Tameside Metropolitan Borough Council

Ashton Moss

Accessible Version Preliminary Geotechnical Report

REP/252590/G001

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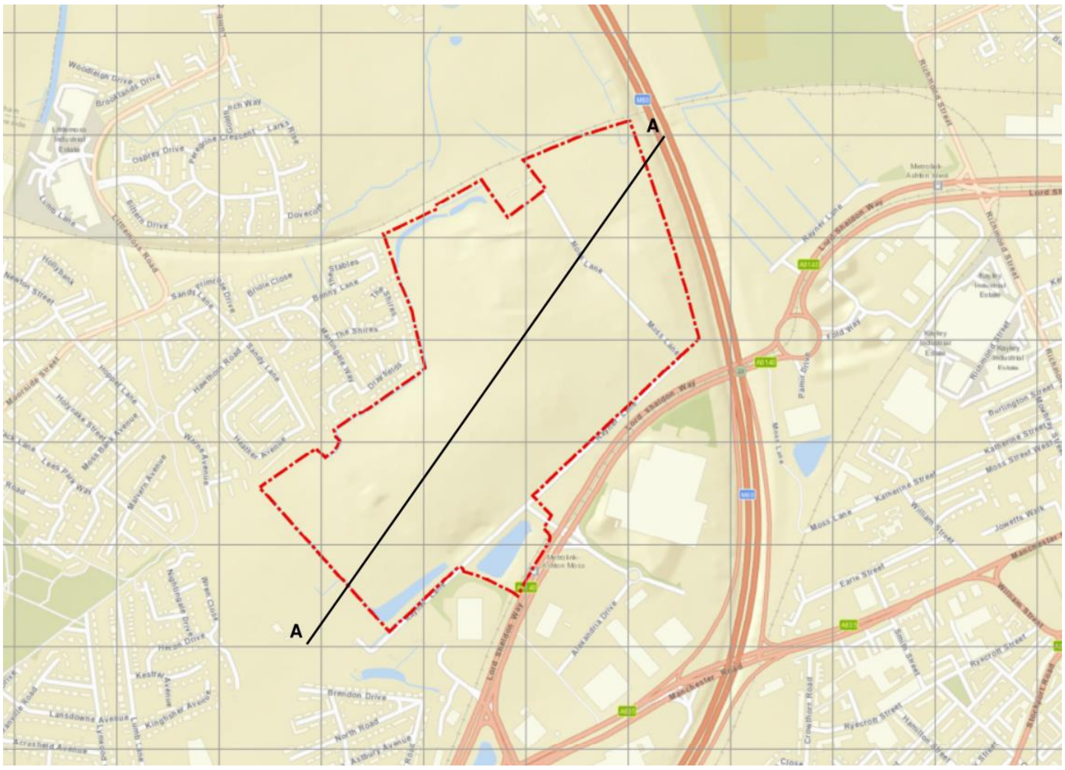
Executive Summary

1.1 Introduction

Tameside MBC have commissioned Ove Arup and Partners Ltd. to provide a preliminary geotechnical assessment on the Ashton Moss development site and a ground investigation has been undertaken by Ian Farmer Associates Ltd (IFA) to inform this assessment. The main focus of the investigation is to assess the composition of the materials placed on the site in the 1990s and 2000s from adjacent road and other development sites. A location plan is shown below. This investigation focussed on the southwest part of the larger Ashton Moss site as shown below.



Site boundary and cross section location

There is no previous ground investigation data available for the site, with some limited information available for the development sites to the west and south. The current preliminary phase of investigation was designed to investigate the placed materials and ground conditions beneath the site and was completed by IFA in March 2018.

There is limited information available for the origin of the placed materials, but available information indicates that the materials originated from the M60 road construction and adjacent areas of other development sites. Prior to this transfer of materials, the site was used for agriculture and allotments.

1.2 Summary of Ground Conditions

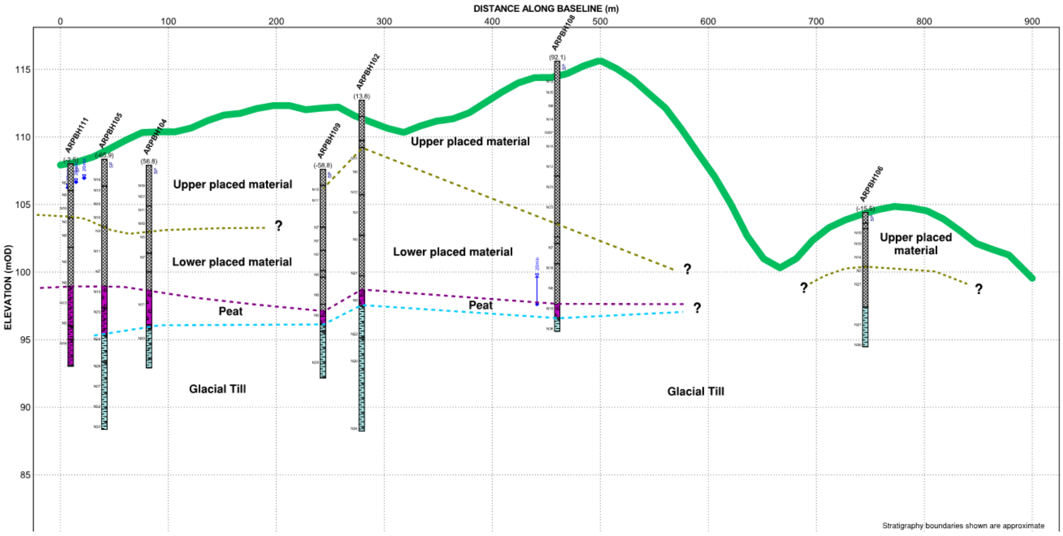
Published geological mapping show the site to be underlain by extensive peat deposits over glacial till. The underlying bedrock is Pennine Upper Coal Measures, which are understood to include coal seams worked from the former Ashton Colliery located to the south of the site. Mapping suggests that the workable coal seams are at depth below the site and are therefore unlikely to influence future development.

Above the coal measures are a layer of naturally occurring glacial till, which would be suitable as a foundation bearing strata, and a layer of natural peat ranging in thickness from 1.2m to 2.5m. The natural strata are overlaid by the placed materials.

The investigation confirmed the presence of extensive placed materials up to 18m thick, over natural peat over glacial till materials, see cross section below. The investigation generally confirmed two layers to the placed materials:

- An upper covering layer of 'engineered fill material' understood to have been placed to form final site levels as a part of a regrading undertaken in the 2000s (**Upper placed material**). This covering layer was generally found to be up to 5m thick but reached up to 8.5m thick in BH108.
- A lower layer of peat and other soft materials likely to have been deposited there as part of an earthworks operation for the construction

of the M60 and surrounding developments (**Lower placed material**)



*Left hand side of the graph is towards Lord Sheldon Way. The right hand side of the graph is towards M60

Section AA - Geological cross section through the site orientated south west (Lord Sheldon Way) to north east (M60).

1.3 Upper Placed Material

The upper placed material is a mixed made ground material. The materials include firm sandy gravelly clays and sandy clayey gravel, with occasional cobbles. The coarse material was generally sandstone, concrete, brick, limestone, coal and ash. It is not considered suitable for reuse in its current condition.

Processing and treatment will be required to make the material suitable for reuse on site. This could include selection and screening, crushing of oversized materials and lime stabilisation to control moisture content.

Following treatment and subject to the settlement characteristics of the lower placed material, the upper placed materials could be suitable as a formation for roads, hardstanding and landscaping.

1.4 Lower Placed Material

The lower placed made ground has a high peat and perishable materials content. It is heterogeneous in composition and distribution including reworked blackish brown partially decomposed peat with gravels of brick and concrete. Pockets of perched water were encountered within the fill body. If assessed as an engineered fill material it would be considered to be an unacceptable earthworks material.

The material is considered to be compressible. There is no data at present on the rate of settlement of the ground. It is likely that considerable settlement will have occurred since this material was placed, but the current rate of settlement is unknown, as is the potential impact on the rate of settlement of either increasing or decreasing the current overlaying ground levels or imposing new loads such as shallow founded buildings.

This material would not be suitable for example as a founding strata.

There are treatment and ground improvement techniques available to improve the geotechnical performance of these types of materials using in-situ and ex-situ methods although these are likely to be extensive and costly. The cost and extent of treatment are likely to be important in the consideration of future development options.

1.5 Performance of Upper and Lower Placed Material in Combination

In order to consider the future of the site for development it is appropriate to consider these materials in combination with each other, and in consideration of the thinner underlying peat layer.

It is not believed that either the upper or particularly the lower placed material is a suitable founding strata for anything but the lightest loaded building. It is expected that all new buildings on the site (including traditional housing) would need to have piled foundations to bear on the underlying glacial till. This would require pile lengths of between approximately 10m and 20m.

However, the upper placed material has the potential, with improvement of being a suitable founding layer for external works such as roads, car parking and public realm, with associated utilities and drainage. This however will depend on the settlement characteristics of the lower placed material. All steps would need to be taken to minimise changes to the loading on this strata, and investigation into current settlement characteristics would be needed to ensure that issues such as differential settlement between buildings on piles and external works can be managed.

1.6 Contamination and Ground Gas Risk

A suite of contamination testing and a qualitative risk assessment has been undertaken to assess contamination risks. The assessment has assumed a conservative residential and public open space end use for future development using generic assessment criteria. Exceedances were noted for heavy metals and hydrocarbons in both the cover and placed made ground materials. Some asbestos was also encountered, although this was generally below the limit of detection. It is considered that the contamination risk could be managed by further, more detailed risk assessment and implementation of a suitable remediation strategy designed for the future site use.

Elevated levels of ground gas have been recorded in some of the recently installed standpipes. It is however noted that some of the monitoring wells were saturated and therefore the results may not be representative of the gas regime at the site. Further assessment and design of a gas monitoring strategy to consider the shallow groundwater is recommended to provide data to characterise the site. It is noted that organic materials present in the fill materials and peat are sources of gas and therefore gas protection for future buildings on the site is likely to be required.

1.7 Next Steps

A detailed earthworks assessment and remediation strategy will be required to consider options for the fill materials and the future development of the site. At this stage it is considered that the strategy would aim to reuse the fill materials and that this would involve limited earthworks activities, treatment and improvement of materials, re-profiling to the upper placed materials and would aim to minimise excavation within the lower placed materials.

Furthermore, extensive ground investigation and analysis is recommended to assess the earthworks and foundation options for the site. Additional contamination testing and gas monitoring is also recommended to provide data for risk assessments and remediation options appraisal. There are existing utilities and drainage on site and is recommended that surveys are undertaken to establish their location and drainage connectivity to the lagoons and their outfalls.

2 Introduction

Tameside Metropolitan Borough Council (TMBC) have commissioned Ove Arup and Partners Ltd. to provide preliminary geotechnical and master planning advice on the Ashton Moss development site. As part of this commission Arup have undertaken an initial desk-based assessment of the site and specified and supervised a preliminary ground investigation to gain an initial understanding of the ground risks that may exist within the site. The desk study and investigation has focused on development Zones 2, 3 and 4 located to the west of the larger Ashton Moss development site, see Figures 1 and 2. This report summarises the findings of both the initial desk based assessment and the recent phase of ground investigation undertaken on the site.

3 Site setting

3.1 Site location

The site is located between a tramway which runs adjacent to Lord Sheldon Way to the south and a railway to the north, approximately 1.9km west of Ashton-under-Lyne town centre. The site covers an area of approximately 42.5 ha and is centred on National Grid Reference SJ 919 988. Freely available LiDAR data indicates that ground levels range from approximately 100 to 118mOD. An aerial photograph of the site is shown in Plate 1.

Plate 1: Aerial view of site [1]

3.2 Site Description and Land use

The site is bound to the south by Lord Sheldon Way, the east by the M60, farmland and residential development to the west by and to the north by a railway line with agricultural areas beyond.

The site is currently unoccupied and temporary fencing has been erected in order to prevent public access. A large proportion of the site is covered by a roughly hexagonal stockpile of material originally associated with the construction of the M60, and the surrounding Ashton Moss development plots. The approximate site levels based on LiDAR data is presented in Figure 3. The stockpile has been provided with engineered drainage which include plastic pipes and concrete headwalls, taking surface water from the top of the stockpile. Several manholes were noted across the stockpile, and whilst they were not lifted during the investigation, they appear to be associated with this drainage system. The drains discharge to a ditch running around most of the base of the stockpile which are connected to two settling pools, one located in the south of the site, adjacent to the tram lines along Lord Sheldon Way, and the second in the north of the site adjacent to the railway. Gabion baskets filled with bricks provide a retaining structure in the north of the stockpile adjacent to the settling pool, which retains approximately 2.5m of material.

Running along the north-eastern boundary of the stockpile, there is another gabion retaining wall along a bend in the drainage ditch. Adjacent to this to the west, the stockpile slopes down at approximately 30^0 to the drainage ditch without any support or retaining structure. From visual inspection, the slope in the northeast boundary appears to be unstable as curved tree trunks and ripples in the near surface materials can be observed.

Rayner Lane runs parallel to the south eastern boundary and turns at a right angle into Moss Lane in the northeast of the site. Moss Lane runs broadly parallel with the M60 and continues to the north of the railway.

A carpark, tram stop and one storey temporary structure is located along the southern boundary associated with the tram line.

At the time of investigation, a haul road for access to the railway line had been established along Rayner Lane and Moss Lane as part of rail upgrade works being carried out offsite.

3.3 Site history

In the absence of a formal Desk Study assessment, a preliminary understanding of the history of the site has been established from a review of publicly available data and previous reports carried out by TerraConsult [2]. Based on published Ordnance Survey (OS) mapping between 1896 to 1963, Ashton Moss appears to have been a generally flat site at approximately 100 to 101mAOD with slightly higher ground in the north-east. The majority of the site was used as allotments, with the exception of an engineered slope along the northern border of site adjacent to the railway. The OS map of 1863 is presented in Figure 4. Several small structures are noted across the site, which are assumed to be associated with the allotments, and there are drainage channels to drain the moss. A spring is located in close proximity to the southwest suggesting relatively high groundwater.

As shown on the 1910 OS map presented in Figure 5, Ashton Colliery was located directly south of the site. Geological maps suggest that any worked coal seems will dip beneath the site.

The TerraConsult ground investigation report (GIR) produced for the construction of what is now the M60 noted that the moss had undergone significant settlement, resulting in problems with drainage outfalls in some areas. The poor drainage impacted the suitability of the land for agricultural use.

Given its limited agricultural use the site was subsequently used during the construction of the M60 as a ‘Restoration Area’ for surplus and unsuitable materials from the road construction. Large volumes of peat and associated naturally occurring materials, as well as construction materials are known to have been transferred onto the site in the 1990s to facilitate the construction of the M60 motorway. We understand that subsequently, material was also brought to the site from Plot 2000 and 1000 of the Ashton Moss industrial park adjacent to the south of the site. This material transfer was undertaken in accordance with an exemption certificate registered with the Environment Agency (EA). No detailed records are available for the fill materials placed on the site.

It is understood that ‘inert’ construction arisings were still being brought to the site in 2005, and following regrading, a cover system was proposed to form the final profile for a golf course development. It is unclear whether the cover layer was placed, and there is little data available on the nature of the materials being imported at this time. Consequently, there is little information on the thickness and engineering behaviour of this material.

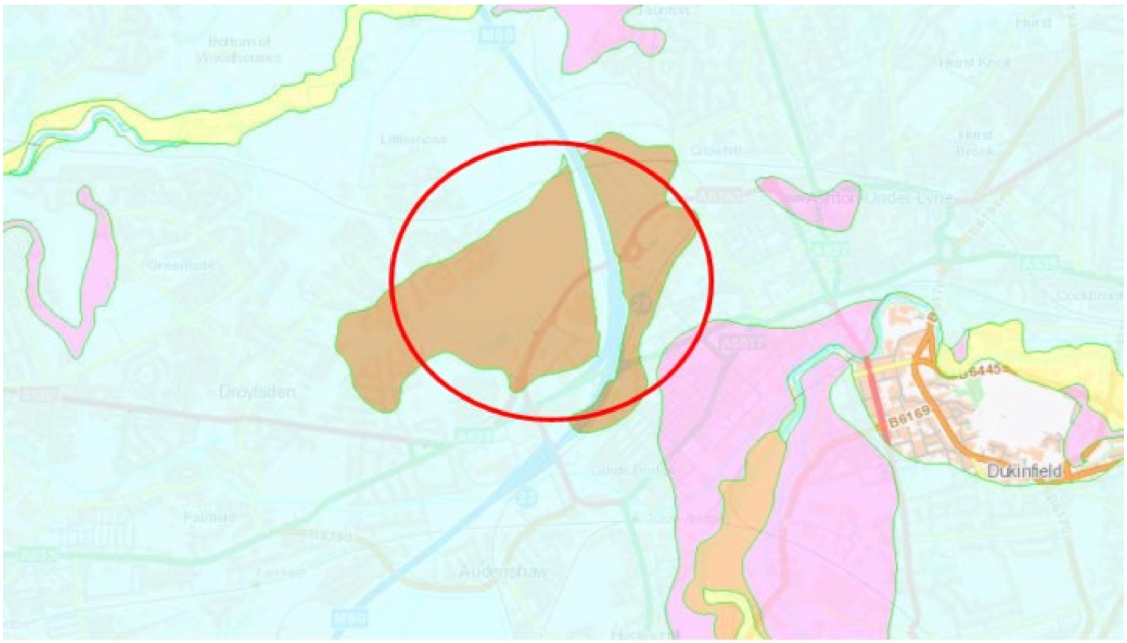
A preliminary assessment of the risk of encountering buried unexploded ordnance (UXO) at the site has concluded a low risk posed by this hazard. Details of the assessment is included in Appendix A.

3.4 Geology

Publicly available geological information from the BGS GeoIndex [3] indicates the site to be underlain by peat over glacial till, over Pennine Upper Coal Measures. This is illustrated in Plate 2. Although the geological mapping does not show any made ground on site, it is known that significant thicknesses of made ground are present above the peat.

Coal measures bedrock is located below the site and potentially worked coal seams may dip 50-70m beneath the site. However, previous investigation boreholes (available via the BGS website [3]) suggest that glacial till is up to 50m thick, suggesting that any instability of the worked seams is unlikely to affect the surface. A Coal Authority Mining Report should be obtained for the site to confirm this.

Plate 2 Superficial deposits on site and in the surround areas. The colours represent the following materials; brown – peat, blue – glacial till, pink – glacial fluvial deposits, orange – river terrace deposits and yellow – alluvium. Accessed from the BGS [3]



3.5 Hydrology and hydrogeology

The glacial till beneath the site is classified by the Environment Agency (EA) as an unproductive stratum. The Pennine Upper Coal Measures are classified as a secondary aquifer by the EA, and the site is not located within a Source Protection Zone (SPZ).

There are no known groundwater abstractions within 1km of the site.

The site is provided with a system of drainage ditches which drain the existing stockpile and discharge via two settling ponds located adjacent to the railway along the northern boundary and Lord Sheldon Way in the south. The nearest natural surface water feature is the River Tame approximately 1km to south, running roughly parallel with the southeast site boundary.

3.6 Utilities

Initial utilities surveys were undertaken by Ian Farmer Associates (IFA) prior to the commencement of the preliminary ground investigation. A high-pressure gas main running beneath Rayner Lane, and a medium-pressure gas main running beneath Moss Lane were identified, both operated by Cadent. No other utilities were identified by this initial survey.

3.7 Ecology

An ecological desk study and walkover survey was undertaken by an appropriately qualified ecologist prior to commencement of the GI and a full report in included in the IFA factual report [4]. In summary, several ponds and drainage ditches with aquatic vegetation which could provide suitable habitats for Great Crested Newts (GCN), were identified across the site. Furthermore, there are 6 records of GCNs within 1km of the site. As such it is considered that GCNs could be present on site. Further assessment for invasive species was not included as part of this report but will need to be undertaken by an appropriately qualified ecologist.

4 Historical ground investigation

4.1 BGS investigations

The on-shore British Geological Survey (BGS) Geoindex [4] Appendix A has been consulted as part of this assessment. No available records of exploratory holes undertaken on the site are held post placement of material. Records from 1981 show ground conditions consisting of 0.3 to 1.3m of topsoil and made ground overlying stiff clay in the east of the site, directly adjacent to the current motorway. In the northwest of the site, 1.7m of made ground is recorded overlying approximately 1.9 to 4.7m of peat, overlying stiff clay.

4.2 Third Party Investigations

Mouchel carried out ground investigation prior to the construction of the M60 to inform slope and bridge construction in the Ashton area. This included approximately 60 shallow and deep boreholes and trial pits. Mouchel describe the area of the site being underlain by between 1.5 to 7m of peat over a thin layer of alluvium over stiff glacial till.

5 Current ground investigation

5.1 Aims of ground investigation

Following the review of publicly available information, the history of the site and the limited historic GI information that is summarised above, further investigation was deemed necessary to give an initial indication of ground conditions beneath the site. The objectives of the ground investigation were to inform cost plans for the potential development of the site by:

- Examining the nature, thickness and extent of the materials placed at the site since 1990.
- Identifying potential contamination risks associated with the stockpiled material
- Examining the occurrence and nature of the underlying superficial deposits, particularly peat. Due to expected depth to solid strata, the GI was not intended to reach rockhead.

The investigation was a targeted intrusive investigation, informed by the limited desk study assessment described above. A rationale for the ground investigation is presented in Appendix A

5.2 Intrusive investigation

The investigation was carried out between 3rd and 18th March 2018 and comprised the following:

- 11 No. cable percussive boreholes to a depth of between 10 and 24mbgl.
- 5 No. dynamic sampler boreholes to depths of between 1.87 and 10.45mbgl (2 No. holes refused on obstructions and had to be redrilled).
- Laboratory geotechnical testing of selected soil samples.

- Laboratory geoenvironmental analysis of selected soil and water samples.
- Gas and groundwater monitoring.

Trial pitting was originally proposed to examine the microfabric of onsite shallow deposits, however these could not be conducted due to the ecological constraints identified at the site. The location of the exploratory location are presented in Figure 6.

All work was carried out under an Ecological Reasonable Avoidance Measures Method Statement (RAMMS), which required that all exploratory hole locations and access routes were inspected by a qualified ecologist before the relevant works were undertaken. Full details of the ecological watching brief are included in the Ian Farmer Associates (IFA) factual report [4]

Materials with organic or peaty constituents were described using the Von Post classification system [5] which sets out a method of quantifying the humification, moisture content and organic content of soils.

5.2.1 Geotechnical laboratory tests

The following laboratory tests were completed on samples obtained from the investigation:

- Hand shear vane
- Soil classification tests (moisture content, Atterberg limits testing)
- Particle size distribution (PSD)
- Bulk density
- Loss on Ignition
- BRE SD1 (sulphate assessment)
- Oedometer tests

5.2.2 Chemical laboratory tests

Selected soil samples were scheduled for chemical testing to allow characterisation of levels of contamination if present. The suites and number of analyses undertaken are presented in Table 1.

Table 1 Summary of soil chemical testing

Suite	Quantity
Metals, metalloids and inorganics (Sb, As, Be, water soluble boron, Cd, Cr, Cu, Pb, Hg, Ni, Se, Vn, Zn, pH, total cyanide	49
Total Petroleum Hydrocarbons (TPH) – TPHCWG banded with aliphatic/aromatic split	49
USEPA 16 polyaromatic hydrocarbons (PAH), benzene, toluene, ethylbenzene and xylene (BTEX)	49
Presence and identification of Asbestos	49

6 Ground conditions

6.1 Introduction

This section presents a summary of ground conditions encountered at the site during the March 2018 GI. As summary of the stratigraphic profile that was indicated by the available GI data is provided in Table 2.

Table 2 Summary of stratigraphy encountered.

Stratum	Base of stratum mbgl (mOD)	Thickness (m)	Description
Made ground	6.0 – 18.0 (94.0 –99.0) *the reduced levels given for the base of the made ground largely reflect the original topography of the site, which was generally level. The range in thickness given for the made ground reflects the varying height of the stockpile above the original topography of the site.	7.0 – 18.0 *the reduced levels given for the base of the made ground largely reflect the original topography of the site, which was generally level. The range in thickness given for the made ground reflects the varying height of the stockpile above the original topography of the site.	Soft dark brown sandy CLAY/clayey SAND with fine to coarse brick and concrete (Upper placed materials) underlain by material (Lowe placed material) variable in texture and composition – see Section 6.2 below for further detail.
In situ peat	11 – 19.0 (95.0 – 97.5) **absent in BH103, BH106 & BH111	1.2 – 2.5	Dark brown slightly decomposed fibrous PEAT with rare

			amorphous material and some coarse fibres.
Glacial till	Not proven	Not proven, >10m	Stiff brown mottled grey sandy gravelly CLAY. Gravel is fine to coarse sandstone mudstone and quartzite.

As discussed in Table 2, significant variations in thickness of made ground have been observed on the site, but the base of the made ground and natural peat deposits were found to be at relatively uniform levels.

Interpreted geological sections are presented in Appendix B and the approximate thickness of made ground and peat is shown in Figure 7.

6.2 Made ground

6.2.1 Overview

Made ground has been encountered in all exploratory hole locations across the site, with a recorded thickness ranging between 7.0 and 18.0m. The thinnest made ground was encountered around the edges of the stockpile, however, at its thickest in the south eastern corner of site near Lord Sheldon Way, the base of the made ground was not identified.

6.2.2 Approach to made ground classification

The historic review presented earlier in this report suggested that two episodes of filling had taken place at the site, with the earlier phase associated with the construction of the M60 motorway and the later phase associated with industrial/commercial development to the south of the site. This general distribution has been confirmed by the findings of the March 2018 ground investigation which found the following two broad material types:

- An upper covering layer of engineered material was placed to form final site levels as a part of a regrading process undertaken in the 2000s (**Upper placed materials**).
- A lower layer of peat and other unsuitable materials associated with the construction of the M60 (**Lower placed materials**).

The following sections of the report provide a summary of the key properties, texture and composition for both identified materials. These summaries are based on the findings of the exploratory holes and are presented for guidance only. Ground conditions encountered between exploratory holes could differ from those presented in this report.

6.2.3 Upper Placed Materials

6.2.3.1 Description

The covering layer fill is the most recently placed material and was placed during the regrading of the stockpile as part of the proposals to use the site as a golf course. The material generally extends to thicknesses of between and 1.8 and 5.0 mbgl, although thickness varies locally. The covering layer appears absent in the west of the site to the west of Moss Lane but was present in all other 2018 exploratory holes.

The materials from the covering layer were found to be firm sandy gravelly clay or sandy clayey gravel, with occasional cobbles. The coarse material was generally sandstone, concrete, brick, limestone, coal and ash.

6.2.3.2 Classification

The particle size distribution curves of samples of the upper placed materials are presented in the IFA report and summarised in Appendix D. The results indicate that this material is predominantly a well graded clayey gravelly sand. Some samples contain higher gravel and cobble content. It can be noted from carrying out walkover surveys that cobble sized fill materials such as concrete flags and bricks are present in the near surface materials.

Thirty-eight natural moisture content tests have been undertaken on samples of the covering layer, and the results range between 11 and 41%. Fourteen plasticity indices range between 7 and 21% as shown in Appendix C. These results indicate that the material is generally clay of low to intermediate plasticity, with one result indicating a high plasticity silt.

6.2.3.3 In situ testing

Standard penetration tests [6] were carried out within the covering upper layer fill and are summarised in Appendix C. Corrected 'N_{60}' values ranged between 7 and 34, i.e. loose to dense for granular components.

6.2.4 Lower Placed Material

6.2.4.1 Description

The lower placed material is known to have been excavated material from the construction of the M60 and is understood to have been surplus or assessed to be unsuitable for reuse as an engineered fill elsewhere on the motorway scheme. As such, the material is highly heterogeneous in composition and distribution.

The material generally extends to thicknesses of between and 1.9 and 10.6mbgl, although thickness has been shown to be locally variable. This older, lower lying fill generally consists of reworked blackish brown partially decomposed peat with gravels of brick and concrete and was encountered at all exploratory hole locations.

Along with descriptions in accordance with BS:5930 [7], organic materials were described using the Von Post description method [5]. Generally, the materials encountered contained 0-40% organic material (N_0 to N_1), had a medium to high range of humification (between H_5 and H_9) and had a moderate moisture content for organic material of less than 500% (B2).

It is noted that during drilling, frequent pockets of perched water were encountered which adversely affected drilling progress. This is discussed further in Section 6.5.

6.2.4.2 Classification

The particle size distribution curves of samples of the lower placed materials are presented in the factual report and summarised in Appendix C. The results indicate that this material grades as a predominantly well graded clayey gravelly sand.

Thirty-three natural moisture content tests have been undertaken on samples of the lower placed made ground layer, and the results range between 12 and 214%. Higher percentages are likely to be associated with the peaty elements within this material. Sixteen plasticity indices range between 4 and 54% as shown in Appendix C. These results indicate that the material is of generally intermediate to high plasticity. Ten specific gravity tests range between 2.13 and 2.66.

6.2.4.3 In situ tests

Standard penetration tests [6]were carried out within the lower placed made ground layer fill and are summarised in Appendix C. Corrected ‘N_{60}’ values ranged between 0 and 32, but typically 0-16 i.e. very loose to medium dense. It is noted that the higher range of ‘N’ values were recorded where obstructions were noted within the fill. The hand shear vanes indicated that the peak undrained shear strength (S_u) ranges from 11 kPa to 174 kPa, but typically between 75 and 115 kPa. No laboratory shear strength testing was carried out during this investigation.

6.3 Peat

6.3.1 Description

Underlying the made ground, natural peat was encountered in the majority of exploratory hole locations. Peat was absent however, along the southern boundary adjacent to Lord Sheldon Way. The material generally extends to thicknesses of between 1.2 and 2.5m and can be described as dark brown slightly decomposed fibrous peat with rare amorphous material and some coarse fibres. Figure 7 present the estimated peat thickness across the site.

Along with descriptions in accordance with BS:5930 [7], organic materials were described using the Von Post description method [5]. Generally, the materials encountered contained 0-40% organic material (N_0 to N_2), had a wide range of humification ranging from low to high (between H_2 and H_8) and has a moderate moisture content for organic material of less than 500% (B2).

6.3.2 Classification

The particle size distribution curves of samples of the peat are presented in the factual report and summarised in Appendix C. The results indicate that the non-humic component of this material grades as a predominantly well graded sandy clay or a well graded gravelly sand.

Seven natural moisture content tests have been undertaken on samples of the placed made ground layer, and the results range between 27 and 123%. Two specific gravity tests range between 1.43 and 2.31.

6.3.3 In situ tests

Standard penetration tests Appendix A were carried out within the peat deposits and are summarised in Appendix C. Corrected 'N_{60}' values ranged between 2 and 23, i.e. very loose to medium dense. It is noted that the higher range of 'N' values were recorded where gravels and cobbles were noted within the peat. The hand shear vanes indicated that the peak undrained shear strength (S_u) ranges from 38 kPa to 166 kPa. No laboratory shear strength testing was carried out during this investigation.

6.3.4 Laboratory tests

Two oedometer consolidation tests were carried out on undisturbed samples of peat. The stress increments and coefficient of volume compressibility (m_v) values are summarised in Table 3.

Table 3 Summary of oedometer tests carried out on peat samples.

Applied Pressure (kPa)	m_v (m^2/MN)
4	0.59
8	0.91
10	1.0
16	0.98
20	0.97
32	0.74
40	0.83
80	0.75

These results indicate that the material is a normally consolidated material of high compressibility Appendix A. It should be noted that it was necessary to select low applied pressures for these tests due to the low strength of the material, which prevented meaningful tests being carried out at higher pressures. The coefficient of compressibility is likely to be higher under normal construction loads and may indicate the material to be of extremely high compressibility.

6.4 Glacial till

6.4.1 Description

Glacial till was encountered in all exploratory hole locations, except those in which refusal on obstructions was noted. The base of the glacial till was not proven, but on the basis of information obtained from the BGS Geoindex, can be expected to be in excess of 50mbgl. The material was generally firm to stiff brownish grey sandy gravelly clay. The gravel comprises fine to coarse angular to rounded sandstone, mudstone, coal and quartzite.

6.4.1.1 Classification

The particle size distribution curves of samples of glacial till are presented in the factual report [4] and summarised in Appendix C. The results indicate that this material is predominantly well graded sandy gravelly clay.

Fifty-two natural moisture content tests have been undertaken on samples of glacial till, and the results range between 8 and 37%. Fourteen plasticity indices tests range between 12 and 25% as shown in Appendix C. These results indicate that the stratum is of low to intermediate plasticity.

6.4.1.2 In situ tests

Standard penetration tests [6] and in situ hand vanes were carried out within the glacial till and are summarised in Appendix C. Corrected 'N_{60}' values ranged between 11 and 37. The hand shear vanes indicated that the peak undrained shear strength (S_u) ranges from 79 kPa indicating low to very low strength at the top of the glacial till, increasing to 190 kPa indicating high to very high strength at the base of the boreholes, with discreet softer results of 53 kPa. No laboratory shear strength testing was carried out during this investigation.

6.4.1.3 Laboratory tests

Five oedometer consolidation tests were carried out on undisturbed samples of glacial till. The stress increments and coefficient of volume compressibility (m_v) values are summarised in Table 4.

Table 4 Summary of oedometer tests carried out on glacial till samples.

Applied Pressure (kPa)	m_v (m^2/MN)
20	0.51
40	0.21 – 0.47
50	0.22
80	0.23 – 0.32
100	0.075 – 0.31
160	0.14 – 0.2
200	0.13 – 0.19
320	0.13 – 0.14
400	0.083 – 0.13
800	0.057

These results indicate that the material is a normally to over consolidated material of low to medium compressibility in normal construction ranges low stresses [8].

6.5 Groundwater

Groundwater strikes encountered during the investigation and groundwater data collected during the subsequent monitoring programme are presented in Table 5 and Since the installations were completed however, the majority of installations have recorded consistent water level readings in the 6 post monitoring visits to date (Table 6). This is despite all the wells being purged after the first monitoring visit to allow for re-equilibration of water levels. The water level readings suggest that there is perched water within the body of the made ground.

Table 6 respectively.

During intrusive works, most of the boreholes remained dry or only encountered seepages during drilling and installation of the standpipes. The exceptions to this are noted in Table 5.

Table 5 Groundwater strikes during ground investigation

Hold ID	Depth to water (mbgl)	Water level (mOD)	Stratum
ARP-BH101	6	101.7	Placed made ground
ARP-BH103	7.5	95.7	Glacial till
ARP-BH105 *Note at end of table	1.4	107.0	Placed made ground
ARP-BH105 *Note at end of table	1.7	106.7	Placed made ground
ARP-BH105 *Note at end of table	2.1	106.3	Placed made ground
ARP-BH108	18	97.6	Peat
ARP-WS102	0.8	105.6	Placed made ground
ARP-WS103	6.5	94.9	Placed made ground

*Several strikes were encountered during progression of ARP-BH105, which indicates the perched nature of the water.

Since the installations were completed however, the majority of installations have recorded consistent water level readings in the 6 post monitoring visits to date (Table 6). This is despite all the wells being purged after the first monitoring visit to allow for re-equilibration of water levels. The water level readings suggest that there is perched water within the body of the made ground.

Table 6 Summary of groundwater encountered during post fieldwork monitoring (visits 1-6)

Hold ID	Depth to water (mbgl)	Water level (mOD)	Installation stratum (mbgl)
ARP-BH101	2.56 – 2.69	105.05 – 108.18	Made ground (4-12)
ARP-BH102	0.44 – 0.74	111.99 – 112.29	Made ground (1-14)
ARP-BH104	0.77 – 1.28	106.63 – 107.14	Made ground (1-11)
ARP-BH105	2.37 – 3.2	105.16 – 105.99	Peat (4-12)
ARP-BH106	6.27 – 6.63	97.79 – 98.15	Peat (8-10)
ARP-BH107	1.56 – 1.86	104.78 – 105.08	Made ground (1-6)
ARP-BH108	0.8 – 3.43	112.19 – 114.82	Made ground (13.5-18)
ARP-BH109	2.55 – 2.78	104.84 – 105.07	Made ground (1-11)
ARP-BH110	4.93 – 5.8	95.74 – 96.64	Peat (5-10)
ARP-BH111	0.99 – 1.18	106.85 – 107.04	Made ground (1-9)
ARP-BH112	4.85 – 5.01	95.93 – 96.09	Made ground (1-5.5)
ARP-WS102	0.9 – 2.06	104.32 – 105.48	Made ground (1-5)
ARP-WS103	0.61 – 1.06	100.35 – 100.8	Made ground (1.5-5.5)

6.6 Ground gas

At the time of writing, the full programme of gas monitoring has not been completed. An update of this report with conclusions of the gas monitoring data will be issued once the monitoring has been completed.

To date, ground gas monitoring has been undertaken at the site over six rounds from the 10th May to the 19th June 2018 and a range of elevated gas levels records. Full details of the gas monitoring undertaken to date are presented in the Contractors factual report [4].

The parameters recorded are as follows:

- Borehole flow rate [l/hr];
- Methane concentration (CH_4) [%];
- Carbon dioxide concentration (CO_2 [%];
- Oxygen concentration (O_2) [%];
- Hydrogen sulphide concentration (H_2S) [ppm];
- Carbon monoxide concentration (CO) [ppm]; and
- Volatile organic compounds (VOCs) [ppm].

As discussed in Section 6.5, many of the response zones have been found to be saturated post drilling. The implications of this are discussed further in Section 7.4.

7 Geoenvironmental considerations

7.1 General

This section provides a high-level summary of potential contaminative issues based on available desk study information and the results of the March 2018 ground investigation undertaken at the site. To allow a conservative assessment to be undertaken, for the purposes of this report it has been assumed that any development of the site would include the construction of low rise residential properties.

7.2 Preliminary conceptual site model

The UK guidance relating to contaminated land describes a risk assessment methodology based on the ‘source-pathway-receptor’ model. This model comprises:

- The principal pollutant hazards associated with the property (the sources);
- The principal targets at risk from the identified hazards (the receptors), such as residents, construction workers and the environment;
- The existence, or absence, of plausible pathways that may exist between the identified hazards and targets.

For a risk to exist, all three elements (source-pathway-receptor) of a significant pollutant linkage must be present. A preliminary conceptual site model has been developed for this site following the framework outlined within the Environment Agency’s “Model Procedures for the Management of Land Contamination” (CLR11) [8]. A preliminary conceptual site model (pCSM) describes the scenario in which the risks to human health and the environment (posed by contaminated land) are assessed. It describes the ground and surface conditions and the activities performed on the site. In particular, the model identifies and describes the sources of potential contamination, the behaviour of the contamination in environmental media such as soil and groundwater, surface water and air. It also identifies and characterises potential human health and environmental receptors.

This pCSM is based on limited desk study information and should be revised with more detailed information prior to any further phases of ground investigation.

7.2.1 Potential sources

Based on the limited desk-based review of the site and adjacent areas presented in Sections 2 above, a number of potential contaminant sources have been identified as summarised in Table 7.

Table 7: Potential sources of contamination

Potential Source	Potential Contaminative Materials	Comments
Made Ground	Asbestos Metals Ground Gases (methane, carbon dioxide) Petroleum hydrocarbons Polyaromatic hydrocarbons (PAHs)	Made Ground imported to the site could contain asbestos, metals and hydrocarbons. The generation of ground gas will depend on the thickness and organic content of Made Ground.
Peat	Ground gas	Organic peaty material has the potential to generate ground gas
Upper Coal Measures	Ground gases (methane, carbon dioxide)	The coal measures have the potential to generate ground gas but are located below a significant thickness of glacial till (> c.50m). The till has the ability to act as a barrier and prevent the migration of gas to the surface.
Offsite sources: railway. *The significance of the railway and other potential offsite sources cannot be determined without more detailed desk-based assessment of the site and adjacent areas.	Heavy metals Petroleum Hydrocarbons Polyaromatic hydrocarbons (PAHs)	Existing railway that has been present for over 100 yrs.

7.2.1.1 Observations of contamination

A mild organic odour was noted in several of the placed made ground peat-rich materials, specifically those where the peat was more decomposed. No other visual or olfactory signs of contamination during the recent investigation by IFA [4].

7.2.2 Receptors

Development proposals have not yet been finalised for this scheme and further detailed desk based assessment is recommended in order to address some of the issues raised in the current assessment. As such a comprehensive assessment of receptors cannot be carried out at this stage. Assumptions have been made of the likely end uses of the site and the types of engineering solutions that may need to be undertaken to facilitate them.

The following receptors have been identified as potentially at risk from exposure to the sources of contamination identified above.

Human health:

- Construction workers;
- Nearby users;
- Future site residents; and
- Maintenance workers (entering confined spaces such as drainage inspection chambers or involved in any small excavations within the site such as utilities maintenance).

Controlled waters:

- Controlled waters or existing sewers into which the site drainage network discharges.

It is considered that the Secondary A aquifer in the Upper Coal Measures is protected from mobile shallow contaminants by the presence of the overlying Glacial Till, which is understood to be at least 50m thick.

Infrastructure:

- Structural concrete;
- Potable water supply pipes.

7.2.3 Pathways

Construction of any proposed development is assumed to involve significant excavation works and stockpiling of made ground materials, as well as removal of existing utilities and drainage.

The use of deep piles is a potential foundation solution for the site. The piles will penetrate through the existing made ground to the underlying glacial till.

The following pathways may link sources of contamination to human receptors at the site:

- Inhalation of soil dust and fibres, vapours and groundwater resulting from earthworks and activities;
- Dermal contact with soils and groundwater during earthworks;
- Ingress and accumulation of toxic, asphyxiating or explosive concentrations of gases or vapours within excavations and other confined spaces.
- Inhalation of vapours, soil or groundwater in areas of soft landscaping

The following pathways may link sources of contamination to controlled waters:

- During construction: contaminants from the made ground and run off from stockpiles migrating through the pathway created by pile bores. Once the construction of piles is complete, this pathway is considered not to be significant.

- Mobile or leachable contaminants entering the existing site drainage system (or future drainage systems) and impacting off-site receptors (receiving sewers or surface water features)

The following pathways may link sources of contamination to buried services at the site:

- Any below ground infrastructure may come into direct contact with possible sources of contamination, which could result in the degradation of construction materials or the permeation of contaminants e.g. into water supply pipes.

7.2.4 Summary conceptual site model

A summary of the preliminary conceptual site model (pCSM) is presented in Table 8 below.

Table 8: pCSM

Source	Pathway	Receptor	PPL?
Made Ground (potentially containing contaminants including hydrocarbons and PAHs, asbestos fibres)	Dermal contact	Construction worker/ Future site user	Yes
Made Ground (potentially containing contaminants including hydrocarbons and PAHs, asbestos fibres)	Ingestion of soil/ soil dust	Construction worker/ Future site user	Yes
Made Ground (potentially containing contaminants including hydrocarbons and PAHs, asbestos fibres)	Inhalation of soil vapour	Construction worker/ Future site user	Yes

Made Ground (potentially containing contaminants including hydrocarbons and PAHs, asbestos fibres)	Inhalation of soil and soil dust, fibres (Pathway broken by hard surfacing)	Construction worker/ Future site user	Yes
Made Ground (potentially containing contaminants including hydrocarbons and PAHs, asbestos fibres)	Leaching and infiltration	Surface water drainage systems and offsite discharge points *Deep aquifer/ During construction, methods will need to be adopted during piling to safeguard the aquifer. In the long term, the pathway prevented by thickness of glacial till.	Yes *Receptor with asterix is no PPL
Made Ground (potentially containing contaminants including hydrocarbons and PAHs, asbestos fibres)	Direct contact	Buried structural concrete/ Potable water supply pipes	Yes
Made Ground (ground gases)	Ingress and accumulation to toxic, asphyxiating or explosive	Future site user	Yes

	concentrations within new buildings		
Upper Coal Measures (ground gas)	Ingress and accumulation to toxic, asphyxiating or explosive concentrations within new buildings	Future site user	No

7.3 Human health screening assessment

Qualitative risk assessment has been carried out in accordance with the Contaminated Land Exposure Assessment (CLEA) model produced by DEFRA and the Environment Agency [10]. CLEA provides a risk assessment basis for developing both generic and site-specific assessment criteria, and also provides risk assessment software to enable their derivation.

Arup has developed a series of generic assessment criteria (GAC), using the CLEA model (v.1.07).

A number of standard land uses have been developed under the CLEA Framework, for which Arup has developed GACs. These values conservatively based upon 2.5% soil organic matter have therefore been used as ‘screening criteria’ for the current investigation.

Recent guidance confirms that the assessment of asbestos on the basis of comparison to generic screening criteria is not appropriate. As a precautionary measure the asbestos laboratory detection limit has been taken as the screening criteria. Further laboratory quantification of asbestos has been carried out on samples detected to have the material.

Three land uses are anticipated for future developments across all or part of the site. These comprise:

- Residential end use with plant uptake (the most sensitive end use);
- Residential end use without plant uptake; and
- Public open space park (the least sensitive end use).

The Arup assessment of chemical test results against the appropriate GAC for each anticipated land use is summarised in the following sections. Contaminants which exceed their GAC are classified as contaminants of concern and require more detailed risk assessment and potential remediation prior to development. Full results are included in Appendix D

7.3.1 Made ground

In total 38 (12 MG-C and 26 MG-P) samples of made ground were tested for heavy metals, inorganics, total petroleum hydrocarbons and polyaromatic hydrocarbons. The analysis results were compared to three separate generic assessment criteria for the various land uses anticipated for the future development at the site. A summary of the exceedances of the generic assessment criteria for a residential end use with plant uptake, a residential end use without plant uptake and a public open space park are shown in Tables 9 - 11 below.

Table 9 Summary of Residential with plant update GAC exceedances

Contaminant	MG-C No of exceedances (Conc range – 12 samples tested)	MG-P No of exceedances (Conc range – 26 samples tested)
Lead	2 (224-483 mg/kg)	1 (264 mg/kg)
Mercury	2 (0.72 – 4.33 mg/kg)	4 (0.63-1.5 mg/kg)

Aromatic C5-C7	2 (5-94.2 mg/kg)	1 (68.1 mg/kg)
Benzene	6 (24.7-178 mg/kg)	3 (7-146 mg/kg)
Benzo (b) fluoranthene	1 (3.83 mg/kg)	1 (5.27 mg/kg)
Benzo (a) pyrene	2 (3.46-3.79 mg/kg)	1 (6.93 mg/kg)
Dibenzo (ah) anthracene	7 (0.33-3.73 mg/kg)	2 (1.48-6.35 mg/kg)

The soil testing identified exceedances for seven contaminants in both the MG-C and the MG-P from various depths when compared to the residential with plant uptake GACs. Many of the borehole records [4] note samples containing tarmacadam, as is to be expected for waste materials from the construction of the motorway. This may explain the higher concentrations of benzene, benzo (b)fluoranthene, benzo(a)pyrene and dibenzo(ah)anthracene that were identified in the analysis results.

Table 10 Summary of residential without plant update GAC exceedances

Contaminant	**MG-C No of exceedances (Conc range – 12 samples tested)**	**MG-P No of exceedances (Conc range – 26 samples tested)**
Lead	1 (483 mg/kg)	0
Mercury	2 (0.72-4.33 mg/kg)	4 (0.63-1.5 mg/kg)
Aromatic C5-C7	2 (5-94.2 mg/kg)	1 (68.1mg/kg)

Benzene	6 (24.7-178 mb/kg)	3 (7-146 mg/kg)
Benzo (b) fluoranthene	0	1 (5.27 mg/kg)
Benzo (a) pyrene	2 (3.46-3.79 mg/kg)	1 (6.93 mg/kg)
Dibenzo (ah) anthracene	7 (0.33 – 3.73 mg/kg)	2 (1.48-6.35 mg/kg)

When compared with the residential without plant uptake GACs, the soil testing identified exceedances for six contaminants in both the MG-C and the MG-P from various depths.

Table 11 Summary of public open space GAC exceedances

Contaminant	MG-C No of exceedances (Conc range – 12 samples tested)	MG-P No of exceedances (Conc range – 26 samples tested)
Aromatic C5-C7	1 (94.2 mg/kg)	0
Benzene	1 (146 mg/kg)	1 (178 mg/kg)
Dibenzo (ah) anthracene	5 (1.48-3.73 mg/kg)	2 (1.48-6.35 mg/kg)

When compared with the public open space GACs, the soil testing identified exceedances for three contaminants within the MG-C and two within the MG-P from various depths.

7.3.2 Asbestos

In total 48 samples were tested for asbestos containing materials, of which 8 returned positive results (Table 12). All positive results were at concentrations below the detection limit (<0.001 %/weight), with the exception of one sample where 0.054% was detected in the MG-C material.

Table 12 Summary of positive asbestos samples

Sample ID	Stratum	Asbestos quantification	Asbestos type
ARPBH102	MG-P	<0.001%	Chrysotile – loose fibres

ARPBH108	MG-P	<0.001%	Chrysotile – loose fibres
ARPBH112	MG-C	<0.001%	Chrysotile – loose fibres
ARPWS101	MG-P	<0.001%	Amosite – loose fibres
ARPWS103	MG-C	<0.001%	Chrysotile – loose fibres
ARPWS107	MG-C	<0.001%	Chrysotile – loose fibres
ARPBH102	MG-C	0.054%	Chrysotile – board and loose fibres
ARPBH104	MG-C	<0.001%	Chrysotile – loose fibres

7.3.3 Superficial deposits

In total 11 samples of superficial deposits (5 peat and 6 glacial till) were tested for heavy metals, inorganics, total petroleum hydrocarbons and polyaromatic hydrocarbons. The analysis results were compared to three separate generic assessment criteria for the various land uses anticipated for the future development at the site. All-natural superficial deposits samples tested were below the generic assessment criteria for the respective contaminants.

7.3.4 Summary of screening assessment

Please note that the assessment included herein is based on a limited number of samples that were recovered from a wide distribution of exploratory hole locations. Further, more detailed sampling and assessment will be required as part of future phases of ground investigation.

In summary, exceedances of the residential with plant uptake generic assessment criteria were noted for samples taken from the two types of made ground across the site and from varying depths. Exceedances were reported for heavy metals (Lead and Mercury), petroleum hydrocarbons (aromatic c5-c7 and benzene) and polyaromatic hydrocarbons (benzo(b)fluoranthene, benzo(a)pyrene and dibenzo(ah)anthracene). Of 48 samples tested, eight samples (5 MG-C and 3 MG-P) were shown to contain asbestos. The asbestos encountered was generally in the form loose fibres of chrysotile or amosite and below 0.001 wt %. In one sample however (BH102 at 1m bgl, MG-C), chrysotile fibres and fragments of insulation board were identified at concentrations above the limit of detection (0.054%).

7.4 Ground gas

As well as monitoring groundwater levels, the installations provided in the March 2018 exploratory holes were provided to allow a programme of gas monitoring to be undertaken. As discussed in Section 6.6 however, whilst few groundwater strikes were encountered during the fieldworks, subsequent monitoring visits have identified that many of the response zones have become saturated. In accordance with CIRIA C665 [11] and BS8485 [12]Appendix A gas monitoring data from saturated response zones will not represent true soil-gas conditions and should not therefore, be used in risk assessment.

At present therefore, it is not possible to undertake a preliminary assessment of gas risk at the site. It is however note that elevated level of ground gas has been recorded, see Contractors factual report [4]. In order to understand gas risk, alternative methods of gas monitoring (such as measurements of surface emissions) will need to be considered as part of future phases of ground investigation. Despite results not being representative of in-situ conditions, given the nature of the materials encountered during the ground investigation it is likely that some form of gas protection will be required.

7.5 Controlled Waters

The pCSM has not identified a risk to the underlying aquifer in the Upper Coal Measures which is protected by the overlying glacial till, which is understood to be at least 50m thick.

During construction activities there is a risk of contaminants migrating through pathways created by pile bores from the made ground and run off from stockpiles. A foundation works risk assessment will be required to consider this and identity appropriated working methods.

Mobile or leachable contaminants could enter the existing site drainage system (or future drainage systems) and impact off-site receptors (receiving sewers or surface water features). It is recommended that further assessment of the existing drainage system and its outfalls is undertaken. Also, consideration of run off during construction activities will need to be considered and appropriately managed.

7.6 Chemical environment for concrete

Structural concrete used in any construction will come into direct contact with made ground, peat and glacial till. A preliminary concrete assessment has been undertaken following the guidance outlines in BRE Special Digest 1 [13]. The assessment is based on soil and water data from soil samples obtained during the March 2018 investigation. A summary of the assessment is presented in Table 13.

Table 13 Summary of BRE classification data

Notes:

It is assumed that groundwater is mobile within the made ground and glacial till due to the low permeability of these layers and lack of a continuous aquifer.

	Made ground	Peat	Glacial till
Number of samples	38	3	16
Characteristic Sulphate value (mg/l)	1130	411	75
Characteristic pH	5.23	5.45	6.17
Design Sulphate class	DS-2	DS-1	DS-1
Aggressive chemical environment for concrete (ACEC) class	AC-3z	AC-2z	AC-1

It is recommended that buried concrete for use on site is assumed to meet design sulphate class DS-2 and ACEC-3z. Further assessment of the chemical environment for concrete is recommended once development proposals are finalised.

7.7 Buried potable water supply pipes

A plausible pollutant linkage has been identified whereby potable water supply pipes come into direct contact with made ground. Details of the water supply network and any proposed pipe material are currently unconfirmed. It is recommended that an assessment following the guidance outlined by the UK Water Industry Research (UKWIR) [14] is used to assist in the selection of an appropriate pipeline material.

8 Geotechnical considerations

8.1 Introduction

Historically, the Ashton Moss site has been used for the transfer of surplus and geotechnically unsuitable material from adjacent construction projects. The material transferred to the site has been placed in an extensive stockpile without any significant compaction and without consideration of future development of the site. The made ground placed to form this stockpile is therefore considered to be unsuitable for development in its current state.

In addition, the natural peat layer shown to be present underlying the stockpile (and at the surface of the site in the areas surrounding the stockpile) is unlikely to be suitable for development without some form of engineering intervention.

Given the large volume of made ground and natural peat deposits present on site, it is considered neither cost-effective or sustainable to re-excavate the unsuitable material and to replace it in accordance with an engineering specification.

As future options for development are considered in greater detail, issues such as proposed development levels or slope stability may require that the stockpile is reprofiled and a requirement for localised earthworks may be identified. Any such localised earthworks will present the opportunity to re-excavate a proportion of the stockpile and it may therefore be possible to consider re-placing these soils as engineered fill in accordance with an appropriate engineering specification. Prior to re-use, excavated materials may need to undergo selection and some form of ex-situ treatment in order for them to comply with the requirements of the specification. A number of ex-situ treatment methods have been considered below. Consideration to change in level and loading which may cause settlement of the placed materials and peat will be required.

It is anticipated however, that the majority of the stockpiled material and the underlying natural peat deposits will not undergo any re-excavation and consideration has been given to the suitability of the material for development either in its current state or after some form of in-situ treatment. A number of potential in-situ treatment methods have been addressed.

In order to present a preliminary assessment of likely earthworks options for future development of the site, Arup have assessed the following material types:

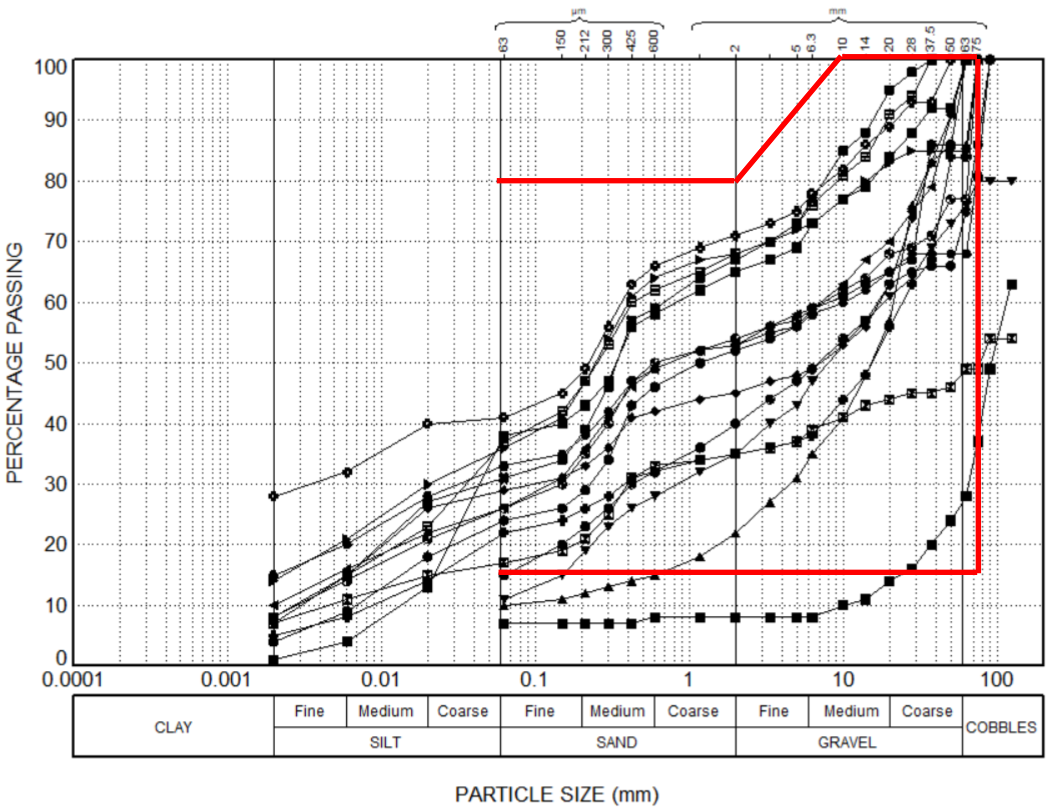
- Upper Place Materials
- Lower Placed Materials
- Natural peat

In the absence of an agreed specification for any future earthworks, this assessment has included a comparison of the materials present and the results of geotechnical testing (principally the PSD grading of the materials encountered) with the requirements of the Specification for Highway Works – 600 Series (SHW) Appendix A.

8.2 Assessment of Material Types

8.2.1 Upper Placed Materials

The results of PSD testing for the upper placed material have been compared with grading envelopes for Class 2 (cohesive) materials as defined in the SHW (Appendix A). As shown in Sketch 3, because of the gravel and cobbles present within the fill, the upper material present on site generally meets the grading requirements of Class 2C – Stony cohesive fill material.



Sketch 3 Upper material grading curves with the grading envelopes for Class 2C fill shown in red [15].

If this material was to form part of proposed reprofiling of the stockpile and was therefore available for re-use as engineered fill, a range of further testing would need to be undertaken to confirm the Class 2C classification that is suggested on the basis of the available PSD data. Amongst the additional testing required it will be necessary to establish the optimum moisture content of the material (OMC - noting that a range of OMC values may need to be determined in such variable material). Without OMC data, it is not currently possible to determine how much, if any, of the material will be suitable for re-use in an as-dug condition or whether some form of stabilisation or other treatment will be required.

It is considered that by careful selection and processing by screening and crushing of oversized material that proportion of these materials would be suitable for reuse as general fill on site. It is likely that treatment to control moisture content will also be required.

8.2.2 Lower placed materials and natural peat deposits

All of the lower placed materials falls in the SHW classification of U1A – unacceptable material. This is due to having peat and perishable constituent materials. As such, this material is not suitable for earthworks in its current state. It may be that certain ground improvement techniques can be employed to improve the material. These are discussed more fully in Section 6.2.4.

8.3 Soil stabilisation

The purpose of the soil stabilisation is to minimise settlement of wet or highly compressible materials and add strength to enable the use of the material in earthworks. Even in the case of non-load bearing earthworks (e.g. landscaping bunds) some form of stabilisation may be required to ensure stability. In addition to soil stabilisation, dewatering of excavations and materials will be critical to proposed development.

Two broad classes of soil stabilisation have been considered in the following preliminary options assessment:

- Ex-situ stabilisation – applied to excavated soils prior to their inclusion in proposed earthworks undertaken in accordance with a formal specification.
- In-situ treatment – applied to in-situ soils to improve the development platform.

8.3.1 Ex-situ stabilisation

Ex-situ soil stabilisation is a technique whereby soils are excavated, graded and sorted, and then replaced on site with additives such as cement or lime, to an engineering specification. Two of the main constraints when carrying out these earthworks activities are often limited working space, and the ability to control the moisture content of the soils.

Given the volume and depths of materials that will likely require stabilisation, coupled with the perched groundwater horizons in the body of the fill; this method is not considered viable for the entire volume of stockpiled material present, however, if existing slopes are regraded or the site as a whole is reprofiled, stabilisation of the regraded material may be appropriate.

8.3.2 In-situ treatment

On the basis of the findings of the above assessment, it is considered unlikely that the existing stockpile at Ashton Moss will be suitable to form the basis of a development platform, without some form of in-situ treatment being undertaken. A number of methods of in-situ treatment are currently available and should be considered as part of future development proposals for the site.

It may be necessary to combine some or all of these techniques in order to stabilise the material sufficiently within manageable timescales.

8.3.2.1 Deep soil mixing

This technique involves mechanically introducing a substance in-situ, usually cement or lime, to improve the strength of soil and reduce settlement. Traditionally it is carried out *en-mass* in the body of a soil material but can also be introduced as columns by a process known as controlled modulus columns (CMCs). Deep soil mixing has a good success rate with peaty materials but can be a costly exercise when undertaken on extensive areas of poor fill or made ground materials. It may be that it is best employed if combined with other techniques in more sensitive areas of a proposed development. One major advantage of CMCs is that in some circumstances they can be used as piled foundations, and therefore can provide a cost and programme saving when compared to separate piling activity.

8.3.2.2 Band drains

Given that the standpipes on site have become saturated following the March 2018 GI, there appears to be excess pore water pressure existing within the made ground strata. In order to allow ground improvement without the requirement for large-scale earthworks, band drains may be appropriate. Band drains are pre-fabricated vertical drains that can be inserted into the in-situ material to allow excess pore water to dissipate and subsequently cause acceleration of natural settlement. It must be noted that this option can require an extended period (>9 months) to allow full dissipation and settlement of materials.

8.3.2.3 Surcharging

Another approach that may be appropriate for the ground improvement of in-situ materials is surcharging. Traditionally used on naturally soft soils, surcharging aims to dissipate excess pore water pressures and therefore accelerate settlement by introducing a significant load on the compressible material. The natural peat materials have been subjected to surcharging by the materials already placed, but further surcharging would be required on the made ground soils. As with any pore water pressure dissipation technique, surcharging requires an extended period to allow full dissipation.

8.4 Settlement

The lower placed materials and peat are compressible. It is likely that considerable settlement will have occurred since this material was placed, but the current rate of settlement and overall settlement since placement of the fill is unknown. Consideration of the potential impact on the rate of settlement of either increasing or decreasing the current overlaying ground levels or imposing new loads such as shallow founded buildings will be required. Some of the above options may help to control and manage settlement of these materials which should be considered as part of the overall earthworks and remediation strategy for the site.

8.5 Foundations

Settlement of the significant thicknesses of the placed made ground and peat under future foundation loading is likely to be high. Given the variability and thickness of placed materials, predicting the magnitude and rate of this potential future settlement will be difficult. Whilst it may be possible to address settlement of lightly loaded areas by undertaking ground treatment/improvement piled foundations transferring structural loads to competent material (assumed to be glacial till) at depth will likely be required for most buildings. It is estimated that piles will be approximately 10m to 20m in length to found in the glacial till materials. These requirements should be re-evaluated when development plans are finalised.

An advance programme of investigation may be required to confirm that the pile locations are free from obstructions. A foundation works risk assessment will be required to ensure risk to ground water from piling are mitigated.

8.6 Slope stability

The site is currently occupied by a large stockpile of varying height and slope angles. Although development levels have not yet been set, it is likely that some regrading will be required to address the current undulating topography. Temporary slopes will likely also be required as part of the earthworks strategy and will require design as part of the temporary works.

Given that extensive GI has not been undertaken across the site, it is not currently possible to undertake assessments of slope stability. Further GI will be required to assess slope stability both in long-term and short-term cases (i.e. during excavations for earthworks). For preliminary assessment, preliminary slope angles of 1:3 can be assumed.

9 Preliminary development risk register

The following items in Table 14 have been identified as commercial and project risks and should be incorporated into any risk registers or assessments for the project as a whole. It must be noted that this list is not exhaustive, and further risks may come to light following detailed desk study or further ground investigation.

Table 14 Summary of development risks and considerations

Ref	Hazard	Risk	Potential mitigation
1.	Utilities	A medium and a high-pressure gas main exist on site. These will require management and may require movement depending on development proposals.	Early engagement with Cadent and a further GPR survey.
2.	Drainage	Drainage existing within the stockpile.	Undertake a GPR and CCTV surveys to identify the location and extent of drainage in-situ. Identify off-site features into which the site drainage discharges. Assess the drainage system for impact from contaminants.
3.	Ecology	Due to water features and the nature of the	Consult an ecological specialist and identify an

		materials present, the site has been identified as a potentially having Great Crested Newts. *Note:* Great Crested Newts have full legal protection under UK law making it an offence to kill, injure, capture, disturb or sell them, or to damage or destroy their habitats.	appropriate range of ecological surveys. Depending on the findings of the surveys, mitigation against loss of habitat, species translocation etc may be required.
4.	Site history	Currently the history of the site and the surrounding area is not well understood.	Undertake a thorough desk study to better understand the potential risks.
	Worked coal seams, mine shafts etc.	The potential for worked coal seams exists beneath the site and collieries have been identified in the area.	Obtain a Coal Authority report
5.	Slope stability	Slope instability was noted in areas of the site.	Further ground investigation and analysis once development proposals are finalised.
6.	Asbestos	Asbestos containing materials were identified from the	Further ground investigation and analysis once

		preliminary screening. Whilst this may not prevent the development of the site, the associated risk will need to be managed during earthworks.	development proposals are finalised.
7.	Contaminated land	Several contaminants were identified from the preliminary GAC screening. High levels of ground gas recorded on site	Further ground investigation and analysis once development proposals are finalised. Installation of gas standpipe and monitoring programme to establish gas regime.
8.	Upper Placed Materials	Highly variable material exists within the body of the made ground.	Further ground investigation and analysis once development proposals are finalised. This material can potentially be re-used as part of future earthworks however, due to high moisture content stabilisation may be required prior to re-use.

9.	Lower Placed Materials	Placed compressible and highly variable material existing within the body of made ground	Further ground investigation and analysis once development proposals are finalised. Given the high organic matter content of this material, re-use may be more challenging than is the case for the upper placed material. Settlement due to changes in site levels and building loading. Piled foundations.
10.	Natural peat	Natural compressible materials exist beneath the site. Compressible and long term settlement due to changes in loading	Further ground investigation and analysis once development proposals are finalised. Transfer building loads to glacial till.
11.	Water ingress	Post intrusive work has indicated large volumes of perched ground water.	Further ground investigation and analysis once development proposals are finalised.

10 References

[1] Google Inc (2017) Google earth accessed 5th July 2018..

[2] Terra consult (2005). Ashton Moss Restoration Area Proposed Golf Course – Area B. Ref: 05/506/05/SO1 Issue 1

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[7] British Standards Institute (2015) BS 5930:2015 Code of practice for ground investigations.

[8] Tomlinson, MJ. Boorman, R. (2001) Foundation Design and Construction, Seventh edition. London.

[9] Environment Agency (2004) Model Procedures for the Management of Land Contamination. Contaminated Land Report 11

[10] Environment Agency, (2009). Updated technical background to the CLEA model, Science Report SC050021/SR3

[11] Construction Industry Research and Information Association (2007) Report C665 Assessing risks posed by hazardous ground gases to buildings.

[12] British Standards Institute (2015) Code of practice for the characterisation and remediation from ground gas in affected developments. BS 8485:2015.

[13] British Research Establishment (2005) Special Digest One: Concrete in aggressive ground.

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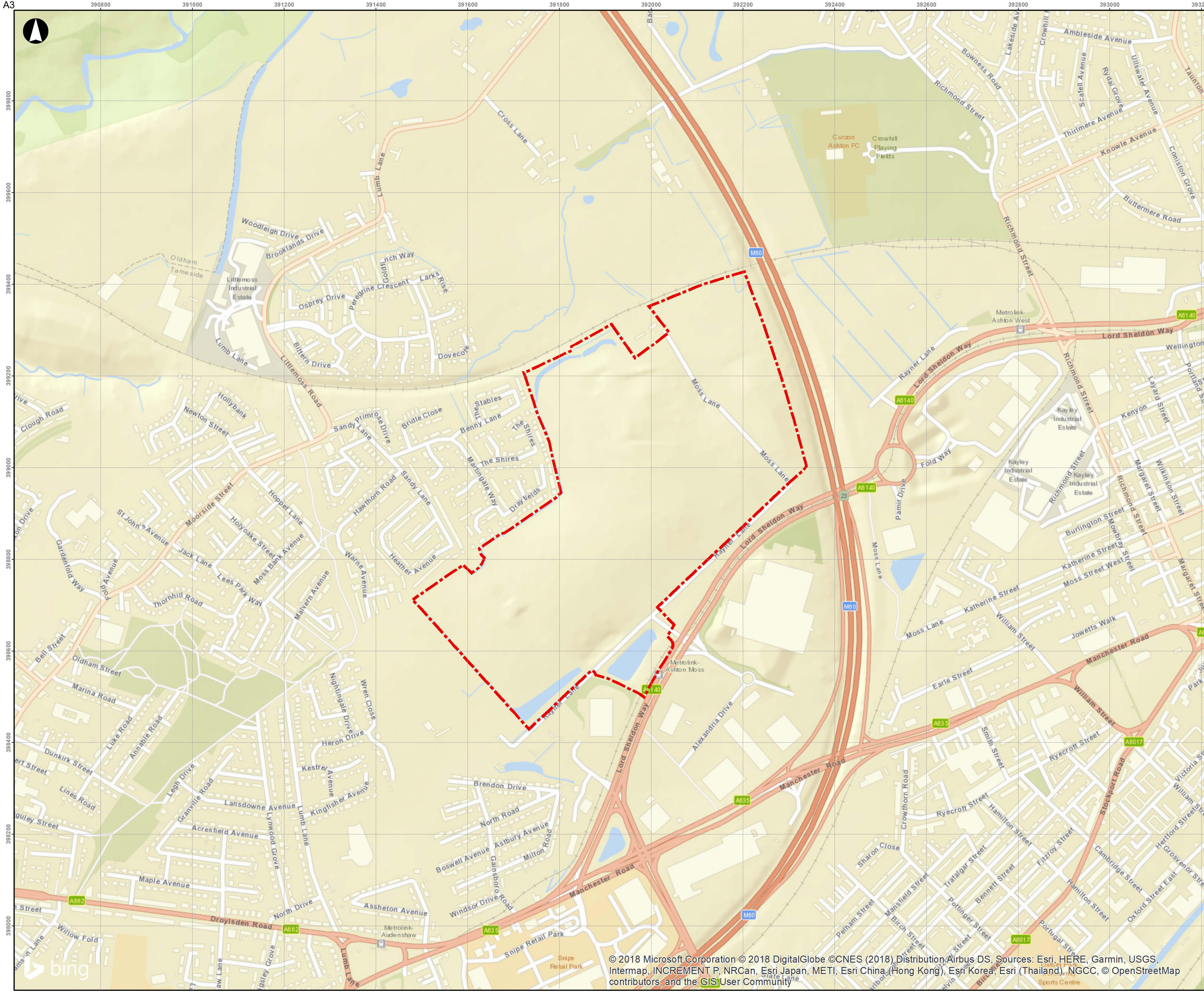
[15] Highways Agency (2018) Manual of Contract Documents for Highway Works. Series 600 – Volume 1.

Appendix A

Figures

A3



Key

Site Boundary

P0	2018-07-17			
Issue	Date	By	Chkd	Appd

Metres
0 75 150 300

ARUP

6th Floor 3 Piccadilly Place
Manchester, M1 3BN
Tel +44 161 228 2331
www.arup.com

Client
Tameside MBC

Project Title
Ashton Moss

Scale at A3
Site Location Plan

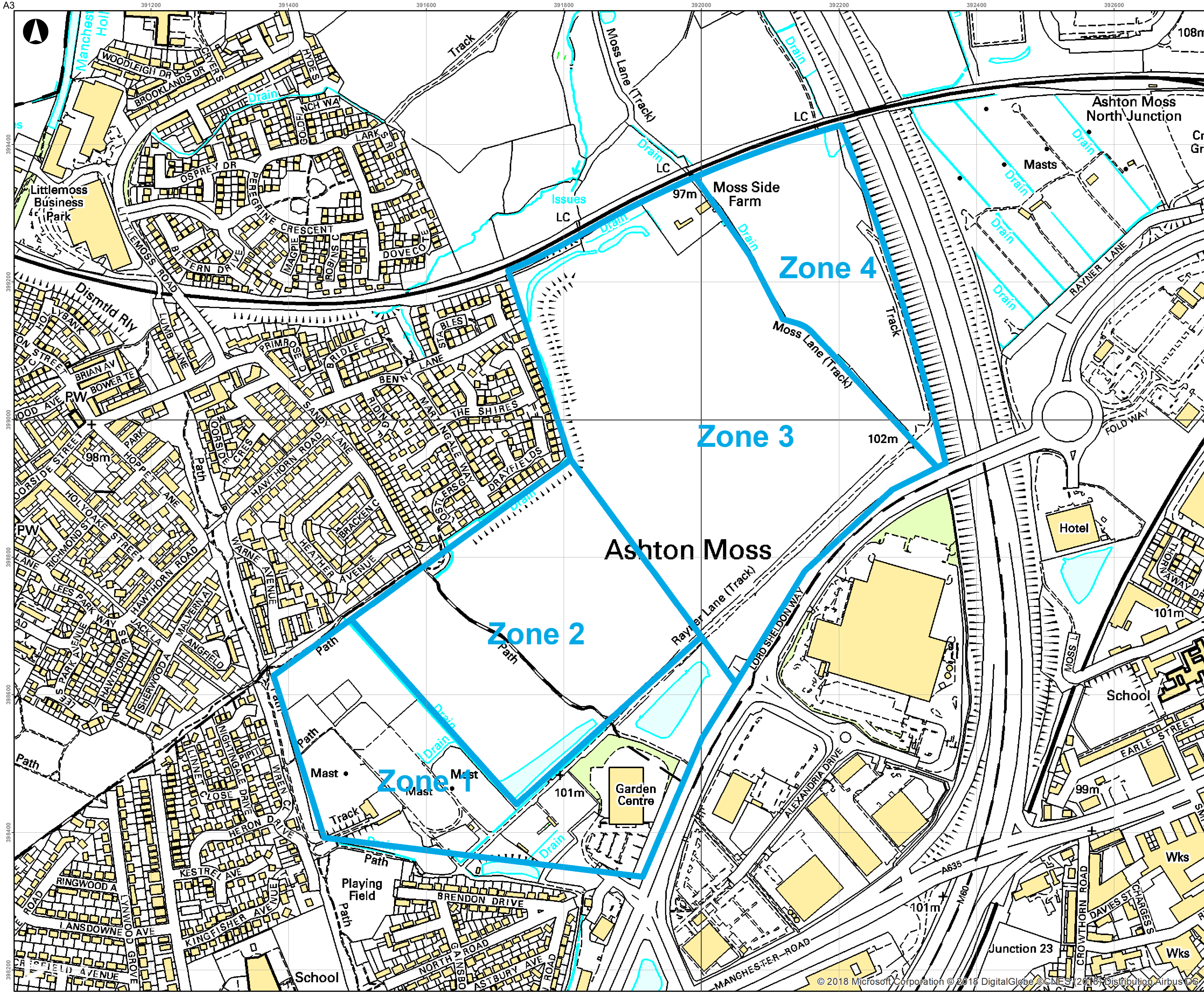
Scale at A3
1:7,500

Arup Job No	Suitability
252590-00	**Preliminary**

Name	Rev
Figure 1	**P0**

\\Global\europe\Manchester\Jobs\250000\252590-00\4 Internal Project Data\4-03 Drawings\3_GIS\Workspaces\Initial GI_R20180321.mxd

A3



Key

Site Zones

P0	2018-07-17			
Issue	Date	By	Chkd	Appd

Metres 0 50 100 200

ARUP

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Client
Tameside MBC

Project Title
Ashton Moss

Scale at A3
Site Zones

Scale at A3
1:5,000

Arup Job No	Suitability
252590-00	**Preliminary**

Name	Rev
Figure 2	**P0**

\\Global\europe\Manchester\Jobs\250000\252590-00\4 Internal Project Data\4-03 Drawings\3_GIS\Workspaces\Initial GI_R20180321.mxd

A3

Key

Site Boundary

1m DTM Lidar

Value

119mOD
112mOD
105mOD
98mOD
91mOD
84mOD
77mOD
70mOD

P0	2018-07-17	[redacted]	[redacted]	[redacted]
Issue	Date	By	Chkd	Appd

Metres
0 37.5 75 150

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Tel +44 161 228 2331
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Client
Tameside MBC

Project Title
Ashton Moss

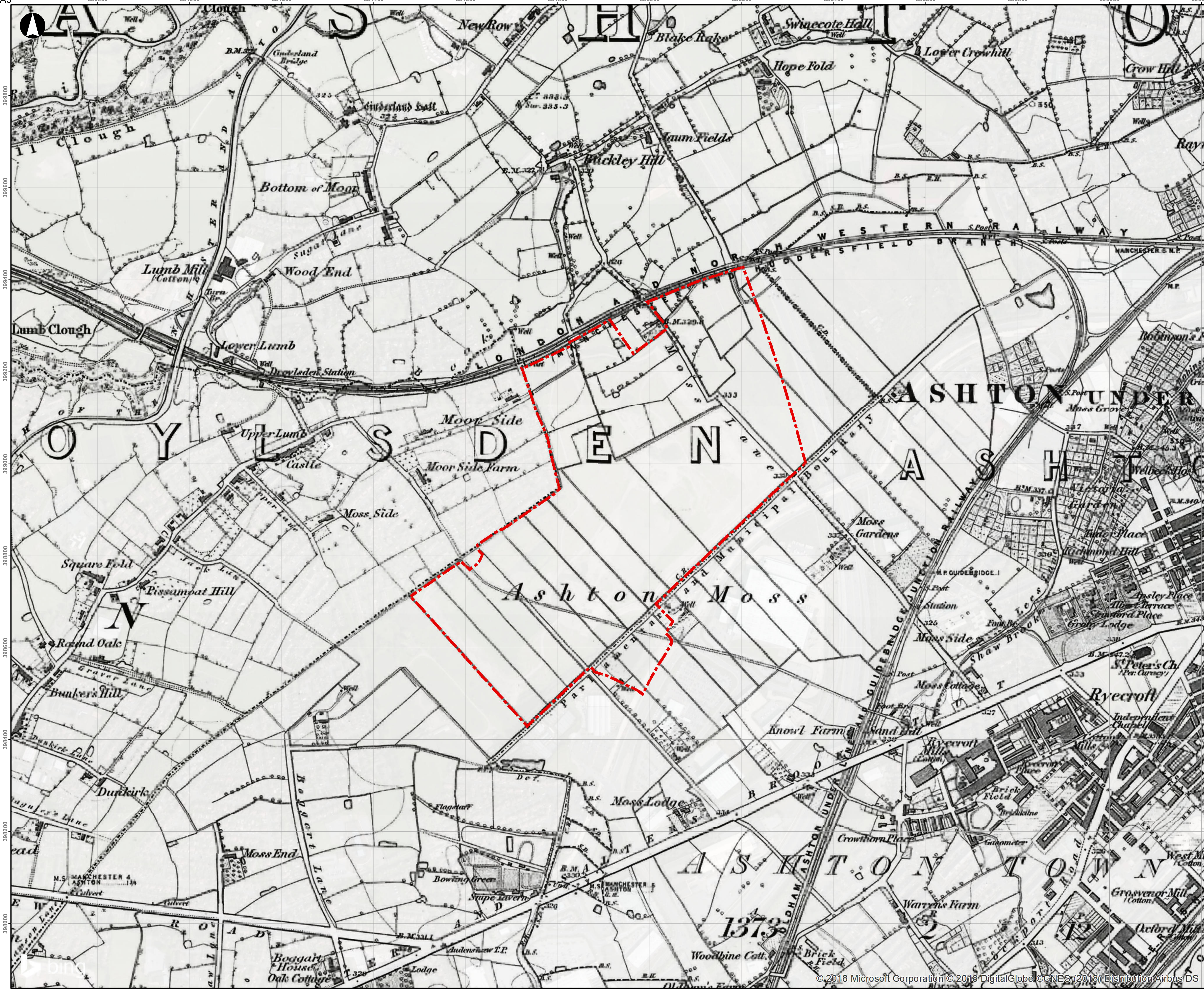
Scale at A3
Topography (LiDAR)

Scale at A3
1:3,750

Arup Job No	Suitability
252590-00	**Preliminary**

Name	Rev
Figure 3	**P0**

A3



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Key

Site Boundary

P0	2018-07-17	■	■	■
Issue	Date	By	Chkd	Appd

Metres
0 75 150 300

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Manchester, M1 3BN
Tel +44 161 228 2331
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Client
Tameside MBC

Project Title
Ashton Moss

Scale at A3
Historical OS Mapping 1863 (1:10,560)

Scale at A3
1:7,500

Arup Job No
252590-00

Suitability
Preliminary

Name
Figure 4

Rev
P0

A3

Key

Site Boundary

P0	2018-07-17			
Issue	Date	By	Chkd	Appd

Metres
0 75 150 300

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Client
Tameside MBC

Project Title
Ashton Moss

Scale at A3
Historical OS Mapping 1910 (1:10,560)

Scale at A3
1:7,500

Arup Job No	Suitability
252590-00	**Preliminary**

Name	Rev
Figure 5	**P0**

\\Global\europe\Manchester\Jobs\250000\252590-00\4 Internal Project Data\4-03 Drawings\3_GIS\Workspaces\Initial GI_R20180321.mxd

A3

Key

Site Boundary

Cable Percussive Borehole

Windowless Sample Hole

Issue	Date	By	Chkd	Appd
P0	2018-07-17	[redacted]	[redacted]	[redacted]

Metres

0 37.5 75 150

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Client

Tameside MBC

Project Title

Ashton Moss

Scale at A3

Ground Investigation Location Plan

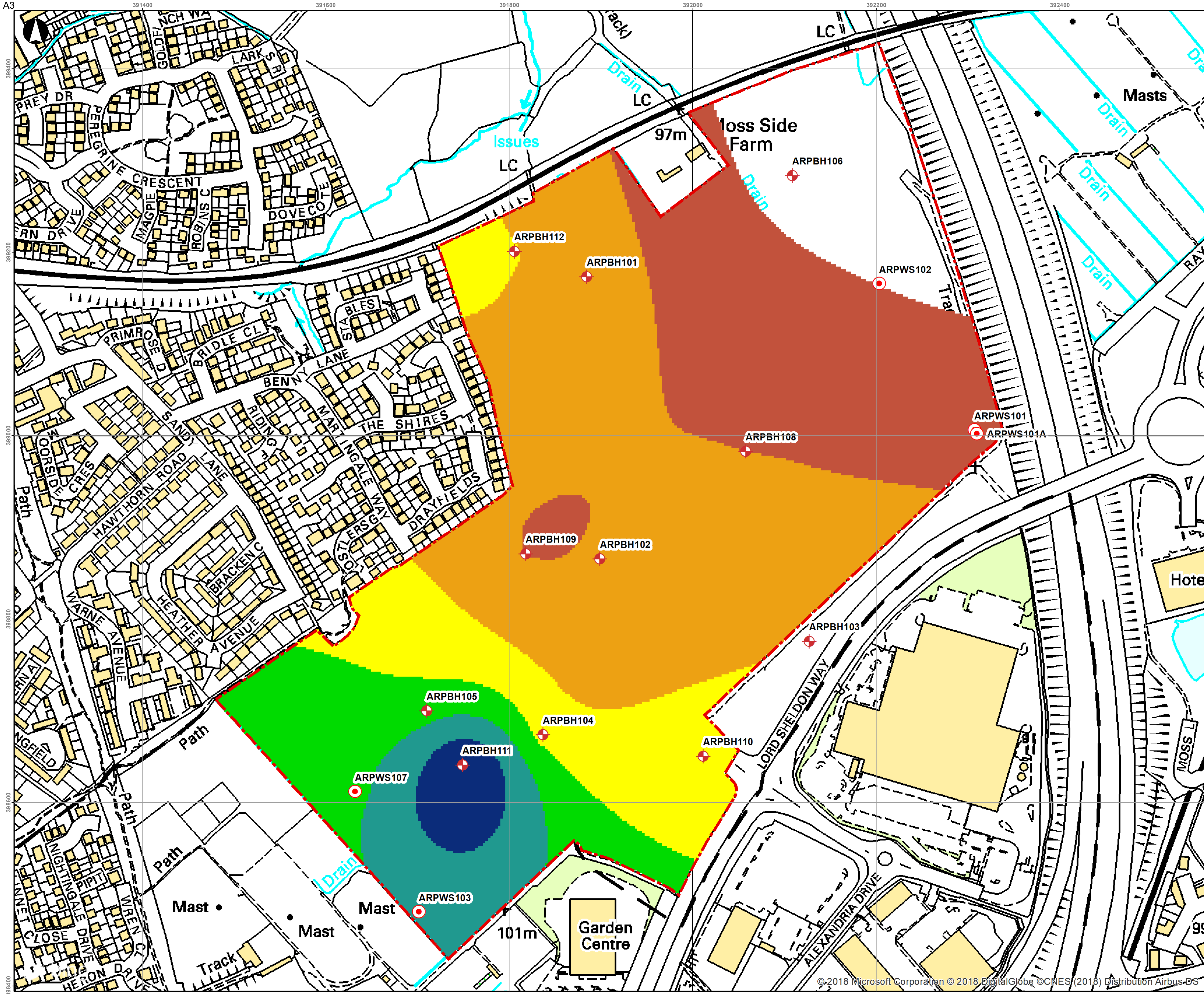
Scale at A3

1:3,750

Arup Job No	Suitability
252590-00	**Preliminary**

Name	Rev
Figure 6	**P0**

A3



Key

- Site Boundary
- *Cable Percussive Borehole*
- *Windowless Sample Hole*

Peat thickness

<VALUE>

- 0.01 - 1 m
- 1.01 - 2 m
- 2.01 - 3 m
- 3.01 - 4 m
- 4.01 - 5 m
- 5.01 - 6 m

P0	2018-07-17			
Issue	Date	By	Chkd	Appd

Metres
0 37.5 75 150

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Manchester, M1 3BN
Tel +44 161 228 2331
www.arup.com

Client
Tameside MBC

Project Title
Ashton Moss

Scale at A3
Estimated Peat Thickness

Scale at A3
1:3,750

Arup Job No
252590-00

Suitability
Preliminary

Name
Figure 7

Rev
P0

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Appendix B

Ground investigation rationale

Ashton Moss Preliminary GI: Rationale

Contents

- Objectives of ground investigation
- Topography
- Site history
- Geology
- Constraints
- Ground investigation rationale

Objectives

“A preliminary ground investigation is proposed to examine the nature and thickness of the tipped materials across Zones 1, 2, 3 and 4 and the nature and extent of the natural materials below.

Undertake approximately five boreholes to examine the nature of the tipped materials and the depth and nature of the undisturbed strata below. Also undertake a small number of shallow trial pits. At this stage and for cost estimate purposes, five boreholes to 30m has been assumed and eight trial pits using a standard wheeled excavator. The scope and extent of the GI can be amended based on the design review and agreed budget.

Estimated contractor’s costs c.£50,000 to £60,000 – GI Scope to be refined where necessary to meet this budget”

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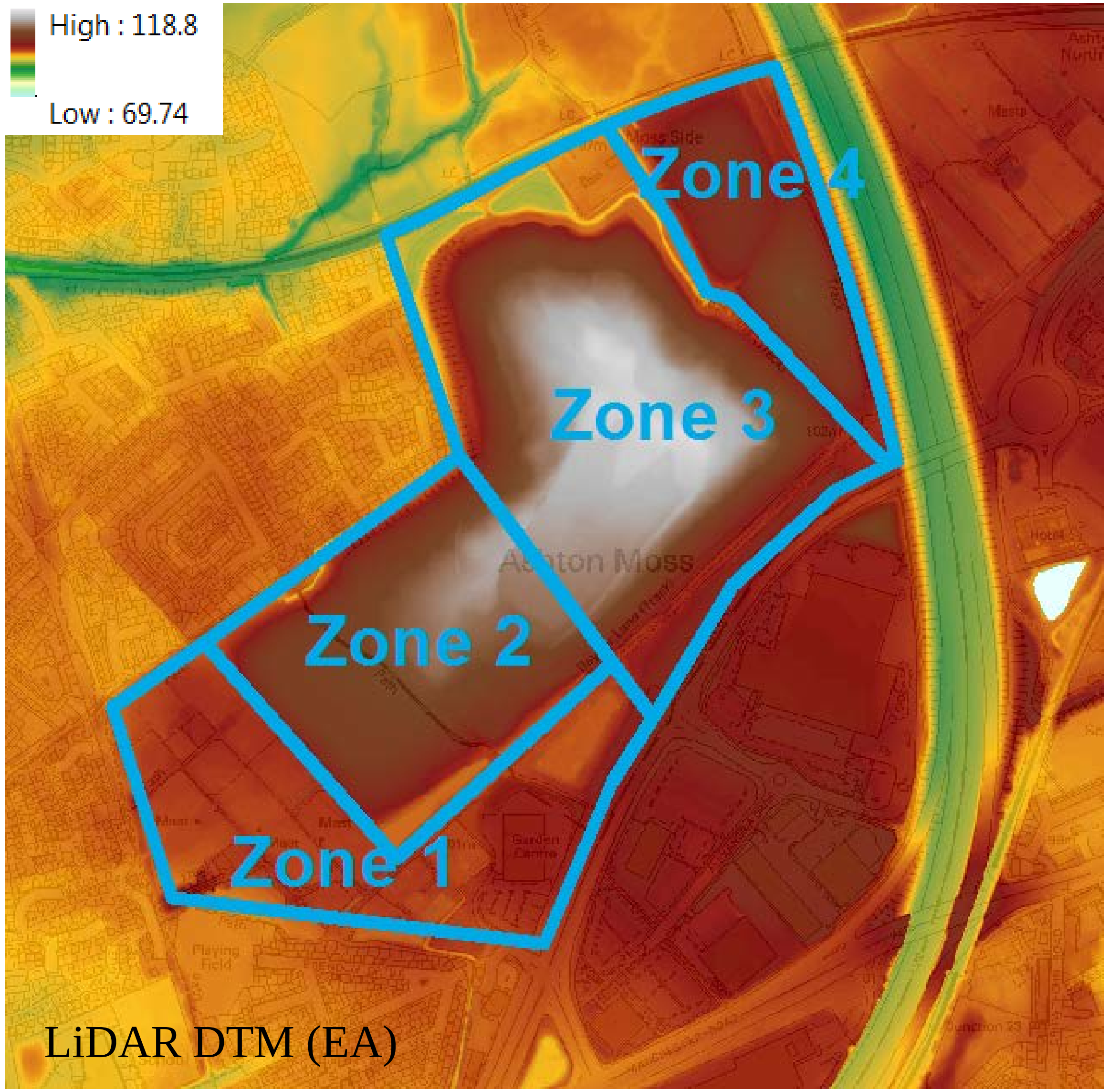
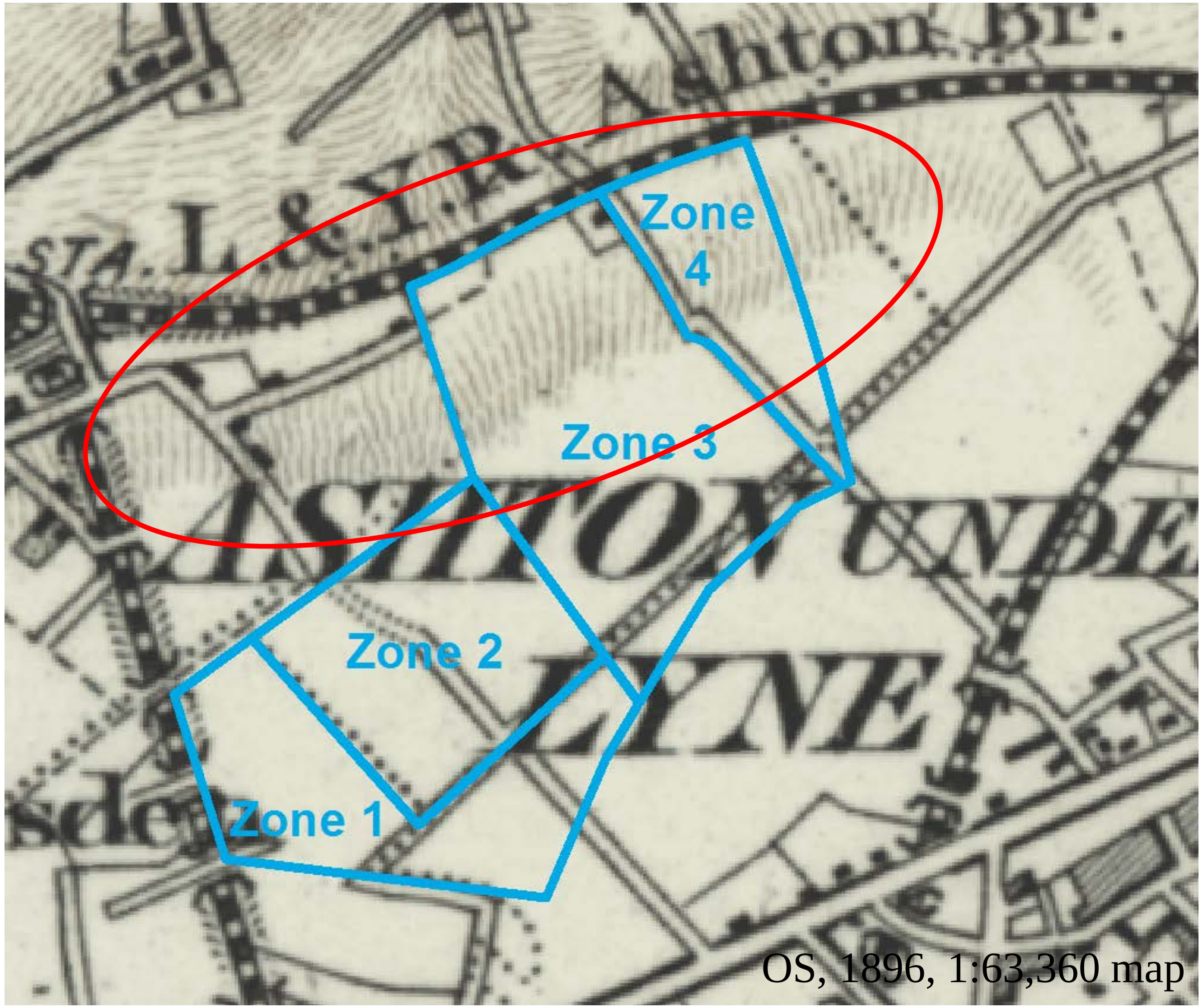
Topography



- The topography ranges from approximately 100 to 118mOD
- Highest point in the centre of Zone 3 and east of Zone 2 with slopes towards the edge of the site
- "Valley" between Zone 3 and Zone 4
- Low point of c.96mOD at Moss Side Farm

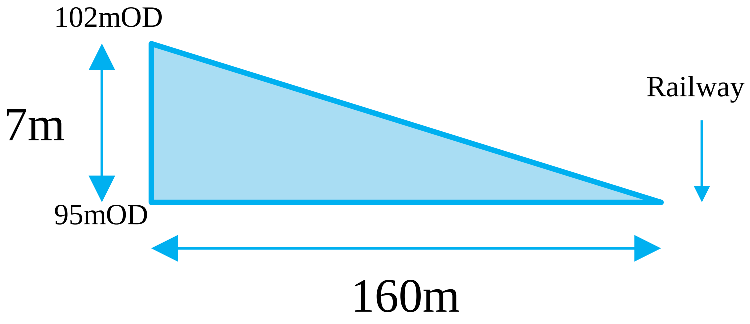
Site history



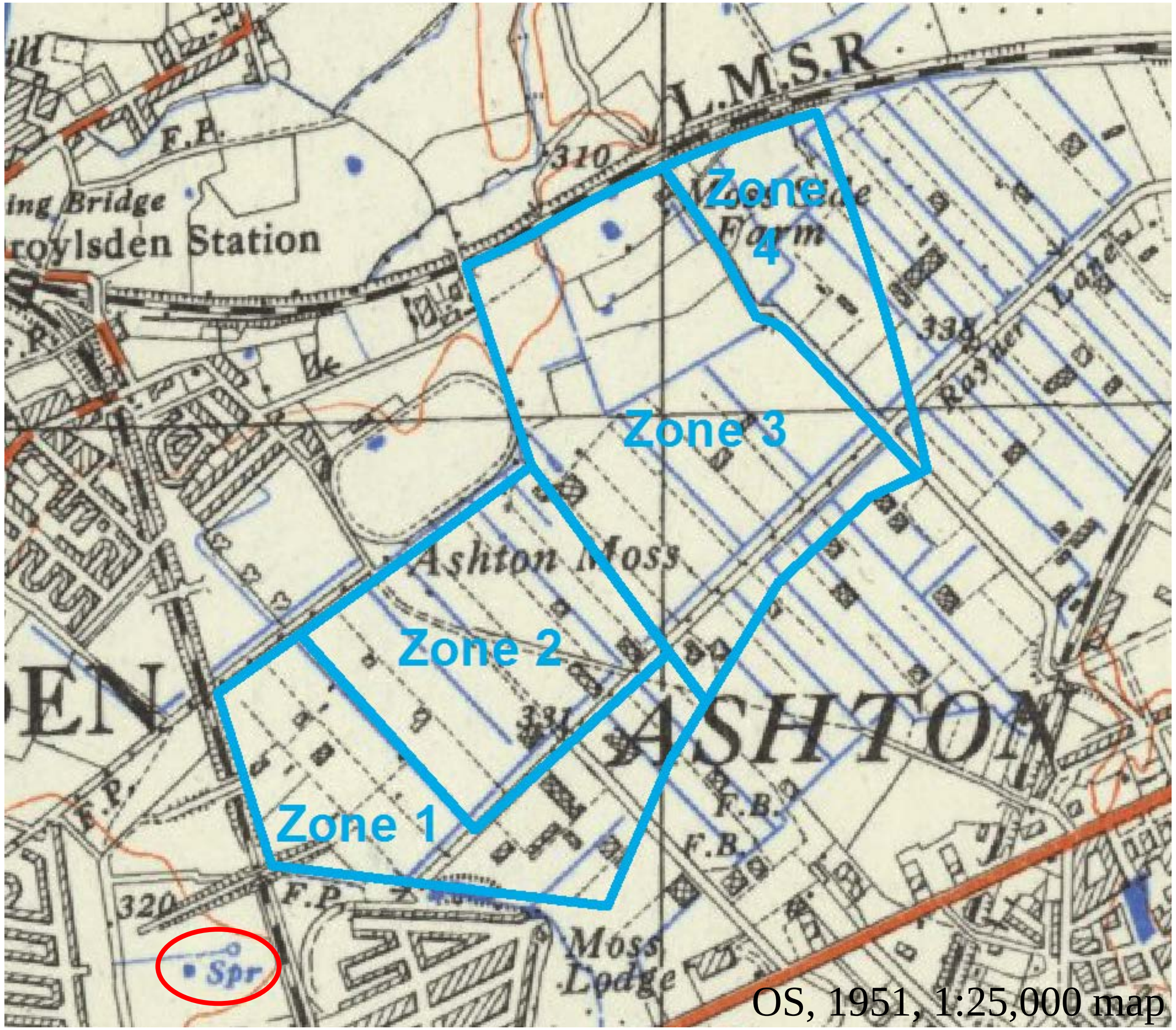
OS, 1896, 1:63,360 map

Initial review of online mapping:
- OS 1:10,560, 1963 (First edition)
- OS 1:63,360 1896 (Hills edition)
- OS 1:10,560, 1910
- OS 1:25,000, 1951

Historical topography:
- Site generally level in the south
- Cutting to railway line in north - slope estimate below taken from benchmarks on 1910 1:10,560 OS map

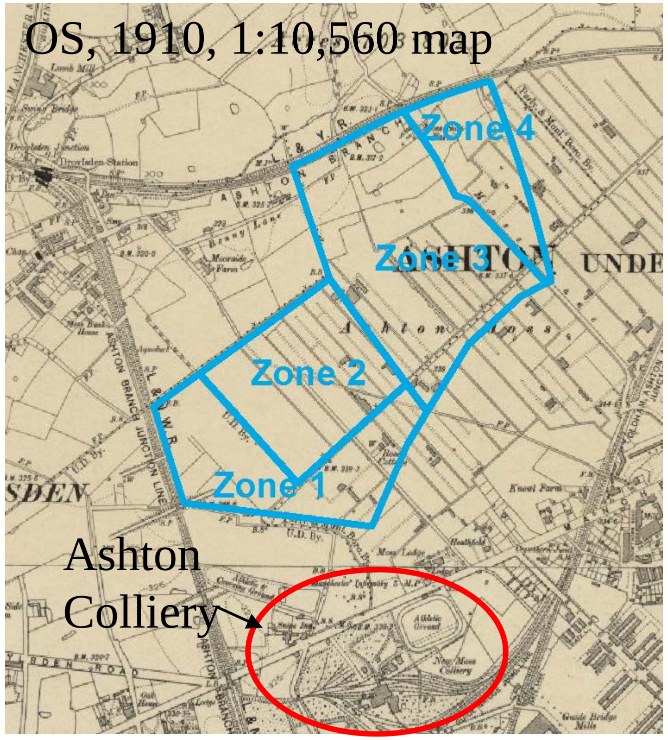


Site history



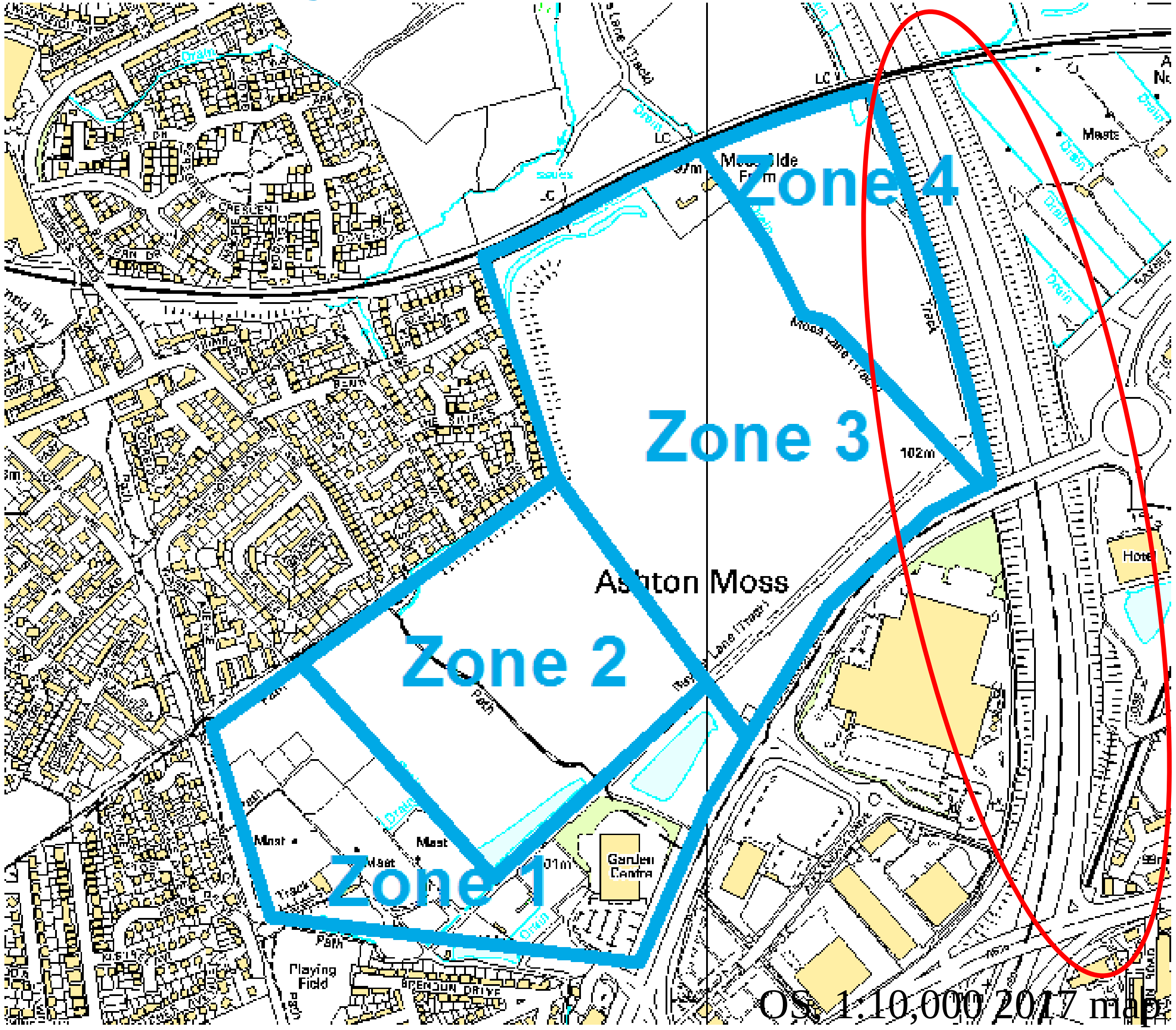
OS, 1951, 1:25,000 map

- Drainage channels created to drain the moss
- Land parcelled for agriculture plus?
- A number of small structures present across the site
- Spring southwest of site (shallow groundwater)
- Ashton Colliery to the south



OS, 1910, 1:10,560 map

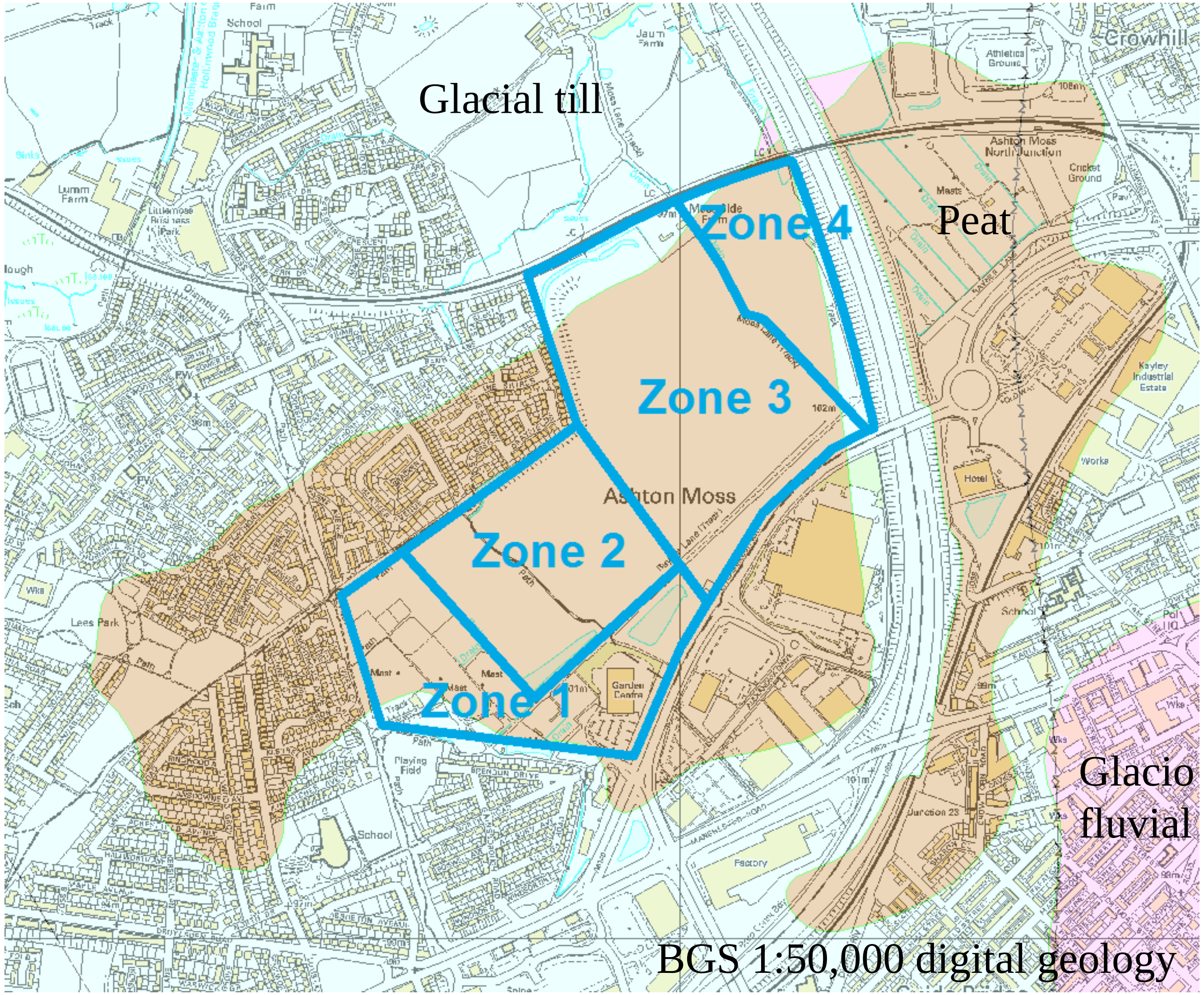
Site history



OS 1:10,000 2017 map

- M60 constructed during1990s
- Site used for surplus material cut during construction
- Estimated thickness of up to 16m based on average ground level of 102mOD

Geology

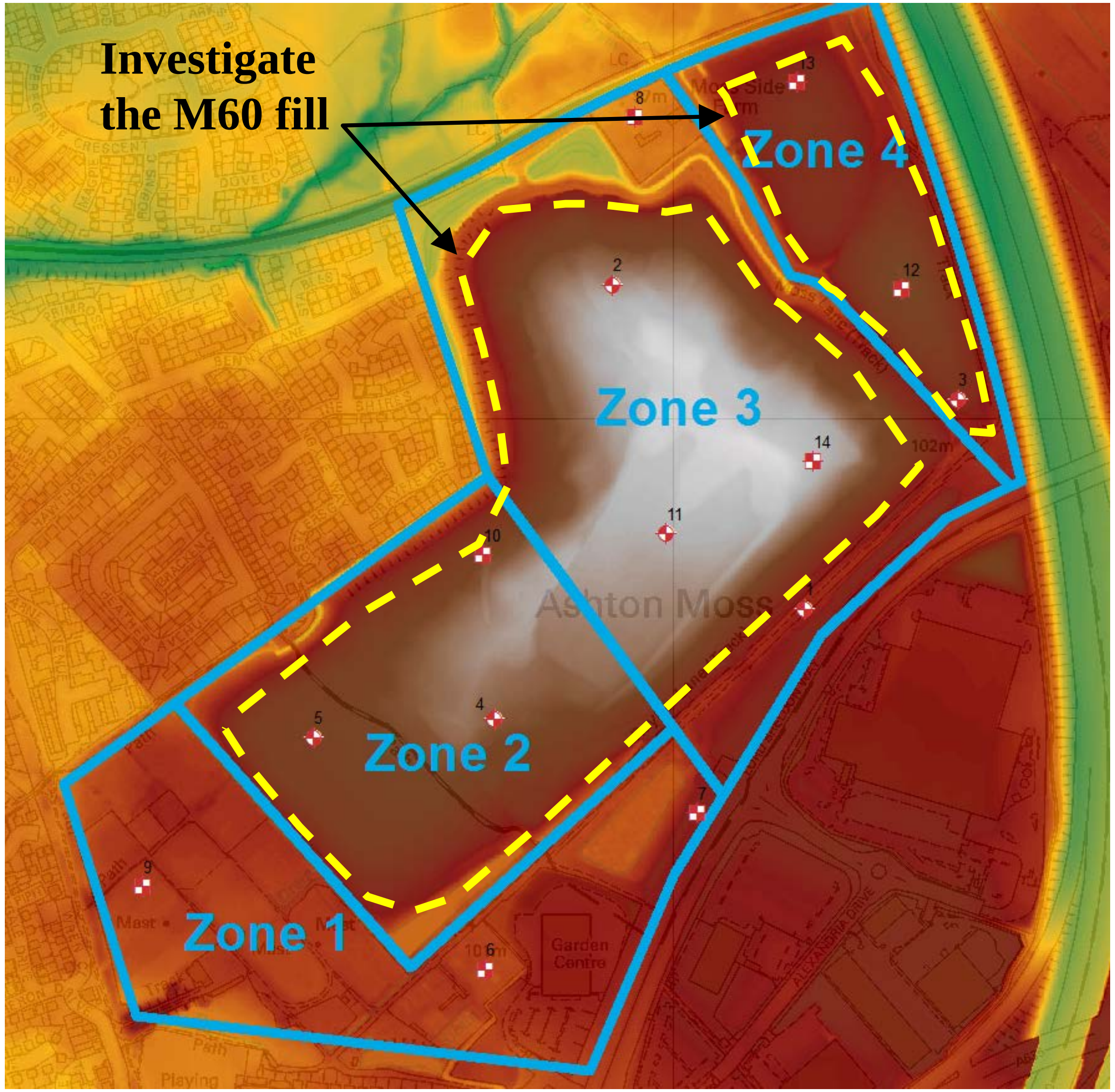


Stratigraphy summary

- Made ground:
  - Fill (variable composition)– up to 14m thick
  - Topsoil/ worked peat (agricultural) – thin <1m
- Peat – estimated up to 6m*, thickest in the south
- Glacial deposits (up to 50m thick – complex)
  - Glaciolacustrine…
  - Fluvioglacial sand and gravel
  - Till
- Pennine Upper Coal Measures
  - Rockhead at c. 50mOD
  - Beds dip 20 to 50° west
  - Mudstone (inc marl), siltstone, sandstone
  - Coal – Coal Authority mapping indicates not a high risk area. Shafts to the south (Ashton Moss colliery)

* Not verified – work undertaken by Mouchel

GI Rationale - General



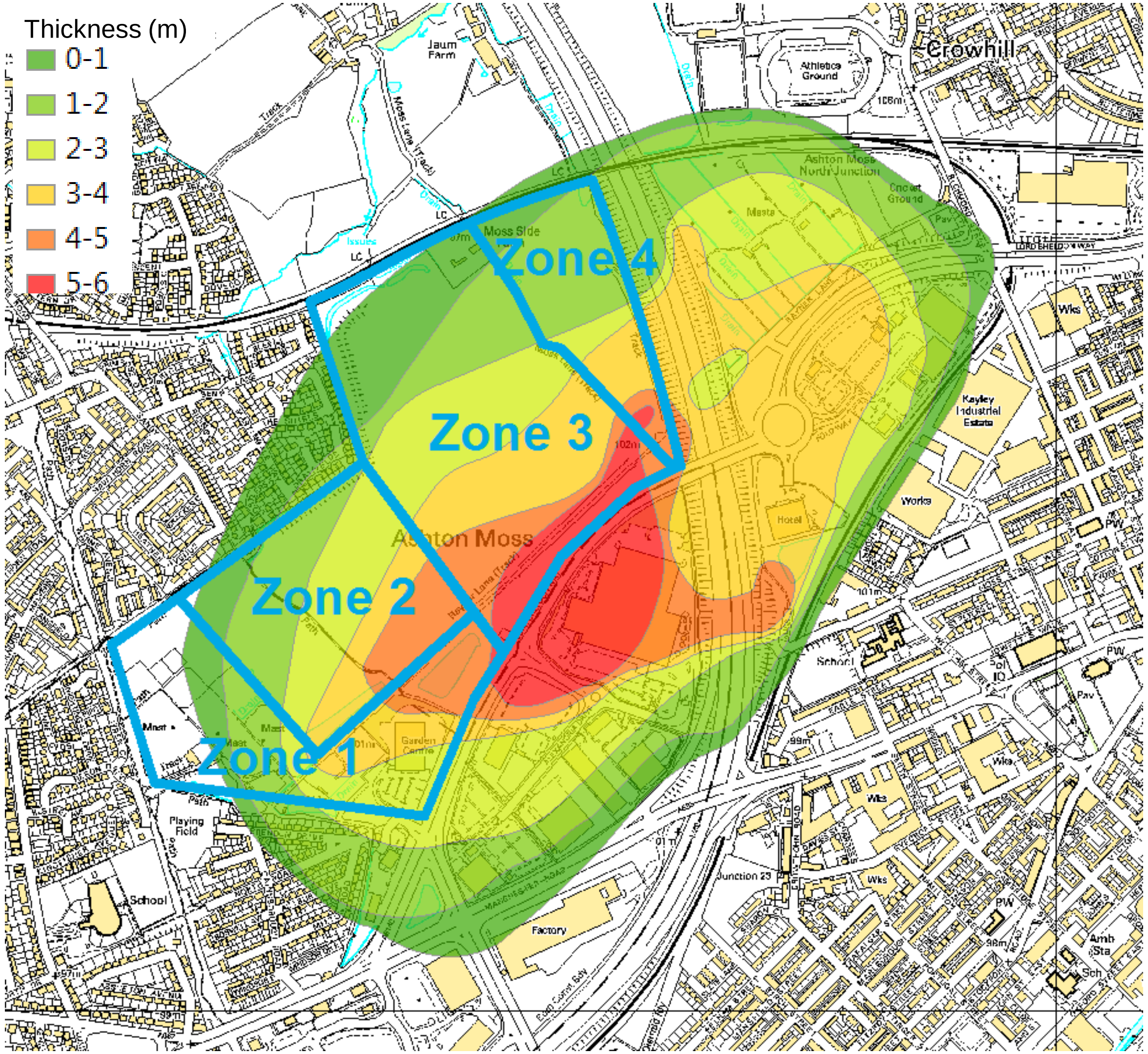
Objectives:

1) Boreholes and trial pits within main M60 infill (Zone 2, 3 and 4) to characterise nature and properties of the fill
2) Boreholes to extend to base of fill, through peat and 10m into glacial strata
3) Selection of TP at periphery to better sample and understand peat texture
4) Focus on understanding physical characteristics of the site

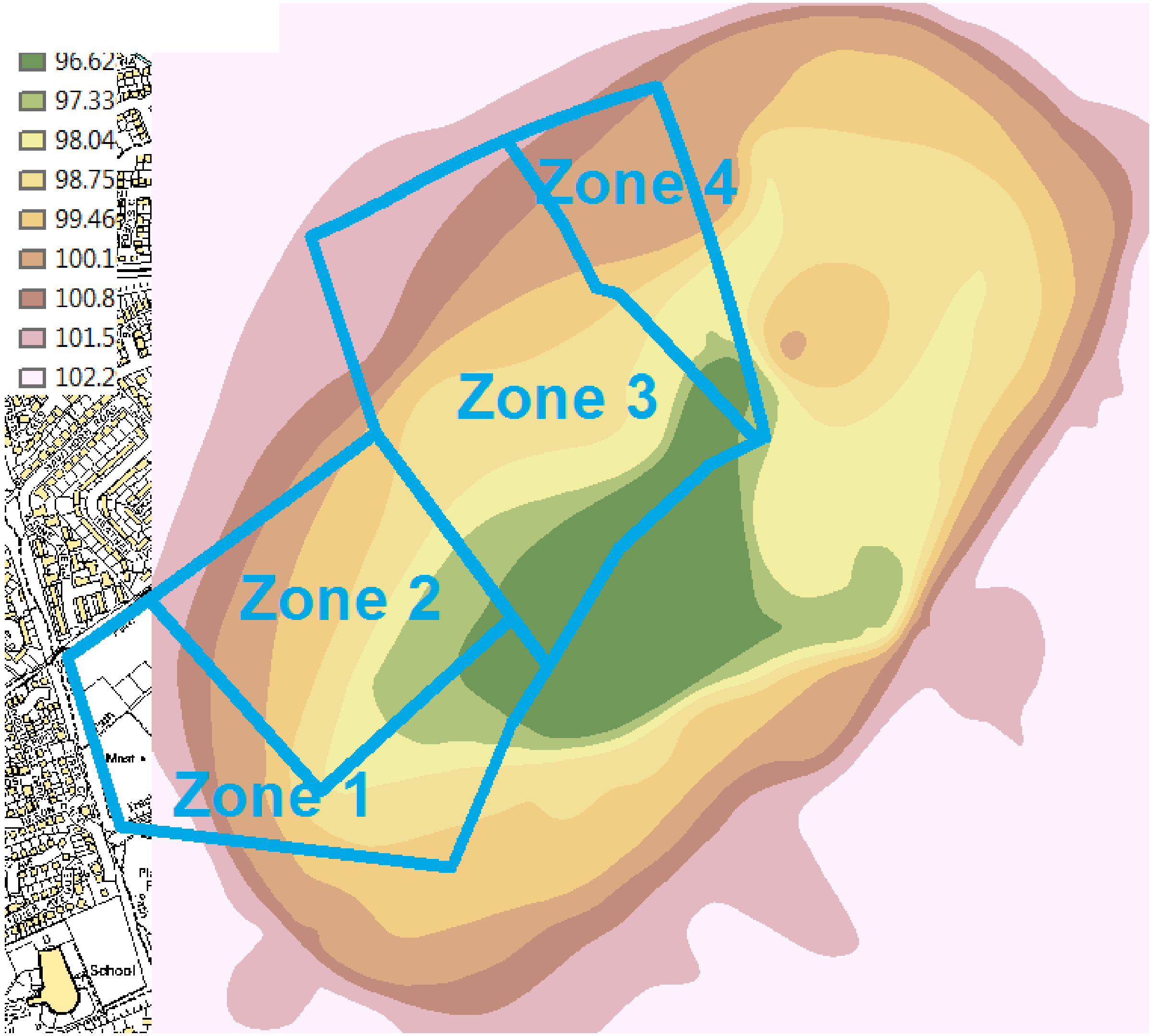
Scope:

- 6 BH to 15 to 30m (total = 140m) – dynamic sampling
- 8 TP to 7mbgl (deep trial pits)
- SPT at 1m intervals through made ground
- PID at 1m intervals
- Generic chemical testing suite at 4m intervals in BH (metals, TPH CWG, BTEX, PAH). VOC/ SVOC on selected samples if visual/ olfactory/ PID evidence suggests presence
- Geotechnical testing c 4m in BH, large bulks from trial pits (MC, PSD, atterbergs, pH and sulphate)

Peat



Estimated peat thickness (Mouchel)



Estimated peat elevation (Mouchel)

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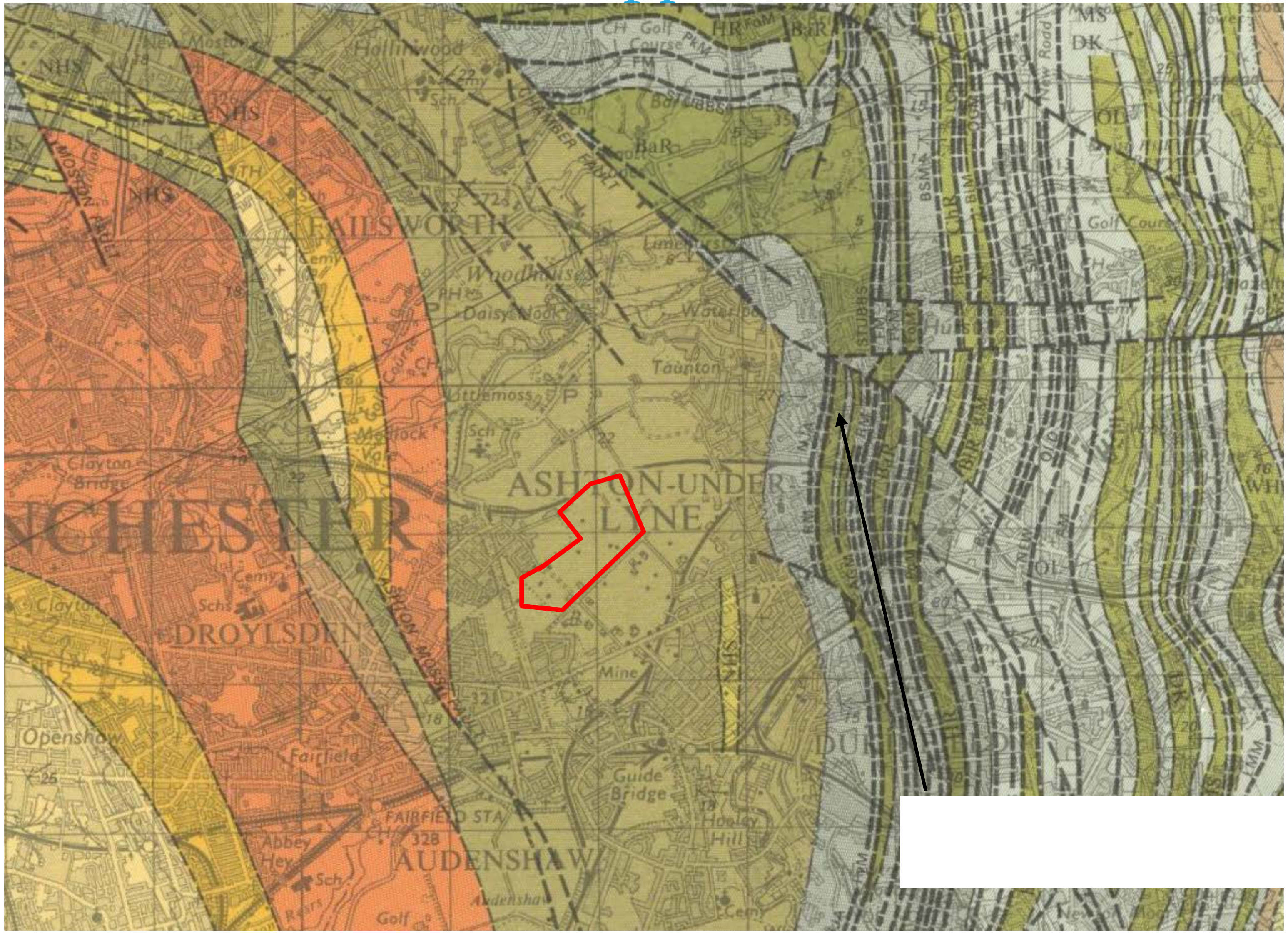
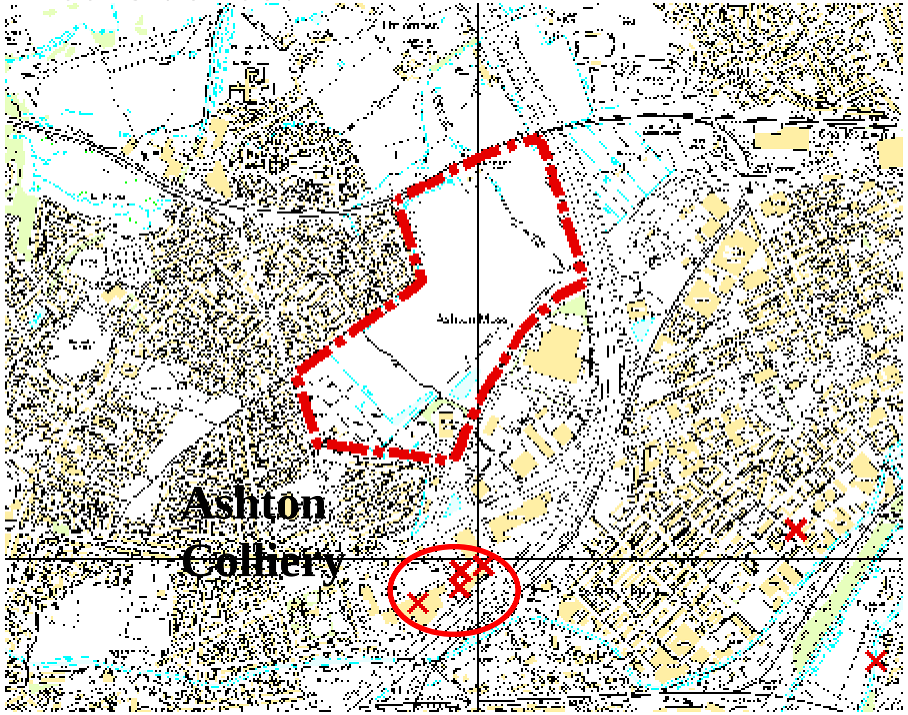
Bedrock – Pennine Upper Coal Measures



BGS, 1975, Sheet 85 1:50,000 Solid Geology

- Bedrock c50mOD (50 to 70mbgl)
- Siltstone and mudstone (with sandstone beds)
- Coal seams at Ashton Colliery worked along strike (i.e. N-S)?
- *Future investigation may need to consider coal*



Coal Authority – recorded mine shafts
http://mapapps2.bgs.ac.uk/coalauthority/home.html

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Constraints

Access – assumed there are no access constraints. Boreholes can be tweaked to suit site conditions if necessary. Client to arrange access with Muse (no site walkover undertaken – based on Drone video).

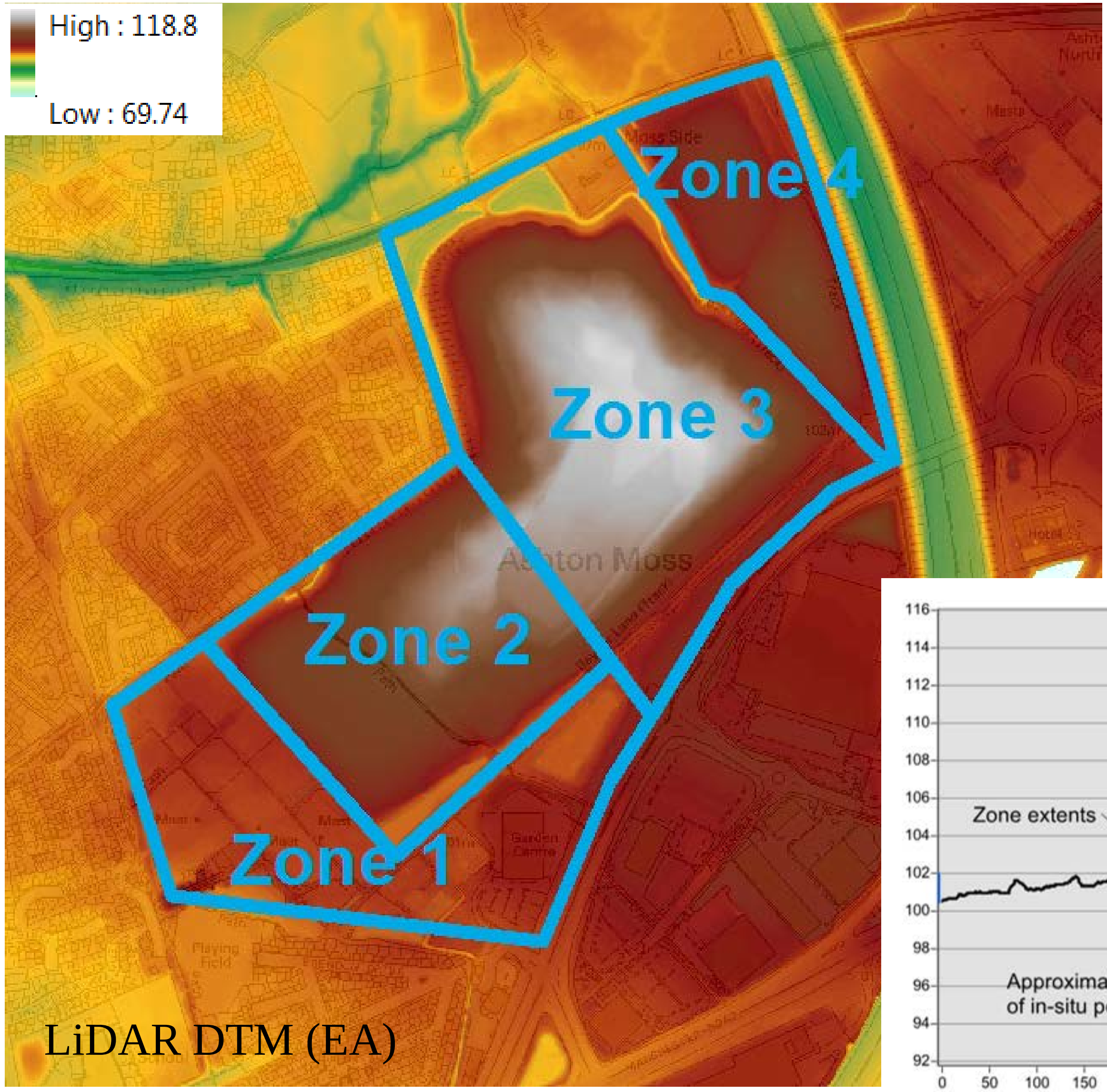
Utilities – no statutory utility searches have been completed.

Assume limited potential for obstructions within made ground – worked natural material from M60.

UXO likely to be low risk

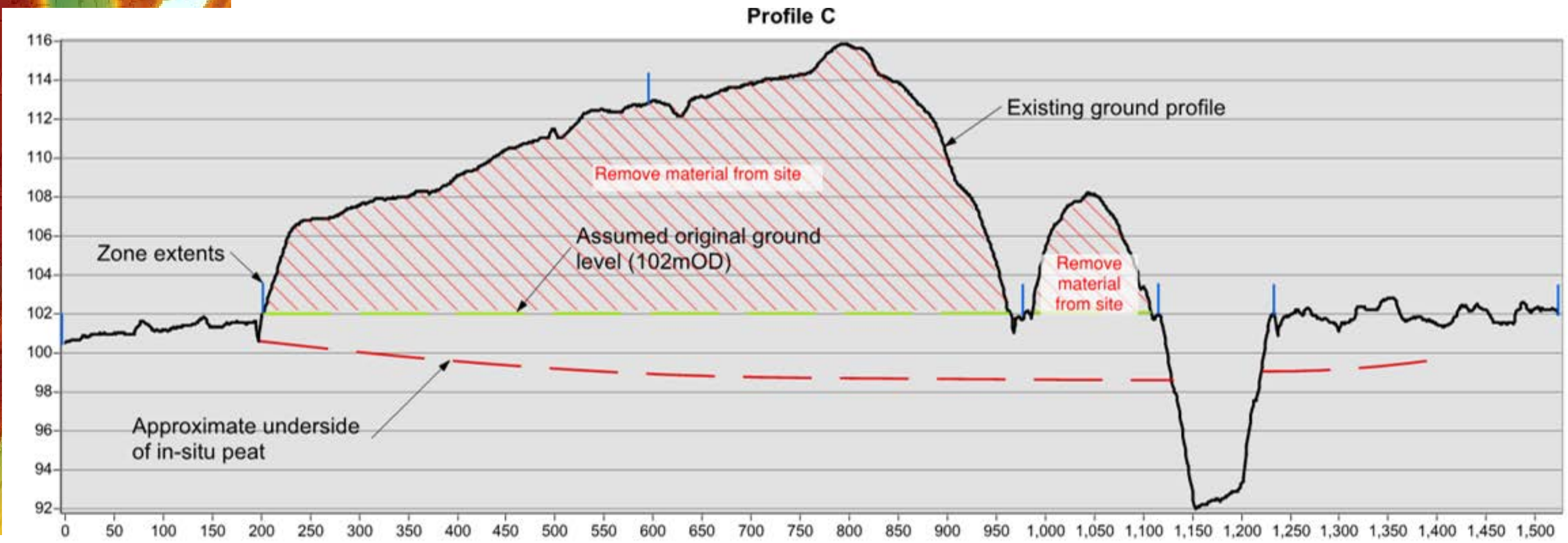
Limited budget (£50k to £60k)

Made ground

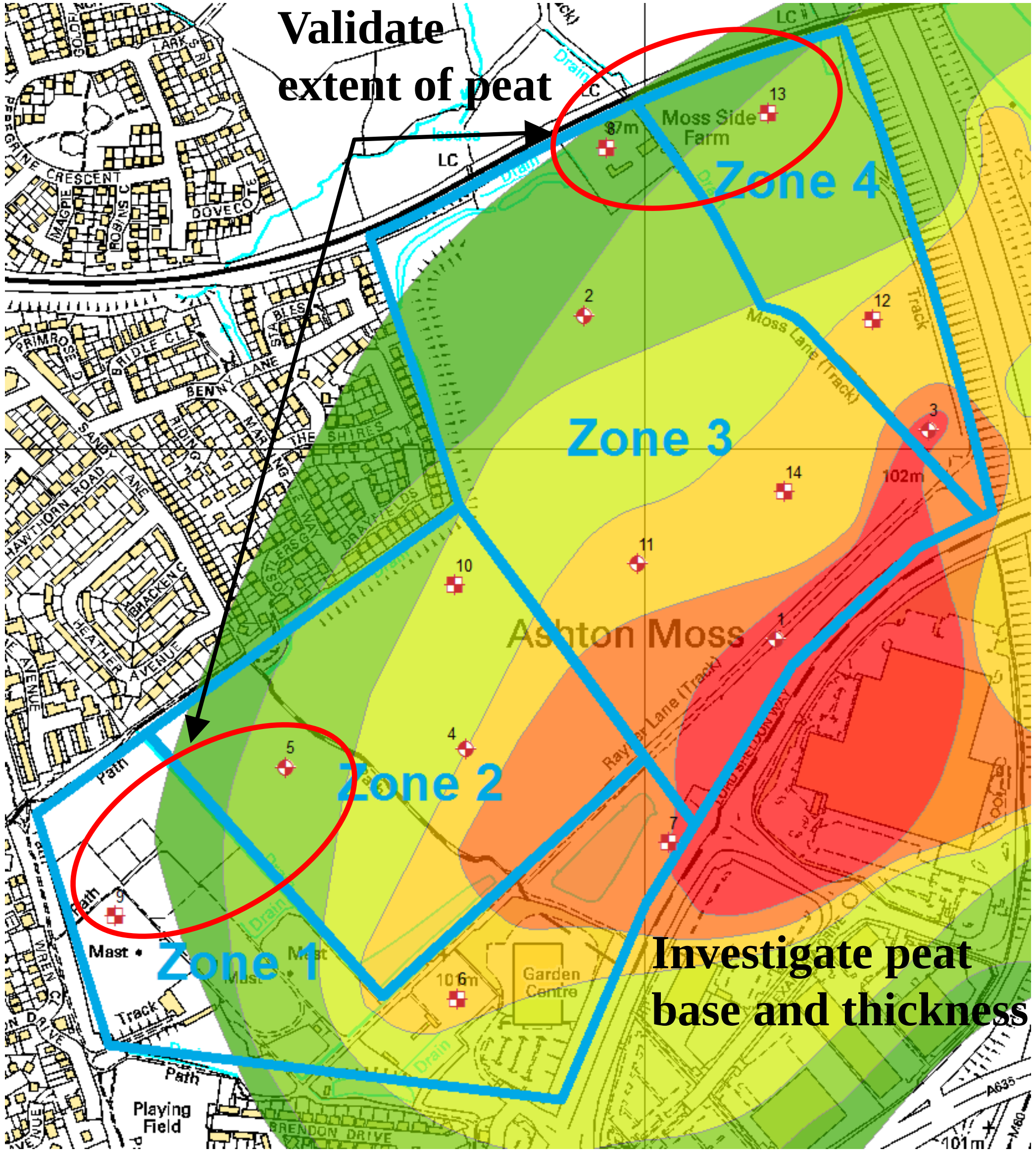


LiDAR DTM (EA)

- Made ground fill is thickest in Zone 3
- Potentially absent in Zone 1
- Estimated thickness of 14 to 16m based on assumed former ground level of 102moD
- Assumed to have been cuttings from M60, may include peat, clay from adjacent areas – assumed sand and gravel re-used elsewhere in M60 scheme



GI Rationale - Peat



Investigate extent of peat, thickness, base of peat (validate Mouchel findings)

Understand the nature of the peat (texture, moisture content, compressibility)

Von Post classification (description) (in addition to BS5930 description)

Future peat investigation might include:
"Undisturbed" samples of the peat: piston samples from boreholes, block samples from trial pits

Testing: Moisture content, bulk density, TOC/ LOI, Atterberg limits, specific gravity, pH and sulphate, oedometer*

Future testing might include:
Shear strength parameters, linear shrinkage?

*1D Consolidation – to estimate primary settlement but provides no information on secondary settlement caused by degradation of organic matter. Use of data on organic matter content (e.g. Von Post description, LOI, TOC) to estimate potential for secondary settlement

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Preliminary UXO Assessment

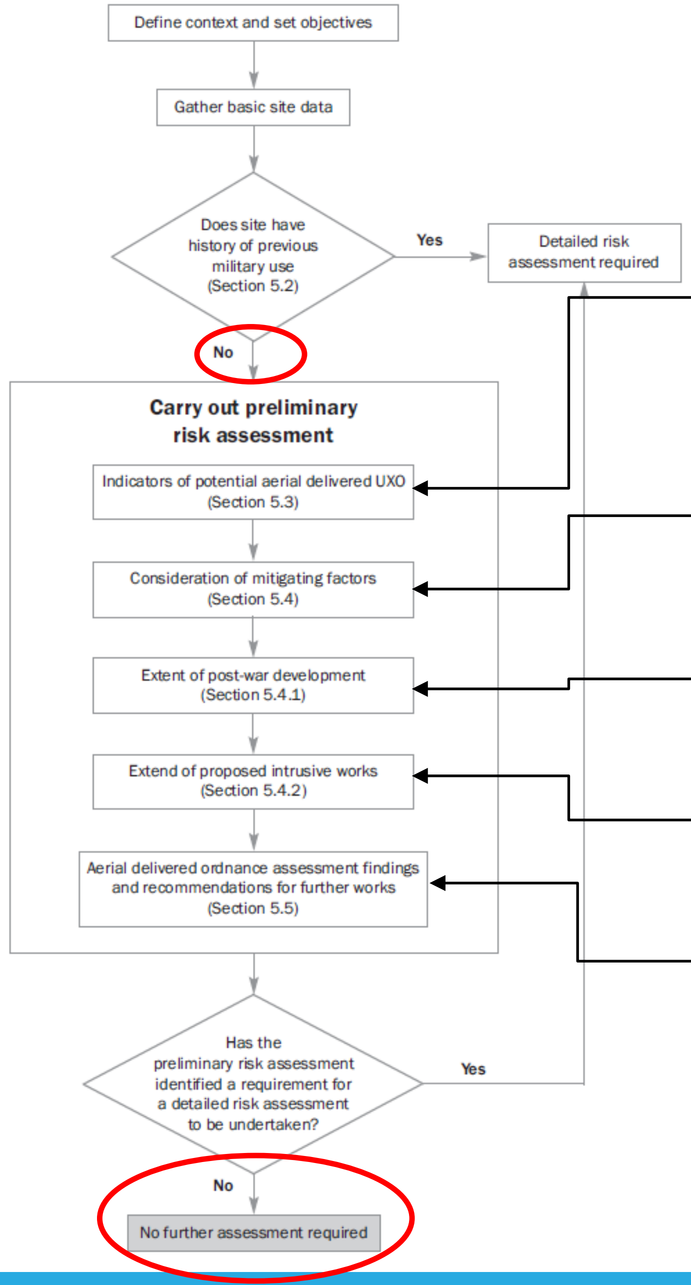

Table 5.1 assessment:
Site Location: Rural/ small town
Site description and land use: Greenfield or agriculture only
Site history: Recorded bomb damage 2km west (in Droylsden). No mapping available for Ashton (http://enriqueta.man.ac.uk/luna/servlet/s/55x5w0)
Conclusion: Generally low potential for aerial delivered UXO hazard

Conclusion: No change to site conditions other than filling in the 1990s

Table 5.2 assessment
Conclusion: No evidence of post-war development

Table 5.3 assessment
Boreholes (6 No.) and shallow trial pitting (8 No.) at c 200m centres
Conclusion: Low potential to encounter aerial delivered UXO

The assessment above has identified a low potential for aerial delivered UXO and this investigation is low density. Therefore it is considered the risk of encountering UXO is low for this preliminary ground investigation. ***This assessment should be updated for further ground investigation and below ground construction activities and if additional data becomes available***

CIRIA,2009, C681 UXO A guide for the construction industry

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Preliminary UXO Assessment

Indicators of potential aerial delivered UXO hazards

Data item	Increasing potential for aerial delivered UXO to be present →			
Site location	Rural	Small towns	Brownfield sites Large towns	Cities
Site description and historical land use	Greenfield site or agricultural land only	Near to wartime[1] site of: Previous military use Railway marshalling yard Power station Gas works Port Industrial centre	Adjacent to wartime[1] site of: Previous military use Railway marshalling yard Power station Gas works Port Industrial centre	Site of previous military use: Former wartime[1] Site of previous military use Railway marshalling yard Power station Gas works Port Industrial centre
Site history	No history of WWII bombing	Near to area of known WWII bombing	Area of known WWII bombing	Area of high intensity WWII bombing

1 Wartime refers to the site being in use during WWI or WWII when due to its significance there is the potential that it may have been the target of enemy attack.

Table 5.2 ***post-war development and the potential to remove aerial delivered UXO hazards***

Nature of post-war development	Increasing potential for UXO to remain →
	Wholesale excavation[1]
	Significant post-war development[2]
	Moderate post-war development[3]
	Minimal post-war development[4]
	No evidence of post-war development

1 Excavation of entire site to a level at or below that of any intrusive works required as part of the proposed development.

2 Excavation of areas of the site to a level at or below that of any intrusive works required as part of the proposed development.

3 Excavation of majority of the site but not to a level below that of any intrusive works required as part of the proposed development.

4 Excavation of limited areas of the site but not to a level below that of any intrusive works required as part of the proposed development.

The further to the right of Table 5.2 the site is placed, the greater the potential for UXO to be present.

Table 5.3 ***Construction activities and the potential to encounter aerial delivered UXO***

Activity	Increasing potential to encounter aerial delivered UXO →
	Borehole drilling
	Shallow trial pits
	Excavations for services
	Low density driven piles
	Shallow excavations over extended area
	Sheet piling
	Deep excavations over limited area
	High density piles*
	Deep excavations over extended area

CIRIA,2009, C681 UXO A guide for the construction industry

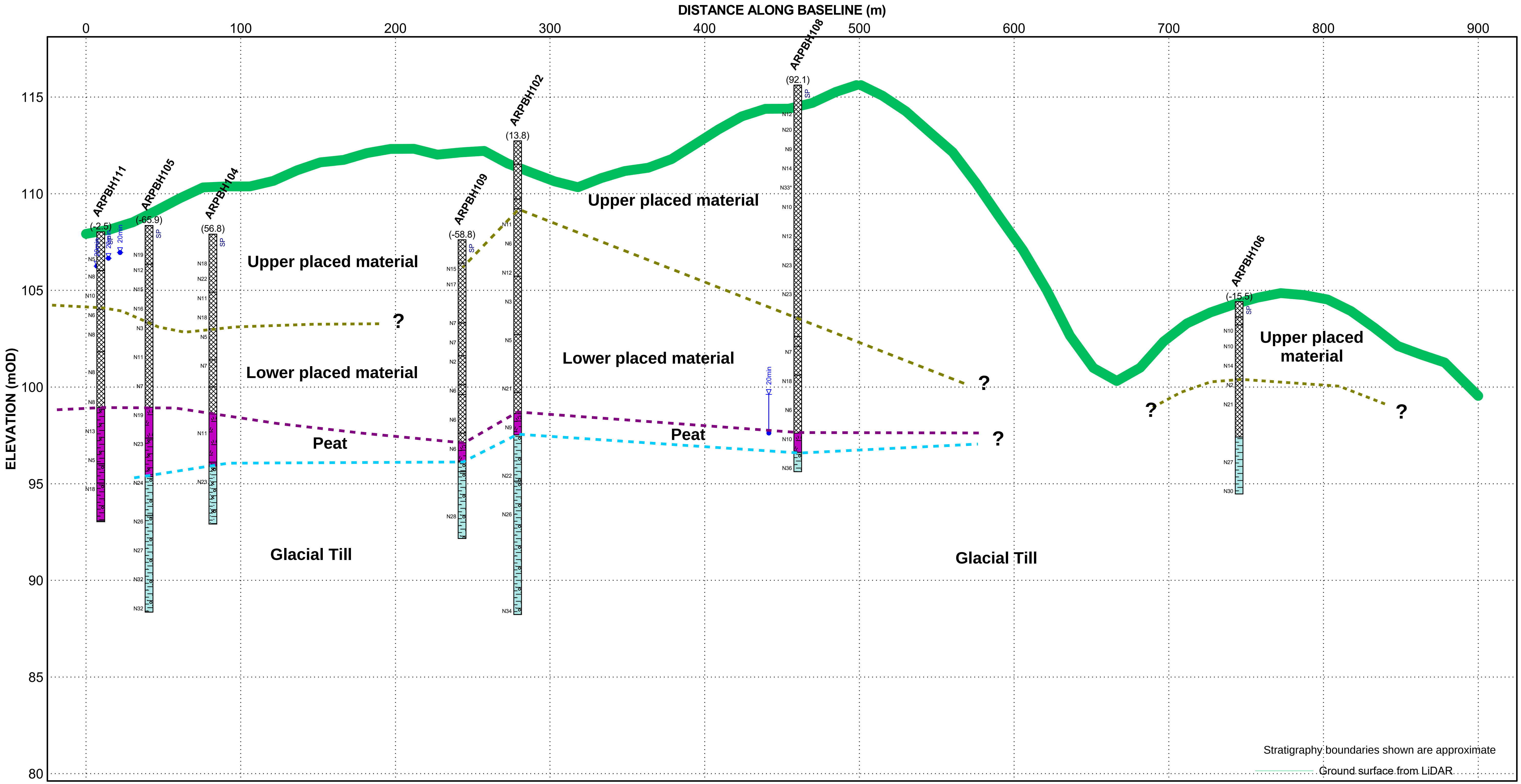
Document verification

01/11/2017: Reviewed and modified on 01/11/2017 with Carl Lowe and Jane

DOCUMENT CHECKING			
01/11/2017	**Prepared by**	**Checked by**	**Approved by**
Name	[redacted]	[redacted]	[redacted]
Signature	[redacted]	[redacted]	

Appendix C

Geological cross sections



SCALE 1:200V 1:2500H @ A3-L

LEGEND

Hole offset is +ve to the RIGHT of the baseline

HoleID

(Offset)

SPT N value, * denotes N extrapolated by gINT:
* from main blows
** from seating blows

N20*

Water strikes during boring / excavation

Time for reported water rise and flow rate remarks

20min. Steady flow

Level that water rose to

Level of water strike

Piezometer readings

Range of water levels recorded

Piezo response zone

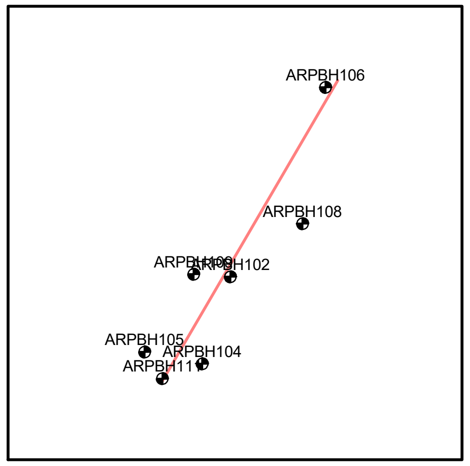
Tip depth

Type of piezometer

SPIE

Key to piezo types:
SP Standpipe

PLAN



COLOUR LEGEND

- Glacial Till Deposits [GTD]
- Peat [Pt]

MATERIALS

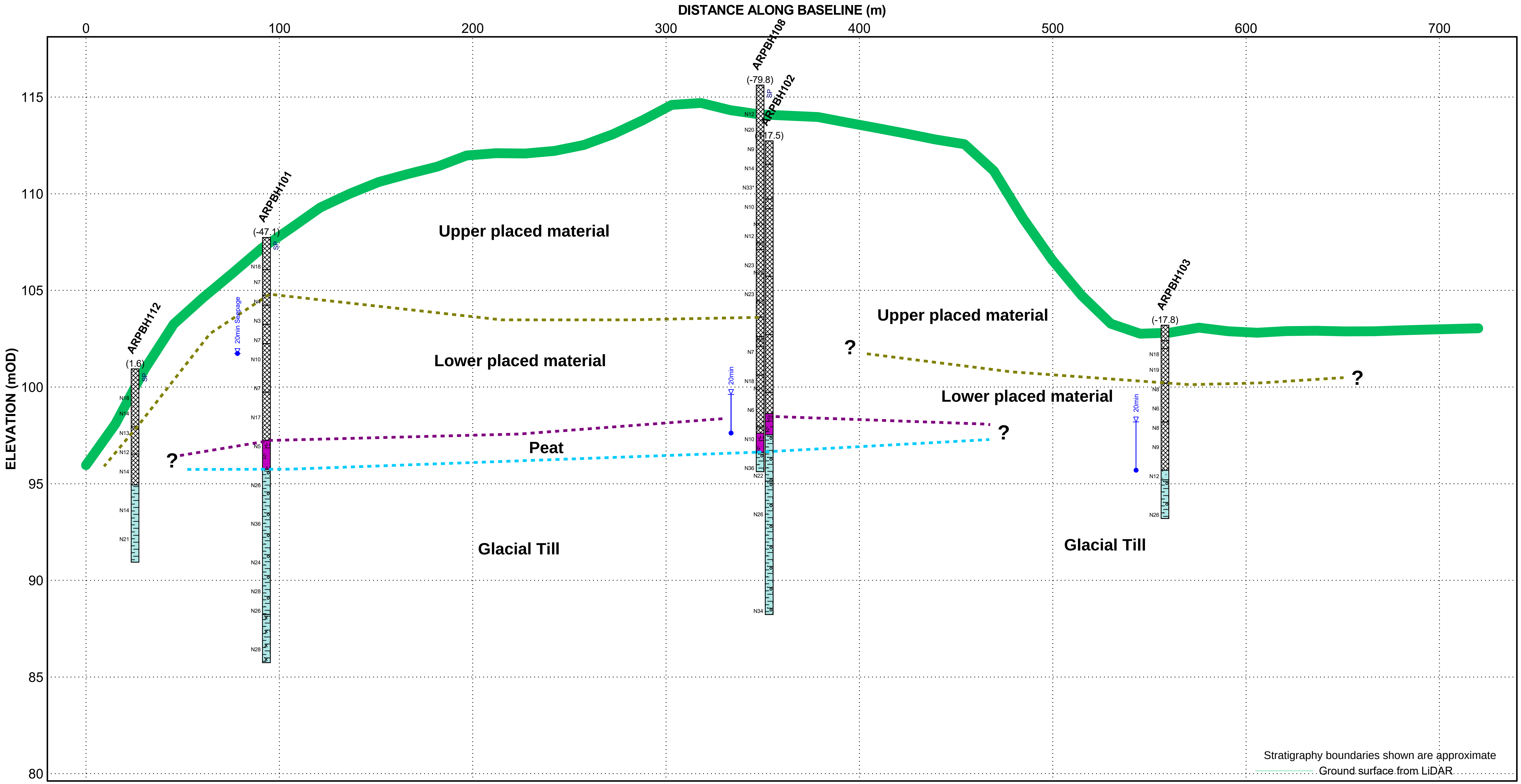
- Fill (MADE GROUND)
- Clayey PEAT
- Sandy gravelly CLAY
- PEAT
- Silty sandy CLAY
- Silty sandy gravelly CLAY
- Silty Clay
- CLAY

ARUP gINT v8.30.004
Made by Mark Griffiths on 17-Jul-18

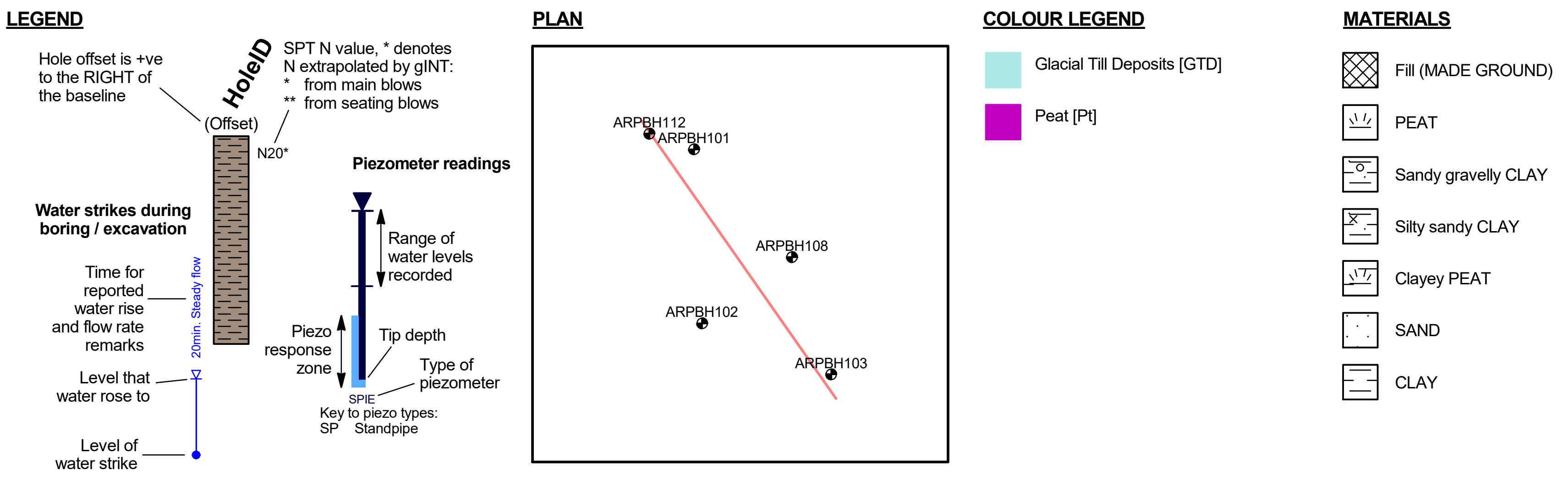
ASHTON MOSS
GEOLOGICAL CROSS SECTION
NORTHEAST - SOUTHWEST

252590-00

FIGURE C1



SCALE 1:200V 1:2000H @ A3-L



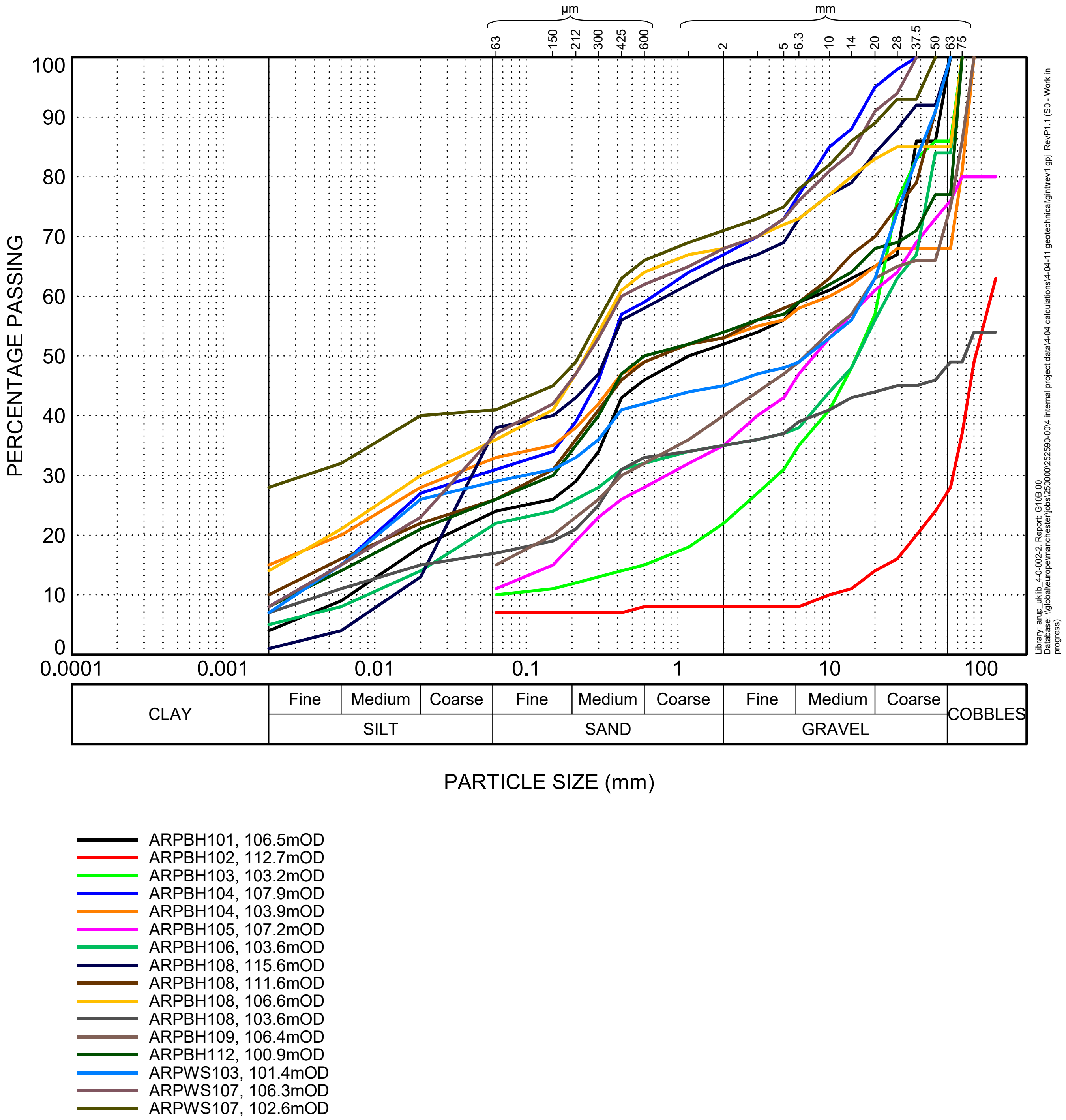
ASHTON MOSS
GEOLOGICAL CROSS SECTION
NORTHWEST - SOUTHEAST

252590-00

FIGURE C2

Appendix D

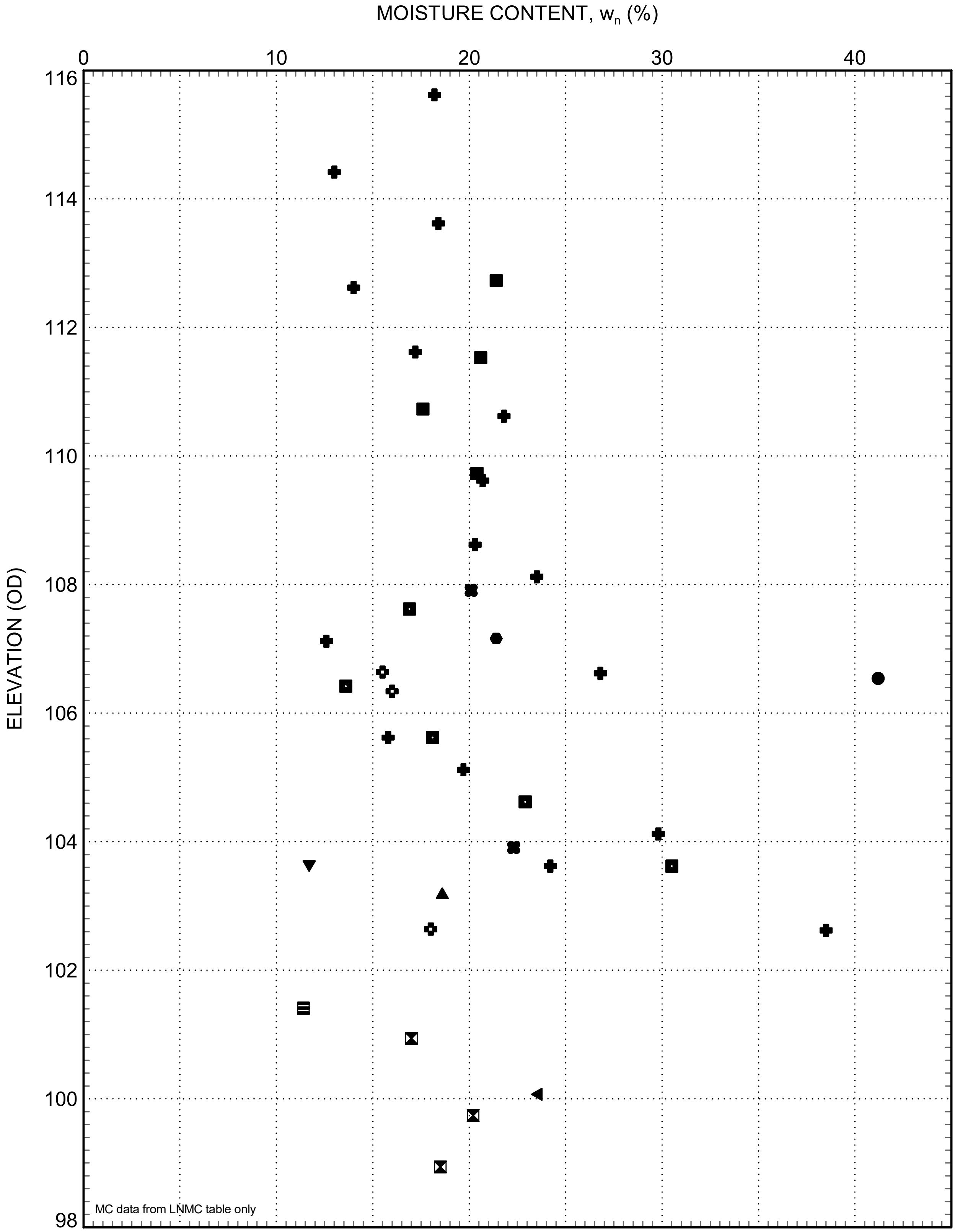
Geotechnical test results



ARUP_gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18

ASHTON MOSS
PARTICLE SIZE DISTRIBUTION
COVERING MADE GROUND
PARTICLE SIZE DISTRIBUTION

252590-00 FIGURE **D1**



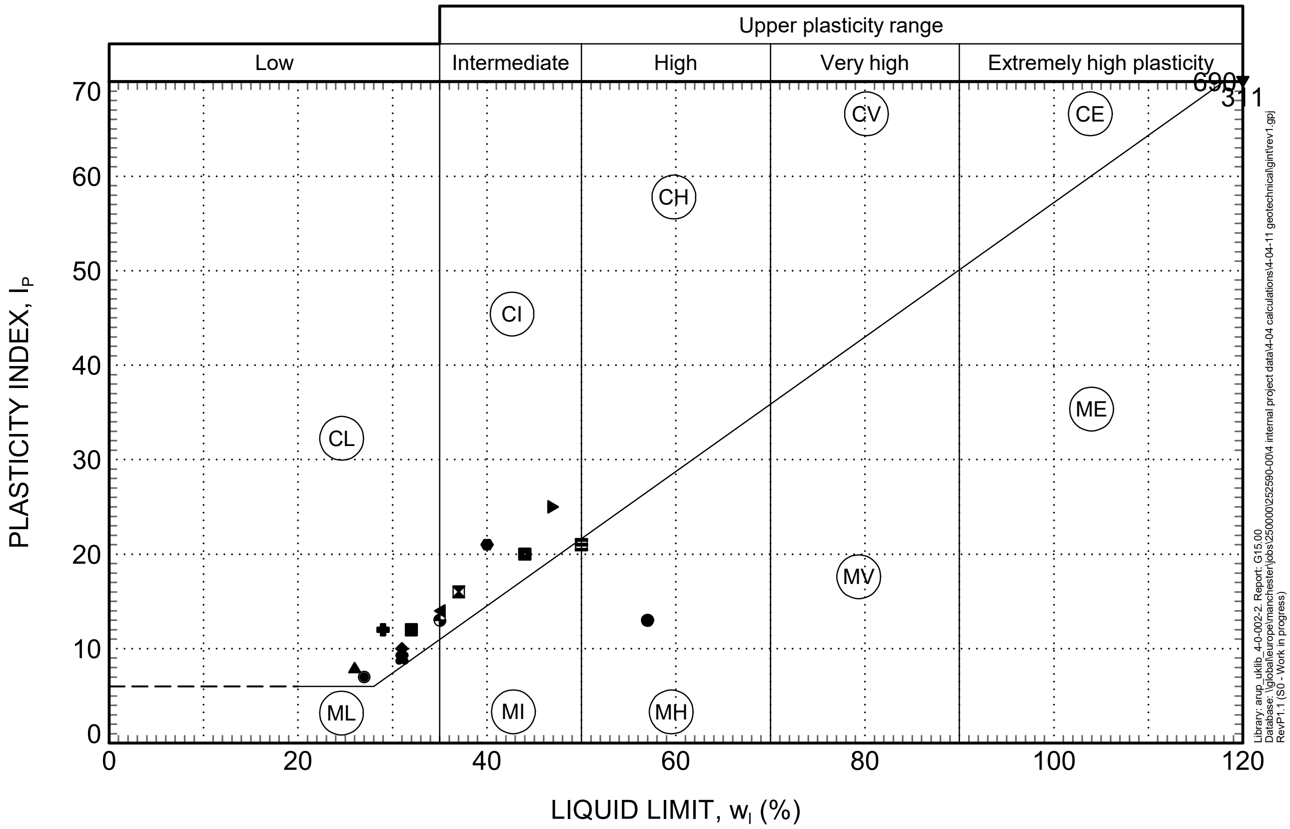
- ● ARPBH101
- ■ ARPBH102
- ▲ ARPBH103
- ✖ ARPBH104
- ⬢ ARPBH105
- ▼ ARPBH106
- ✚ ARPBH108
- ▣ ARPBH109
- ◀ ARPBH110
- ⧗ ARPBH112
- ☰ ARPWS103
- ✜ ARPWS107

Library: arup_uklib_4-0-002-2. Report: G16.42.L
Database: \\global\europe\manchester\jobs\250000\252590-00\4 internal project data\4-04 calculations\4-04-11 geotechnical\gint\rev1.gpj RevP1.1 (S0 - Work in progress)

ARUP_gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18

ASHTON MOSS
NATURAL MOISTURE CONTENT
COVERING MADE GROUND
MOISTURE CONTENT

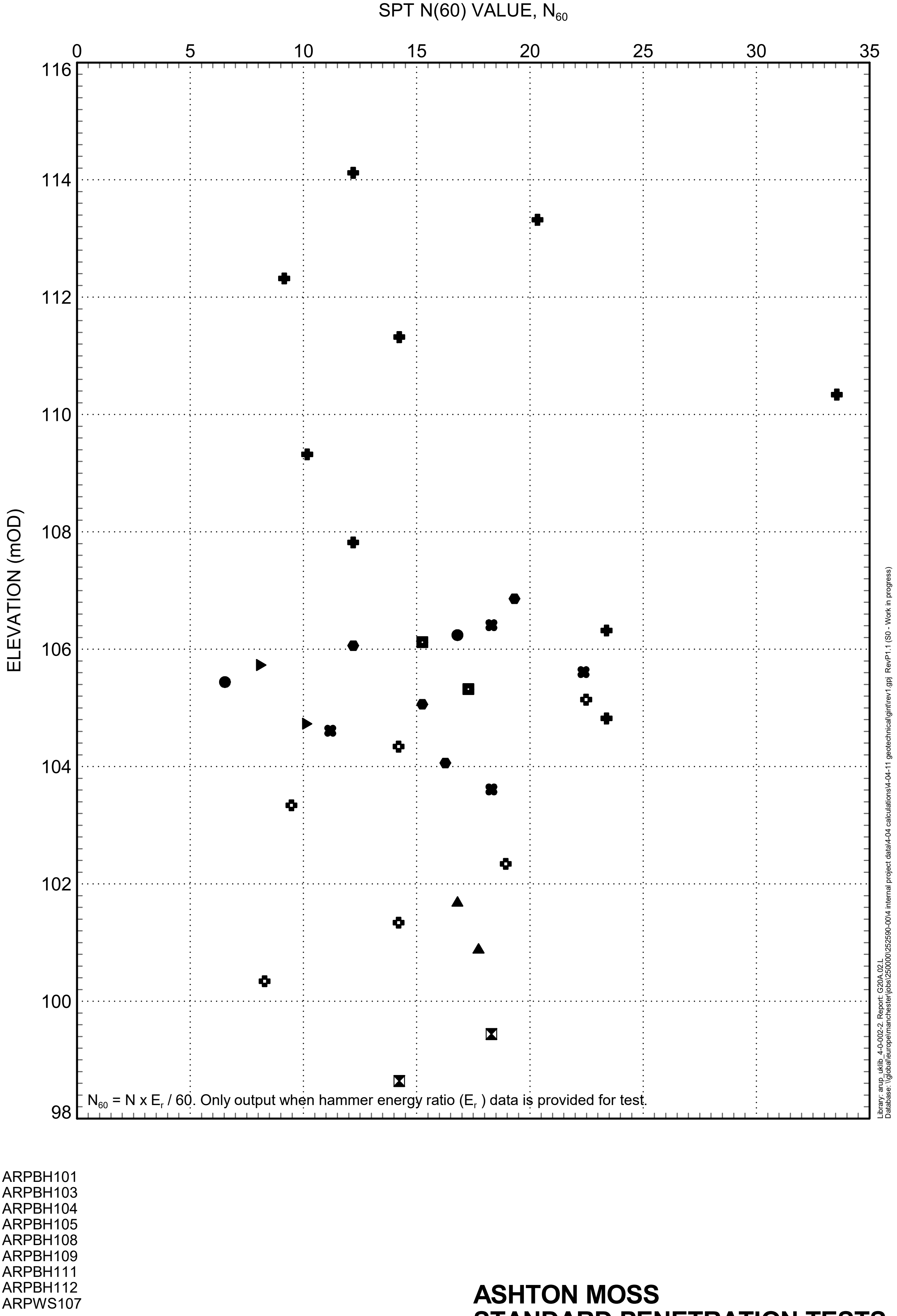
252590-00 **FIGURE D2**



- ● ARPBH101, 106.5mOD
- ■ ARPBH102, 112.7mOD
- ▲ ARPBH103, 103.2mOD
- ✖ ARPBH104, 107.9mOD
- ⬢ ARPBH104, 103.9mOD
- ▼ ARPBH105, 107.2mOD
- ✚ ARPBH108, 115.6mOD
- ▣ ARPBH108, 111.6mOD
- ◀ ARPBH108, 106.6mOD
- ▶ ARPBH108, 103.6mOD
- ⧗ ARPBH110, 100.1mOD
- ◉ ARPBH112, 100.9mOD
- ◐ ARPWS103, 101.4mOD
- ◆ ARPWS107, 106.3mOD
- ⊟ ARPWS107, 102.6mOD

ASHTON MOSS
PLASTICITY CHART
COVERING MADE GROUND
PLASTICITY A-LINE

252590-00 **FIGURE D3**

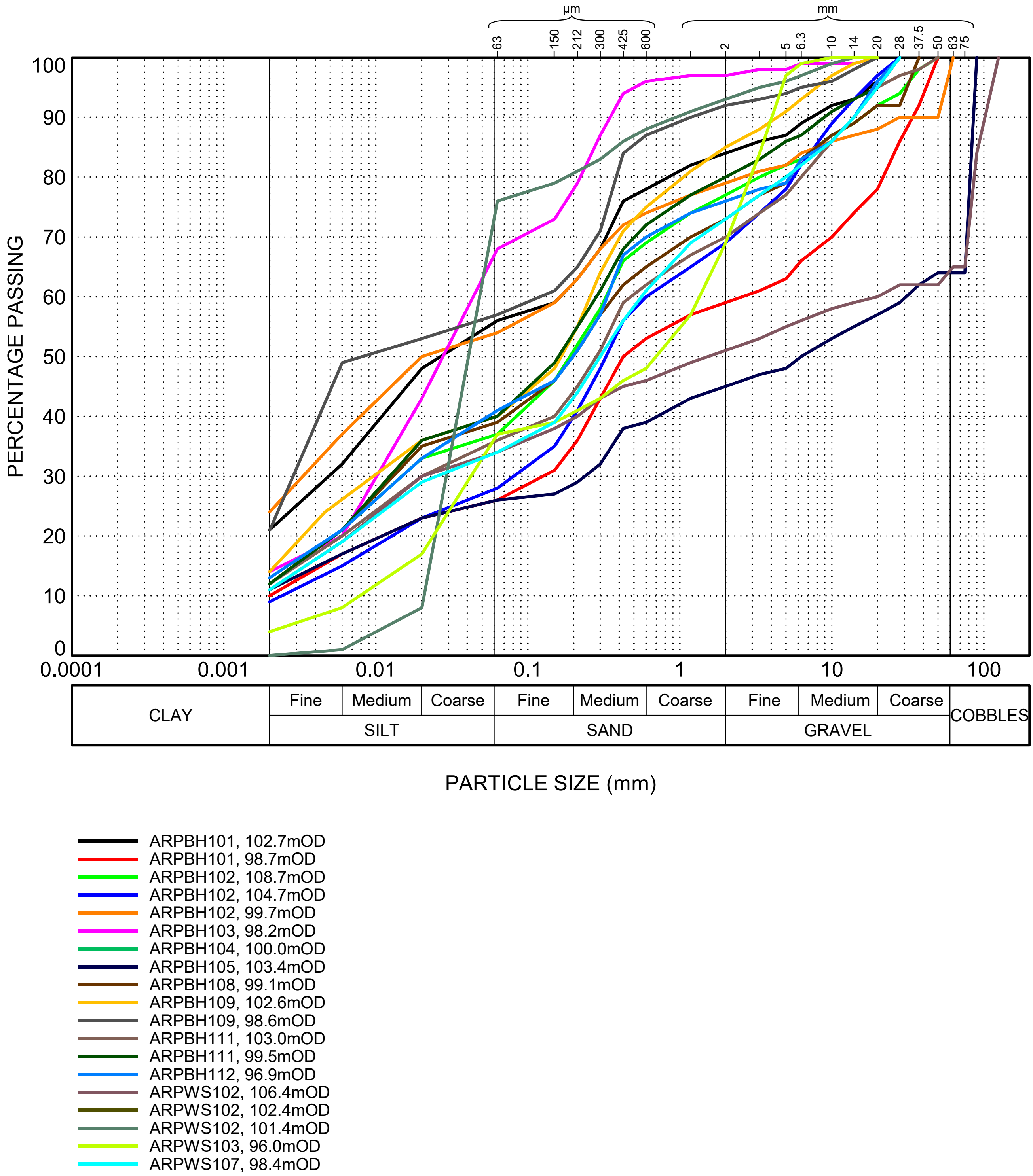


ARUP_gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18

ASHTON MOSS
STANDARD PENETRATION TESTS
COVERING MADE GROUND
CORRECTED SPT N'60' VALUES

252590-00

FIGURE D4

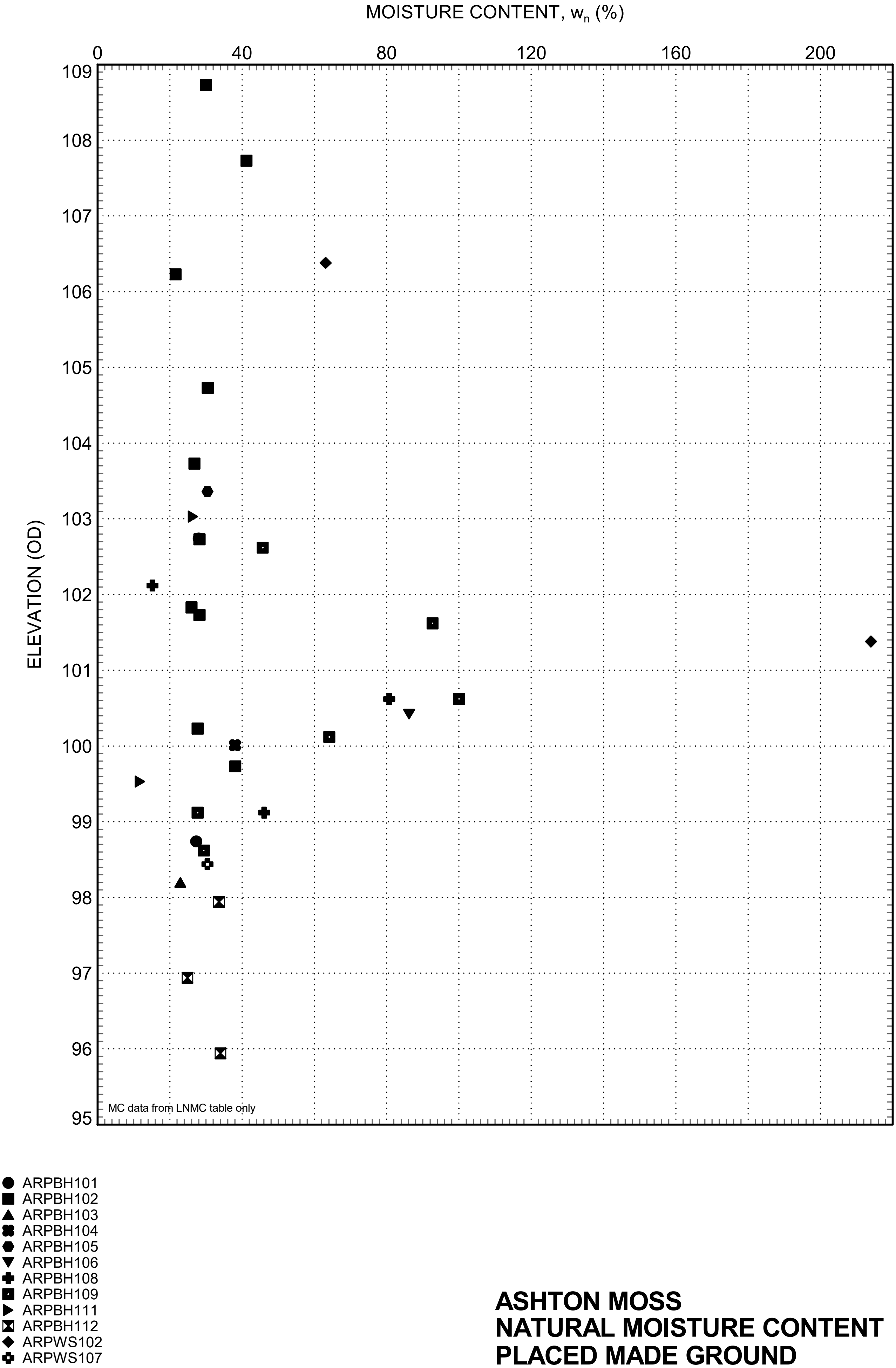


Library: arup_uklib_4-0-002-2. Report: G10B.00
Database: \\global\europe\manchester\jobs\250000\252590-00\4 internal project data\4-04 calculations\4-04-11 geotechnical\gint\rev1.gpj RevP1.1 (S0 - Work in progress)

ASHTON MOSS
PARTICLE SIZE DISTRIBUTION
PLACED MADE GROUND
PARTICLE SIZE DISTRIBUTION

ARUP_gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18

252590-00 **FIGURE D5**



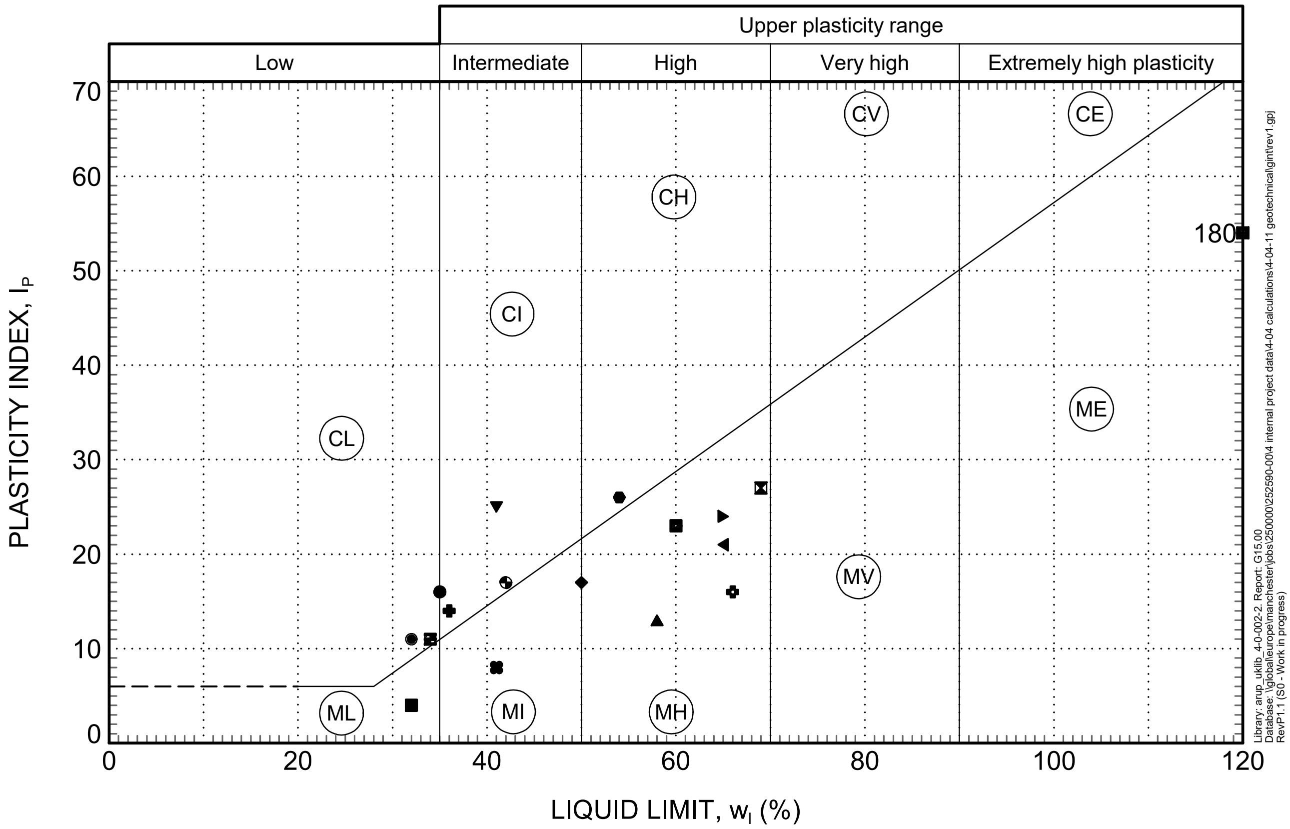
Library: arup_uklib_4-0-002-2. Report: G16.42.L
Database: \\global\europe\manchester\jobs\250000\252590-00\4 internal project data\4-04 calculations\4-04-11 geotechnical\gint\rev1.gpj RevP1.1 (S0 - Work in progress)

ARUP_gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18

ASHTON MOSS
NATURAL MOISTURE CONTENT
PLACED MADE GROUND
MOISTURE CONTENT

252590-00

FIGURE D6

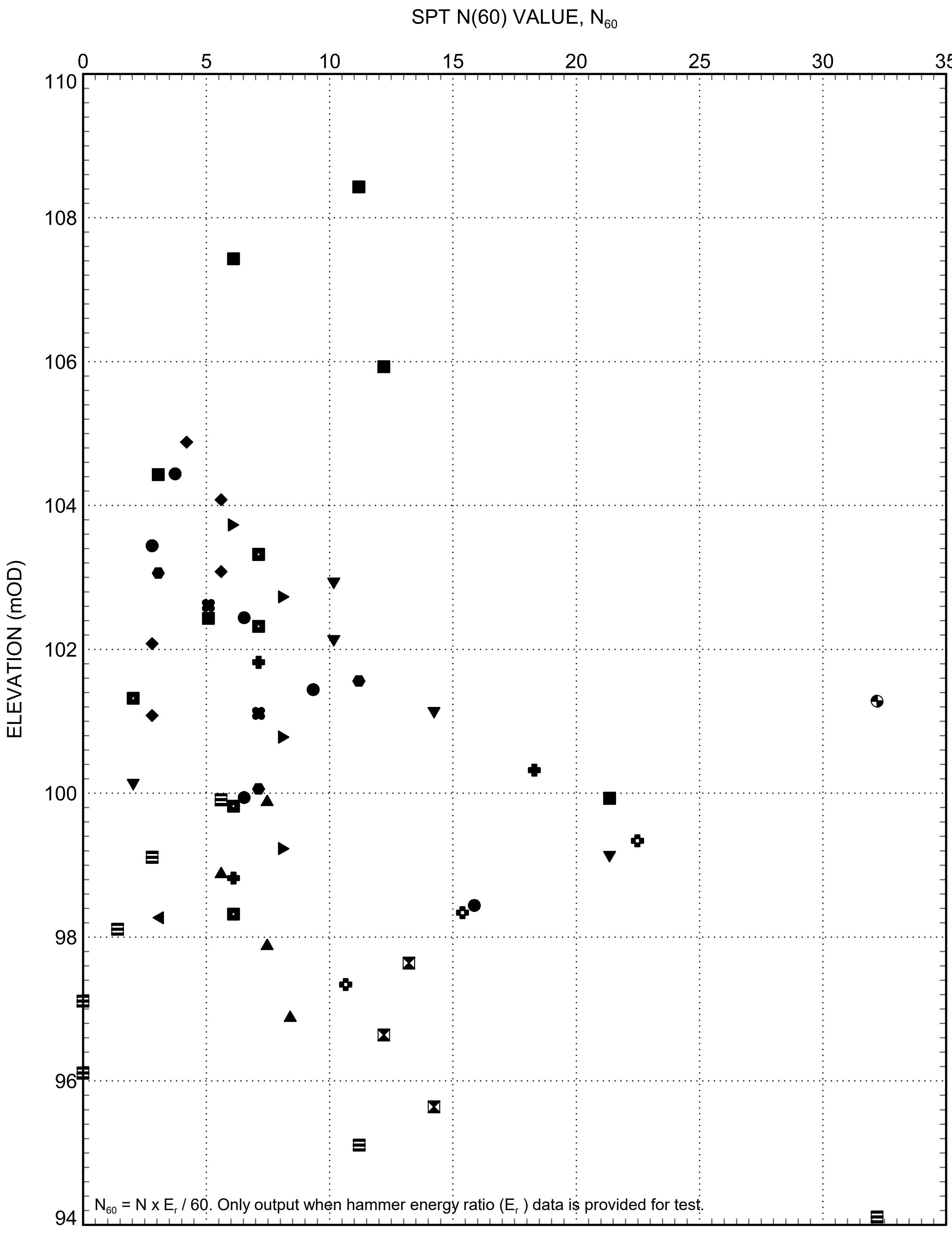


- ARPBH101, 102.7mOD
- ARPBH101, 98.7mOD
- ARPBH102, 108.7mOD
- ARPBH102, 104.7mOD
- ARPBH102, 99.7mOD
- ARPBH103, 98.2mOD
- ARPBH104, 100.0mOD
- ARPBH105, 103.4mOD
- ARPBH106, 100.4mOD
- ARPBH108, 99.1mOD
- ARPBH109, 102.6mOD
- ARPBH109, 98.6mOD
- ARPBH111, 103.0mOD
- ARPBH111, 99.5mOD
- ARPBH112, 96.9mOD
- ARPWS102, 106.4mOD
- ARPWS103, 96.0mOD
- ARPWS107, 98.4mOD

ARUP_gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18

ASHTON MOSS
PLASTICITY CHART
PLACED MADE GROUND
PLASTICITY A-LINE

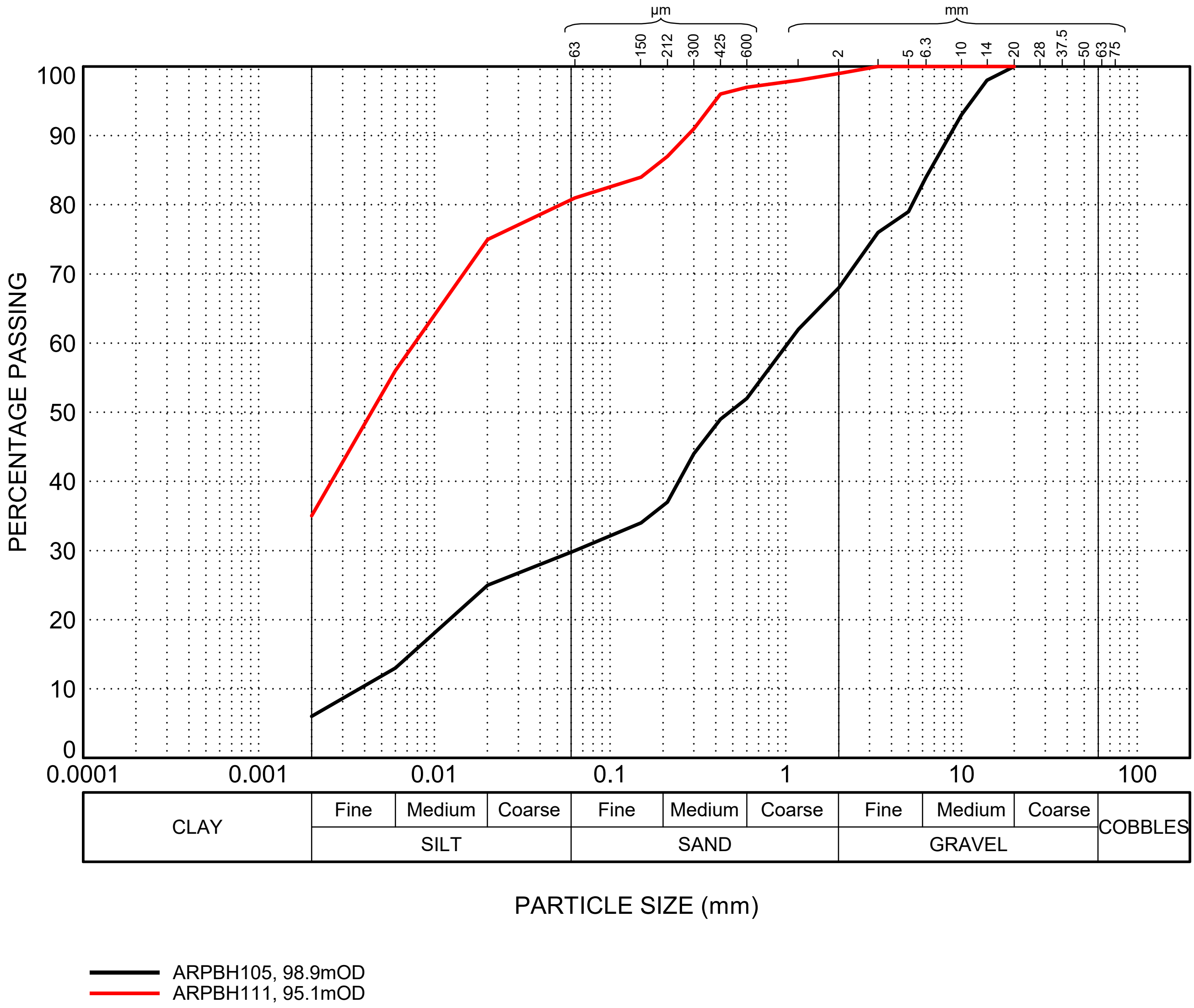
252590-00 **FIGURE D7**



- ARPBH101
- ARPBH102
- ARPBH103
- ARPBH104
- ARPBH105
- ARPBH106
- ARPBH108
- ARPBH109
- ARPBH110
- ARPBH111
- ARPBH112
- ARPWS101A
- ARPWS102
- ARPWS103
- ARPWS107

ASHTON MOSS
STANDARD PENETRATION TESTS
PLACED MADE GROUND
CORRECTED SPT N'60' VALUES

252590-00 **FIGURE D8**



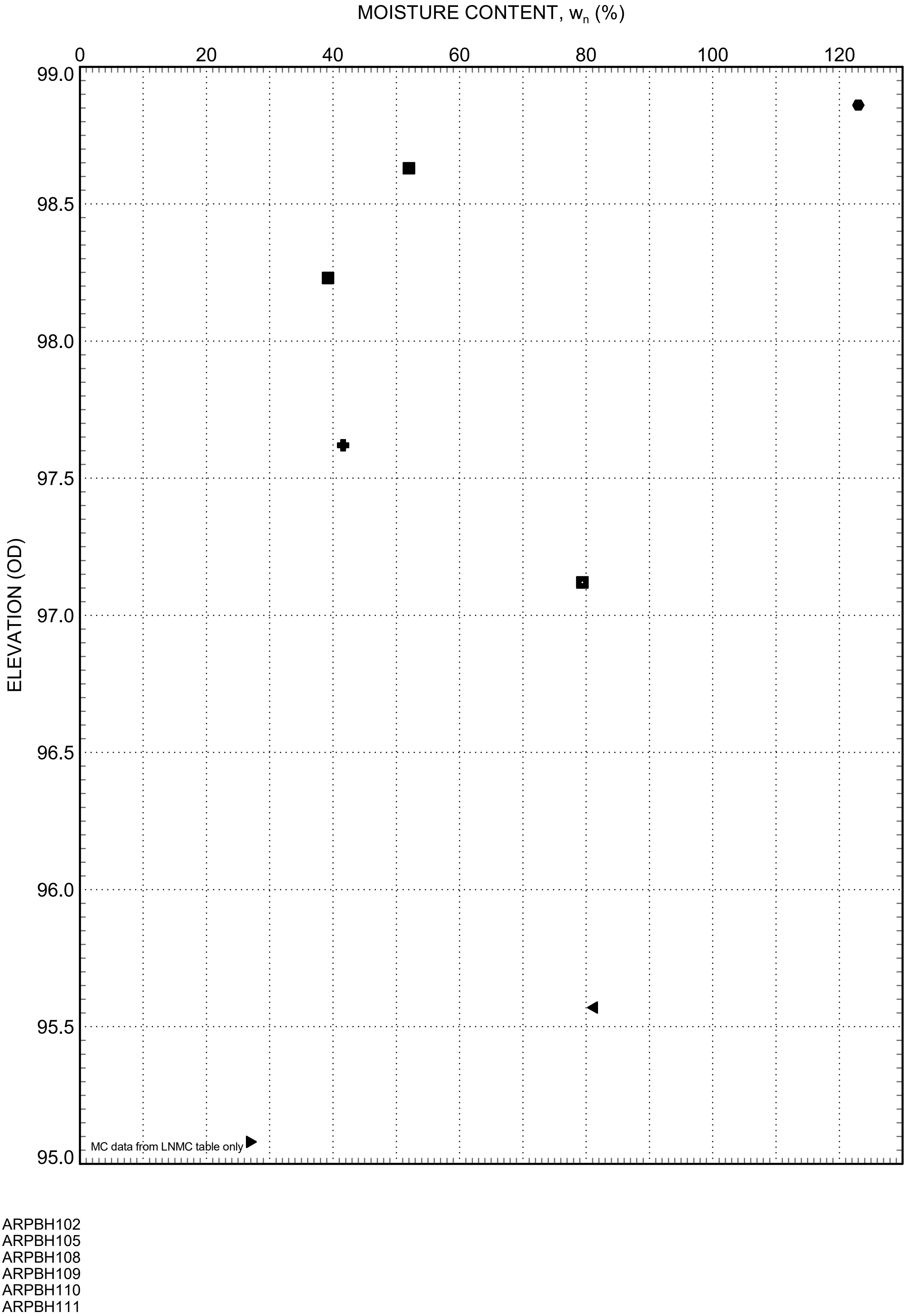
Library: arup_uklib_4-0-002-2. Report: G10B.00
Database: \\global\europe\manchester\jobs\250000\252590-00\4 internal project data\4-04 calculations\4-04-11 geotechnical\gint\rev1.gpj RevP1.1 (S0 - Work in progress)

ASHTON MOSS
PARTICLE SIZE DISTRIBUTION
NATURAL PEAT
PARTICLE SIZE DISTRIBUTION

252590-00

FIGURE D9

ARUP_gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18

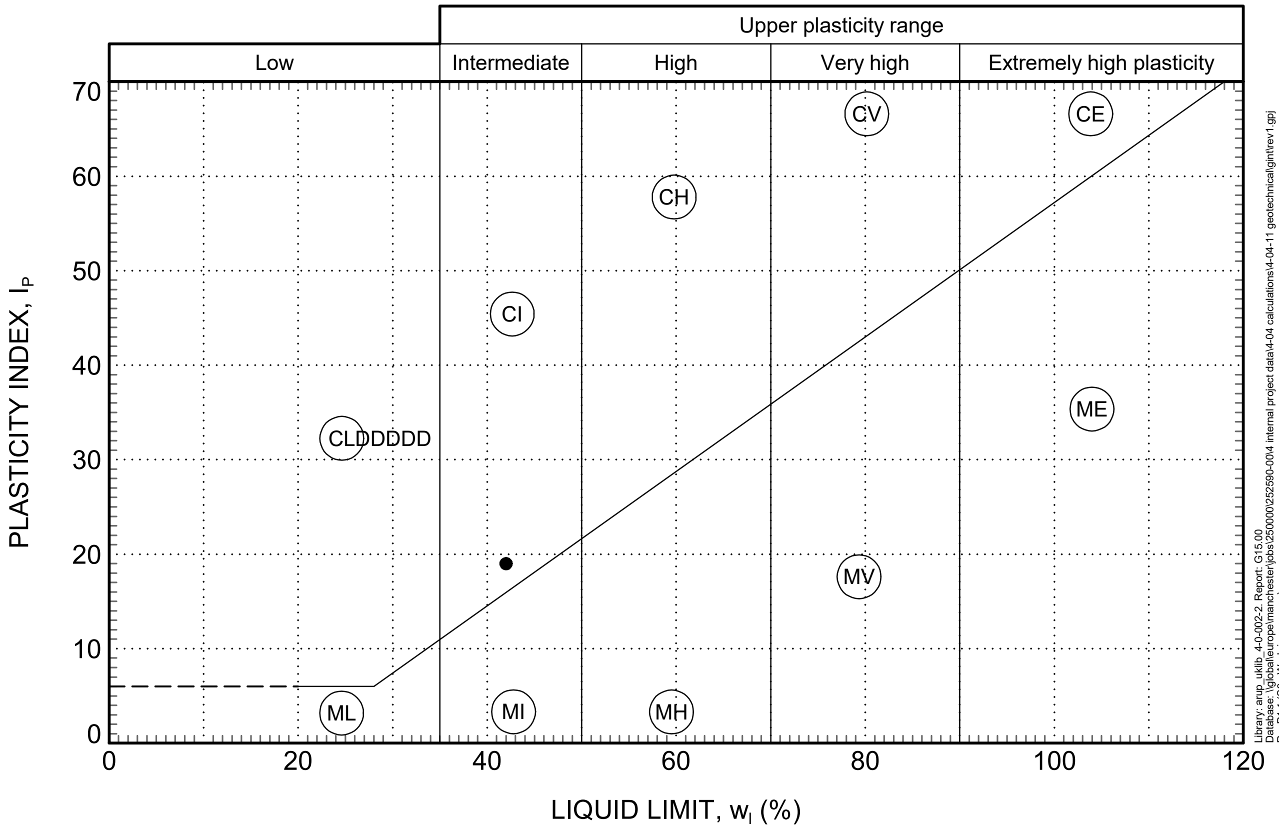


Library: arup_uklib_4-0-002-2. Report: G16.42.L
Database: \\global\europe\manchester\jobs\250000\252590-00\4 internal project data\4-04 calculations\4-04-11 geotechnical\gint\rev1.gpj RevP1.1 (S0 - Work in progress)

ARUP_gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18DDDDD

ASHTON MOSS
NATURAL MOISTURE CONTENT
NATURAL PEAT
MOISTURE CONTENT

252590-00 **FIGURE D10**



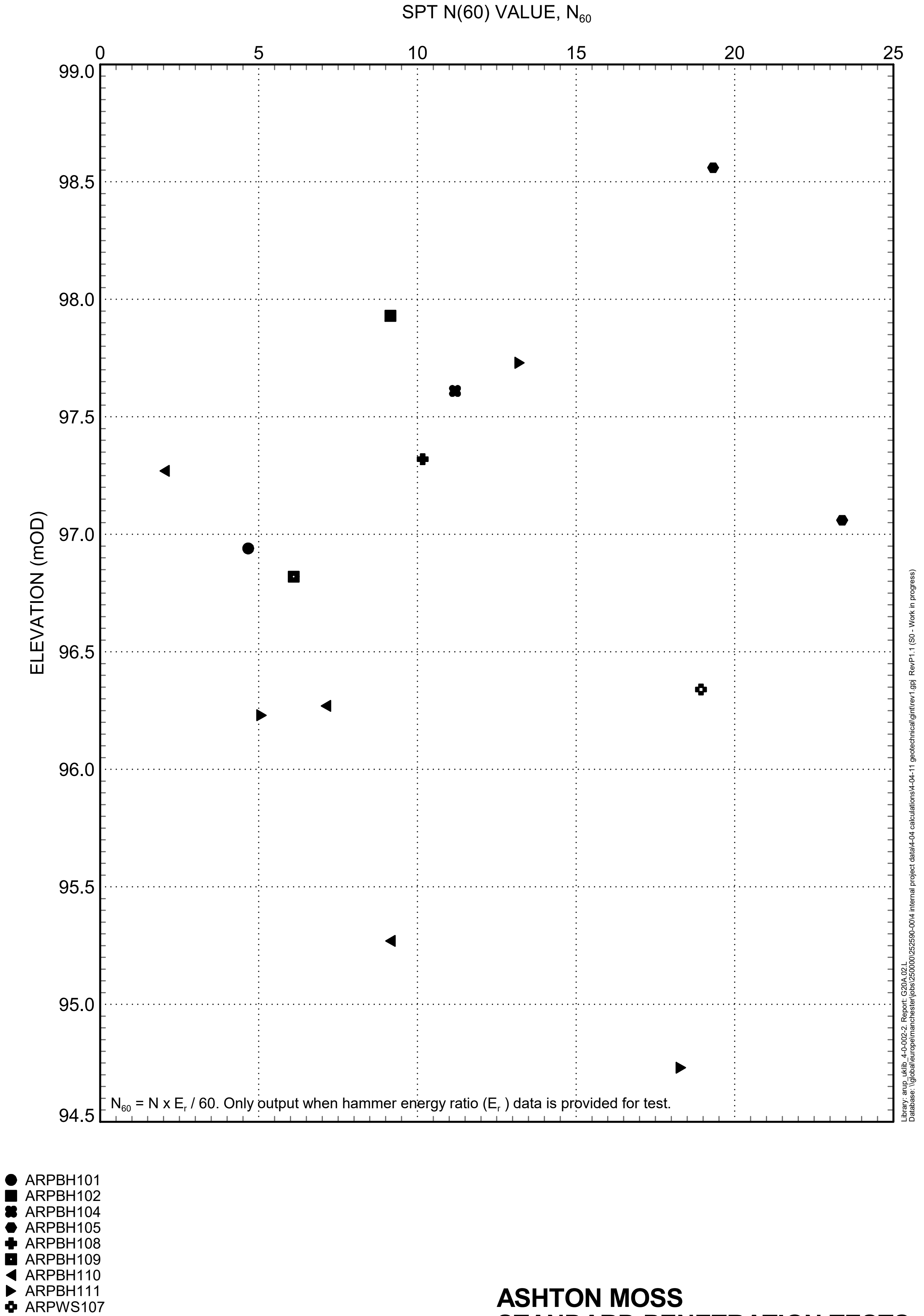
● ARPBH111, 95.1mOD

Library: arup_uklib_4-0-002-2. Report: G15.00
Database: \\global\europe\manchester\jobs\250000\252590-00\4 internal project data\4-04 calculations\4-04-11 geotechnical\gint\rev1.gpj
RevP1.1 (S0 - Work in progress)

ARUP_gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18

ASHTON MOSS
PLASTICITY CHART
NATURAL PEAT
PLASTICITY A-LINE

252590-00 **FIGURE D11**



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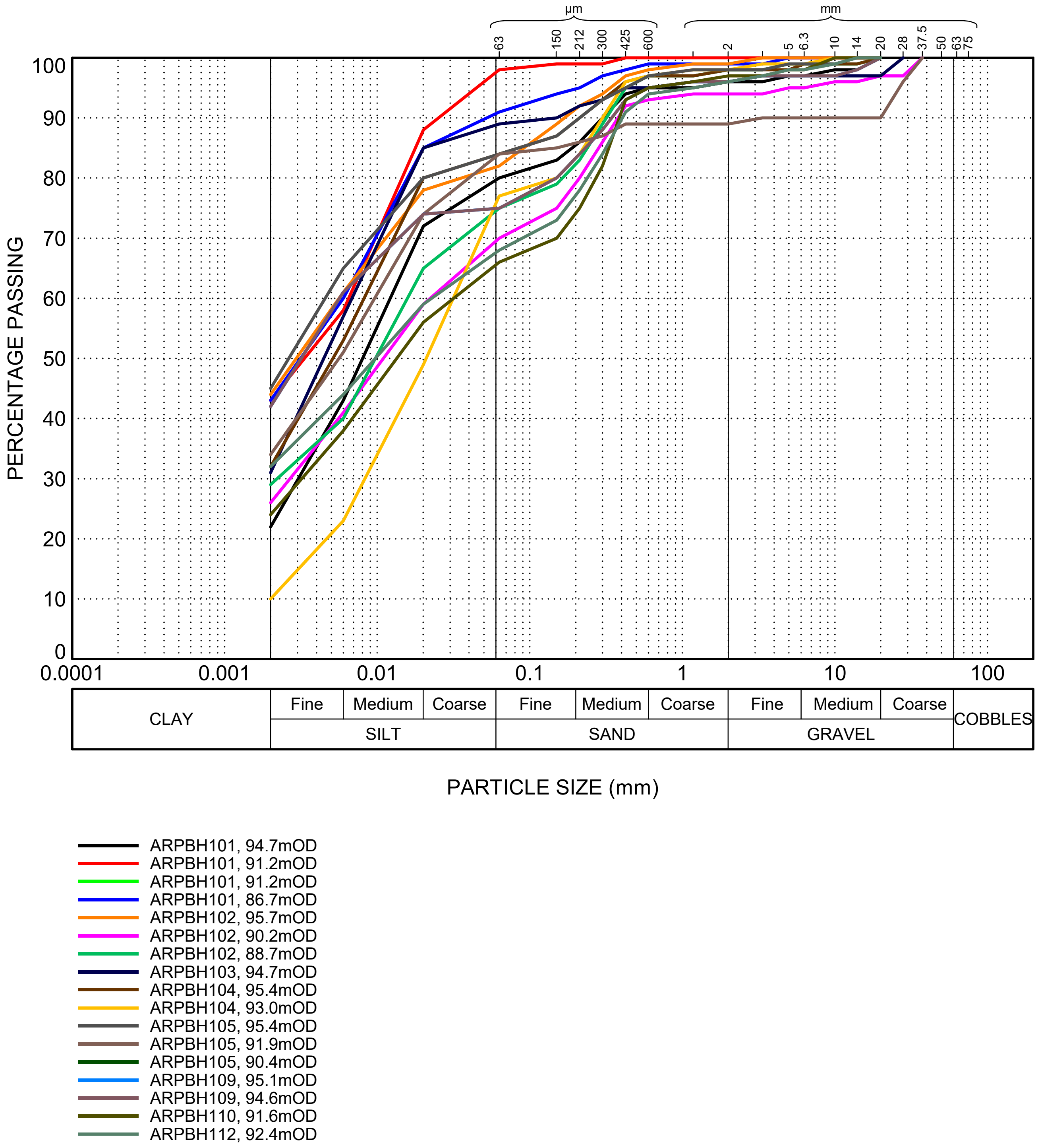
ARUP_gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18

ASHTON MOSS
STANDARD PENETRATION TESTS
NATURAL PEAT
CORRECTED SPT N'60' VALUES

252590-00 **FIGURE D12**



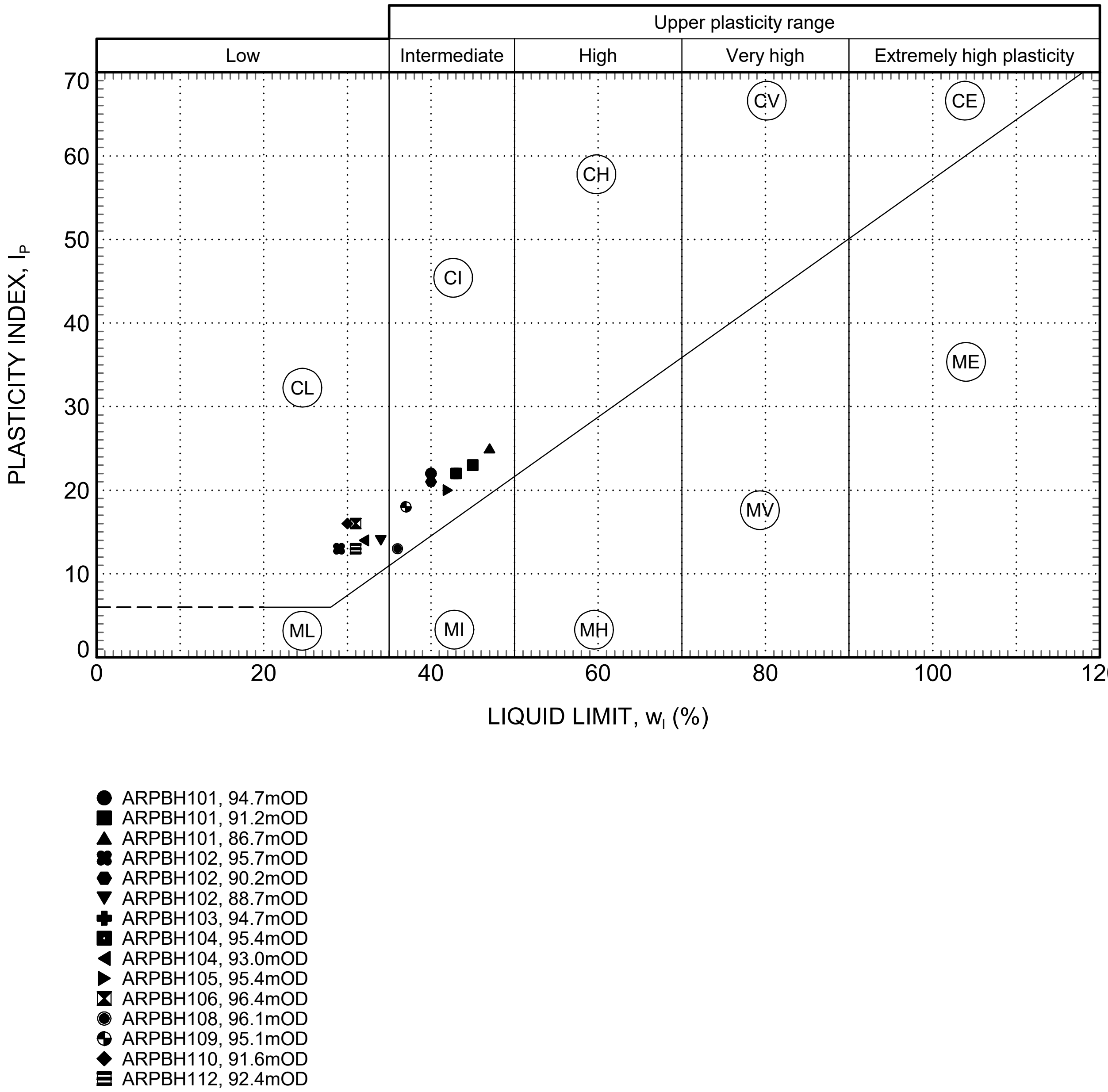
Library: arup_uklib_4-0-002-2, Report: G108.00
Database: \\global\europe\manchester\jobs\250000\252590-00\4 internal project data\4-04 calculations\4-04-11 geotechnical\gint\rev1.gpj RevP1.1 (S0 - Work in progress)

ARUP_gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18D

ASHTON MOSS
PARTICLE SIZE DISTRIBUTION
GLACIAL TILL DEPOSITS
PARTICLE SIZE DISTRIBUTION

252590-00

FIGURE D14

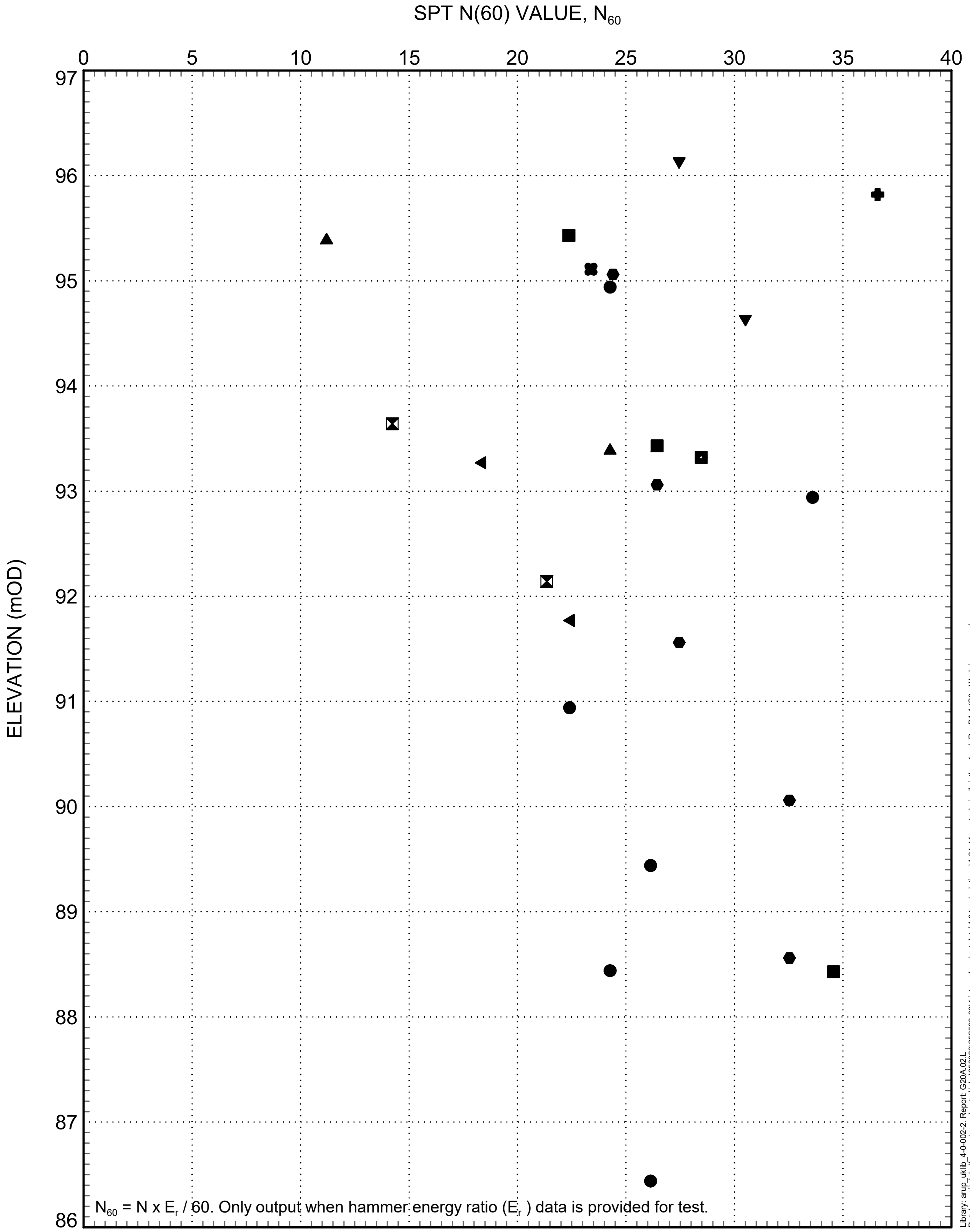


Library: arup_uklib_4-0-002-2. Report: G15.00
Database: \\global\europe\manchester\jobs\250000\252590-00\4 internal project data\4-04 calculations\4-04-11 geotechnical\gint\rev1.gpj
RevP1.1 (S0 - Work in progress)

ARUP. gINT v8.30.004
Made by Sachin Gosai on 10-Jul-18

ASHTON MOSS
PLASTICITY CHART
GLACIAL TILL DEPOSITS
PLASTICITY A-LINE

252590-00 **FIGURE D15**



ASHTON MOSS
STANDARD PENETRATION TESTS
GLACIAL TILL DEPOSITS
CORRECTED SPT N'60' VALUES

252590-00 **FIGURE D16**

Appendix E

Geoenvironmental test results

Residential 2.5%

Exceedance | LOD > GAC | MG-C | MG-P

Analytical Parameter (Soil Analysis)	Method	Units	Limit of detection	GAC	Count > GAC	Minimum (detected)	Max	Average (Excluding those not detected)	18/02990/1	18/02990/2	18/02990/3	18/02990/4	18/02990/5	18/03153/1	18/03153/2	18/03369/1	18/03369/5	18/03369/9	18/03369/13	18/03369/16	18/03369/19	18/03369/22	18/03369/26
Sample ID									ARPBH106	ARPBH106	ARPBH106	ARPBH110	ARPBH110	ARPBH108	ARPBH108	ARPBH101	ARPBH101	ARPBH101	ARPBH102	ARPBH102	ARPBH102	ARPBH105	ARPBH105
Depth (mbgl)									0.50	4.00	7.00	0.20	4.00	1.00	3.00	1.00	5.00	10.00	4.90	8.90	13.60	1.00	4.90
Client Sample ID									2	13	22	2		2	6	2	13	24	10	20	32	2	10
Sample Type									Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES
Sampling Date									09-Apr-18	09-Apr-18	10-Apr-18	10-Apr-18	10-Apr-18	18-Apr-18	18-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	20-Apr-18	20-Apr-18	20-Apr-18	24-Apr-18	24-Apr-18
Sampling Time									n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Asbestos quantification OHR			0.001	-	-	0.054	0.054	0.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	<0.001	N/A	N/A	N/A	N/A
Metals																							
Antimony	DETSC 2301*	mg/kg	1	322	0	<1	<1	0.0	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	DETSC 2301#	mg/kg	0.2	37	0	1	36	10.367	<1	6	<1	3	21	7	5	7	4	4	7	3	9	5	2
Beryllium	DETSC 2301#	mg/kg	0.2	1.7	0	0.5	1.5	0.820	<0.5	0.7	1.2	0.7	1.1	0.9	0.7	0.8	1	1	0.6	0.7	1.1	0.9	1.1
Boron	DETSC 2123#	mg/kg	0.2	290	0	1	3.9	0.653	<1.0	1	<1.0	<1.0	1.4	<1.0	1.4	<1.0	<1.0	<1.0	1.2	1.1	1.3	<1.0	<1.0
Cadmium	DETSC 2301#	mg/kg	0.1	14	0	0.8	4.4	1.437	1	1	3.4	1.1	1.6	1.6	1.2	1.4	1.4	1.1	1	1.2	1.9	1.1	1.2
Chromium	DETSC 2301#	mg/kg	0.15	907	0	10	134	36.673	10	43	19	19	85	36	35	32	21	32	36	24	39	36	26
Chromium (VI)	DETSC 2204*	mg/kg	1	6	0	<1	<1	0.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	DETSC 2301#	mg/kg	0.2	2430	0	15	38	22.9	17	19	30	19	16	30	18	22	27	32	16	24	25	22	25
Lead	DETSC 2301#	mg/kg	0.3	200	3	9	483	74.3	13	82	17	27	194	70	63	67	19	42	90	39	59	118	31
Mercury	DETSC 2325#	mg/kg	0.05	0.56	6	0.17	4.33	0.3	<0.17	**1.44**	<0.17	0.23	**0.65**	0.47	0.37	0.31	<0.17	<0.17	0.23	<0.17	0.52	0.3	<0.17
Nickel	DETSC 2301#	mg/kg	1	126	0	16	46	26.9	22	20	40	23	22	24	20	25	34	32	19	25	28	23	33
Selenium	DETSC 2301#	mg/kg	0.5	253	0	1	4	0.8	1	2	2	2	2	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Vanadium	DETSC 2301	mg/kg	0.8	320	0	13	38	24.6	13	22	31	22	29	28	23	27	26	33	23	24	31	29	30
Zinc	DETSC 2301#	mg/kg	1	3745	0	43	239	84.0	43	90	67	54	106	80	82	74	57	81	88	67	82	86	66
Inorganics																							
pH	DETSC 2008#			-	-	5.26	10.44	7.9	8.39	7.19	7.41	7.52	5.48	8.6	7.93	9.19	8.72	7.41	7.97	8.24	7.57	9.46	8.1
Total Cyanide	DETSC 2130#	mg/kg	0.1	1.4	0	<0.1	<0.1	0.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PID Reading	*	ppm	0.1	-	-	<0.1	<0.1	#DIV/0!															
Total Organic Carbon	DETSC 2002	%	0.1	-	-	0.37	38	5.66	0.37	5.77	1.25	1.92	32.9	4.98	2.28	1.62	0.88	6.11	7.36	3.03	7.12	2.16	2.41
Sulphate Aqueous Extract as SO4	DETSC 2076#	mg/l	10	#N/A	0	<10	<10	#DIV/0!															
Petroleum Hydrocarbons																							
Aliphatic C5-C6	DETSC 3321*	mg/kg	0.01	78	0	<0.01	<0.01	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01	<0.01
Aliphatic C6-C8	DETSC 3321*	mg/kg	0.01	231	0	0.01	0.07	0.0	<0.01	0.01	<0.01	<0.01	0.07	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01	<0.01
Aliphatic C8-C10	DETSC 3321*	mg/kg	0.01	65	0	0.44	0.44	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01	<0.01
Aliphatic C10-C12	DETSC 3072#	mg/kg	1.5	326	0	0.05	1.2	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	<0.1	0.5	<0.1
Aliphatic C12-C16	DETSC 3072#	mg/kg	1.2	2411	0	0.5	2	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2	<0.1
Aliphatic C16-C21	DETSC 3072#	mg/kg	1.5	26100	0	0.6	19.4	0.7	<0.1	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.6	<0.1	3.9	<0.1
Aliphatic C21-C35	DETSC 3072#	mg/kg	3.4	26100	0	2.4	57.7	4.2	<0.1	11.1	<0.1	2.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	13.3	<0.1	57.7	<0.1
Aliphatic C5-C35	DETSC 3072*	mg/kg	10	55311	0	2.4	64.1	3.9	<0.1	11.9	<0.1	2.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	14	<0.1	64.1	<0.1
Aromatic C5-C7	DETSC 3321*	mg/kg	0.01	0.2	3	5	94.2	3.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01	<0.01
Aromatic C7-C8	DETSC 3321*	mg/kg	0.01	289	0	0.01	0.01	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01	<0.01
Aromatic C8-C10	DETSC 3321*	mg/kg	0.01	83.0	0	0.02	0.02	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01	<0.01
Aromatic C10-C12	DETSC 3072#	mg/kg	0.9	175	0	0.03	2.2	0.3	<0.1	0.9	<0.1	<0.1	<0.1	0.7	0.5	0.6	<0.1	0.5	0.2	<0.1	<0.1	0.6	<0.1
Aromatic C12-C16	DETSC 3072#	mg/kg	0.5	323	0	0.2	8.2	1.6	<0.1	5	<0.1	<0.1	<0.1	8.2	4.8	2.2	<0.1	4.2	1.2	<0.1	<0.1	4	<0.1
Aromatic C16-C21	DETSC 3072#	mg/kg	0.6	524	0	1.3	25	4.5	<0.1	14.2	<0.1	<0.1	<0.1	25	16.8	3.5	<0.1	6.1	3.2	<0.1	<0.1	7.4	<0.1
Aromatic C21-C35	DETSC 3072#	mg/kg	1.4	1488	0	0.9	55.8	11.8	0.9	55.8	<0.1	<0.1	<0.1	40.4	40.9	16.4	<0.1	6.1	7.5	13.6	<0.1	52.3	<0.1
Aromatic C5-C35	DETSC 3072*	mg/kg	10	2882	0	0.9	76	15.6	0.9	76	<0.1	<0.1	<0.1	74.3	62.9	22.6	<0.1	16.9	12.2	13.6	<0.1	64.2	<0.1
TPH Ali/Aro Total	DETSC 3072*	mg/kg	10	-	-	0.9	128	26.6	0.9	87.7	<0.1	2.4	<0.1	74.3	62.9	22.6	<0.1	16.9	12.2	27.4	<0.1	128	<0.1
Benzene	DETSC 3321#	mg/kg	0.01	0	10	7	178	11.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01	<0.01
Ethylbenzene	DETSC 3321#	mg/kg	0.01	110	0	<0.01	<0.01	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01	<0.01
Toluene	DETSC 3321#	mg/kg	0.01	289	0	0.01	0.01	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01	<0.01
Xylene	DETSC 3321#	mg/kg	0.01	#N/A	0	<0.01	<0.01	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01	<0.01
PAHs																							
Naphthalene	DETSC 3301	mg/kg	0.1	6	0	0.04	2.6	0.3	<0.03	0.29	<0.03	<0.03	<0.03	2.59	0.14	0.06	<0.03	0.13	0.04	0.06	0.05	0.37	0.06
Acenaphthylene	DETSC 3301	mg/kg	0.1	415	0	0.01	2.63	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.06	<0.01
Acenaphthene	DETSC 3301	mg/kg	0.1	506	0	0.01	2.67	0.2	<0.01	0.28	<0.01	0.03	<0.01	2.67	0.36	0.08	<0.01	0.11	0.08	0.17	0.06	1.95	0.12
Fluorene	DETSC 3301	mg/kg	0.1	398	0	0.01	17.5	1.2	<0.01	0.19	<0.01	0.02	<0.01	3.92	0.29	0.09	<0.01	0.06	0.05	0.1	0.03	1.49	0.06
Phenanthrene	DETSC 3301	mg/kg	0.1	218	0	0.03	19.1	1.0	0.03	1	<0.03	0.15	<0.03	19.1	2.05	0.97	<0.03	0.29	0.32	0.45	0.25	8.23	0.26
Anthracene	DETSC 3301	mg/kg	0.1	5360	0	0.02	4.57	0.2	<0.02	0.2	<0.02	0.04	<0.02	4.57	0.48	0.35	<0.02	0.08	0.11	0.16	0.08	1.93	0.1
Fluoranthene	DETSC 3301	mg/kg	0.1	558	0	0.09	15.2	0.8	<0.08	0.91	<0.08	0.16	<0.08	15.2	2.71	1.25	<0.08	0.29	0.48	0.51	0.28	8.45	0.23
Pyrene	DETSC 3301	mg/kg	0.1	1240	0	0.07	15.8	1.6	<0.07	0.83	<0.07	0.17	<0.07	12.1	2.43	0.94	<0.07	0.26	0.46	0.44	0.26	7.07	0.2
Benzo (a) anthracene	DETSC 3301	mg/kg	0.1	11	0	0.05	5.18	0.5	<0.04	0.31	<0.04	0.08	<0.04	5.18	1.06	0.5	<0.04	0.08	0.14	0.13	0.09	2.72	0.06
Chrysene	DETSC 3301	mg/kg	0.1	22	0	0.08	4.39	0.4	<0.06	0.4	<0.06	0.11	<0.06	4.39	1.12	0.58	<0.06	0.14	0.22	0.18	0.12	2.75	0.08
Benzo (b) fluoranthene	DETSC 3301	mg/kg	0.1	3	2	0.06	5.27	0.6	<0.05	0.22	<0.05	0.07	<0.05	**3.83**	0.94	0.36	<0.05	0.11	0.13	0.11	0.08	2.27	<0.05
Benzo (k) fluoranthene	DETSC 3301	mg/kg	0.1	93	0	0.14	2.22	0.2	<0.07	<0.07	<0.07	<0.07	<0.07	1.25	0.27	0.2	<0.07	<0.07	<0.07	<0.07	<0.07	1.06	<0.07
Benzo (a) pyrene	DETSC 3301	mg/kg	0.1	3	3	0.06	6.93	0.6	<0.04	0.19	<0.04	0.06	<0.04	**3.46**	0.75	0.34	<0.04	0.1	0.12	0.1	0.08	1.93	<0.04
Indeno (1,2,3 - cd) pyrene	DETSC 3301	mg/kg	0.1	36	0	0.01	2.14	0.3	<0.03	0.16	<0.03	0.05	<0.03	2.14	0.53	0.16	<0.03	0.06	0.05	0.04	<0.03	0.94	<0.03
Dibenzo (ah) anthracene	DETSC 3301	mg/kg	0.1	0	10	0.07	6.35	0.4	<0.04	<0.04	<0.04	<0.04	<0.04	**0.33**	0.08	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.23	<0.04
Benzo (ghi) perylene	DETSC 3301	mg/kg	0.1	338	0	0.05	5.85	0.5	<0.05	0.13	<0.05	0.05	<0.05	1.61	0.43	0.13	<0.05	<0.05	<0.05	<0.05	<0.05	0.81	<0.05
PAH Total	DETSC 3301	mg/kg	1.6	-	-	0.14	82.3	5.0	<0.08	5.08	<0.08	0.99	<0.08	82.3	13.7	6.03	<0.08	1.72	2.23	2.43	1.31	42.3	1.19

Lab Sample Number	18/03369/29	18/03369/35	18/03369/48	18/03369/52	18/03369/56	18/03369/57	18/03369/58	18/03369/62	18/03369/63	18/03369/66	18/03369/69	18/03369/74	18/03369/79	18/03064/1
Sample ID	ARPBH105	ARPBH108	ARPBH112	ARPBH112	ARPWS101	ARPWS101A	ARPWS102	ARPWS102	ARPWS103	ARPWS103	ARPWS107	ARPWS107	ARPWS107	ARPBH102
Depth (mbgl)	8.90	7.00	1.00	4.90	1.70	0.60	0.50	4.50	0.40	4.50	0.20	4.70	8.50	1.00
Client Sample ID	18	14	2	11	6	2	2	14	2	13	2	16	30	2
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES
Sampling Date	24-Apr-18	19-Apr-18	23-Apr-18	23-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	26-Apr-18	26-Apr-18	27-Apr-18	18-Apr-18
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s					
Asbestos quantification OHR	N/A	<0.001	<0.001	N/A	<0.001	N/A	N/A	N/A	<0.001	N/A	N/A	<0.001	N/A	0.054
Metals														
Antimony	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	19	7	5	36	5	15	9	16	7	17	9	6	3	14
Beryllium	1.4	0.8	<0.5	1.5	<0.5	1	0.8	0.9	0.6	0.9	0.8	0.5	1	0.5
Boron	1.5	<1.0	1.2	2.4	3.9	<1.0	<1.0	1.9	<1.0	1.8	<1.0	<1.0	<1.0	<1.0
Cadmium	1.7	1.3	1	4.4	0.9	1.3	1.1	1.7	1.2	1.2	1.4	1	0.8	1
Chromium	79	24	30	134	33	43	36	80	38	55	45	41	40	21
Chromium (VI)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	29	21	15	26	38	20	18	19	17	16	16	15	23	17
Lead	147	28	60	**264**	72	72	64	157	77	118	**483**	88	37	80
Mercury	0.37	<0.17	0.37	**1.5**	0.44	0.22	0.19	**0.63**	0.21	0.36	0.42	0.3	<0.17	0.29
Nickel	33	29	18	35	17	28	23	24	20	19	23	19	22	16
Selenium	<1	<1	<1	2	<1	<1	1	2	<1	2	<1	<1	<1	2
Vanadium	38	21	17	38	21	23	22	28	20	22	21	19	22	20
Zinc	182	66	76	218	92	94	86	134	92	114	97	79	49	87
Inorganics														
pH	6.86	7.94	7.71	7.1	8.89	8.06	7.75	6.75	7.45	5.79	7.72	9.11	6.75	8.74
Total Cyanide	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PID Reading														
Total Organic Carbon	13.7	0.59	1.05	12.9	4.54	6.15	9.85	14.5	3.23	38	2.21	1.92	4.19	2.38
Sulphate Aqueous Extract as SO4														
Petroleum Hydrocarbons														
Aliphatic C5-C6	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05	
Aliphatic C6-C8	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Aliphatic C8-C10	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	0.44	<0.01	<0.01	<0.05	<0.01
Aliphatic C10-C12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.01
Aliphatic C12-C16	<0.1	<0.1	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C16-C21	<0.1	<0.1	5.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C21-C35	<0.1	7.4	30.1	<0.1	<0.1	<0.1	<0.1	10.9	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C5-C35	<0.1	7.4	37.1	<0.1	<0.1	<0.1	<0.1	12.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatic C5-C7	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05	<0.1
Aromatic C7-C8	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05	0.01
Aromatic C8-C10	<0.05	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Aromatic C10-C12	<0.1	0.4	2.2	2.2	0.4	1.3	<0.1	<0.1	<0.1	<0.1	0.8	0.5	0.4	<0.01
Aromatic C12-C16	0.8	2.6	4.3	5.2	2.5	4.9	1	1.2	1.6	<0.1	6	5.5	5	1.3
Aromatic C16-C21	3.9	3.7	5.8	12	5.5	14.4	2.3	6.1	8.9	<0.1	14.8	11.6	10.5	4.3
Aromatic C21-C35	9.8	4.6	18.8	23.6	14	19.8	8.9	21.8	31.2	13.3	31.5	22.9	19.7	13
Aromatic C5-C35	14.5	11.2	31.1	42.8	22.6	40.5	12.2	28.9	41.7	13.3	53.1	40.5	35.7	<0.1
TPH Ali/Aro Total	14.5	18.7	68.2	42.8	22.6	40.5	12.2	41	41.7	13.3	53.1	40.5	35.7	61.1
Benzene	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05	**61.1**
Ethylbenzene	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Toluene	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05	0.01
Xylene	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
PAHs														
Naphthalene	<0.03	<0.03	0.12	0.2	0.12	0.05	<0.03	0.24	<0.03	<0.03	0.16	0.17	0.09	1.12
Acenaphthylene	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	0.52
Acenaphthene	0.05	0.06	0.17	0.25	0.12	0.03	0.01	0.17	0.08	<0.01	0.35	0.16	0.16	
Fluorene	0.02	0.05	0.11	0.13	0.06	0.01	<0.01	0.1	0.05	<0.01	0.21	0.1	0.09	4.89
Phenanthrene	0.19	0.26	0.9	0.95	0.4	0.09	0.11	1	0.5	<0.03	1.65	0.5	0.63	0.29
Anthracene	0.07	0.07	0.24	0.23	0.08	0.03	0.03	0.24	0.17	<0.02	0.35	0.12	0.13	0.04
Fluoranthene	0.24	0.27	1.14	1.12	0.42	<0.08	0.16	0.73	0.8	<0.08	1.93	0.39	0.73	0.27
Pyrene	0.24	0.24	1.07	1.02	0.41	<0.07	0.16	0.7	0.77	<0.07	1.93	0.34	0.71	3.36
Benzo (a) anthracene	0.07	0.07	0.41	0.37	0.14	<0.04	<0.04	0.19	0.3	<0.04	0.65	0.09	0.23	0.83
Chrysene	0.1	0.12	0.56	0.48	0.22	<0.06	<0.06	0.29	0.42	<0.06	0.88	0.13	0.36	0.83
Benzo (b) fluoranthene	<0.05	0.07	0.42	0.28	0.14	<0.05	<0.05	0.12	0.34	<0.05	0.61	0.07	0.23	2.02
Benzo (k) fluoranthene	<0.07	<0.07	0.18	0.15	<0.07	<0.07	<0.07	<0.07	0.16	<0.07	0.3	<0.07	0.14	1.01
Benzo (a) pyrene	<0.04	0.06	0.39	0.27	0.13	<0.04	<0.04	0.15	0.3	<0.04	0.57	0.06	0.22	2.26
Indeno (1,2,3 - cd) pyrene	<0.03	<0.03	0.22	0.12	0.07	<0.03	<0.03	<0.03	0.17	<0.03	0.24	<0.03	0.09	0.41
Dibenzo (ah) anthracene	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.07	<0.04	<0.04	**2.48**
Benzo (ghi) perylene	<0.05	<0.05	0.2	0.12	0.07	<0.05	<0.05	<0.05	0.16	<0.05	0.24	<0.05	0.1	2.36
PAH Total	0.95	1.29	6.14	5.7	2.42	0.21	0.47	3.98	4.2	<0.08	10.2	2.15	3.88	4.43

Lab Sample Number	18/03064/2	18/03064/3	18/03064/4	18/03064/5	18/03064/6	18/03064/7	18/03064/9	18/03064/10	18/03064/11	18/03064/13	18/03064/40
Sample ID	ARPBH103	ARPBH103	ARPBH103	ARPBH104	ARPBH104	ARPBH104	ARPBH109	ARPBH109	ARPBH109	ARPBH111	ARPBH111
Depth (mbgl)	1.00	4.00	7.00	1.00	3.90	7.90	0.50	5.00	9.00	5.60	1.00
Client Sample ID	3	12	21	2	11	22	2	15	26	16	2
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES
Sampling Date	17-Apr-18	17-Apr-18	18-Apr-18	13-Apr-18	13-Apr-18	16-Apr-18	16-Apr-18	16-Apr-18	16-Apr-18	17-Apr-18	17-Apr-18
Sampling Time											
Asbestos quantification OHR	N/A	N/A	N/A	<0.001	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Metals											
Antimony	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	32	18	21	12	16	30	17	15	12	18	6
Beryllium	0.8	0.9	1	0.5	0.9	0.9	0.6	0.6	0.7	0.9	0.6
Boron	1.6	1.7	<1.0	<1.0	1.2	<1.0	1.5	1.4	<1.0	1.1	<1.0
Cadmium	1.4	1.5	1.8	1	1.5	1.6	1.6	1.3	1.2	1.4	1.4
Chromium	62	52	23	25	34	37	31	27	27	29	33
Chromium (VI)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	33	24	27	16	29	18	32	29	17	22	21
Lead	**224**	79	14	61	72	27	64	49	21	50	62
Mercury	**4.33**	0.43	<0.17	<0.17	0.41	<0.17	**0.72**	<0.17	<0.17	<0.17	<0.17
Nickel	22	28	37	18	30	37	26	22	26	26	42
Selenium	2	2	1	2	2	3	<1	1	1	2	<1
Vanadium	19	25	25	18	27	19	32	19	17	24	20
Zinc	239	108	61	66	75	73	83	69	48	70	69
Inorganics											
pH	9.29	8.15	8.49	9.15	8.37	8.07	10.44	7.75	7.77	8.13	8.56
Total Cyanide	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PID Reading											
Total Organic Carbon	3.57	5.74	1.26	2.03	3.15	8.95	1.92	4.16	5.2	3.39	3.11
Sulphate Aqueous Extract as SO4											
Petroleum Hydrocarbons											
Aliphatic C5-C6											
Aliphatic C6-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aliphatic C8-C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aliphatic C10-C12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aliphatic C12-C16	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C16-C21	<0.1	19.4	<0.1	<0.1	<0.1	<0.1	1.7	<0.1	<0.1	<0.1	<0.1
Aliphatic C21-C35	<0.1	32.2	<0.1	<0.1	<0.1	<0.1	10.8	<0.1	<0.1	<0.1	<0.1
Aliphatic C5-C35	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	7.6	<0.1	<0.1	<0.1	<0.1
Aromatic C5-C7	**5**	**68.1**	<0.1	<0.1	<0.1	<0.1	**94.2**	<0.1	<0.1	<0.1	<0.1
Aromatic C7-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aromatic C8-C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aromatic C10-C12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01
Aromatic C12-C16	0.7	1	<0.1	0.7	0.3	0.9	0.2	<0.1	<0.1	0.4	0.3
Aromatic C16-C21	2.8	11.5	<0.1	4.3	1.3	3.5	2	<0.1	<0.1	1.9	2.6
Aromatic C21-C35	6	31	<0.1	10.6	6.5	2	10	<0.1	<0.1	5.3	10.9
Aromatic C5-C35	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	14.7	<0.1	<0.1	<0.1	<0.1
TPH Ali/Aro Total	19.8	78.4	<0.1	38.7	25.9	7	84	<0.1	<0.1	12.6	32.5
Benzene	**24.7**	**146**	<0.1	**38.7**	**25.9**	**7**	**178**	<0.1	<0.1	**12.6**	**32.5**
Ethylbenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Toluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PAHs											
Naphthalene	0.98	0.62	<0.03	1.41	0.75	<0.03	0.83	0.07	<0.03	2.6	0.39
Acenaphthylene	0.4	0.65	0.01	2.63	0.64	0.05	0.35	0.06	0.02	2.31	0.32
Acenaphthene											
Fluorene	3.87	3.71	<0.08	9.69	3.83	0.16	3.04	0.41	<0.08	17.5	1.82
Phenanthrene	0.5	0.62	<0.03	2.12	0.49	0.51	0.22	<0.03	<0.03	0.82	0.29
Anthracene	0.08	0.12	<0.01	0.08	0.03	<0.01	0.03	<0.01	<0.01	0.09	0.02
Fluoranthene	0.24	0.16	<0.04	0.34	0.18	<0.04	0.19	<0.04	<0.04	0.58	0.09
Pyrene	2.78	3.82	0.07	10	3.09	0.44	2.17	0.39	0.1	15.8	1.36
Benzo (a) anthracene	0.58	0.93	<0.02	2.42	0.8	0.05	0.57	0.08	<0.02	3.82	0.34
Chrysene	0.69	0.53	<0.07	1.36	0.59	<0.07	0.61	<0.07	<0.07	2.41	0.28
Benzo (b) fluoranthene	1.63	1.14	<0.04	2.98	1.34	0.06	1.46	0.11	<0.04	**5.27**	0.66
Benzo (k) fluoranthene	0.95	0.54	<0.05	1.25	0.67	<0.05	0.77	<0.05	<0.05	2.22	0.35
Benzo (a) pyrene	1.84	1.52	<0.04	**3.79**	1.67	0.09	1.51	0.15	<0.04	**6.93**	0.85
Indeno (1,2,3 - cd) pyrene	0.35	0.79	0.01	2.13	0.57	0.05	0.29	0.06	0.01	2.12	0.23
Dibenzo (ah) anthracene	**1.99**	**1.48**	<0.06	**3.73**	**1.62**	0.11	**1.55**	0.17	<0.06	**6.35**	**0.89**
Benzo (ghi) perylene	1.92	1.32	<0.05	3.42	1.61	0.09	1.7	0.15	<0.05	5.85	0.81
PAH Total	3.58	3.15	<0.07	8.51	3.39	0.15	2.79	0.35	<0.07	14.7	1.71

Residential no plant uptake 2.5%

Exceedance
LOD > GAC

MG-C
MG-P

Lab Sample Number									18/02990/1	18/02990/2	18/02990/3	18/02990/4	18/02990/5	18/03153/1	18/03153/2	18/03369/1	18/03369/5	18/03369/9	18/03369/13	18/03369/16	18/03369/19
Sample ID									ARPBH106	ARPBH106	ARPBH106	ARPBH110	ARPBH110	ARPBH108	ARPBH108	ARPBH101	ARPBH101	ARPBH101	ARPBH102	ARPBH102	ARPBH102
Depth (mbgl)									0.50	4.00	7.00	0.20	4.00	1.00	3.00	1.00	5.00	10.00	4.90	8.90	13.60
Client Sample ID									2	13	22			2	6	2	13	24	10	20	32
Sample Type									Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES
Sampling Date									09-Apr-18	09-Apr-18	10-Apr-18	10-Apr-18	10-Apr-18	18-Apr-18	18-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	20-Apr-18	20-Apr-18	20-Apr-18
Sampling Time									n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Analytical Parameter (Soil Analysis)	**Method**	**Units**	**Limit of detection**	**GAC**	**Count > GAC**	**Minimum (detected)**	**Max**	**Average (including those detected)**													
Asbestos quantification OHR			0.001	-	-	0.054	0.054	0.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	<0.001	N/A	N/A
Metals																					
Antimony	DETSC 2301*	mg/kg	1	617.5682	0	<1	<1	0.0	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	DETSC 2301#	mg/kg	0.2	39.9	0	1	36	10.367	<1	6	<1	3	21	7	5	7	4	4	7	3	9
Beryllium	DETSC 2301#	mg/kg	0.2	1.724086	0	0.5	1.5	0.820	<0.5	0.7	1.2	0.7	1.1	0.9	0.7	0.8	1	1	0.6	0.7	1.1
Boron	DETSC 2123#	mg/kg	0.2	10775.16	0	1	3.9	0.653	<1.0	1	<1.0	<1.0	1.4	<1.0	1.4	<1.0	<1.0	<1.0	1.2	1.1	1.3
Cadmium	DETSC 2301#	mg/kg	0.1	85	0	0.8	4.4	1.437	1	1	3.4	1.1	1.6	1.6	1.2	1.4	1.4	1.1	1	1.2	1.9
Chromium	DETSC 2301#	mg/kg	0.15	907	0	10	134	36.673	10	43	19	19	85	36	35	32	21	32	36	24	39
Chromium (VI)	DETSC 2204*	mg/kg	1	6	0	<1	<1	0.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	DETSC 2301#	mg/kg	0.2	7130	0	15	38	22.9	17	19	30	19	16	30	18	22	27	32	16	24	25
Lead	DETSC 2301#	mg/kg	0.3	310	1	9	483	74.3	13	82	17	27	194	70	63	67	19	42	90	39	59
Mercury	DETSC 2325#	mg/kg	0.05	0.57	6	0.17	4.33	0.3	<0.17	1.44	<0.17	0.23	0.65	0.47	0.37	0.31	<0.17	<0.17	0.23	<0.17	0.52
Nickel	DETSC 2301#	mg/kg	1	181	0	16	46	26.9	22	20	40	23	22	24	20	25	34	32	19	25	28
Selenium	DETSC 2301#	mg/kg	0.5	430	0	1	4	0.8	1	2	2	2	2	<1	<1	<1	<1	<1	<1	<1	<1
Vanadium	DETSC 2301	mg/kg	0.8	651	0	13	38	24.6	13	22	31	22	29	28	23	27	26	33	23	24	31
Zinc	DETSC 2301#	mg/kg	1	40400	0	43	239	84.0	43	90	67	54	106	80	82	74	57	81	88	67	82
Inorganics																					
pH	DETSC 2008#			-	-	5.26	10.44	7.9	8.39	7.19	7.41	7.52	5.48	8.6	7.93	9.19	8.72	7.41	7.97	8.24	7.57
Total Cyanide	DETSC 2130#	mg/kg	0.1	800.0	0	<0.1	<0.1	0.0	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PID Reading	*	ppm	0.1	-	-	<0.1	<0.1	#DIV/0!													
Total Organic Carbon	DETSC 2002	%	0.1	-	-	0.37	38	5.66	0.37	5.77	1.25	1.92	32.9	4.98	2.28	1.62	0.88	6.11	7.36	3.03	7.12
Sulphate Aqueous Extract as SO4	DETSC 2076#	mg/l	10	#N/A	0	<10	<10	#DIV/0!													
Petroleum Hydrocarbons																					
Aliphatic C5-C6	DETSC 3321*	mg/kg	0.01	78	0	<0.01	<0.01	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05
Aliphatic C6-C8	DETSC 3321*	mg/kg	0.01	231	0	0.01	0.07	0.0	<0.01	0.01	<0.01	<0.01	0.07	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05
Aliphatic C8-C10	DETSC 3321*	mg/kg	0.01	65	0	0.44	0.44	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05
Aliphatic C10-C12	DETSC 3072#	mg/kg	1.5	327	0	0.05	1.2	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	<0.1
Aliphatic C12-C16	DETSC 3072#	mg/kg	1.2	2420	0	0.5	2	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C16-C21	DETSC 3072#	mg/kg	1.5	26200	0	0.6	19.4	0.7	<0.1	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.6	<0.1
Aliphatic C21-C35	DETSC 3072#	mg/kg	3.4	26200	0	2.4	57.7	4.2	<0.1	11.1	<0.1	2.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	13.3	<0.1
Aliphatic C5-C35	DETSC 3072*	mg/kg	10	55521	0	2.4	64.1	3.9	<0.1	11.9	<0.1	2.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	14	<0.1
Aromatic C5-C7	DETSC 3321*	mg/kg	0.01	0.7	3	5	94.2	3.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05
Aromatic C7-C8	DETSC 3321*	mg/kg	0.01	1870	0	0.01	0.01	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05
Aromatic C8-C10	DETSC 3321*	mg/kg	0.01	115.0	0	0.02	0.02	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05
Aromatic C10-C12	DETSC 3072#	mg/kg	0.9	594	0	0.03	2.2	0.3	<0.1	0.9	<0.1	<0.1	<0.1	0.7	0.5	0.6	<0.1	0.5	0.2	<0.1	<0.1
Aromatic C12-C16	DETSC 3072#	mg/kg	0.5	2300	0	0.2	8.2	1.6	<0.1	5	<0.1	<0.1	<0.1	8.2	4.8	2.2	<0.1	4.2	1.2	<0.1	<0.1
Aromatic C16-C21	DETSC 3072#	mg/kg	0.6	1680	0	1.3	25	4.5	<0.1	14.2	<0.1	<0.1	<0.1	25	16.8	3.5	<0.1	6.1	3.2	<0.1	<0.1
Aromatic C21-C35	DETSC 3072#	mg/kg	1.4	1930	0	0.9	55.8	11.8	0.9	55.8	<0.1	<0.1	<0.1	40.4	40.9	16.4	<0.1	6.1	7.5	13.6	<0.1
Aromatic C5-C35	DETSC 3072*	mg/kg	10	8490	0	0.9	76	15.6	0.9	76	<0.1	<0.1	<0.1	74.3	62.9	22.6	<0.1	16.9	12.2	13.6	<0.1
TPH Ali/Aro Total	DETSC 3072*	mg/kg	10	-	-	0.9	128	26.6	0.9	87.7	<0.1	2.4	<0.1	74.3	62.9	22.6	<0.1	16.9	12.2	27.4	<0.1
Benzene	DETSC 3321#	mg/kg	0.01	1	10	7	178	11.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05
Ethylbenzene	DETSC 3321#	mg/kg	0.01	192	0	<0.01	<0.01	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05
Toluene	DETSC 3321#	mg/kg	0.01	1870	0	0.01	0.01	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05
Xylene	DETSC 3321#	mg/kg	0.01	#N/A	0	<0.01	<0.01	0.0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05
PAHs																					
Naphthalene	DETSC 3301	mg/kg	0.1	6	0	0.04	2.6	0.3	<0.03	0.29	<0.03	<0.03	<0.03	2.59	0.14	0.06	<0.03	0.13	0.04	0.06	0.05
Acenaphthylene	DETSC 3301	mg/kg	0.1	4582	0	0.01	2.63	0.2	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	DETSC 3301	mg/kg	0.1	4690	0	0.01	2.67	0.2	<0.01	0.28	<0.01	0.03	<0.01	2.67	0.36	0.08	<0.01	0.11	0.08	0.17	0.06
Fluorene	DETSC 3301	mg/kg	0.1	3819	0	0.01	17.5	1.2	<0.01	0.19	<0.01	0.02	<0.01	3.92	0.29	0.09	<0.01	0.06	0.05	0.1	0.03
Phenanthrene	DETSC 3301	mg/kg	0.1	1447	0	0.03	19.1	1.0	0.03	1	<0.03	0.15	<0.03	19.1	2.05	0.97	<0.03	0.29	0.32	0.45	0.25
Anthracene	DETSC 3301	mg/kg	0.1	34709	0	0.02	4.57	0.2	<0.02	0.2	<0.02	0.04	<0.02	4.57	0.48	0.35	<0.02	0.08	0.11	0.16	0.08
Fluoranthene	DETSC 3301	mg/kg	0.1	1562	0	0.09	15.2	0.8	<0.08	0.91	<0.08	0.16	<0.08	15.2	2.71	1.25	<0.08	0.29	0.48	0.51	0.28
Pyrene	DETSC 3301	mg/kg	0.1	3750	0	0.07	15.8	1.6	<0.07	0.83	<0.07	0.17	<0.07	12.1	2.43	0.94	<0.07	0.26	0.46	0.44	0.26
Benzo (a) anthracene	DETSC 3301	mg/kg	0.1	14	0	0.05	5.18	0.5	<0.04	0.31	<0.04	0.08	<0.04	5.18	1.06	0.5	<0.04	0.08	0.14	0.13	0.09
Chrysene	DETSC 3301	mg/kg	0.1	31	0	0.08	4.39	0.4	<0.06	0.4	<0.06	0.11	<0.06	4.39	1.12	0.58	<0.06	0.14	0.22	0.18	0.12
Benzo (b) fluoranthene	DETSC 3301	mg/kg	0.1	4	1	0.06	5.27	0.6	<0.05	0.22	<0.05	0.07	<0.05	3.83	0.94	0.36	<0.05	0.11	0.13	0.11	0.08
Benzo (k) fluoranthene	DETSC 3301	mg/kg	0.1	107	0	0.14	2.22	0.2	<0.07	<0.07	<0.07	<0.07	<0.07	1.25	0.27	0.2	<0.07	<0.07	<0.07	<0.07	<0.07
Benzo (a) pyrene	DETSC 3301	mg/kg	0.1	3	3	0.06	6.93	0.6	<0.04	0.19	<0.04	0.06	<0.04	3.46	0.75	0.34	<0.04	0.1	0.12	0.1	0.08
Indeno (1,2,3 - cd) pyrene	DETSC 3301	mg/kg	0.1	46	0	0.01	2.14	0.3	<0.03	0.16	<0.03	0.05	<0.03	2.14	0.53	0.16	<0.03	0.06	0.05	0.04	<0.03
Dibenzo (ah) anthracene	DETSC 3301	mg/kg	0.1	0	10	0.07	6.35	0.4	<0.04	<0.04	<0.04	<0.04	<0.04	0.33	0.08	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Benzo (ghi) perylene	DETSC 3301	mg/kg	0.1	358	0	0.05	5.85	0.5	<0.05	0.13	<0.05	0.05	<0.05	1.61	0.43	0.13	<0.05	<0.05	<0.05	<0.05	<0.05
PAH Total	DETSC 3301	mg/kg	1.6	-	-	0.14	82.3	5.0	<0.08	5.08	<0.08	0.99	<0.08	82.3	13.7	6.03	<0.08	1.72	2.23	2.43	1.31

Lab Sample Number	18/03369/22	18/03369/26	18/03369/29	18/03369/35	18/03369/48	18/03369/52	18/03369/56	18/03369/57	18/03369/58	18/03369/62	18/03369/63	18/03369/66	18/03369/69	18/03369/74
Sample ID	ARPBH105	ARPBH105	ARPBH105	ARPBH108	ARPBH112	ARPBH112	ARPWS101	ARPWS101A	ARPWS102	ARPWS102	ARPWS103	ARPWS103	ARPWS107	ARPWS107
Depth (mbgl)	1.00	4.90	8.90	7.00	1.00	4.90	1.70	0.60	0.50	4.50	0.40	4.50	0.20	4.70
Client Sample ID	2	10	18	14	2	11	6	2	2	14	2	13	2	16
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES
Sampling Date	24-Apr-18	24-Apr-18	24-Apr-18	19-Apr-18	23-Apr-18	23-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	26-Apr-18	26-Apr-18
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s			
Asbestos quantification OHR	N/A	N/A	N/A	<0.001	<0.001	N/A	<0.001	N/A	N/A	N/A	<0.001	N/A	N/A	<0.001
Metals														
Antimony	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	5	2	19	7	5	36	5	15	9	16	7	17	9	6
Beryllium	0.9	1.1	1.4	0.8	<0.5	1.5	<0.5	1	0.8	0.9	0.6	0.9	0.8	0.5
Boron	<1.0	<1.0	1.5	<1.0	1.2	2.4	3.9	<1.0	<1.0	1.9	<1.0	1.8	<1.0	<1.0
Cadmium	1.1	1.2	1.7	1.3	1	4.4	0.9	1.3	1.1	1.7	1.2	1.2	1.4	1
Chromium	36	26	79	24	30	134	33	43	36	80	38	55	45	41
Chromium (VI)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	22	25	29	21	15	26	38	20	18	19	17	16	16	15
Lead	118	31	147	28	60	264	72	72	64	157	77	118	483	88
Mercury	0.3	<0.17	0.37	<0.17	0.37	1.5	0.44	0.22	0.19	0.63	0.21	0.36	0.42	0.3
Nickel	23	33	33	29	18	35	17	28	23	24	20	19	23	19
Selenium	<1	<1	<1	<1	<1	2	<1	<1	1	2	<1	2	<1	<1
Vanadium	29	30	38	21	17	38	21	23	22	28	20	22	21	19
Zinc	86	66	182	66	76	218	92	94	86	134	92	114	97	79
Inorganics														
pH	9.46	8.1	6.86	7.94	7.71	7.1	8.89	8.06	7.75	6.75	7.45	5.79	7.72	9.11
Total Cyanide	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PID Reading														
Total Organic Carbon	2.16	2.41	13.7	0.59	1.05	12.9	4.54	6.15	9.85	14.5	3.23	38	2.21	1.92
Sulphate Aqueous Extract as SO4														
Petroleum Hydrocarbons														
Aliphatic C5-C6	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01
Aliphatic C6-C8	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01
Aliphatic C8-C10	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	0.44	<0.01	<0.01
Aliphatic C10-C12	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.2	<0.1	<0.1	<0.1	<0.1
Aliphatic C12-C16	2	<0.1	<0.1	<0.1	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C16-C21	3.9	<0.1	<0.1	<0.1	5.8	<0.1	<0.1	<0.1	<0.1	10.9	<0.1	<0.1	<0.1	<0.1
Aliphatic C21-C35	57.7	<0.1	7.4	<0.1	30.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C5-C35	64.1	<0.1	7.4	<0.1	37.1	<0.1	<0.1	<0.1	<0.1	12.1	<0.1	<0.1	<0.1	<0.1
Aromatic C5-C7	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01
Aromatic C7-C8	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01
Aromatic C8-C10	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01
Aromatic C10-C12	0.6	<0.1	<0.1	0.4	2.2	2.2	0.4	1.3	<0.1	<0.1	<0.1	<0.1	0.8	0.5
Aromatic C12-C16	4	<0.1	0.8	2.6	4.3	5.2	2.5	4.9	1	1.2	1.6	<0.1	6	5.5
Aromatic C16-C21	7.4	<0.1	3.9	3.7	5.8	12	5.5	14.4	2.3	6.1	8.9	<0.1	14.8	11.6
Aromatic C21-C35	52.3	<0.1	9.8	4.6	18.8	23.6	14	19.8	8.9	21.8	31.2	13.3	31.5	22.9
Aromatic C5-C35	64.2	<0.1	14.5	11.2	31.1	42.8	22.6	40.5	12.2	28.9	41.7	13.3	53.1	40.5
TPH Ali/Aro Total	128	<0.1	14.5	18.7	68.2	42.8	22.6	40.5	12.2	41	41.7	13.3	53.1	40.5
Benzene	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01
Ethylbenzene	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01
Toluene	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01
Xylene	<0.01	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01
PAHs														
Naphthalene	0.37	0.06	<0.03	<0.03	0.12	0.2	0.12	0.05	<0.03	0.24	<0.03	<0.03	0.16	0.17
Acenaphthylene	0.06	<0.01	<0.01	<0.01	0.05	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01
Acenaphthene	1.95	0.12	0.05	0.06	0.17	0.25	0.12	0.03	0.01	0.17	0.08	<0.01	0.35	0.16
Fluorene	1.49	0.06	0.02	0.05	0.11	0.13	0.06	0.01	<0.01	0.1	0.05	<0.01	0.21	0.1
Phenanthrene	8.23	0.26	0.19	0.26	0.9	0.95	0.4	0.09	0.11	1	0.5	<0.03	1.65	0.5
Anthracene	1.93	0.1	0.07	0.07	0.24	0.23	0.08	0.03	0.03	0.24	0.17	<0.02	0.35	0.12
Fluoranthene	8.45	0.23	0.24	0.27	1.14	1.12	0.42	<0.08	0.16	0.73	0.8	<0.08	1.93	0.39
Pyrene	7.07	0.2	0.24	0.24	1.07	1.02	0.41	<0.07	0.16	0.7	0.77	<0.07	1.93	0.34
Benzo (a) anthracene	2.72	0.06	0.07	0.07	0.41	0.37	0.14	<0.04	<0.04	0.19	0.3	<0.04	0.65	0.09
Chrysene	2.75	0.08	0.1	0.12	0.56	0.48	0.22	<0.06	<0.06	0.29	0.42	<0.06	0.88	0.13
Benzo (b) fluoranthene	2.27	<0.05	0.07	0.07	0.42	0.28	0.14	<0.05	<0.05	0.12	0.34	<0.05	0.61	0.07
Benzo (k) fluoranthene	1.06	<0.07	<0.07	<0.07	0.18	0.15	<0.07	<0.07	<0.07	<0.07	0.16	<0.07	0.3	<0.07
Benzo (a) pyrene	1.93	<0.04	<0.04	0.06	0.39	0.27	0.13	<0.04	<0.04	0.15	0.3	<0.04	0.57	0.06
Indeno (1,2,3 - cd) pyrene	0.94	<0.03	<0.03	<0.03	0.22	0.12	0.07	<0.03	<0.03	<0.03	0.17	<0.03	0.24	<0.03
Dibenzo (ah) anthracene	0.23	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.07	<0.04
Benzo (ghi) perylene	0.81	<0.05	<0.05	<0.05	0.2	0.12	0.07	<0.05	<0.05	<0.05	0.16	<0.05	0.24	<0.05
PAH Total	42.3	1.19	0.95	1.29	6.14	5.7	2.42	0.21	0.47	3.98	4.2	<0.08	10.2	2.15

Lab Sample Number	18/03369/79	18/03064/1	18/03064/2	18/03064/3	18/03064/4	18/03064/5	18/03064/6	18/03064/7	18/03064/9	18/03064/10	18/03064/11	18/03064/13	18/03064/40
Sample ID	ARPWS107	ARPBH102	ARPBH103	ARPBH103	ARPBH103	ARPBH104	ARPBH104	ARPBH104	ARPBH109	ARPBH109	ARPBH109	ARPBH111	ARPBH111
Depth (mbgl)	8.50	1.00	1.00	4.00	7.00	1.00	3.90	7.90	0.50	5.00	9.00	5.60	1.00
Client Sample ID	30	2	3	12	21	2	11	22	2	15	26	16	2
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES
Sampling Date	27-Apr-18	18-Apr-18	17-Apr-18	17-Apr-18	18-Apr-18	13-Apr-18	13-Apr-18	16-Apr-18	16-Apr-18	16-Apr-18	16-Apr-18	17-Apr-18	17-Apr-18
Sampling Time													
Asbestos quantification OHR	N/A	0.054	N/A	N/A	N/A	<0.001	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Metals													
Antimony	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	3	14	32	18	21	12	16	30	17	15	12	18	6
Beryllium	1	0.5	0.8	0.9	1	0.5	0.9	0.9	0.6	0.6	0.7	0.9	0.6
Boron	<1.0	<1.0	1.6	1.7	<1.0	<1.0	1.2	<1.0	1.5	1.4	<1.0	1.1	<1.0
Cadmium	0.8	1	1.4	1.5	1.8	1	1.5	1.6	1.6	1.3	1.2	1.4	1.4
Chromium	40	21	62	52	23	25	34	37	31	27	27	29	33
Chromium (VI)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	23	17	33	24	27	16	29	18	32	29	17	22	21
Lead	37	80	224	79	14	61	72	27	64	49	21	50	62
Mercury	<0.17	0.29	4.33	0.43	<0.17	<0.17	0.41	<0.17	0.72	<0.17	<0.17	<0.17	<0.17
Nickel	22	16	22	28	37	18	30	37	26	22	26	26	42
Selenium	<1	2	2	2	1	2	2	3	<1	1	1	2	<1
Vanadium	22	20	19	25	25	18	27	19	32	19	17	24	20
Zinc	49	87	239	108	61	66	75	73	83	69	48	70	69
Inorganics													
pH	6.75	8.74	9.29	8.15	8.49	9.15	8.37	8.07	10.44	7.75	7.77	8.13	8.56
Total Cyanide	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PID Reading													
Total Organic Carbon	4.19	2.38	3.57	5.74	1.26	2.03	3.15	8.95	1.92	4.16	5.2	3.39	3.11
Sulphate Aqueous Extract as SO4													
Petroleum Hydrocarbons													
Aliphatic C5-C6	<0.05												
Aliphatic C6-C8	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aliphatic C8-C10	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aliphatic C10-C12	<0.1	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aliphatic C12-C16	<0.1	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C16-C21	<0.1	<0.1	<0.1	19.4	<0.1	<0.1	<0.1	<0.1	1.7	<0.1	<0.1	<0.1	<0.1
Aliphatic C21-C35	<0.1	<0.1	<0.1	32.2	<0.1	<0.1	<0.1	<0.1	10.8	<0.1	<0.1	<0.1	<0.1
Aliphatic C5-C35	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	7.6	<0.1	<0.1	<0.1	<0.1
Aromatic C5-C7	<0.05	<0.1	5	68.1	<0.1	<0.1	<0.1	<0.1	94.2	<0.1	<0.1	<0.1	<0.1
Aromatic C7-C8	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aromatic C8-C10	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aromatic C10-C12	0.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01
Aromatic C12-C16	5	1.3	0.7	1	<0.1	0.7	0.3	0.9	0.2	<0.1	<0.1	0.4	0.3
Aromatic C16-C21	10.5	4.3	2.8	11.5	<0.1	4.3	1.3	3.5	2	<0.1	<0.1	1.9	2.6
Aromatic C21-C35	19.7	13	6	31	<0.1	10.6	6.5	2	10	<0.1	<0.1	5.3	10.9
Aromatic C5-C35	35.7	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	14.7	<0.1	<0.1	<0.1	<0.1
TPH Ali/Aro Total	35.7	61.1	19.8	78.4	<0.1	38.7	25.9	7	84	<0.1	<0.1	12.6	32.5
Benzene	<0.05	61.1	24.7	146	<0.1	38.7	25.9	7	178	<0.1	<0.1	12.6	32.5
Ethylbenzene	<0.05	<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	<0.05	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	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PAHs													
Naphthalene	0.09	1.12	0.98	0.62	<0.03	1.41	0.75	<0.03	0.83	0.07	<0.03	2.6	0.39
Acenaphthylene	<0.01	0.52	0.4	0.65	0.01	2.63	0.64	0.05	0.35	0.06	0.02	2.31	0.32
Acenaphthene	0.16												
Fluorene	0.09	4.89	3.87	3.71	<0.08	9.69	3.83	0.16	3.04	0.41	<0.08	17.5	1.82
Phenanthrene	0.63	0.29	0.5	0.62	<0.03	2.12	0.49	0.51	0.22	<0.03	<0.03	0.82	0.29
Anthracene	0.13	0.04	0.08	0.12	<0.01	0.08	0.03	<0.01	0.03	<0.01	<0.01	0.09	0.02
Fluoranthene	0.73	0.27	0.24	0.16	<0.04	0.34	0.18	<0.04	0.19	<0.04	<0.04	0.58	0.09
Pyrene	0.71	3.36	2.78	3.82	0.07	10	3.09	0.44	2.17	0.39	0.1	15.8	1.36
Benzo (a) anthracene	0.23	0.83	0.58	0.93	<0.02	2.42	0.8	0.05	0.57	0.08	<0.02	3.82	0.34
Chrysene	0.36	0.83	0.69	0.53	<0.07	1.36	0.59	<0.07	0.61	<0.07	<0.07	2.41	0.28
Benzo (b) fluoranthene	0.23	2.02	1.63	1.14	<0.04	2.98	1.34	0.06	1.46	0.11	<0.04	5.27	0.66
Benzo (k) fluoranthene	0.14	1.01	0.95	0.54	<0.05	1.25	0.67	<0.05	0.77	<0.05	<0.05	2.22	0.35
Benzo (a) pyrene	0.22	2.26	1.84	1.52	<0.04	3.79	1.67	0.09	1.51	0.15	<0.04	6.93	0.85
Indeno (1,2,3 - cd) pyrene	0.09	0.41	0.35	0.79	0.01	2.13	0.57	0.05	0.29	0.06	0.01	2.12	0.23
Dibenzo (ah) anthracene	<0.04	2.48	1.99	1.48	<0.06	3.73	1.62	0.11	1.55	0.17	<0.06	6.35	0.89
Benzo (ghi) perylene	0.1	2.36	1.92	1.32	<0.05	3.42	1.61	0.09	1.7	0.15	<0.05	5.85	0.81
PAH Total	3.88	4.43	3.58	3.15	<0.07	8.51	3.39	0.15	2.79	0.35	<0.07	14.7	1.71

Public Open Space Residential 2.5%		Exceedance	MG-C
		LOD > GAC	MG-P

Analytical Parameter (Soil Analysis)	Method	Units	Limit of detection	GAC	Count > GAC	Minimum (detected)	Max	Average (including those detected)
Asbestos quantification OHR			0.001	-	-	0.054	0.054	0.0
Metals								
Antimony	DETSC 2301*	mg/kg	1	1070	0	<1	<1	0.0
Arsenic	DETSC 2301#	mg/kg	0.2	79	0	1	36	10.367
Beryllium	DETSC 2301#	mg/kg	0.2	2.19	0	0.5	1.5	0.820
Boron	DETSC 2123#	mg/kg	0.2	21500	0	1	3.9	0.653
Cadmium	DETSC 2301#	mg/kg	0.1	106	0	0.8	4.4	1.437
Chromium	DETSC 2301#	mg/kg	0.15	1539	0	10	134	36.673
Chromium (VI)	DETSC 2204*	mg/kg	1	7.7	0	<1	<1	0.0
Copper	DETSC 2301#	mg/kg	0.2	12000	0	15	38	22.9
Lead	DETSC 2301#	mg/kg	0.3	630	0	9	483	74.3
Mercury	DETSC 2325#	mg/kg	0.05	15.7	0	0.17	4.33	0.3
Nickel	DETSC 2301#	mg/kg	1	231	0	16	46	26.9
Selenium	DETSC 2301#	mg/kg	0.5	1140	0	1	4	0.8
Vanadium	DETSC 2301	mg/kg	0.8	1100	0	13	38	24.6
Zinc	DETSC 2301#	mg/kg	1	80500	0	43	239	84.0
Inorganics								
pH	DETSC 2008#			-	-	5.26	10.44	7.9
Total Cyanide	DETSC 2130#	mg/kg	0.1	1595.0	0	<0.1	<0.1	0.0
PID Reading	*	ppm	0.1	-	-	<0.1	<0.1	#DIV/0!
Total Organic Carbon	DETSC 2002	%	0.1	-	-	0.37	38	5.66
Sulphate Aqueous Extract as SO4	DETSC 2076#	mg/l	10	#N/A	0	<10	<10	#DIV/0!
Petroleum Hydrocarbons								
Aliphatic C5-C6	DETSC 3321*	mg/kg	0.01	591000	0	<0.01	<0.01	0.0
Aliphatic C6-C8	DETSC 3321*	mg/kg	0.01	609000	0	0.01	0.07	0.0
Aliphatic C8-C10	DETSC 3321*	mg/kg	0.01	12600	0	0.44	0.44	0.0
Aliphatic C10-C12	DETSC 3072#	mg/kg	1.5	12600	0	0.05	1.2	0.0
Aliphatic C12-C16	DETSC 3072#	mg/kg	1.2	12600	0	0.5	2	0.1
Aliphatic C16-C21	DETSC 3072#	mg/kg	1.5	251000	0	0.6	19.4	0.7
Aliphatic C21-C35	DETSC 3072#	mg/kg	3.4	251000	0	2.4	57.7	4.2
Aliphatic C5-C35	DETSC 3072*	mg/kg	10	1739800	0	2.4	64.1	3.9
Aromatic C5-C7	DETSC 3321*	mg/kg	0.01	72.3	1	5	94.2	3.4
Aromatic C7-C8	DETSC 3321*	mg/kg	0.01	55900	0	0.01	0.01	0.0
Aromatic C8-C10	DETSC 3321*	mg/kg	0.01	5030.0	0	0.02	0.02	0.0
Aromatic C10-C12	DETSC 3072#	mg/kg	0.9	5040	0	0.03	2.2	0.3
Aromatic C12-C16	DETSC 3072#	mg/kg	0.5	5050	0	0.2	8.2	1.6
Aromatic C16-C21	DETSC 3072#	mg/kg	0.6	3770	0	1.3	25	4.5
Aromatic C21-C35	DETSC 3072#	mg/kg	1.4	3770	0	0.9	55.8	11.8
Aromatic C5-C35	DETSC 3072*	mg/kg	10	78632	0	0.9	76	15.6
TPH Ali/Aro Total	DETSC 3072*	mg/kg	10	-	-	0.9	128	26.6
Benzene	DETSC 3321#	mg/kg	0.01	72	2	7	178	11.0
Ethylbenzene	DETSC 3321#	mg/kg	0.01	24300	0	<0.01	<0.01	0.0
Toluene	DETSC 3321#	mg/kg	0.01	55900	0	0.01	0.01	0.0
Xylene	DETSC 3321#	mg/kg	0.01	#N/A	0	<0.01	<0.01	0.0
PAHs								
Naphthalene	DETSC 3301	mg/kg	0.1	4890	0	0.04	2.6	0.3
Acenaphthylene	DETSC 3301	mg/kg	0.1	14800	0	0.01	2.63	0.2
Acenaphthene	DETSC 3301	mg/kg	0.1	14800	0	0.01	2.67	0.2
Fluorene	DETSC 3301	mg/kg	0.1	9870	0	0.01	17.5	1.2
Phenanthrene	DETSC 3301	mg/kg	0.1	3070	0	0.03	19.1	1.0
Anthracene	DETSC 3301	mg/kg	0.1	74100	0	0.02	4.57	0.2
Fluoranthene	DETSC 3301	mg/kg	0.1	3080	0	0.09	15.2	0.8
Pyrene	DETSC 3301	mg/kg	0.1	7410	0	0.07	15.8	1.6
Benzo (a) anthracene	DETSC 3301	mg/kg	0.1	29	0	0.05	5.18	0.5
Chrysene	DETSC 3301	mg/kg	0.1	57	0	0.08	4.39	0.4
Benzo (b) fluoranthene	DETSC 3301	mg/kg	0.1	7	0	0.06	5.27	0.6
Benzo (k) fluoranthene	DETSC 3301	mg/kg	0.1	191	0	0.14	2.22	0.2
Benzo (a) pyrene	DETSC 3301	mg/kg	0.1	6	1	0.06	6.93	0.6
Indeno (1,2,3 - cd) pyrene	DETSC 3301	mg/kg	0.1	82	0	0.01	2.14	0.3
Dibenzo (ah) anthracene	DETSC 3301	mg/kg	0.1	1	8	0.07	6.35	0.4
Benzo (ghi) perylene	DETSC 3301	mg/kg	0.1	637	0	0.05	5.85	0.5
PAH Total	DETSC 3301	mg/kg	1.6	-	-	0.14	82.3	5.0

Lab Sample Number	18/02990/1	18/02990/2	18/02990/3	18/02990/4	18/02990/5	18/03153/1	18/03153/2	18/03369/1	18/03369/5	18/03369/9	18/03369/13	18/03369/16	18/03369/19	18/03369/22
Sample ID	ARPBH106	ARPBH106	ARPBH106	ARPBH110	ARPBH110	ARPBH108	ARPBH108	ARPBH101	ARPBH101	ARPBH101	ARPBH102	ARPBH102	ARPBH102	ARPBH105
Depth (mbgl)	0.50	4.00	7.00	0.20	4.00	1.00	3.00	1.00	5.00	10.00	4.90	8.90	13.60	1.00
Client Sample ID	2	13	22			2	6	2	13	24	10	20	32	2
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES
Sampling Date	09-Apr-18	09-Apr-18	10-Apr-18	10-Apr-18	10-Apr-18	18-Apr-18	18-Apr-18	23-Apr-18	23-Apr-18	23-Apr-18	20-Apr-18	20-Apr-18	20-Apr-18	24-Apr-18
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Asbestos quantification OHR	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	<0.001	N/A	N/A	N/A
Metals														
Antimony	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	<1	6	<1	3	21	7	5	7	4	4	7	3	9	5
Beryllium	<0.5	0.7	1.2	0.7	1.1	0.9	0.7	0.8	1	1	0.6	0.7	1.1	0.9
Boron	<1.0	1	<1.0	<1.0	1.4	<1.0	1.4	<1.0	<1.0	<1.0	1.2	1.1	1.3	<1.0
Cadmium	1	1	3.4	1.1	1.6	1.6	1.2	1.4	1.4	1.1	1	1.2	1.9	1.1
Chromium	10	43	19	19	85	36	35	32	21	32	36	24	39	36
Chromium (VI)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	17	19	30	19	16	30	18	22	27	32	16	24	25	22
Lead	13	82	17	27	194	70	63	67	19	42	90	39	59	118
Mercury	<0.17	1.44	<0.17	0.23	0.65	0.47	0.37	0.31	<0.17	<0.17	0.23	<0.17	0.52	0.3
Nickel	22	20	40	23	22	24	20	25	34	32	19	25	28	23
Selenium	1	2	2	2	2	<1	<1	<1	<1	<1	<1	<1	<1	<1
Vanadium	13	22	31	22	29	28	23	27	26	33	23	24	31	29
Zinc	43	90	67	54	106	80	82	74	57	81	88	67	82	86
Inorganics														
pH	8.39	7.19	7.41	7.52	5.48	8.6	7.93	9.19	8.72	7.41	7.97	8.24	7.57	9.46
Total Cyanide	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PID Reading														
Total Organic Carbon	0.37	5.77	1.25	1.92	32.9	4.98	2.28	1.62	0.88	6.11	7.36	3.03	7.12	2.16
Sulphate Aqueous Extract as SO4														
Petroleum Hydrocarbons														
Aliphatic C5-C6	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Aliphatic C6-C8	<0.01	0.01	<0.01	<0.01	0.07	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Aliphatic C8-C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Aliphatic C10-C12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.5
Aliphatic C12-C16	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	2
Aliphatic C16-C21	<0.1	0.6	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.6	<0.1	3.9
Aliphatic C21-C35	<0.1	11.1	<0.1	2.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	13.3	<0.1	57.7
Aliphatic C5-C35	<0.1	11.9	<0.1	2.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	14	<0.1	64.1
Aromatic C5-C7	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Aromatic C7-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Aromatic C8-C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Aromatic C10-C12	<0.1	0.9	<0.1	<0.1	<0.1	0.7	0.5	0.6	<0.1	0.5	0.2	<0.1	<0.1	0.6
Aromatic C12-C16	<0.1	5	<0.1	<0.1	<0.1	8.2	4.8	2.2	<0.1	4.2	1.2	<0.1	<0.1	4
Aromatic C16-C21	<0.1	14.2	<0.1	<0.1	<0.1	25	16.8	3.5	<0.1	6.1	3.2	<0.1	<0.1	7.4
Aromatic C21-C35	0.9	55.8	<0.1	<0.1	<0.1	40.4	40.9	16.4	<0.1	6.1	7.5	13.6	<0.1	52.3
Aromatic C5-C35	0.9	76	<0.1	<0.1	<0.1	74.3	62.9	22.6	<0.1	16.9	12.2	13.6	<0.1	64.2
TPH Ali/Aro Total	0.9	87.7	<0.1	2.4	<0.1	74.3	62.9	22.6	<0.1	16.9	12.2	27.4	<0.1	128
Benzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Ethylbenzene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Toluene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
Xylene	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.01	<0.05	<0.01
PAHs														
Naphthalene	<0.03	0.29	<0.03	<0.03	<0.03	2.59	0.14	0.06	<0.03	0.13	0.04	0.06	0.05	0.37
Acenaphthylene	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	0.02	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.06
Acenaphthene	<0.01	0.28	<0.01	0.03	<0.01	2.67	0.36	0.08	<0.01	0.11	0.08	0.17	0.06	1.95
Fluorene	<0.01	0.19	<0.01	0.02	<0.01	3.92	0.29	0.09	<0.01	0.06	0.05	0.1	0.03	1.49
Phenanthrene	0.03	1	<0.03	0.15	<0.03	19.1	2.05	0.97	<0.03	0.29	0.32	0.45	0.25	8.23
Anthracene	<0.02	0.2	<0.02	0.04	<0.02	4.57	0.48	0.35	<0.02	0.08	0.11	0.16	0.08	1.93
Fluoranthene	<0.08	0.91	<0.08	0.16	<0.08	15.2	2.71	1.25	<0.08	0.29	0.48	0.51	0.28	8.45
Pyrene	<0.07	0.83	<0.07	0.17	<0.07	12.1	2.43	0.94	<0.07	0.26	0.46	0.44	0.26	7.07
Benzo (a) anthracene	<0.04	0.31	<0.04	0.08	<0.04	5.18	1.06	0.5	<0.04	0.08	0.14	0.13	0.09	2.72
Chrysene	<0.06	0.4	<0.06	0.11	<0.06	4.39	1.12	0.58	<0.06	0.14	0.22	0.18	0.12	2.75
Benzo (b) fluoranthene	<0.05	0.22	<0.05	0.07	<0.05	3.83	0.94	0.36	<0.05	0.11	0.13	0.11	<0.05	2.27
Benzo (k) fluoranthene	<0.07	<0.07	<0.07	<0.07	<0.07	1.25	0.27	0.2	<0.07	<0.07	<0.07	<0.07	<0.07	1.06
Benzo (a) pyrene	<0.04	0.19	<0.04	0.06	<0.04	3.46	0.75	0.34	<0.04	0.1	0.12	0.1	0.08	1.93
Indeno (1,2,3 - cd) pyrene	<0.03	0.16	<0.03	0.05	<0.03	2.14	0.53	0.16	<0.03	0.06	0.05	0.04	<0.03	0.94
Dibenzo (ah) anthracene	<0.04	<0.04	<0.04	<0.04	<0.04	0.33	0.08	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.23
Benzo (ghi) perylene	<0.05	0.13	<0.05	0.05	<0.05	1.61	0.43	0.13	<0.05	<0.05	<0.05	<0.05	<0.05	0.81
PAH Total	<0.08	5.08	<0.08	0.99	<0.08	82.3	13.7	6.03	<0.08	1.72	2.23	2.43	1.31	42.3

Lab Sample Number	18/03369/26	18/03369/29	18/03369/35	18/03369/48	18/03369/52	18/03369/56	18/03369/57	18/03369/58	18/03369/62	18/03369/63	18/03369/66	18/03369/69	18/03369/74	18/03369/79
Sample ID	ARPBH105	ARPBH105	ARPBH108	ARPBH112	ARPBH112	ARPWS101	ARPWS101A	ARPWS102	ARPWS102	ARPWS103	ARPWS103	ARPWS107	ARPWS107	ARPWS107
Depth (mbgl)	4.90	8.90	7.00	1.00	4.90	1.70	0.60	0.50	4.50	0.40	4.50	0.20	4.70	8.50
Client Sample ID	10	18	14	2	11	6	2	2	14	2	13	2	16	30
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES
Sampling Date	24-Apr-18	24-Apr-18	19-Apr-18	23-Apr-18	23-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	25-Apr-18	26-Apr-18	26-Apr-18	27-Apr-18
Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s	n/s				
Asbestos quantification OHR	N/A	N/A	<0.001	<0.001	N/A	<0.001	N/A	N/A	N/A	<0.001	N/A	N/A	<0.001	N/A
Metals														
Antimony	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	2	19	7	5	36	5	15	9	16	7	17	9	6	3
Beryllium	1.1	1.4	0.8	<0.5	1.5	<0.5	1	0.8	0.9	0.6	0.9	0.8	0.5	1
Boron	<1.0	1.5	<1.0	1.2	2.4	3.9	<1.0	<1.0	1.9	<1.0	1.8	<1.0	<1.0	<1.0
Cadmium	1.2	1.7	1.3	1	4.4	0.9	1.3	1.1	1.7	1.2	1.2	1.4	1	0.8
Chromium	26	79	24	30	134	33	43	36	80	38	55	45	41	40
Chromium (VI)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	25	29	21	15	26	38	20	18	19	17	16	16	15	23
Lead	31	147	28	60	264	72	72	64	157	77	118	483	88	37
Mercury	<0.17	0.37	<0.17	0.37	1.5	0.44	0.22	0.19	0.63	0.21	0.36	0.42	0.3	<0.17
Nickel	33	33	29	18	35	17	28	23	24	20	19	23	19	22
Selenium	<1	<1	<1	<1	2	<1	<1	1	2	<1	2	<1	<1	<1
Vanadium	30	38	21	17	38	21	23	22	28	20	22	21	19	22
Zinc	66	182	66	76	218	92	94	86	134	92	114	97	79	49
Inorganics														
pH	8.1	6.86	7.94	7.71	7.1	8.89	8.06	7.75	6.75	7.45	5.79	7.72	9.11	6.75
Total Cyanide	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PID Reading														
Total Organic Carbon	2.41	13.7	0.59	1.05	12.9	4.54	6.15	9.85	14.5	3.23	38	2.21	1.92	4.19
Sulphate Aqueous Extract as SO4														
Petroleum Hydrocarbons														
Aliphatic C5-C6	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05
Aliphatic C6-C8	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05
Aliphatic C8-C10	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	0.44	<0.01	<0.01	<0.05
Aliphatic C10-C12	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.2	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C12-C16	<0.1	<0.1	<0.1	1.2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C16-C21	<0.1	<0.1	<0.1	5.8	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C21-C35	<0.1	<0.1	7.4	30.1	<0.1	<0.1	<0.1	<0.1	10.9	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C5-C35	<0.1	<0.1	7.4	37.1	<0.1	<0.1	<0.1	<0.1	12.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aromatic C5-C7	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05
Aromatic C7-C8	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05
Aromatic C8-C10	<0.01	<0.05	<0.01	<0.01	<0.01	0.02	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05
Aromatic C10-C12	<0.1	<0.1	0.4	2.2	2.2	0.4	1.3	<0.1	<0.1	<0.1	<0.1	0.8	0.5	0.4
Aromatic C12-C16	<0.1	0.8	2.6	4.3	5.2	2.5	4.9	1	1.2	1.6	<0.1	6	5.5	5
Aromatic C16-C21	<0.1	3.9	3.7	5.8	12	5.5	14.4	2.3	6.1	8.9	<0.1	14.8	11.6	10.5
Aromatic C21-C35	<0.1	9.8	4.6	18.8	23.6	14	19.8	8.9	21.8	31.2	13.3	31.5	22.9	19.7
Aromatic C5-C35	<0.1	14.5	11.2	31.1	42.8	22.6	40.5	12.2	28.9	41.7	13.3	53.1	40.5	35.7
TPH Ali/Aro Total	<0.1	14.5	18.7	68.2	42.8	22.6	40.5	12.2	41	41.7	13.3	53.1	40.5	35.7
Benzene	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05
Ethylbenzene	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05
Toluene	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05
Xylene	<0.01	<0.05	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.05	<0.01	<0.05	<0.01	<0.01	<0.05
PAHs														
Naphthalene	0.06	<0.03	<0.03	0.12	0.2	0.12	0.05	<0.03	0.24	<0.03	<0.03	0.16	0.17	0.09
Acenaphthylene	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01
Acenaphthene	0.12	0.05	0.06	0.17	0.25	0.12	0.03	0.01	0.17	0.08	<0.01	0.35	0.16	0.16
Fluorene	0.06	0.02	0.05	0.11	0.13	0.06	0.01	<0.01	0.1	0.05	<0.01	0.21	0.1	0.09
Phenanthrene	0.26	0.19	0.26	0.9	0.95	0.4	0.09	0.11	1	0.5	<0.03	1.65	0.5	0.63
Anthracene	0.1	0.07	0.07	0.24	0.23	0.08	0.03	0.03	0.24	0.17	<0.02	0.35	0.12	0.13
Fluoranthene	0.23	0.24	0.27	1.14	1.12	0.42	<0.08	0.16	0.73	0.8	<0.08	1.93	0.39	0.73
Pyrene	0.2	0.24	0.24	1.07	1.02	0.41	<0.07	0.16	0.7	0.77	<0.07	1.93	0.34	0.71
Benzo (a) anthracene	0.06	0.07	0.07	0.41	0.37	0.14	<0.04	<0.04	0.19	0.3	<0.04	0.65	0.09	0.23
Chrysene	0.08	0.1	0.12	0.56	0.48	0.22	<0.06	<0.06	0.29	0.42	<0.06	0.88	0.13	0.36
Benzo (b) fluoranthene	<0.05	<0.05	0.07	0.42	0.28	0.14	<0.05	<0.05	0.12	0.34	<0.05	0.61	0.07	0.23
Benzo (k) fluoranthene	<0.07	<0.07	<0.07	0.18	0.15	<0.07	<0.07	<0.07	<0.07	0.16	<0.07	0.3	<0.07	0.14
Benzo (a) pyrene	<0.04	<0.04	0.06	0.39	0.27	0.13	<0.04	<0.04	0.15	0.3	<0.04	0.57	0.06	0.22
Indeno (1,2,3 - cd) pyrene	<0.03	<0.03	<0.03	0.22	0.12	0.07	<0.03	<0.03	<0.03	0.17	<0.03	0.24	<0.03	0.09
Dibenzo (ah) anthracene	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	0.07	<0.04	<0.04
Benzo (ghi) perylene	<0.05	<0.05	<0.05	0.2	0.12	0.07	<0.05	<0.05	<0.05	0.16	<0.05	0.24	<0.05	0.1
PAH Total	1.19	0.95	1.29	6.14	5.7	2.42	0.21	0.47	3.98	4.2	<0.08	10.2	2.15	3.88

Lab Sample Number	18/03064/1	18/03064/2	18/03064/3	18/03064/4	18/03064/5	18/03064/6	18/03064/7	18/03064/9	18/03064/10	18/03064/11	18/03064/13	18/03064/40
Sample ID	ARPBH102	ARPBH103	ARPBH103	ARPBH103	ARPBH104	ARPBH104	ARPBH104	ARPBH109	ARPBH109	ARPBH109	ARPBH111	ARPBH111
Depth (mbgl)	1.00	1.00	4.00	7.00	1.00	3.90	7.90	0.50	5.00	9.00	5.60	1.00
Client Sample ID	2	3	12	21	2	11	22	2	15	26	16	2
Sample Type	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES	Soil - ES
Sampling Date	18-Apr-18	17-Apr-18	17-Apr-18	18-Apr-18	13-Apr-18	13-Apr-18	16-Apr-18	16-Apr-18	16-Apr-18	16-Apr-18	17-Apr-18	17-Apr-18
Sampling Time												
Asbestos quantification OHR	0.054	N/A	N/A	N/A	<0.001	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Metals												
Antimony	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Arsenic	14	32	18	21	12	16	30	17	15	12	18	6
Beryllium	0.5	0.8	0.9	1	0.5	0.9	0.9	0.6	0.6	0.7	0.9	0.6
Boron	<1.0	1.6	1.7	<1.0	<1.0	1.2	<1.0	1.5	1.4	<1.0	1.1	<1.0
Cadmium	1	1.4	1.5	1.8	1	1.5	1.6	1.6	1.3	1.2	1.4	1.4
Chromium	21	62	52	23	25	34	37	31	27	27	29	33
Chromium (VI)	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Copper	17	33	24	27	16	29	18	32	29	17	22	21
Lead	80	224	79	14	61	72	27	64	49	21	50	62
Mercury	0.29	4.33	0.43	<0.17	<0.17	0.41	<0.17	0.72	<0.17	<0.17	<0.17	<0.17
Nickel	16	22	28	37	18	30	37	26	22	26	26	42
Selenium	2	2	2	1	2	2	3	<1	1	1	2	<1
Vanadium	20	19	25	25	18	27	19	32	19	17	24	20
Zinc	87	239	108	61	66	75	73	83	69	48	70	69
Inorganics												
pH	8.74	9.29	8.15	8.49	9.15	8.37	8.07	10.44	7.75	7.77	8.13	8.56
Total Cyanide	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
PID Reading												
Total Organic Carbon	2.38	3.57	5.74	1.26	2.03	3.15	8.95	1.92	4.16	5.2	3.39	3.11
Sulphate Aqueous Extract as SO4												
Petroleum Hydrocarbons												
Aliphatic C5-C6												
Aliphatic C6-C8	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aliphatic C8-C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aliphatic C10-C12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aliphatic C12-C16	<0.1	<0.1	0.5	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Aliphatic C16-C21	<0.1	<0.1	19.4	<0.1	<0.1	<0.1	<0.1	1.7	<0.1	<0.1	<0.1	<0.1
Aliphatic C21-C35	<0.1	<0.1	32.2	<0.1	<0.1	<0.1	<0.1	10.8	<0.1	<0.1	<0.1	<0.1
Aliphatic C5-C35	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	7.6	<0.1	<0.1	<0.1	<0.1
Aromatic C5-C7	<0.1	5	68.1	<0.1	<0.1	<0.1	<0.1	**94.2**	<0.1	<0.1	<0.1	<0.1
Aromatic C7-C8	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aromatic C8-C10	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Aromatic C10-C12	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.04	<0.01
Aromatic C12-C16	1.3	0.7	1	<0.1	0.7	0.3	0.9	0.2	<0.1	<0.1	0.4	0.3
Aromatic C16-C21	4.3	2.8	11.5	<0.1	4.3	1.3	3.5	2	<0.1	<0.1	1.9	2.6
Aromatic C21-C35	13	6	31	<0.1	10.6	6.5	2	10	<0.1	<0.1	5.3	10.9
Aromatic C5-C35	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	14.7	<0.1	<0.1	<0.1	<0.1
TPH Ali/Aro Total	61.1	19.8	78.4	<0.1	38.7	25.9	7	84	<0.1	<0.1	12.6	32.5
Benzene	61.1	24.7	**146**	<0.1	38.7	25.9	7	**178**	<0.1	<0.1	12.6	32.5
Ethylbenzene	<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	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	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PAHs												
Naphthalene	1.12	0.98	0.62	<0.03	1.41	0.75	<0.03	0.83	0.07	<0.03	2.6	0.39
Acenaphthylene	0.52	0.4	0.65	0.01	2.63	0.64	0.05	0.35	0.06	0.02	2.31	0.32
Acenaphthene												
Fluorene	4.89	3.87	3.71	<0.08	9.69	3.83	0.16	3.04	0.41	<0.08	17.5	1.82
Phenanthrene	0.29	0.5	0.62	<0.03	2.12	0.49	0.51	0.22	<0.03	<0.03	0.82	0.29
Anthracene	0.04	0.08	0.12	<0.01	0.08	0.03	<0.01	0.03	<0.01	<0.01	0.09	0.02
Fluoranthene	0.27	0.24	0.16	<0.04	0.34	0.18	<0.04	0.19	<0.04	<0.04	0.58	0.09
Pyrene	3.36	2.78	3.82	0.07	10	3.09	0.44	2.17	0.39	0.1	15.8	1.36
Benzo (a) anthracene	0.83	0.58	0.93	<0.02	2.42	0.8	0.05	0.57	0.08	<0.02	3.82	0.34
Chrysene	0.83	0.69	0.53	<0.07	1.36	0.59	<0.07	0.61	<0.07	<0.07	2.41	0.28
Benzo (b) fluoranthene	2.02	1.63	1.14	<0.04	2.98	1.34	0.06	1.46	0.11	<0.04	5.27	0.66
Benzo (k) fluoranthene	1.01	0.95	0.54	<0.05	1.25	0.67	<0.05	0.77	<0.05	<0.05	2.22	0.35
Benzo (a) pyrene	2.26	1.84	1.52	<0.04	3.79	1.67	0.09	1.51	0.15	<0.04	**6.93**	0.85
Indeno (1,2,3 - cd) pyrene	0.41	0.35	0.79	0.01	2.13	0.57	0.05	0.29	0.06	0.01	2.12	0.23
Dibenzo (ah) anthracene	**2.48**	**1.99**	**1.48**	<0.06	**3.73**	**1.62**	0.11	**1.55**	0.17	<0.06	**6.35**	**0.89**
Benzo (ghi) perylene	2.36	1.92	1.32	<0.05	3.42	1.61	0.09	1.7	0.15	<0.05	5.85	0.81
PAH Total	4.43	3.58	3.15	<0.07	8.51	3.39	0.15	2.79	0.35	<0.07	14.7	1.71