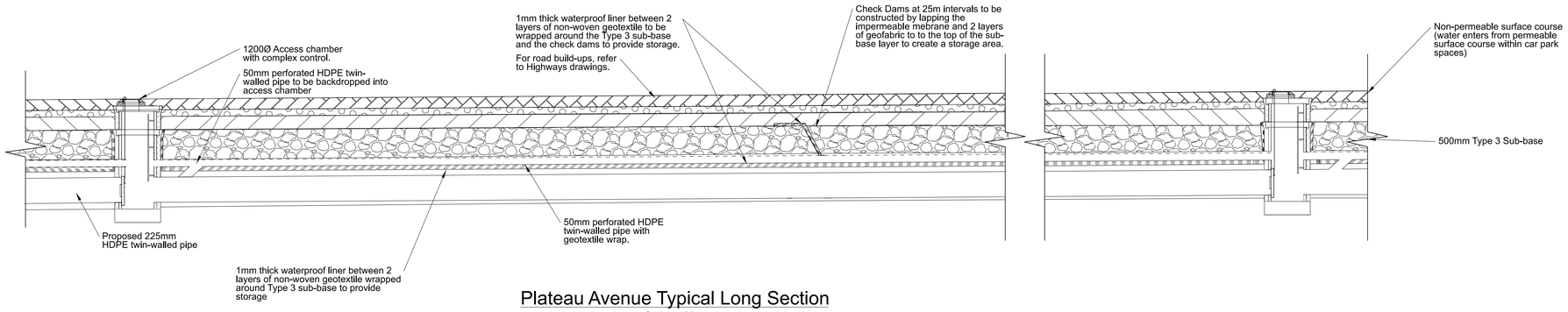
Do not scale

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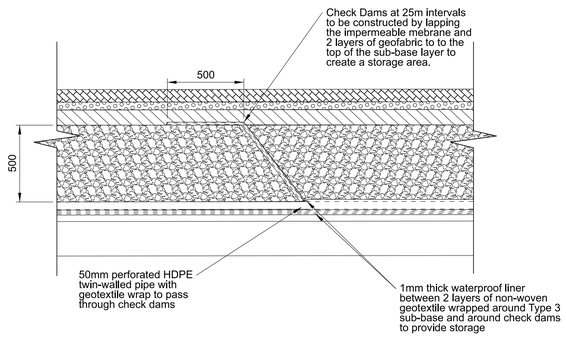
Plateau Avenue Typical Section

Scale 1:50



Plateau Avenue Typical Long Section

Scale 1:100
5x vertical exaggeration
(Long section taken down centreline of road)



Typical Lapping Detail

Scale 1:20
5x vertical exaggeration

Notes.

1. All dimensions are in millimeters unless noted otherwise.
2. All levels are given in meters (AOD).
3. This drawing should be read in conjunction with all relevant drawings, schedules, details and specifications:
   - VNIF-ARP-00-YYY-DR-CD-0001 to 0017
4. For CBR below 2.5%, remove and replace with capping material to a depth of 1.0m below base of sub base and assume just under 3% CBR for design of capping and sub-base.
5. Nonwoven polypropylene geotextile (Terram
   - T1000 GT or similar approved).
   - Tensile strength 8.0kN/m
   - Tensile elongation 60%
   - CBR puncture resistance 2kN
   - Mean pore size 75µm
   - Permeability (H50) 90l/m2.s
6. For details on road build-ups refer to Highways Engineering drawings.

Rev	Date	Description	By	Chkd	Appd	Auth
	17/12/21		DH	RG	RG	—
P02	11/03/22		DH	DH	RG	—

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Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Drainage Sections
Sheet 1

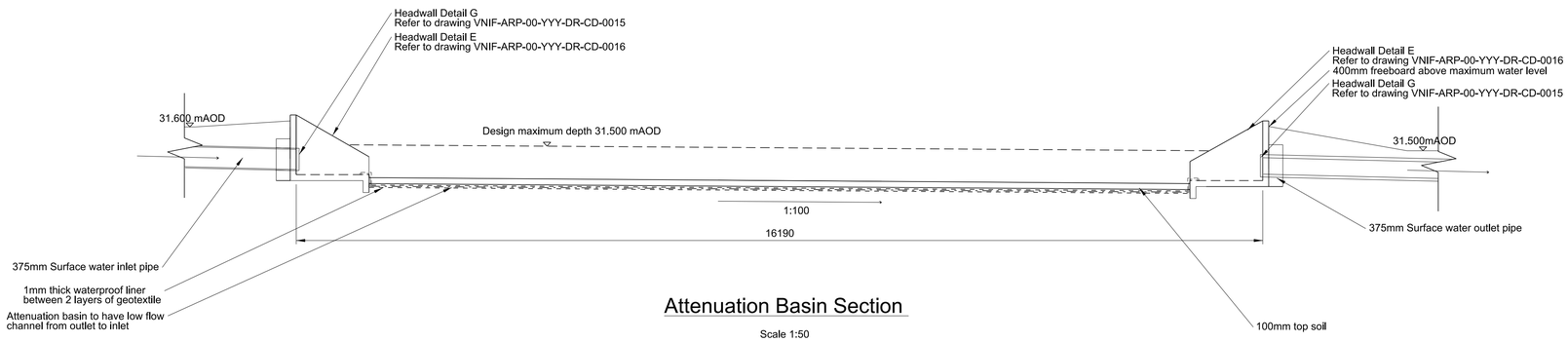
Scale at A1 1:25			Arup Job No 282022-00
Role: Civil - Drainage			
Suitability: S3 - Issued for Review and Comment			
Rev: P02	By: DH	Chkd: DH	Appd: RG
	Date: 10/03/22	Date: 10/03/22	Date: 11/03/22

Name

VNIF	- ARP -	00	- YYY -	DR	- CD -	0013
Project	Originator	Volume	Location	Type	Role	Number

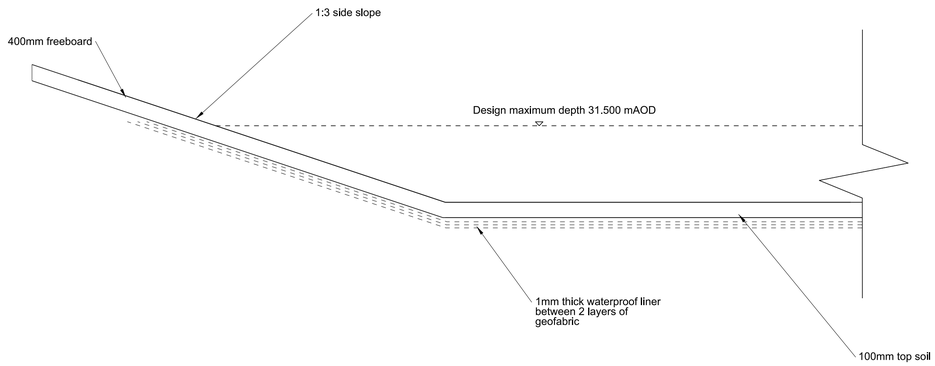
Do not scale

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Attenuation Basin Section

Scale 1:50



Typical Attenuation Basin Detail

Scale 1:20

Notes.

1. All dimensions are in millimeters unless noted otherwise.
2. All levels are given in meters (AOD).
3. This drawing should be read in conjunction with all relevant drawings, schedules, details and specifications:
   - VNIF-ARP-00-YYY-DR-CD-0001 - 0017
4. For CBR below 2.5%, remove and replace with capping material to a depth of 1.0m below base of sub base and assume just under 3% CBR for design of capping and sub-base.
5. Nonwoven polypropylene geotextile (Terram
   - T1000 GT or similar approved).
   - Tensile strength 8.0kN/m
   - Tensile elongation 60%
   - CBR puncture resistance 2kN
   - Mean pore size 75µm
   - Permeability (H50) 90l/m2.s
6. Refer to Landscape Architects details and specifications for detail for growing media and top soil.

Rev	Date	Description	By	Chkd	Appd	Auth
P01	17/12/21		DH	RG	RG	—
P02	01/02/22		DH	RG	RG	—

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Drawing Title

Drainage Pond Details

Scale at A1	1:25	Arup Job No	282022-00
Role	Civil - Drainage		
Suitability	S3 - Issued for Review and Comment		

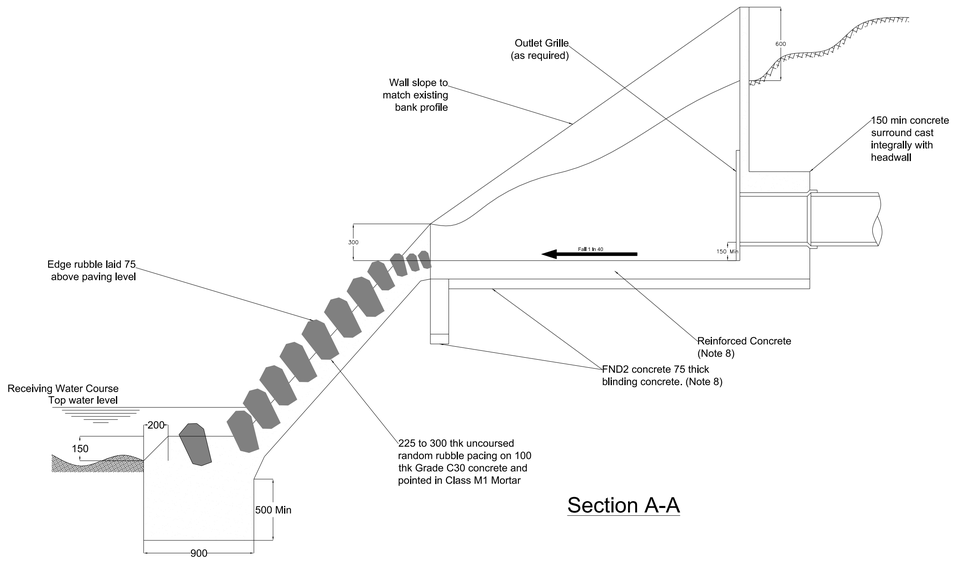
Rev	By	Chkd	Appd	
P02	DH	RG	RG	---
	Date 01/02/22	Date 01/02/22	Date 01/02/22	---

Name

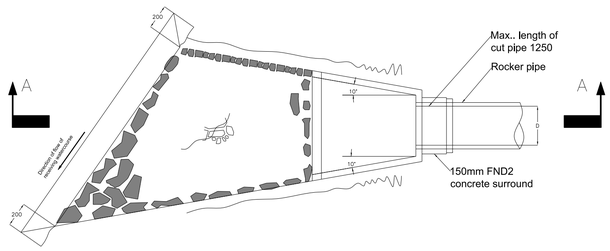
VNIF	- ARP -	00	- YYY -	DR	- CD -	0014
Project	Originator	Volume	Location	Type	Role	Number

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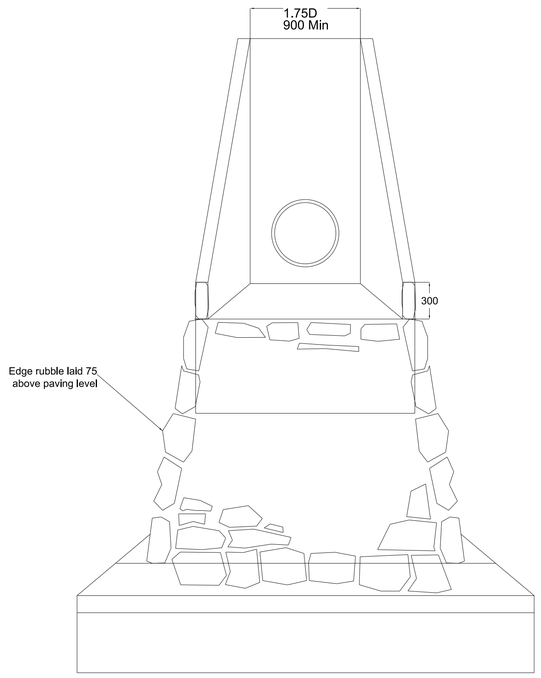
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Section A-A



Plan

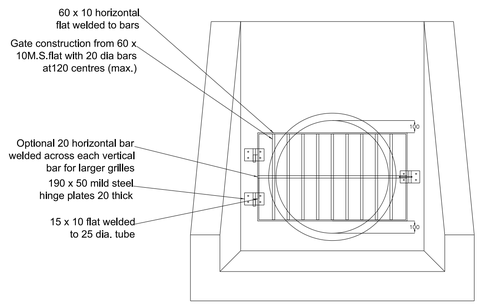


Elevation

Typical Detail D
Typical Outfall Detail Type 1

Notes

1. All dimensions in millimetres.
2. Generally the angle between the direction of flow od the receiving watercourse and the outfall pipe should be 45 degrees.
3. All reinforced concrete edges to be finished with a 25 x 25 fillet.
4. Min cover to reinforcement in the top face of the base slab to be 40.
5. The bed and opposite bank if the watercourse may, in certain circumstances need to be protected by 225 to 300 thick uncoursed rubble pitching laid on a 100 thick bed of FND2 concrete (Note 8) and pointed in Class M1 Mortar. The stone for pitching shall consist oflarge smooth faced stones roughly dressed square and shall be of a hard durable and inert material. Bunter sandstone, Keuper waterstones and Carboniferous shales and mudstones are not to be used.
6. An Outlet Grille as shown on Typical Detail G must be provided on all outfalls where the pipe size exceeds 459mm. Where pipe diameters are 375 to 450, 20 dia stainless steel bars are to be provided across outlet at max. 120mm c/c leaving 100mm max. clear opening.
7. Where outlets have a flap valve, a special detailed grille must be provided on all outlets 375mm diameter and above.
8. Secure handrailing shall be supplied where a person may fall 2 metres or more or where a fall of less than 2 metres carries an increased risk of injury due to the landing surface.
9. FND2 to be used for soil conditions Sulphate class 1 only. Designated mix references FND3, FND4A & FND4B to be used in soil conditions with sulphate classes 3 4A and 4B respectively (refer to specification clause 4.3.1).



Front Elevation

Notes

1. All dimensions in millimetres.
2. All grilles and fittings are to be manufactured with mild steel 'hot dip' galvanised to BS 729 and treated with 2 no coates of bituminous paint.
3. The sizes detailed on the grille indicate the preferred member size in normal locations. Consideration should be given to up-sizing members where the grille is in exposed locations or is of particularly large size.

Detail G
Typical Outlet Grille

Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.
2. Do not scale from this drawing.
3. This drawing should be read in conjunction with all relevant Engineer's and Architect's drawings, reports and specifications

Rev	Date	Description	By	Chkd	Appd	Auth
P01	17/12/21		DH	RG	RG	—

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Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Typical Drainage Outfall Details
Sheet 1 of 2

Scale at A1	NTS	Arup Job No	282022-00
Role	Civil - Drainage		
Suitability	S3 - Issued for Review and Comment		

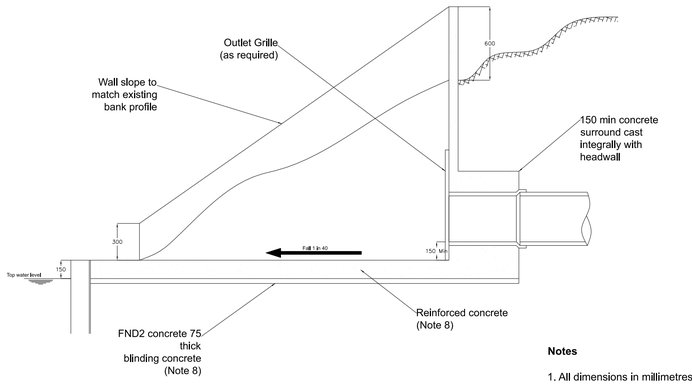
Rev	By	Chkd	Appd	
P01	DH	RG	RG	—
	Date 17/12/21	Date 17/12/21	Date 17/12/21	—

Name

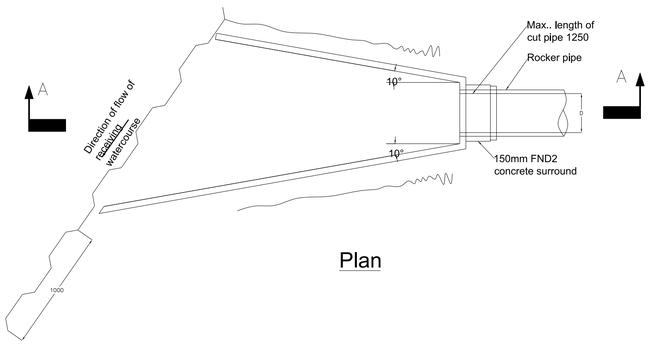
VNIF	- ARP -	00	- YYY -	DR	- CD -	0015
Project	Originator	Volume	Location	Type	Role	Number

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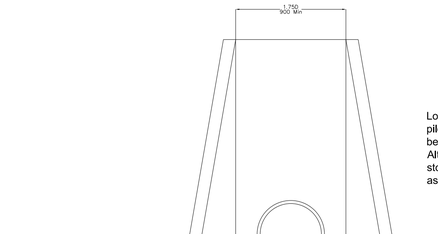
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Section A-A



Plan

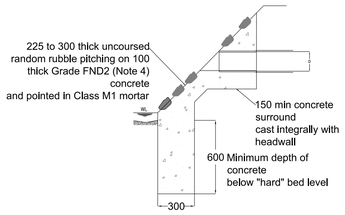


Elevation

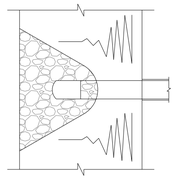
Typical Detail E
Typical Outfall Detail Type 2

Notes

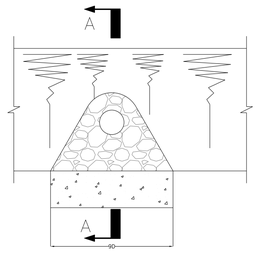
1. All dimensions in millimetres.
2. Generally the angle between the direction of flow of the receiving watercourse and the outfall pipe should be 45 degrees.
3. All reinforced concrete edges to be finished with a 25 x 25 fillet.
4. Min cover to reinforcement in the top face of the base slab to be 40.
5. The bed and opposite bank of the watercourse may,in certain circumstances need to be protected by 225 to 300 thick uncoursed rubble pitching laid on a 100 thick bed of FND2 concrete (Note 8)and pointed in Class M1 Mortar. The stone for pitching shall consist of large smooth faced stones roughly dressed square and shall be of a hard durable and inert material. Bunter sandstone, Keuper waterstones and Carboniferous shales and mudstones are not to be used.
6. An Outlet Grille as shown on Typical Detail G must be provided on all outfalls where the pipe size exceeds 450mm. Where pipe diameters are 375 to 450, 20 dia. stainless steel bars are to be provided across outlet at max. 120mm c/c leaving 100mm max. clear opening.
7. Where outlets have a flap valve, a special detailed grille must be provided on all outlets 375mm diameter and above.
8. Secure handrailing shall be supplied where a person may fall 2 metres or more or where a fall of less than 2 metres carries an increased risk of injury due to the landing surface.
9. FND2 to be used for soil conditions Sulphate class 1 only. Designated mix references FND3, FND4A & FND4B to be used in soil conditions with sulphate classes 3,4A and 4B respectively (refer to specification clause 4.3.1).



Sectional Elevation A-A



Plan



Section A-A

Typical Detail F
Typical Outfall Detail Type 3
(Maximum Pipe Size 225mm)

Notes

1. All dimensions in millimetres.
2. The bed and opposite bank of the watercourse may in certain circumstances, need to be protected by 225 to 300 thick uncursed rubble pitching laid on 100 thick bed of FND2 concrete (Note 4) and bed of FND2 concrete (Note 4) and pointed in Class M1 mortar. The stone for pitching shall consist of large smooth faced stones roughly dressed square and shall be of a hard durable and inert material. Bunter sandstones, Keuper waterstones and carboniferous shales and mudstones are not to be used.
3. Maximum diameter 225mm.
4. FND2 to be used for soil conditions sulphate class 1 only. Designated mix references FND3, FND4A & FND4B to be used in soil conditions with sulphate classes 3,4A and 4B respectively (refer to specification clause 4.3.1).

Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.
2. Do not scale from this drawing.
3. This drawing should be read in conjunction with all relevant Engineer's and Architect's drawings, reports and specifications

Rev	Date	Description	By	Chkd	Appd	Auth
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Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Typical Drainage Outfall Details
Sheet 2 of 2

Scale at A1	Arup Job No
	282022-00

Role: Civil - Drainage

Suitability: S3 - Issued for Review and Comment

Rev	By	Chkd	Appd	
P01	DH	RG	RG	—
	Date	Date	Date	
	17/12/21	17/12/21	17/12/21	—

Name

VNIF	- ARP -	00	- YYY -	DR	- CD -	0016
Project	Originator	Volume	Location	Type	Role	Number

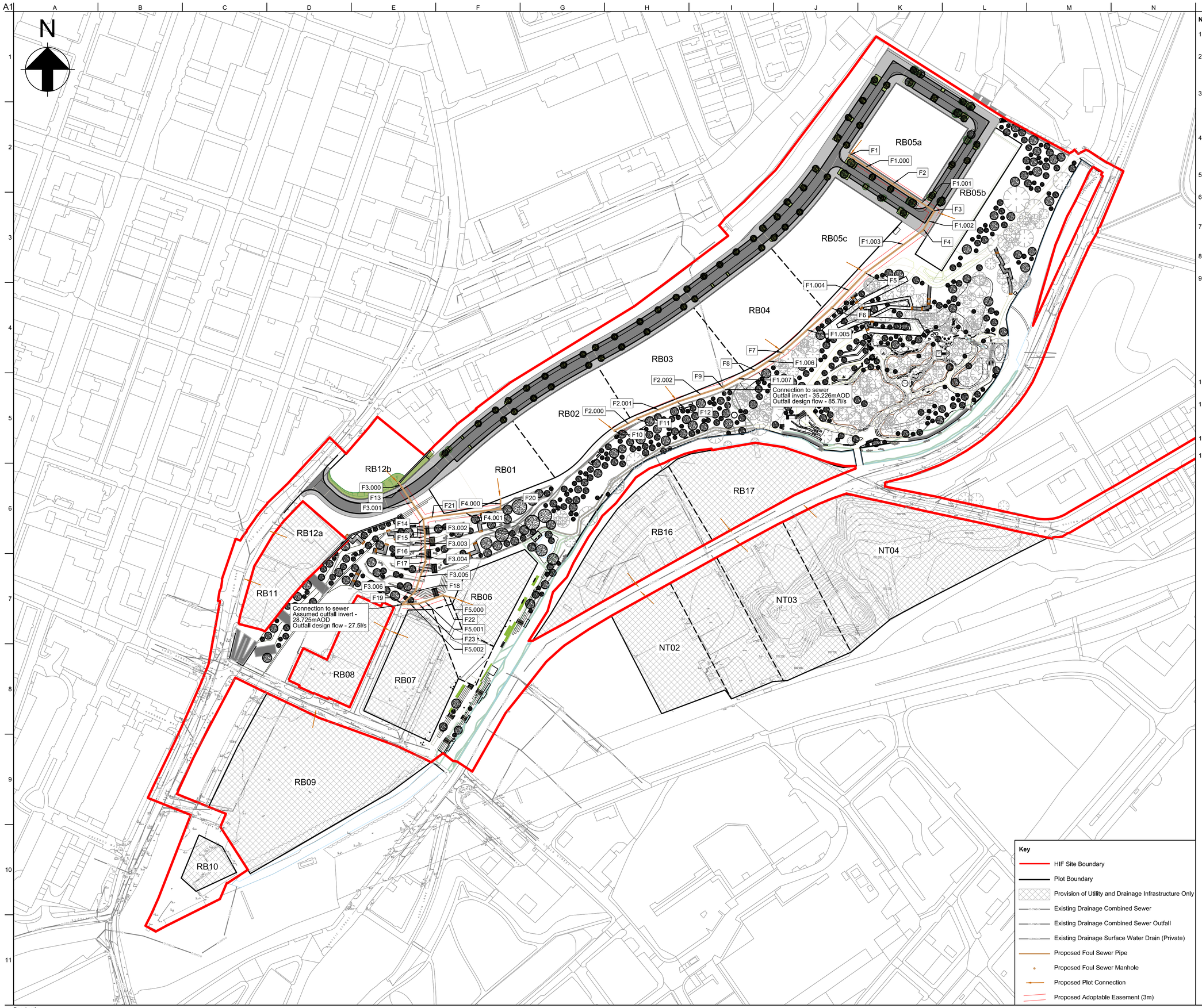
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Appendix E

Foul Water General Arrangement

A1



Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.
2. This map is reproduced from Ordnance Survey Material with the permission of the Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office (c) Crown Copyright. License Number 100019568 (2021).
3. Layout is based on:
   • Landscape Architect masterplan drawing VNIF-PLA-ZZ-YYY-DR-L-1011 Rev P02.06 dated 14/02/2022 by Planit.
   • Topographical Survey drawing PS-2158-TS by Paragon Surveys dated September 2021.
4. No guarantee is given for the accuracy of the information contained herein, which is provided for general guidance only and must not be relied upon for excavation or detailed design until apparatus locations are verified / validated through further site investigation works.
5. Extents of road refurbishments, new roads, and street works are WIP based on WS3 Design.
6. Existing Drainage layout based on the following information:
   - Utility Search Map drawing 97079 undertaken by Atkins dated 24/06/2021.
7. For the Standard Drainage Specification refer to the "Design and Construction Guidance for foul and surface water sewers offered for adoption" - Rev 2.1 - dated 25th May 2021.
8. This drawing should be read with reference to the Arup Stage 3 Report and Drainage Strategy.
9. Utilities have been drawn to PAS128 standard. The Located Service Classification table below gives a brief overview. For further details refer to document 'PAS 128:2014 Specification for underground utility detection, verification and location'.

Located Service Classification	Certainty/Risk
Type A Verification - Visual Identification	
Type B Detection - Typically GPR and EML techniques are used	Depth
Type C Site reconnaissance + Physical surface features identified	
Type D Desktop utility records search	

10. A connection point has been provided for each plot within the HIF Boundary at a minimum depth of 2.0-2.5m as agreed with WSP.
11. Drainage construction materials, unless otherwise stated:
   - Drainage pipes - Polyethylene in accordance with BS 13476
   - Manholes - Precast Concrete
   - Inspection Chambers - Polypropylene in accordance with BS 7158
12. For drainage diversions and abandonments, refer to drawing VNIF-ARP-00-YYY-DR-CU-1001
13. The finalised location of trees is to be confirmed at the next design stage.

Key

- HIF Site Boundary
- Plot Boundary
- Provision of Utility and Drainage Infrastructure Only
- Existing Drainage Combined Sewer
- Existing Drainage Combined Sewer Outfall
- Existing Drainage Surface Water Drain (Private)
- Proposed Foul Sewer Pipe
- Proposed Foul Sewer Manhole
- Proposed Plot Connection
- Proposed Adoptable Easement (3m)

Rev	Date	Description	By	Chkd	Appd	Auth
P01	26/08/21		AS	AS	AS	---
P02	17/12/21		DH	RG	RG	---
P03	01/02/22		DH	RG	RG	---
P04.02	17/02/22		---	---	---	---

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Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Proposed Foul Drainage
General Arrangement

Scale at A1	1:1250	Arup Job No	282022-00
Role	Civil - Drainage		
Suitability	S0 - Initial Status or WIP		

Rev	By	Chkd	Appd	
P04.02	---	---	---	---
	Date	Date	Date	
	---	---	---	---

Name

VNIF - ARP - 00 - YYY - DR - CD - 0003
Project | Originator | Volume | Location | Type | Role | Number

Do not scale

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Appendix F

Surface Water Exceedance Flow Drawings

A1



Key

- HIF Site Boundary
- Plot Boundary
- Provision of Utility and Drainage Infrastructure Only
- Exceedance Flow Path (Main Route)
- Exceedance Flow Path (Contributory Route)

Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.
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3. Layout is based on:
   - Landscape Architect masterplan drawing VNIF-PLA-ZZ-YYY-DR-L-1011 Rev P02.06 dated 14/02/2022 by Planit.
   - Topographical Survey drawing PS-2158-TS by Paragon Surveys dated September 2021.
4. Extents of road refurbishments, new roads, and street works are WIP based on WS3 Design.
5. This drawing should be read with reference to the Arup Stage 3 Report and Drainage Strategy.
6. The purpose of this drawing is to show the exceedance flow paths for Surface Water in the event of system failure or an extreme storm event (> 100yr +40%cc)

Rev	Date	Description	By	Chkd	Appd	Auth
	01/02/22		DH	RG	RG	—
	01/02/22		DH	RG	RG	—
	18/02/22	Amended for Planning Comments	DH	DH	RG	—
P04	01/03/22		DH	DH	LS	—

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Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Proposed Exceedance Route Drawing
Sheet 1 of 2

Scale at A1	1:500	Arup Job No	282022-00
Role	Civil - Drainage		
Suitability	S3 - Issued for Review and Comment		

Rev	By	Chkd	Appd	
P04	DH	DH	LS	—
	Date 01/03/22	Date 01/03/22	Date 01/03/22	—

Name

VNIF - ARP - 00 - YYY - DR - CD - 0018

Project | Originator | Volume | Location | Type | Role | Number

Do not scale

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A1



Key

- HIF Site Boundary
- Plot Boundary
- Provision of Utility and Drainage Infrastructure Only
- Exceedance Flow Path (Main Route)
- Exceedance Flow Path (Contributory Route)

Notes

1. All dimensions are in mm, all levels in mAOD, unless specified otherwise.
2. This map is reproduced from Ordnance Survey Material with the permission of the Ordnance Survey on behalf of the Controller of Her Majesty's Stationery Office (c) Crown Copyright. License Number 100019568 (2021).
3. Layout is based on:
   - Landscape Architect masterplan drawing VNIF-PLA-ZZ-YYY-DR-L-1011 Rev P02.06 dated 14/02/2022 by Planit.
   - Topographical Survey drawing PS-2158-TS by Paragon Surveys dated September 2021.
4. Extents of road refurbishments, new roads, and street works are WIP based on WS3 Design.
5. This drawing should be read with reference to the Arup Stage 3 Report and Drainage Strategy.
6. The purpose of this drawing is to show the exceedance flow paths for Surface Water in the event of system failure or an extreme storm event (> 100yr +40%cc)

Rev	Date	Description	By	Chkd	Appd	Auth
P01	01/02/22		DH	RG	RG	—
P02	01/02/22		DH	RG	RG	—
P03	01/02/22		DH	RG	RG	—
P04	18/02/22	Amended for Planning Comments	DH	DH	RG	—
P05	01/03/22		DH	DH	LS	—

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Client

MANCHESTER CITY COUNCIL

bam nuttall

Project Title

Victoria North HIF Infrastructure & Enabling Works

Drawing Title

Proposed Exceedance Route Drawing
Sheet 2 of 2

Scale at A1	1:500		Arup Job No	282022-00
Role	Civil - Drainage			
Suitability	S3 - Issued for Review and Comment			
Rev	By	Chkd	Appd	
P05	DH	DH	LS	—
	Date	Date	Date	
	01/03/22	01/03/22	01/03/22	—

Name

VNIF - ARP - 00 - YYY - DR - CD - 0019

Project | Originator | Volume | Location | Type | Role | Number

Do not scale

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