

HB Newport

Ground Investigation Report

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FAIRHURST

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EXECUTIVE SUMMARY

The below provides only a brief summary of the report and the recommendations – the reader is directed to the main body of the text for further detail.

Background and Objectives
The Site is located at West Retail Park, Docks Way, Newport with postcode NP20 2NZ, and approximate National Grid Reference 331150, 186330. The purpose of the ground investigation is to assess the geotechnical and environmental conditions present at the Site and identify any associated constraints that may restrict the proposed development. The report also aims to discharge pre-commencement Planning Condition 3, and further will feed into geotechnical detailed design.
Development Proposals
The proposed development will comprise of the demolition of existing retail park (Class A1) and subsequent erection of 1 No. retail unit (Class A1) with associated access and serving arrangements and car parking.
Site Details
The site (approximately 1.36 hectares) currently comprises of two warehouses, developed with associated infrastructure including car parking, access roads and a sewage pumping station in the north west of the site.
Ground Investigation
The ground investigation comprised of 2 No. Cable Percussive boreholes with rotary follow on to 25.00m bgl, 2 No. Cable Percussive boreholes to 20.00m bgl and 5 No. trial pits to 3.50m bgl. Ground gas and groundwater monitoring wells were installed and subsequently monitored on 3 No. occasions. The ground investigation design took into consideration engineering requirements and the pollutant linkages identified in the initial conceptual site model.
Ground Conditions
Hardstanding – Asphalt. Depth to base 0.08m bgl to 0.40m bgl (7.51m AOD to 6.86m AOD). Made Ground – Sandy gravel including anthropogenic materials. Depth to base 1.10m bgl to 2.00m bgl (6.18m AOD to 5.56m AOD). Tidal Flat Deposits – Very soft to firm, grey / greyish brown / blueish grey clay with occasional peat layers. Depth to base 10.50m bgl to 11.20m bgl (-3.94m AOD to -3.34m AOD). Gravels – Clayey, gravelly sand with sandstone and limestone gravel, and occasional cobbles. Depth to base 14.20m bgl to 15.90m bgl (-8.46m AOD to -6.94m AOD). Weathered Mercia Mudstone – Firm to stiff, reddish brown / blueish grey clay with mudstone inclusions and occasional gravel and rare cobbles. Depth to base 16.50m bgl to 21.20m bgl (-13.61m AOD to -17.94m AOD). Mercia Mudstone – Very weak to moderately strong mudstone. Depth to base 25.20m bgl to 25.50m bgl (-18.34m AOD to -17.61m AOD).
Geo-Environmental Assessment
No exceedances were reported against the relevant assessment criteria for soil laboratory results. As such, it is considered that the soils encountered across the site represent a low risk to the human health in the context of the proposed commercial end users. A positive identification was identified in one sample within the Made Ground, the bulk sample contained fibre bundles and free fibres at a concentration of <0.001% in the form of chrysotile and amosite. Asbestos containing material (ACM) were not encountered during works or within the geo-environmental sampling.

Exceedances were encountered against the UKWIR threshold concentrations for PE or PVE pipes.

Water chemical analysis results identified elevated concentrations of Heavy Metals, PAH (fluoranthene) and Ammonia above the DWS and EQS thresholds. However, the risk to groundwater is determined as low since the Heavy Metals and PAH exceedances are unlikely to be in hydraulic continuity with off-site hydrological freshwater receptors and / or minor exceedances that are not considered representative of the Site. The exceedances identified for Ammonia are not likely a result of the existing sewage pumping station present on Site. It is likely due to background concentrations attributed to the organic matter content present within the Tidal Flat Deposits.

6 No. round of ground gas monitoring have been undertaken, with the Site concluded to be CS4 classification, requiring 4.5 gas protection points for the proposed development which is considered a Type C building. The CS4 characterisation is a product of high concentrations of methane (CH₄) and carbon dioxide (CO₂) and flow rates. Gas concentrations are likely attributed to the organic matter content within the Tidal Flat Deposits. While the high flow rates identified were assessed in relation to tidal influences with no correlation found, subsequently a correlation was found with low and significantly falling atmospheric conditions (please refer to the recommendations below).

Geotechnical Assessment

The pile capacities for bored piles were calculated assuming a 5.0m rock socket into unweathered mudstone. The preliminary design suggests that a safe working load of 800kN for 450mm diameter pile, 1125kN for 600mm and 1500kN for 750mm.

A preliminary settlement calculation was undertaken for the specified slab load 25kN/m² and the predicted settlements ranged between 45mm and 75mm (please refer to the recommendations below).

The concrete classification of the Site is Design Sulphate DS-4 and ACEC class AC-4 for the Site.

Conclusions and Recommendations

Based upon the results of the investigation the following conclusions and recommendations are made:

- Made Ground should not be considered a suitable founding stratum in its current state.
- Water ingress should be anticipated during excavation, therefore, it is recommended that allowances for temporary shoring and appropriate dewatering measures are made to prevent excavation collapse / flooding.
- It is considered that the use of soakaway infiltration drainage is not be feasible for the proposed development.
- A preliminary pile design undertaken suggests that required pile capacity would be achieved with bored piles socketing 5.00m into competent Mercia Mudstone stratum.
- A preliminary settlement calculation undertaken suggests the settlement will be in excess of the 25mm limit under the slab. Therefore, ground improvement via Controlled Modulus Columns (CMC) or surcharging are considered appropriate remediation.
- Liaison with a specialist ground improvement contractor should be sought for the potential for CMCs or surcharging.
- A Foundations Risk Assessment is recommended to ensure that the contaminated soils and pile installation do not pose a risk to the underlying aquifer within the Mercia Mudstone.
- Concrete classification of the Site is Design Sulphate DS-4 and ACEC class AC-4.
- No exceedances for soil laboratory sampling was encountered. However, there is the potential for contaminants to be present in areas not investigated. As such, a watching brief is recommended to be carried out during the development works for any visual or olfactory evidence of contaminations within the shallow soils.

- Asbestos was identified within one sample of the Made Ground, however since the majority of the Site is covered in hardstanding, the pathway associated with the risk of inhalation is prevented. A clean/inert capping system is recommended as a precautionary measure in any areas of proposed soft landscaping.
- It is also recommended that dampening down of soils during periods of dry weather is undertaken when excavating, stockpiling and placing of soils during any proposed works to mitigate the potential risk of asbestos release.
- Furthermore, it is recommended that an asbestos survey is undertaken within the existing structures, with all ACM if encountered to be removed prior to demolition, and that the Principal Contractor reviews the findings of investigations to inform their working practices and method statements, engaging with an asbestos specialist if required.
- Materials requiring off-site disposal shall be tested to characterise whether it is suitable for re-use. If the materials are geotechnically or geo-environmentally unsuitable for reuse on site, they will be either sent to a waste recovery facility for recycling or a suitably licensed waste disposal facility.
- A pre-demolition asbestos surveyor should be undertaken on all buildings proposed for demolition to confirm the presence of any asbestos, with any positive identifications removed by a correctly licenced specialist contractor.
- It is considered that barrier pipeline is required for proposed drinking water pipelines.
- The risk to groundwater and surface water receptors is determined as low due to limited granular deposits providing a pathway. However, it is recommended to avoid placing water abstraction points within the site boundary due to the background concentration of ammonia.
- It is recommended that an additional 3 No. monitoring rounds are to be undertaken at the Site to inform a detailed gas risk assessment. If the ground gas regime of the Site is concluded to be CS4 classification, 4.5 gas protection points is required for the proposed development which is considered a Type C building.
- An Options Appraisal and Remediation Strategy giving full details of remedial measures to break the identified contaminant linkages including a Verification Plan, is required. The report shall be submitted to Newport City Council to discharge Planning Condition 3.
- The Principal Contractor should be provided with this Ground Investigation Report and develop appropriate RAMS to address the potential to encounter asbestos during the construction works. A low risk has been identified, however it is recommended that the Principal Contractor reviews the findings of investigations to inform their working practices and method statements.

1.0 INTRODUCTION AND OBJECTIVES

1.1 Scope

Fairhurst have been commissioned by Quod on behalf of TJ Morris Ltd (the Client) to design, supervise and report on a geo-environmental and geotechnical ground investigation for the proposed development, namely HB Newport (the 'Site'). The site is located at West Retail Park, Docks Way, Newport with postcode NP20 2NZ, and approximate National Grid Reference 331150, 186330. The Site Location Plan is presented within Appendix A.

This Ground Investigation was designed to quantitatively assess the conditions present at the site, and to delineate the various geo-environmental and geotechnical considerations identified within the Fairhurst Preliminary Risk Assessment (PRA) (Ref. 151157/R1.0, dated November 2022). In addition, this report aims to achieve the partial discharge of pre-commencement Planning Condition 3 (Planning Application Ref. 23/0091) as required by Newport City Council.

Therefore, the specific objectives include:

- Carry out and report on an intrusive ground investigation designed to determine the characteristic ground conditions and hydrogeology underlying the site and to identify any potentially significant environmental or geotechnical development constraints;
- Review and assess the chemical and geo-environmental test results to inform and develop the conceptual site model (CSM);
- Make recommendations for further actions, if applicable, relating to any remaining pollutant linkages identified by the ground investigation; and,
- Make recommendations relating to any geotechnical constraints to the development as identified by the ground investigation.

1.2 Development Proposals

It is understood that the proposed development will comprise of the demolition of existing retail park (Class A1) and subsequent erection of 1 No. retail unit (Class A1) with associated access and serving arrangements and car parking. A Proposed Development Plan is presented within Appendix A.

1.3 Planning Context

The full Planning Application for the site (Planning Application Ref. 23/0091) was submitted to Newport City Council and granted in October 2023 with Planning Conditions, including the pre-commencement Planning Condition 3 which requires:

- a) An appropriate Desk-Study of the site has been carried out, to include a conceptual model and a preliminary risk assessment, and the results of that study have been submitted to and approved in writing by the Local Planning Authority.*
- b) If potential contamination is identified then an appropriate intrusive site investigation shall be undertaken and a Site Investigation Report to (BS10175/2011), containing the results of any intrusive investigation, shall be submitted and approved in writing by the Local Planning Authority.*
- c) Unless otherwise agreed in writing by the Local Planning Authority as unnecessary, a Remediation Strategy, including Method statement and full Risk Assessment shall be submitted to and approved in writing by the Local Planning Authority.*

No part of the development hereby permitted shall be occupied until:

- d) Following remediation a Completion/Verification Report, confirming the remediation has being carried out in accordance with the approved details, shall be submitted to, and approved in writing by, the Local Planning Authority.*
- e) Any additional or unforeseen contamination encountered during the development shall be notified to the Local Planning Authority as soon as is practicable. Suitable revision of the remediation strategy shall be submitted to and approved in writing by the Local Planning Authority and the revised strategy shall be fully implemented prior to further works continuing.*

This GIR will be submitted to Newport City Council to facilitate the discharge of section (b) of Planning Condition 3 and inform a remediation strategy, as required.

1.4 Sources of Information

The following documents associated with the development have previously been prepared by Fairhurst and should be read in conjunction with this Ground Investigation Report:

- Fairhurst Preliminary Risk Assessment (Ref. 151157/R2.0, dated August 2022).

The following factual report pertaining to the recent ground investigations has been utilised in the preparation of this report:

- LMB Geosolutions Ltd, Factual Report for Ground Investigation (Issue 1, dated 29th February 2024).

Any published data or standards used in the preparation of this report are referenced throughout the text.

2.0 BACKGROUND INFORMATION

This section provides a summary of the pertinent background information obtained from the Fairhurst PRA (Ref. 151157/R1.0, dated November 2022).

2.1 Site Description

The site (approximately 1.36 hectares) currently comprises of two warehouses, developed with associated infrastructure including car parking, access roads and a sewage pumping station in the north west of the site. At the time of writing this report, two retail businesses were active (Home Bargains and Newlife Clothing) while the remaining units were vacant in preparation for demolition.

Adjacent land uses include:

- North – Highway (Docks Way) with adjacent Mendalgief Retail Park including commercial units (e.g., Argos and Smyths Toys).
- East – Predominantly residential with near-adjacent highway (Mendalgief Road). The river Usk is also located c. 100m from the site.
- South – Undeveloped Greenfield and a leisure centre known as Connect Centre.
- West – A river (Twenty Acres Reen) and associated culverts with a highway (Usk Way), railway and industrial land (e.g., driver training centre, a self-storage unit, a car dealership and a timber and builders merchant) beyond.

2.2 Site History

The pertinent on-site and off-site historical development relative to potential sources of contamination and / or potential geotechnical risks are presented below.

On-Site

- 1884 – 1887 (earliest available mapping): Undeveloped agricultural land with Upper Great Wharf Reen and possible settling ponds in the southeast of the site.
- 1902: Possible settling ponds in the southeast of the site not shown on mapping.
- 1956 – 1957: Possible settling ponds become infilled.
- 1993 – 2000: The present day warehouses and associated car parking / service yard were developed, now proposed to be developed.
- 2021: Sewage pumping station noted in the north-western corner of the site.

Off-Site

Since the earliest available mapping (1884 - 1887) a number of potential off-site sources of contamination have been identified within 250m of the site, including infilled land (water), contemporary trade directories, electrical sub-stations, Alexandra Docks Railway, infilled land (non-water), licenced waste management facilities, historical landfill site, historical gas holder and specific points of interest (vehicle repair, testing and servicing).

2.3 Geology

The anticipated geology is summarised below, based on the British Geological Survey (BGS) 1:50,000 mapping, Sheet No. 249, Newport Solid and Drift (dated 1997), historical BGS borehole records and the BGS GeoIndex Onshore Bedrock and Superficial Geology Viewer.

- Made Ground described as Fill (topsoil with occasional brick fragments) to a maximum depth of 0.50m bgl.
- Tidal Flat Deposits (superficial) comprising of clay and silt with layers of sand, gravel and peat.
- Mercia Mudstone Group (bedrock) comprising mudstones and sub-ordinate siltstones with widespread gypsum / anhydrite. Sandstones may also be present.

2.4 Hydrology and Hydrogeology

Hydrology

- Two culverted river drains associated with the Twenty Acres Reen extends c. 45.00m of the north-western boundary, c. 10.00m off the western boundary and adjacent to the south-western boundary, flowing in a south-westerly direction.
- A dock (Alexandra Docks) is positioned c. 380m south which is associated with the River Usk positioned c. 453m east of the site.
- Existing sewage pumping station present on the northern corner within the site boundary.
- Two surface water abstraction points associated with 'metal' works are located c. 332m south-west, therefore within 1km of the site.

Hydrogeology

- Tidal Flat Deposit (superficial): unproductive strata, however perched groundwater may be present within the gravels.
- Mercia Mudstone (bedrock): Secondary B Aquifer anticipated to be at c.15.00m bgl.
- Groundwater flow direction is approximated to be a south-eastern direction (to be confirmed by the Ground Investigation).
- River Usk is tidal therefore variations in the groundwater table.

2.5 Geo-Environmental Considerations

The qualitative Conceptual Site Model as assessed within the Fairhurst PRA is presented as Table 1 within this report. The qualitative CSM indicates that the majority of risk ratings are classed as low to moderate risk.

Table 1 – Qualitative Conceptual Model

Source	Potential Pathways	Potential Receptors	Assessment	Consequence	Probability	Risk Class	Investigation Required
Potential on-site sources (see Table 4 and Table 5)	Direct contact dermal / ingestion and / or inhalation of contaminated soils	On-site human health (see Section 5)	Given the commercial nature of the development, the potential harm to human health relating to the potential pathway is reduced. In regions where hardstanding concrete is present the pathway is broken. However, in soft landscaped areas the pathway is active and a clean cover layer should be considered.	Medium	Unlikely	Low	Yes
	Inhalation of accumulated ground gases and/or soil vapours		Made Ground soil (depending on its thickness and composition) associated with the backfilling of the removed field boundaries, trees and Upper Great Wharf Reen, as well as the current development on site, and the underlying peat may present a source of ground gas on site.	Medium	Likely	Moderate	Yes
	Permeation of water supply pipework		The presence of Made Ground means that contaminants with the potential to deteriorate water supply pipes and migrate into the on-site water supply may be present within the underlying soils.	Medium	Low Likelihood	Moderate /Low	Yes
	Inhalation of wind-blown contaminated soils	Off-site human health (see Section 5)	This pathway is active during construction where risks are managed by implementation of RAMS and/or CEMP including dust suppression methods.	Medium	Unlikely	Low	No
	Off-site migration, followed by inhalation of accumulated ground gases and/or soil vapours		There are potential on-site sources of ground gas which could migrate off site from within the unsaturated zone of soil.	Medium	Likely	Moderate	Yes
	Direct contact of building fabric with contaminated soils and/or groundwater	On-site building materials and services	There is potential for Made Ground/groundwater to contain contaminants and sulphates which may degrade building structures.	Mild	Likely	Moderate /Low	Yes
	Ground gas and / or soil vapour accumulation within voids or beneath structures.		Made Ground soil (depending on its thickness and composition) associated with the backfilling of the removed field boundaries, trees and Upper Great Wharf Reen, as well as	Medium	Likely	Moderate	Yes

Source	Potential Pathways	Potential Receptors	Assessment	Consequence	Probability	Risk Class	Investigation Required
			the current development on site, and Peat present a source of ground gas.				
	Off-site migration of potentially contaminated groundwater from on-site sources.	Off-site building materials and services	Groundwater is anticipated to be present within Bedrock deposits and presents a pathway for on-site contamination to migrate off-site and come into contact with off-site buildings and services. The likelihood of aggressive sulphate or pH conditions originating on site is low.	Mild	Low Likelihood	Low	Yes
	Off-site migration, followed by ground gas and/or soil vapour accumulation within voids or beneath structures.		Made Ground soil (depending on its thickness and composition) associated with the backfilling of the removed field boundaries, trees and Upper Great Wharf Reen, as well as the current development on site, and Peat present a source of ground gas, and migration via the granular unsaturated zone is feasible.	Medium	Low Likelihood	Moderate /Low	Yes
	Vertical leaching and migration of contaminants from soil to groundwater	Bedrock groundwater (Secondary B Aquifer) and subsequent migration to Twenty Acres Reen and River Usk	Made Ground soils are anticipated which may contain chemical constituents of concern with the potential to impact upon groundwater resource.	Medium	Low Likelihood	Moderate /Low	Yes
Potential off-site sources (see Tables 4 and 5)	Dermal contact / ingestion and / or inhalation of contaminated soils	Human Health (on-site)	The surrounding area is developed and either covered in hardstanding or established vegetation. Significant wind whip and associated dust generation is not anticipated.	Medium	Unlikely	Low	No
	Migration onto site followed by accumulation and inhalation of ground gas and / or soil vapour		Organic material associated with the historic landfills, infilled land and gasholder and associated tanks may represent a source of elevated ground gas.	Severe	Low Likelihood	Moderate	Yes
	Migration of contaminants onto site followed by direct contact with building fabric	Property (on-site)	There is potential for foundations to come into direct contact with Bedrock groundwater at the site and potential associated contamination	Mild	Low Likelihood	Low	Yes

Source	Potential Pathways	Potential Receptors	Assessment	Consequence	Probability	Risk Class	Investigation Required
			from off-site sources. Albeit offsite sources of potential contamination are relatively limited.				
	Migration onto site, followed by accumulation of ground gas / soil vapours and ignition		Organic material associated with the historic landfill, infilled land and historical gasholder and associated tanks may represent a source of elevated ground gas.	Medium	Likely	Moderate	Yes

Please note the above table has been taken from the Nott Group report which has been submitted in support of the Planning Application 11 (ref. DM2019/01977) in support of the proposed development

Risk Ratings:

- High - The available information indicates a significant possibility of harm to a receptor requiring further investigation, assessment or treatment.
- Moderate - The available information indicates a potential for significant harm to a receptor requiring further investigation and assessment.
- Low - The available information does not indicate a significant potential for harm to a receptor requiring further investigation. This does not indicate zero risk.

2.6 Geotechnical Considerations

The following qualitative geotechnical constraints have been identified with the Fairhurst PRA.

- Made Ground is anticipated to be present on-site which can comprise significantly variable material resulting in poor and variable engineering properties, such as high compressibility and low shear strength. Made Ground is expected to be present predominantly owing to the removal and backfilling of historical field boundaries, Upper Great Wharf Reen and settling ponds, as well as the existence of the current development on site.
- Made Ground may contain obstructions typically in the form of brick, building rubble, cobbles and boulders.
- The Tidal Flat Deposits may contain varying proportions of clay and silt with layers of sand, gravel and peat, which may potentially have variable and poor engineering properties. The peat layers within the Tidal Flat Deposits can be highly compressible, resulting in unacceptable immediate and consolidation settlement. Peat also contains a high organic matter content which can result in an elevated ground gas risk.
- The clay and silt within the Tidal Flat Deposits may have the potential for high volume change upon loading. Given the presence of trees in the western tip of the site, it would be prudent to confirm if the soils are susceptible to shrink/swell. This should be considered in respect to the sub-structure design, depending on the thickness of the overlying superficial deposits, whether the soils are desiccated and the nature and magnitude of applied loads.
- Pyrite (sulphate 'attack') may represent a risk to the fabric of the proposed building structures and foundations associated with the presence of Made Ground, groundwater and natural soils.
- Potential for a groundwater body within the Bedrock and perched groundwater within the Tidal Flat Deposits may require pumping/dewatering during any intrusive works involving excavations and/or earthworks. Variation of groundwater levels due to tidal influence should be confirmed by groundwater monitoring.
- Infilled features on site can lead to unacceptable total and differential settlement, particularly when building across the boundaries between infilled features and natural ground, due to the unknown composition and thickness of such material and the likelihood that the material was not placed and compacted according to a specification. Infilled features also present a potential ground gas risk.
- Existing buried services are anticipated to be present across site. A utilities survey is recommended to identify any services in the proposed development area, which may require decommissioning or diversion. Safe clearances from live services should be observed during ground investigation works.
- The proposed structural design should take consideration of existing on-site and neighbouring foundations and structures to avoid undermining the integrity of such through excavations, earthworks or any form of dewatering in their vicinity.
- Potential for buried obstructions associated with previous development on site. Where demolition works are to be undertaken of the existing structures, it should be ensured that all obstructions, including any buried underground obstructions, within influencing depth of the proposed development are removed as required.

3.0 GROUND INVESTIGATION

3.1 Scope of Investigation

The intrusive ground investigation was carried out by LMB Geosolutions (LMB) between 8th January and 16th January 2024 under the management and direction of Fairhurst, with subsequent groundwater and ground gas monitoring rounds. The scope of works were to include the following:

- Buried services clearance using CAT and Genny;
- 2 No. Cable Percussive boreholes (BH101 and BH103) with rotary follow on to depths of up to 25.00m bgl.
- 2 No. Cable Percussive boreholes (BH102 and BH104) to depths of up to 20.00m bgl.
- 5 No. Trail Pits to depths of 3.50m bgl.
- Installation of groundwater and ground gas monitoring wells (BH101 to BH104).
- 3 No. groundwater and ground gas monitoring rounds, including groundwater sampling and laboratory analysis.
- Geo-environmental and geotechnical soil sampling and associated ex-situ laboratory testing.

The factual record of the intrusive ground investigation works are detailed in the LMB Factual Ground Investigation Report, dated July 2023, as presented in Appendix B of this report. The positions of the exploratory hole locations are present within Appendix A.

The ground investigation was specified in accordance with the ICE UK Specification for Ground Investigation (2012) and was undertaken in accordance with techniques outlined in Eurocode 7 - BS EN 1997-1:2004, BS 5930:2015+A1:2020 Code of Practice for Site Investigations and BS 10175 Investigation of potentially contaminated sites. The works were carried out under the supervision of an engineer from LMB as the Ground Investigation Contractor.

3.2 Exploratory Hole Rationale

The ground investigation scheme has been designed relative to the qualitative Conceptual Site Model and geotechnical considerations presented within the Fairhurst PRA, and was also completed in accordance with the relevant standards (including BS 8485:2015 and CIRIA C665: 2007, BS 8576:2013 and BS 10175 and BS 5930). The works undertaken on site and the rationale behind exploratory positions and installs are presented in Table 2.

Table 2 - Rationale for the Ground Investigation Design

Hole No.	Type	Scheduled Depth (m)	Rational	Installations
BH101	Cable Percussive Borehole (15.00m) (Including concrete coring and rotary follow on if required to 25.00m bgl)	25.00	Determine ground conditions beneath the internal areas and installation of standpipes for ground gas and groundwater monitoring. Thickness of the Tidal Flat Deposit and condition of the Mercia Mudstone must be determined.	1
BH102				1
BH103	Cable Percussive Borehole (Including concrete coring and rotary follow on if required to 20.00m bgl)	20.00	Determine ground conditions across the external areas of the proposed development and installation of standpipe for ground gas and groundwater. Thickness of the Tidal Flat Deposit and condition of the Mercia Mudstone must be determined.	1
BH104				1
TP101 – TP107	Trial Pit (Machine excavated including concrete breaker)	3.50	Collect bulk samples for environmental and geotechnical testing.	N/A

3.3 Deviation from Ground Investigation Scheme

The proposed scope of works and rationale behind the ground investigation designed by Fairhurst is outlined in Section 3.2. However, deviations to the initial ground investigation design were implemented and are outlined below:

- Rotary follow on was removed from BH103 and BH104 as it was considered that core sampling was only necessary beneath the building footprint to inform pile design.
- Dual install monitoring wells were utilised instead of the proposed single installs to avoid the risk of discounting ground gas data due to the inaccuracies inherent within flooded wells. During the ground investigation works, groundwater strikes were encountered and rose to c. 4.00m bgl within all cable percussive boreholes. The source of groundwater was likely contained within gravel components of the Mercia Mudstone (Secondary B) and perched water within the Tidal Flat Deposits. Dual installs were therefore instructed to ensure that ground gas data is obtained to quantitatively assess the Made Ground and the peat within the Tidal Flat Deposits.

3.4 Laboratory Testing

Geo-environmental and geotechnical laboratory testing was scheduled by Fairhurst and sent for laboratory testing by LMB. The testing was undertaken by I2 Analytical and Elemental Materials Technology with appropriate MCERTS and UKAS accreditations for the relevant testing. All laboratory results are provided within the LMB Factual report included as Appendix B.

3.5 Sample Deviations

Sample deviations were reported within the i2 Analytical test reports for groundwater sampling, including ammonia (BH101s and BH104), pH (BH101d, BH101s, BH102d and BH104) and suspended solids (BH104).

Upon careful consideration of the results, the deviations are not considered to impact the geo-environmental conclusions. The values for the deviated ammonia testing is not likely to be greater than the respective values reported, and since both of the ammonia test results were found to exceed the DWS and EQS thresholds (Ref. Section 7.4), the assessment has been accepted as reliable for groundwater sample characterisation. Likewise, the deviated pH and suspended particle tests have also been accepted as reliable, since the deviated samples were compared against non-deviated samples reporting similar values.

4.0 GROUND CONDITIONS

The following section of this report provides a summary of the ground conditions encountered during the ground investigation works undertaken at the site.

4.1 Geology

Ground conditions encountered were broadly consistent with the BGS records. A summary of the ground conditions encountered is presented in Table 3 below.

Table 3– Summary of Ground Conditions Encountered

Strata	General Description	Depth to base (m bgl)	Depth to base (m AOD)	Thickness (m)
Hardstanding	Asphalt	0.08 – 0.40	7.51 – 6.86	0.08 – 0.40
Made Ground	Sandy GRAVEL including anthropogenic materials	1.10 – 2.00	6.18 – 5.56	1.00 – 1.92
Tidal Flat Deposit*	Very soft to firm, grey / greyish brown / blueish grey CLAY with occasional PEAT layers (see Section 4.4 for peat layer details)	10.50 – 11.20	-3.94 – -3.34	9.00 – 9.50
Gravel	Clayey, gravelly SAND with sandstone and limestone GRAVEL, and occasional cobbles.	14.20 – 15.90	-8.46 – -6.94	3.00 – 4.90
Weathered Mercia Mudstone**	Firm to stiff, reddish brown / blueish grey CLAY with mudstone inclusions and occasional gravel and rare cobbles.	16.50 – 21.20	-13.61 – -17.94	1.80 – 6.00
Mercia Mudstone***	Very weak to moderately strong MUDSTONE	25.20 – 25.50	-18.34 – -17.61	4.00 – 9.00

* Trail pits terminated within the Tidal Flat Deposit

** BH103 and BH104 terminated within the Weathered Mercia Mudstone

***Base not proven.

4.2 Hardstanding

Hardstanding (asphalt) was encountered within all exploratory boreholes and trial pits from ground level to depths of between 0.08m bgl to 0.40m bgl (6.86m AOD to 7.51m AOD).

4.3 Made Ground

Made Ground was encountered within all exploratory boreholes and trial pits to a maximum proven depths of 1.10m bgl to 2.00m bgl (5.56m AOD to 6.18m AOD). The Made Ground is granular dominant generally described as a sandy GRAVEL including materials such as sub-base, road stone (also encountered as cobbles and occasional boulders), asphalt, concrete and brick.

Within TP103 a layer of 'concrete with brick' was encountered between 0.25m bgl to 0.40m bgl (7.01m AOD to 6.86m AOD).

4.4 Tidal Flat Deposits (Superficial)

The Tidal Flat Deposits were encountered within all exploratory boreholes from the base of the Made Ground to depths of between 10.50m bgl to 11.20m bgl (-3.94m AOD to -3.34m AOD). All of the Trial Pits terminated within the Tidal Flat Deposits therefore the base of the deposit was not encountered in

these instances. The unit was encountered as predominantly cohesive, generally described as very soft to firm, grey / greyish brown / blueish grey CLAY and locally sandy.

In addition to the general description, there are 2 No. consistent peat layers correlated across the site described as a brown to dark brown slightly clayey PEAT. The depths of the two layers are described below.

Peat layer 1 - encountered within all positions at 4.30m bgl to 4.90m bgl (3.14m AOD to 2.66m AOD) with thickness ranging from 0.70m to 0.90m.

Peat layer 2 - Encountered within BH101, BH102 and BH103 at 9.00m bgl to 9.50m bgl (-1.41m AOD to -2.24m AOD) with thickness ranging from 0.50m to 1.00m.

At approximately +/- 1m of the peat layers identified above, the Tidal Flat Deposits generally contained decaying plant materials, occasional peat bands, peat fragments and organic odour.

The Tidal Flat Deposits do not increase in strength with depth. Where deposits contain organic material the strength descriptor is described as very soft.

4.5 Gravels (Superficial)

A layer of gravels and sands were encountered within all Cable Percussive from the base of the Tidal Flat Deposits to depths of 10.50m bgl to 11.20m bgl (-3.94m AOD to -3.34m AOD). This granular layer was not anticipated on-site, however it is likely to be a superficial deposit associated with fluvial processes such as the River Terrace Deposit.

At BH101, BH102 and BH103 the unit is generally described as slightly clayey sandy, sub-angular to sub-rounded, medium to coarse sandstone and occasional limestone GRAVEL. In addition, BH101 and BH102 contained a layer of clayey gravelly SAND with frequent sub-rounded cobbles immediately above the gravel deposit.

Alternatively, at BH104 the deposit is predominately sand, described as a clayey gravelly sand. The gravel contained within is sub-angular to rounded, fine to coarse sandstone.

4.6 Weathered Mercia Mudstone (Bedrock)

The weathered component of the Mercia Mudstone were encountered within all exploratory boreholes from the base of the Gravels to depths of between 16.50m bgl to 21.20m bgl (-13.61m AOD to -17.94m AOD). The unit was generally described as a firm to stiff, reddish brown / blueish grey CLAY with mudstone inclusions and occasional sub-rounded gravel and rare cobbles.

4.7 Mercia Mudstone (Bedrock)

The non-weathered component of the Mercia Mudstone was encountered within BH101 from the base of the Weathered Mercia Mudstone to unproven base depths of 25.50m bgl (-17.61m AOD). The unit was generally described as very weak to weak MUDSTONE and CLAY throughout with moderately strong mudstone encountered beyond c. 21.00m bgl. BH102 was also scheduled to 25.00m bgl, however the weathered profile extended to the base of this borehole. Fracturing was identified throughout the unit classified as a Fracture Index (FI) between I12 to I30.

4.8 Groundwater Strikes

Groundwater strikes and seepages were observed at a range of depths within the Made Ground, Tidal Flat Deposits and Gravel.

The strikes ranged from 4.20m bgl to 13.50m bgl (3.44m AOD to -6.34m AOD) and rose to 3.00m bgl to 9.30m bgl (4.44m AOD to -1.86m AOD). A summary of these strikes is provided below in Table 4.

Table 4 - Summary of Depths to Groundwater Strikes and Seepages

Location ID	Strike / Seepage Depth		Stratum	Strike Depth + 20 Minutes		Notes
	m bgl	m AOD		m bgl	m AOD	
BH101	4.20	2.96	TFD	4.10	3.06	-
BH101	13.50	-6.34	G	3.00	4.16	-
BH102	4.00	2.59	TFD	4.00	3.59	-
BH103	5.70	2.06	TFD	-	-	Did not rise after 20 minutes
BH103	10.60	-3.34	TFD	9.00	-1.74	-
BH104	4.00	3.44	TFD	3.00	4.44	-
BH104	11.00	-3.56	TFD	-	-	Did not rise after 20 minutes
BH104	12.60	-5.16	G	9.30	-1.86	-
TP102	0.90	6.69	MG	-	-	Seepage
TP103	2.20	5.08	TFD	-	-	Seepage
TP103	3.00	4.28	TFD	-	-	Seepage
TP104	1.15	6.44	MG	-	-	Seepage
TP105	0.90	6.58	MG	-	-	Seepage
TP105	2.50	4.98	TFD	-	-	Seepage

It should be noted that the speed of drilling, use of water flush and casing of holes can often mask minor seepages and water strikes.

4.9 Groundwater Monitoring

2 No. groundwater monitoring rounds were undertaken on 26th January 2024 and 7th February 2024 (an additional 1 No. round is scheduled to take place and will be included under a separate revision). A summary of the groundwater monitoring levels are presented within Table 5.

Table 5 – Summary of Groundwater Monitoring Data

Borehole Reference	Target Strata	Response Zone		Groundwater Level	
		m bgl	m AOD	m bgl	m AOD
BH101(s)	TFD	2.00 – 10.00	5.16 – - 2.84	2.73	4.43
				2.91	4.25
BH101(d)	G	10.50 – 14.00	-3.34 – -6.84	3.45	3.62
				3.86	3.30
BH102(s)	MG	0.50 – 2.50	7.09 – 5.09	1.78	5.81
				1.83	5.76
BH102(d)	G	3.00 – 15.00	4.59 – -7.41	4.41	3.18
				4.42	3.17
BH103(s)	TFD	2.00 – 9.00	5.26 – -1.74	2.69	4.57
				1.98	5.28
BH103(d)	TFD / G			3.59	3.67

		10.50 – 14.00	-3.24 – -6.74	3.66	3.60
BH104	TFD	2.00 – 5.00	5.44 – 2.44	1.01	6.43
				1.38	6.06

The results indicate that perched groundwater is present within the permeable lenses of the Made Ground, Tidal Flat Deposits and the Gravel unit. The data suggest that the perched water for both units are relatively continuous across the Site. It should be noted that perched groundwater is not typically tidally influenced, however due to the proximity to the Severn Estuary, some strikes encountered below Ordinance Datum and the consistent granular lenses within the Tidal Flat Deposits, the effect of tidal influence is more likely to be encountered within the perched groundwater and thus the groundwater levels may fluctuate.

As mentioned in Section 2.4, the Mercia Mudstone is defined as a Secondary B aquifer where the water table was anticipated to be at c. 15.00m bgl. All cable percussive boreholes achieved depths greater than 15.00m bgl (up to 20.00m bgl or 25.00m bgl), however no groundwater strikes were encountered and the strata was described as clay and mudstone. As such, groundwater monitoring wells were not installed in the Mercia Mudstone.

4.10 Visual and/or Olfactory Contamination

No visual or olfactory evidence of contamination was encountered during the Fairhurst/LMB intrusive ground investigation, as noted on the exploratory borehole logs (Appendix B).

4.11 Obstructions

Obstructions were not reported during the Fairhurst/LMB ground investigation, as indicated on the exploratory borehole logs (Appendix B).

5.0 GEOTECHNICAL TESTING & ENGINEERING PROPERTIES

The following section discusses the in-situ and laboratory testing undertaken as part of the LMB ground investigation (see Table 6). Where necessary, determination of characteristic parameters has been based on a cautious estimate of results derived from laboratory, published correlations and field tests, complemented with engineering judgement and consideration of the relevant limit state. The parameters are not considered to be absolute and should be referenced with the specific strata text in this section and reviewed when considering a specific area or development requirement of the site. The below figures at the rear of this report and should be referenced accordingly in relation to the field and laboratory testing results.

- Figure 1 – Casagrande Plasticity Chart
- Figure 2 – Particle Size Distribution Chart
- Figure 3 – SPT 'N₆₀' Values vs Depth (m bgl)
- Figure 4 – SPT 'N₆₀' Values vs Elevation (m AOD)
- Figure 5 – Undrained Shear Strength Vs. Depth (m bgl)
- Figure 6 – Undrained Shear Strength Vs. Elevation (m AOD)
- Figure 7 – Unconfined Compressive Strength Vs. Depth (m bgl)
- Figure 8 – Unconfined Compressive Strength Vs. Depth (m AOD)

Table 6 – Summary of Geotechnical Testing Undertaken

Geotechnical Test		MG	TFD	G	WMM	MM
Laboratory	Atterberg Limits and Moisture Content	2	6	-	3	2
	Particle Size Distribution (PSD)	3	3	2	-	-
	Bulk Density	-	2	-	2	-
	Point Load	-	-	-	2	5
	Oedometer	-	2	-	-	-
	Undrained Triaxial	-	2	-	1	-
	Soil Organic Matter (SOM)	2	5	-	1	-
	Loss on Ignition (LOI)	-	4	-	-	-
	BRE SD1 Suite D	3	6	1	1	1
In-situ	Standard Penetration Tests (SPT)	4	25	10	5	-

5.1 Made Ground

Particle Size Distribution (PSD)

PSD testing was undertaken on 3 No. samples of the granular Made Ground at depths from 0.60m bgl to 1.40m bgl (6.99m AOD to 6.16m AOD).

The results of the PSD testing identified the soils to consist of 36% to 75% gravel, 12% to 30% sand, 9% to 23% silt and 3% to 11% clay as shown on Figure 1.

Moisture Content and Atterberg Limits

2 No. Moisture Content tests and Atterberg tests were undertaken on samples of the cohesive Made Ground at a depths of 1.20m bgl to 1.30m bgl (6.29m AOD to 5.96m AOD).

The moisture content recorded from 19% and 27% (average 23%), with liquid limits of 43% and 60%, plastic limits of 26% and 30%, and plasticity indices of 17% and 30% which is considered an 'Intermediate' to 'High' plasticity clay (see Figure 2). The modified plasticity index for the samples were recorded as 7% and 30% of 'high' volume change potential in accordance with NHBC Chapter 4.2 'Building Near Trees' (2023).

Strength and Stiffness

4 No. Standard Penetration Tests (SPTs) were undertaken within the Made Ground at 1.20m bgl (6.39m AOD to 5.96m AOD) the correlated strengths for the granular and cohesive layers are described below, in accordance with BS EN ISO 14688-2:2017 and BS 5930:2015.

- 3 No. SPTs were undertaken within the granular Made Ground recording N_{60} values of 14 to 42, indicative of a medium dense to dense granular material.
- 1 No. SPT was undertaken within the cohesive Made Ground recording an N_{60} value of 15. Applying an f_1 factor of 4.5 proposed by Stroud (1974) the undrained shear strength of the cohesive material is derived to be 68kN/m².

As shown on Figure 3 and Figure 4 the Made Ground does not show an increase in strength/density with depth.

Soil Organic Matter (SOM)

2 No. of samples of the Made Ground were submitted for SOM analysis at depths of 1.00m bgl and 1.10m bgl (6.48m AOD and 6.18m AOD) at TP103 and TP105 respectively, recording values of 1.60% and 7.00%. The soil descriptions on the trial pit logs do not provide a visual indication of SOM, however the elevated organics are likely associated with the reworking of the underlying Tidal Flat Deposit.

BRE SD1 Concrete Classification

3 No. BRE tests were undertaken on the Made Ground at depths of 0.50m bgl to 1.50m bgl (6.40m AOD to 5.98m AOD).

The Made Ground recorded oxidisable sulphides concentrations less than 0.3% and therefore it is considered that pyrite is not likely present within these samples.

In accordance with BRE Special Digest 1:2005 'Concrete in Aggressive Ground', the characteristic values were determined recording a minimum pH value of 8.1 and total potential sulphate of 0.20% (mean highest two values). The concrete classification for the Made Ground was determined to be Design Sulphate DS-1 and ACEC class AC-1, relative to Table C2 of the guidance.

5.2 Tidal Flat Deposits

Particle Size Distribution (PSD)

PSD testing was undertaken on 3 No. samples of the Tidal Flat Deposits at depths of 7.00m bgl to 10.20m bgl (0.59m AOD to -2.76m AOD) described as clay and silt.

The results of the PSD testing identified the associated soils to consist of 0% to 1% gravel, 7% to 41% sand, 35% to 62% silt and 23% to 93% clay, as shown on Figure 1.

It should be noted that the PSD for BH102 at 8.50m bgl (-0.91m AOD) and BH104 at 10.20m bgl (-2.76m AOD) determined the material as silt dominant, however this was not reflected in the exploratory borehole logs.

Moisture Content and Atterberg Limits

6 No. Moisture Content tests and Atterberg tests were undertaken on samples of the Tidal Flat Deposits at a depths of 1.20m bgl to 7.50m bgl (6.08m AOD to 0.09m AOD).

The moisture content of the samples were recorded from 29% and 48% (average 35%), with liquid limits of 42% and 66%, plastic limits of 23% and 30%, and plasticity indices of 19% and 36% which classifies as an 'Intermediate' to 'High' plasticity clay (Ref. Figure 2). The modified plasticity index for the samples were recorded as 19% and 36% of 'high' volume change potential, in accordance with NHBC Chapter 4.2 'Building Near Trees' (2023).

Bulk Density

2 No. bulk density testing was undertaken on the Tidal Flat Deposits at a depth of 3.50m bgl and 8.40m bgl (3.76m AOD and -1.24m AOD), recording values of 1.48mg/m³ and 1.84mg/m³.

Strength and Stiffness

25 No. Standard Penetration Tests (SPTs) were undertaken within the Tidal Flat Deposits between 3.00m bgl to 10.50m bgl (4.59m AOD to -3.34m AOD) the correlated strengths for the cohesive and peat layers are described below, in accordance with BS EN ISO 14688-2:2017.

- 21 No. SPTs were undertaken within the cohesive Tidal Flat Deposits recording a N_{60} values of 0 to 47. Applying an f_1 factor of 4.5 proposed by Stroud (1974) the undrained shear strength of the cohesive material is derived to be 0.00kN/m² to 210.90kN/m².
- 4 No. SPTs was undertaken within the peat layers of the Tidal Flat Deposit recording an N_{60} values of 0 to 3.

As shown on Figure 3 and Figure 4 the N_{60} values of the Tidal Flat Deposits shows that soft material is present between approximately 2.50m bgl to 10.00m bgl (4.00m AOD to -2.00m AOD) at a thickness c. 6.00m. As discussed in Section 4.4, two layers of peat were identified on the exploratory logs at 4.30m bgl to 4.90m bgl (3.14m AOD to 2.66m AOD) and 9.00m bgl to 9.50m bgl (-1.41m AOD to -2.24m AOD). In addition, at approximately +/- 1m of the layers identified, decayed plant materials, occasional peat bands, peat fragments and organic odour were recorded accounting for the total thickness of soft material of 6.00m.

It was also identified on Figure 3 and Figure 4 that 3 No. SPTs recorded an increase in strength with depth, from N_{60} 19 to 37 at approximately -2.91m AOD to -3.34m AOD.

2 No. Un-consolidated Undrained Triaxial Compression tests were undertaken on the Tidal Flat Deposits at depths of 2.00m bgl and 4.00m bgl (5.26m AOD and 3.16m AOD). The tests recorded shear strength values of 8.00kPa to 112.00kPa, corresponding to an extremely low to high strength material in accordance with BS EN ISO 14688-2:2017, as shown on Figure 3 and Figure 4.

Consolidation

2 No. of One Dimensional Oedometer Consolidation tests were undertaken on the Tidal Flat Deposits at 2.00 bgl (5.44m AOD and 5.16m AOD) as shown on Figure 7 and Figure 8.

The reported coefficient of compressibility (m_v) results for the corresponding pressures approximately equal to overburden pressure for each sample ranged between 0.39m²/MN and 0.40m²/MN, and coefficient of consolidation (c_v) at overburden pressure ranged between 3.20m²/yr to 4.30m²/yr with an average result of 3.75m²/yr.

Soil Organic Matter (SOM)

5 No. of samples of the Made Ground were submitted for SOM analysis at a depths of between 1.50m bgl to 7.30m bgl (5.74m AOD to 0.54m AOD), recording values between 0.90% and 12.00%. The soil descriptions of the samples on the trial pit and borehole logs do not provide a visual indication of SOM.

Loss on Ignition (LOI)

4 No. of samples of the Tidal Flat Deposits were submitted for LOI at a depths of between 4.50m bgl to 10.50m bgl (2.66m AOD to -2.74m AOD), to provide an approximate measure of the organic matter content, recording values between 1.70% and 21.40%. The soil descriptions on the borehole logs suggest that these samples were composed of peat.

BRE SD1 Suite D (BRE)

6 No. BRE tests were undertaken on the Tidal Flat Deposits at depths of 0.60m bgl to 10.50m bgl (6.68m AOD to -3.24m AOD).

The Tidal Flat Deposits recorded oxidisable sulphides concentrations greater than 0.3% and therefore it is considered that pyrite is likely present within these samples.

In accordance with BRE Special Digest 1:2005 'Concrete in Aggressive Ground', the characteristic values were determined recording a minimum pH value of 7.8 and total potential sulphate of 1.90% (mean highest two values). As such, the concrete classification of the Tidal Flat Deposits was determined to be Design Sulfate class DS-4 and ACEC class AC-4, relative to Table C2 of the guidance.

5.3 Gravel

Particle Size Distribution (PSD)

PSD testing was undertaken on 2 No. samples of the Gravel within BH104 at 13.00m bgl (-5.56m AOD) and BH102 at 15.00m bgl (-7.41m AOD), described as granular and cohesive material, respectively.

The granular material identified at BH104 corresponds to the exploratory borehole log descriptions as described in Section 4.0, however the cohesive material identified at BH102 was described as a slightly gravelly, slightly sandy silty clay.

The results of the PSD testing identified the associated soils to consist of 0% very coarse (cobbles and boulders), 4% to 71% gravel, 21% to 34% sand, 0% to 33% silt, and 29% to 62% clay, as shown on Figure 1.

Strength and Stiffness

10 No. SPTs were undertaken within the Gravel unit between 12.00m bgl and 15.00m bgl (-4.41m AOD to 7.56m AOD) as shown on Figure 3 and Figure 4. 4 No. tests recorded N value of 50 which is considered refusal, while the remaining 6 No. tests recorded N_{60} values of 27 to 42. The correlated strengths for all testing undertaken within the Gravel indicates a medium dense to dense material, in accordance with BS 5930:2015.

BRE SD1 Suite D (BRE)

1 No. BRE tests were undertaken on the Gravel unit at depths of 12.00m bgl (-4.84m AOD).

The Gravel unit recorded oxidisable sulphides concentrations greater than 0.3% and therefore it is considered that pyrite is likely present within the sample.

In accordance with BRE Special Digest 1:2005 'Concrete in Aggressive Ground', the characteristic values were determined recording a minimum pH value of 8.4 and total potential sulphate of 0.60%. As such, the concrete classification of the Gravel was determined to be Design Sulfate class DS-2 and ACEC class AC-2, relative to Table C2 of the guidance.

5.4 Weathered Mercia Mudstone

Moisture Content and Atterberg Limits

3 No. Moisture Content tests and Atterberg tests were undertaken on samples of the Weathered Mercia Mudstone at a depths between 16.50m bgl to 24.90m bgl (-9.24m AOD to -17.64m AOD).

The moisture content of the samples were recorded from 13% to 28% (average 19%), with liquid limits of 25% to 26%, plastic limits of 17% to 18% and plasticity indices of 7% to 9% which is considered a 'low' plasticity clay (Ref. Figure 2). The modified plasticity index was recorded as 6% to 8% of 'low' volume change potential, in accordance with NHBC Chapter 4.2 'Building Near Trees' (2023).

Soil Organic Matter (SOM)

1 No. of sample of the Weathered Mercia Mudstone were submitted for SOM analysis at a depth of 15.50m bgl (-7.91m AOD), recording a value of 0.30%. The soil descriptions on the borehole log did not provide a visual indication of SOM.

Bulk Density

2 No. bulk density testing was undertaken on the Weathered Mercia Mudstone at a depth of 2.04m bgl and 2.06m bgl (1.70m AOD and 1.66m AOD), recording values of 1.66mg/m³ and 1.70mg/m³.

Strength and Stiffness

5 No. SPTs were undertaken within the Weathered Mercia Mudstone at 15.00m bgl to 16.50m bgl (-7.74m AOD to -9.34m AOD). The material encountered was cohesive, where 4 No. tests recorded N value of 50 which is considered refusal, while the remaining 1 No. test recorded an N₆₀ value of 46. Applying an f1 factor of 4.5 proposed by Stroud (1974) the undrained shear strength of the cohesive material is derived to be 262kN/m² to 285kN/m², in accordance with BS EN ISO 14688-2:2017 as shown on Figure 3 and Figure 4.

2 No. axial PLTs were undertaken on selected sub samples of the Weathered Mercia Mudstone from BH103 at depths of 17.87m bgl and 23.80m bgl (-10.61m AOD to -16.54m AOD) as shows on Figure 7 and Figure 8. The results provided I_{s50} values of between 0.02MPa and 0.04MPa. These values have been converted to UCS using a correction factor of 24, giving UCS ranging between 0.48MPa and 0.96MPa; indicative of extremely weak rock in accordance with BS 14689.

BRE SD1 Suite D (BRE)

1 No. BRE tests was undertaken on the Weathered Mercia Mudstone unit at depths of 15.00m bgl (-7.74m AOD).

The Weathered Mercia Mudstone unit recorded oxidisable sulphides concentrations less than 0.3% and therefore it is considered that pyrite is not likely present within the sample.

In accordance with BRE Special Digest 1:2005 'Concrete in Aggressive Ground', the characteristic values were determined recording a minimum pH value of 9.5 and total potential sulphate of 0.10%. As such, the concrete classification of the Tidal Flat Deposits was determined to be Design Sulfate class DS-2 and ACEC class AC-2, relative to Table C2 of the guidance.

5.5 Mercia Mudstone

Moisture Content and Atterberg Limits

2 No. Moisture Content tests and Atterberg tests were undertaken on samples of the Mercia Mudstone at depths of 16.50m bgl and 17.80m bgl (-8.91m AOD and -10.64m AOD).

The moisture content of the samples were recorded from 13% and 22% (average 18%), with liquid limits of 25% to 32%, plastic limits of 17% to 21% and plasticity indices of 8% to 11% 7% to 9% which is considered a 'low' plasticity clay (Ref. Figure 2). The modified plasticity index was recorded as of 'low' volume change potential, in accordance with NHBC Chapter 4.2 'Building Near Trees' (2023).

Strength and Stiffness

5 No. axial Point Load Tests (PLT) were undertaken on selected sub samples of the Mercia Mudstone from BH101 at depths of 19.20m bgl to 24.00m bgl (-12.04m AOD to -16.84m AOD), as shown on Figure 7 and Figure 8. The results show that I_{s50} values of between 0.03MPa and 0.87MPa were recorded. These values have been converted to UCS using a correction factor of 22 giving UCS ranging between 0.44MPa and 19.14MPa; indicative of extremely weak to moderately weak rock in accordance with BS EN ISO 14689. However, the majority of results were between 6.00MPa and c. 8.00MPa indicating weak rock.

BRE SD1 Suite D (BRE)

1 No. BRE test was undertaken on the Mercia Mudstone unit at depths of 7.16m bgl (-9.34m AOD).

The Mercia Mudstone recorded oxidisable sulphides concentrations less than 0.3% and therefore it is considered that pyrite is not likely present within the sample.

In accordance with BRE Special Digest 1:2005 'Concrete in Aggressive Ground', the characteristic values were determined recording a minimum pH value of 9.3 and total potential sulphate of 0.08%. As such, the concrete classification of the Mercia Mudstone was determined to be Design Sulfate class DS-2 and ACEC class AC-2, relative to Table C2 of the guidance.

6.0 GEOTECHNICAL ASSESSMENT

Presence of Existing Services

Existing services underlying the site / present within the surrounding area may require capping and or diversion to facilitate the construction of the proposed development, which should be managed through the appropriate utility suppliers during the construction phase. The Principal Contractor should ensure that appropriate mitigation measures are put in place during the construction phase (i.e. during foundation excavation).

Made Ground

Made Ground was encountered within all exploratory boreholes and trial pits to a maximum proven depth of 2.00m bgl (5.56m AOD). Made Ground should not be considered a suitable founding stratum in its current state.

Groundwater and Excavations

Monitoring data indicates that perched groundwater is contained within the Made Ground, Tidal Flat Deposits and Gravel unit up to 1.01m bgl (6.43m AOD). Water ingress should be anticipated during excavation, therefore, it is recommended that allowances for temporary shoring and appropriate dewatering measures are made to prevent excavation collapse / flooding.

Drainage and Soakaways

Soakaway tests were not undertaken, given the extent of cohesive clay deposits beneath the site, considered to be of low permeability. It is considered that the use of soakaway infiltration drainage is not be feasible for the proposed development.

Foundation Solution & Ground Improvement

A Preliminary Risk Assessment (Ref. 151157/R1.0) was previously undertaken by Fairhurst, issued November 2022, which qualitatively identified Tidal Flat Deposits beneath the proposed development. Tidal Flat Deposits typically contain varying proportions of clay and silt with layers of sand, gravel and peat, suggesting that variable and poor engineering properties are likely to be encountered at the Site. The peat layers within the Tidal Flat Deposits can also be highly compressible, resulting in unacceptable immediate and consolidation settlement.

The proposed loads and design performance requirements were defined by Fairhurst structural engineers as summarised below:

- Foundations (safe bearing pressure) – 100kN/m²
- Slab – 25kN/m²
- Settlement – <25mm
- Differential settlement – 1:500mm

Based on the required safe bearing pressures, deep foundations will be required to transfer foundation loads to competent bearing stratum. A preliminary pile design has been undertaken to inform foundation design.

The Made Ground and Tidal Flat Deposits have been ignored within the Preliminary Pile Design calculations conservatively. Negative skin friction has not been considered on the basis that the ground will be treated to support the slab.

The pile capacities for bored piles calculated assuming a 5.0m rock socket into unweathered mudstone and assuming no pile testing is undertaken are noted in Table 7.

Table 7 – Summary of Pile Design

Pile Diameter (mm)	Rock Socket Length (m)	SWL (kN)
450	5.0	800
600	5.0	1125
750	5.0	1500

A preliminary settlement calculation was undertaken for the specified slab load 25kN/m² and the predicted settlements ranged between 45mm and 75mm. Therefore, ground improvement will be required to achieve the required safe bearing capacity and differential settlement criterion for the slab. Ground treatment using Controlled Modulus Columns (CMC) or surcharging are considered appropriate for the prevailing ground conditions.

Chemical Attack on Concrete

The Fairhurst Preliminary Risk Assessment (Ref. 151157/R1.0, dated November 2022) determined that the Made Ground and Tidal Flat Deposits were likely to contain oxidisable sulfates which is a risk to buried concrete. As such, the procedures within Section C5.1.4 'Brownfield Locations Containing Pyrite' of BRE Special Digest 1:2005 'Concrete in Aggressive Ground' were carried out to determine the Design Sulfate Class and ACEC Class.

The results suggest that the concrete classification of the Site is Design Sulphate DS-4 and ACEC class AC-4 for the Site. A summary of the results are presented within Table 8.

Table 8 – Summary of Concrete Aggressivity Testing

Strata	Test Source	Number of Tests	Parameter	Characteristic Value	Concrete Classification
Made Ground	Soil	3	pH	8.1	DS-1 AC-1
			Total Potential Sulphate (%)	0.2	
Tidal Flat Deposits	Soil	6	pH	7.8	DS-4 AC-4
			Total Potential Sulphate (%)	1.9	
Gravels	Soil	1	pH	8.4	DS-2 AC-2
			Total Potential Sulphate (%)	0.6	
Weathered Mercia Mudstone	Soil	1	pH	9.5	DS-1 AC-1
			Total Potential Sulphate (%)	0.1	

Strata	Test Source	Number of Tests	Parameter	Characteristic Value	Concrete Classification
Mercia Mudstone	Soil	1	pH	9.3	DS-1 AC-1
			Total Potential Sulphate (%)	0.08	

7.0 GEOENVIRONMENTAL RISK ASSESSMENT

7.1 Summary of Analytical Laboratory Testing Undertaken

Geo-environmental laboratory testing was undertaken on soil samples collected during the ground investigation, a summary of the testing undertaken is provided in Table 9.

Table 9 – Geo-environmental Laboratory Soil Testing.

Geo-environmental Test	Made Ground	Tidal Flat Deposits
Heavy Metals	5	2
Volatile Organic Compounds (VOC)	5	2
Semi-Volatile Organic Compounds (SVOC)	5	2
Phenols	5	2
Polycyclic Aromatic Hydrocarbons (PAH)	5	2
Total Petroleum Hydrocarbon (TPH)	5	2
MTBE, Benzene, Toluene, Ethylbenzene and Xylenes (BTEX)	5	2
Polychlorinated Biphenyls (PCBs)	3	-
Hexavalent Chromium & Chromium III	5	2
Asbestos Screen & Identification	8	1
Asbestos Gravimetric & Quantification	1	-

Geo-environmental laboratory testing was undertaken 4 No. groundwater samples (BH101(s), BH101(d), BH102(d) and BH104) collected on 8th February 2024. A summary of the groundwater testing is summarised in Table 10.

Table 10 – Geo-Environmental Laboratory Groundwater Testing

Geo-Environmental Test	No. Scheduled
Heavy Metals	4
Polycyclic aromatic hydrocarbons (PAH)	4
Total petroleum hydrocarbon (TPH)	4
pH	4
Phenols	4
Sulphide and Sulphates	4
Cyanide	4
Ammonia	2
Total Solid Particles	2

7.2 Assessment Criteria and Approach – Risks to Human Health

For the assessment of the soil analytical results, with the exception of Lead, the human health assessment criteria applied are the 2015 LQM/CIEH 'Suitable 4 Use Levels' (S4ULs) that have been developed in accordance with developments in UK human health risk assessment. The S4ULs are based on Health Criteria that represent minimal or tolerable levels of risks to health as described in the Environment Agency's SR2 guidance, ensuring that the resulting assessment criteria are 'suitable for use' under planning.

For Lead, the 'low risk' Category 4 Screening Level (C4SL) for the 'residential without home grown produce' land-use was adopted.

For each substance, these criteria have been derived for six generic land uses (including the two Public Open Space land uses defined in C4SL guidance) and a range of Soil Organic Matter contents (organic contaminants only). All toxicological and physical-chemical data inputs used in the derivation of the S4ULs and C4SLs are presented and discussed in the respective LQM/CIEH and C4SL publications.

The assessment criteria outlined above have been used to provide a Generic Quantitative Risk Assessment (GQRA). No statistical analysis has been completed and recorded concentrations have been compared directly to the applied S4ULs / C4SL.

The most sensitive human health receptors on site are considered to be the proposed commercial end users, as such the associated testing thresholds have been utilised within the assessment presented within this report. Should any future development plans vary from this end use, the contaminated land risk assessment should be revised. For the assessment, 1% SOM has been utilised as it is the most conservative approach.

The laboratory certificates are presented in the LMB Factual Ground Investigation Report within Appendix B of this report while the Fairhurst generic assessment screening results are provided as Appendix D.

7.2.1 Assessment of Inorganic and Organic Soil Contamination – Risks To Human Health

The results of the geo-environmental soil laboratory analysis have been compared against the relevant assessment criteria. No exceedances were reported. As such, it is considered that the soils encountered across the site represent a low risk to the human health in the context of the proposed commercial end users. It is noted that the sampling methodology deployed during the ground investigation is discreet and sporadic, therefore there is the potential for contaminants to be present in areas not investigated. As such, a watching brief should be carried out during the development works for any visual or olfactory evidence of contaminations within the shallow soils.

7.2.2 Asbestos Containing Materials (ACM) in Soils – Risks to Human Health

Asbestos screening was carried out on 8 No. soil samples within the Made Ground and 1 No. within the Tidal Flat Deposits. A positive identification was identified in one sample at BH103 within the Made Ground at 0.45m bgl and subsequently asbestos gravimetric and quantification was scheduled.

The description of the bulk analysis was stones and brick / cement debris. Within the bulk sample fibre bundles and free fibres were identified at a concentration of <0.001% in the form of chrysotile and amosite. Asbestos containing material (ACM) were not encountered during works or within the geo-environmental sampling.

A review of the Proposed Development Plan (see Appendix A) indicates that the majority of the site is proposed to be covered in hardstanding, which will break the associated contaminant pathway and thus

mitigate the risk to proposed residential end users. However, localised areas of soft landscaping are proposed along the south eastern reaches of the proposed development. It is considered that a clean capping cover system should be installed in areas of soft landscaping to mitigate potential for disturbance of inhalation of asbestos fibres within the underlying soils.

Despite the limited identification of asbestos within the Made Ground, it is recommended that dampening down of soils during periods of dry weather is undertaken when excavating, stockpiling and placing of soils during any proposed works to mitigate the potential risk of asbestos release.

Furthermore, it is recommended that an asbestos survey is undertaken within the existing structures, with all ACM to be removed prior to demolition, and that the Principal Contractor reviews the findings of investigations to inform their working practices and method statements, engaging with an asbestos specialist if required.

7.3 Contamination in Soils – Risks to Drinking Water Supply Pipes

A preliminary assessment of soil concentrations against the UKWIR threshold concentrations for PE or PVE pipes has been undertaken. Exceedances were encountered at all 7 No. locations which were submitted for VOC, MTBE (BTEX) SVOC and phenol analysis relative to PE and PVC barrier thresholds. As such, it is considered that barrier pipeline is required for proposed drinking water pipelines.

7.4 Risk to Controlled Waters

Groundwater sampling and chemical analysis was carried out on 4 No. water samples within BH101s (TFD), BH101d (G), BH102d (TFD) and BH104 (TFD). The Fairhurst PRA (Ref. Ref. 151157/R1.0, dated November 2022) identified an existing sewage pumping station present on the northern corner within the site boundary, therefore groundwater sampling and chemical analysis was scheduled to quantify and assess the risk to the identified receptors.

The results were compared to both Drinking Water Standards (DWS) and Environmental Quality Standards (EQS) due to the surface and groundwater receptors as mentioned in Section 2.4. This includes the nearby Twenty Acres Reen, Alexandra Docks, two surface water abstraction points (within 1km), and underlying perched groundwater and Secondary B aquifer within the Mercia Mudstone.

The water chemical analysis results identified elevated concentrations of Heavy Metals, PAH (fluoranthene) and Ammonia above the DWS and EQS thresholds, as shown in Table 12. Arsenic exceeded the DWS threshold, while copper exceeded the EQS threshold. There is no DWS screening criteria available for fluoranthene, therefore it was compared with the EQS screening criteria only and was found to be in exceedance of this threshold.

Table 12 – Groundwater Sampling Exceedances

Determinant	Location of Exceedance	Strata	Screening Criteria (ug/l)		Max. Concentration (ug/l)
			DWS	EQS	
Arsenic	BH104	TFD	10	50	10.5
Copper	BH102(d)	TFD & G	2000	1	1.6
Fluoranthene	BH101(s)	TFD	No Criteria	0.02	0.26

Ammonia	BH101(s) & BH104	TFD	No Criteria	1500	3200
Total Suspended Particles	BH101(s) & BH104	TFD	-	-	4300000

The exceedances identified on site are not considered to have a detrimental impact on the wider groundwater environment. Copper and fluoranthene marginally exceed the EQS at a single location each (BH102(d) and BH101(s), respectively), and since groundwater is expected to be limited laterally within more granular lenses, it is unlikely to be in hydraulic continuity with off-site hydrological freshwater receptors. Likewise, arsenic is marginally elevated against the DWS threshold value at a single location (BH104), as such these minor exceedances are not considered to be representative of the Site.

Elevated concentrations of ammonia exceeds the EQS threshold values. Ammonia was scheduled to target the existing sewage pumping station present on Site. However, the concentrations are not likely a result of the historical land use since BH104 (near sewage pump source) and BH101 (approximately 100m west and up hydraulic gradient) have similar concentrations, therefore the ammonia present on site is likely due to background concentrations. The source of background concentrations is likely attributed to the organic matter content present within the Tidal Flat Deposits.

As such, the risk to groundwater is determined a low, nevertheless, it is recommended to avoid placing water abstraction points within the site boundary.

7.5 Ground Gas Risk Assessment

6 No. gas monitoring visits were undertaken between 26th January and 12th April 2024. The data is provided in the LMB Factual Report within Appendix B and the gas monitoring assessment results are within Appendix C. The assessment has been undertaken in accordance with CIRIA Report C665 and BS8485:2015+A1:2019.

In accordance with BS8485, a hazardous Gas Screening Value (GSV) based on a 'worst-case' scenario has been calculated, whereby GSV equals the maximum hazardous gas concentration divided by 100 and then multiplied by the maximum flow rate recorded in any of the monitored boreholes.

Based on the results shown within the gas monitoring assessment results in Appendix C, the 'worst-case' Gas Screening Value (GSV) for methane (CH₄) and Carbon Dioxide (CO₂) are 13.725l/hr and 1.425l/hr, equating to a maximum Characteristic Situation (CS) of CS4. This is due to a combination of the recorded high flow rates (maximum value 25.00l/hr) and exceedances against the advisory thresholds for CH₄ (maximum value 54.90%) and CO₂ (maximum value 5.70%). The recorded ground gas concentrations are unexpectedly high considering the source (Tidal Flat Deposits), as a result to confirm the validity of the results the calibration certificates of the monitoring equipment were scrutinised and highlighted no issues, therefore it has been assumed that the results are accurate for use in the analysis.

It should be noted that a number of wells were flooded during all monitoring visits, including BH101(d), BH103(d) and BH104, as can be seen in Table 13 below. Therefore, in accordance with guidance in Section 6.3.6 of BS8485, these monitoring wells have been excluded from the analysis.

Table 13 – Groundwater Sampling Exceedances

Exploratory Borehole	Target Strata	Response Zone (m bgl)	Groundwater Level range (m bgl)	Status
BH101(d)	G	10.50 – 14.00	3.54 – 3.86	Flooded
BH103(d)	TFD / G	10.50 – 14.00	3.45 – 3.66	Flooded
BH104	TFD	2.00 – 5.00	1.01 – 1.50	Flooded

Additional analysis was undertaken on the ground gas monitoring results to ascertain the GSVs of methane and carbon dioxide for each respective monitoring well for comparison with the 'worst-case' scenario. This assessment found that GSVs for individual monitoring wells were equating to CS2, CS3 and CS4 classifications across the same two monitoring rounds (Rounds 2 and 5) that identified the increased 'worst-case' scenario Characteristic Situation classifications.

Other ground-gas constituents, such as hydrogen sulphide (H₂S), carbon monoxide (CO) and PID (photo-ionisation detector) were also recorded reporting elevated concentrations. H₂S was encountered between 0.00ppm to 10.00ppm; CO between 0.00ppm to 11.00ppm; and PID between 0.00ppm to 6.70ppm.

In addition, oxygen (O₂) was also recorded at a range of 1.10% to 18.00% providing an indication of geochemical processes within the underlying soils. The Earth's atmosphere is composed of approximately 21% O₂, as such, BH101s at 5.50% O₂ and BH102d 1.10% O₂ indicates that anoxic conditions are likely prevalent at the Site.

The ground gas regime of elevated CH₄ and CO₂ could be attributed to the presents of the organic matter content within the Tidal Flat Deposits. The thickness of the unit was generally consistent (up to 9.50m thick) containing deposits of peat as well as decaying plant materials, occasional peat bands, peat fragments and organic odour. In addition, the lower values of O₂ identified suggest that anoxic conditions are likely prevalent resulting in the release of CH₄ and CO₂.

The location of the site being in close proximity to the tidally influenced Severn Estuary was considered to be a potential driver of the increased flow rates recorded within the monitoring wells through significant fluctuations in potentially tidally influenced groundwater levels, creating a differential pressure in the standpipes compared to surrounding soils leading to increased flow into the monitoring standpipes. In order to assess this, the monitoring rounds were undertaken across a range of time periods in order to capture both high and low tide, as well as rising and falling tide, scenarios. Groundwater level results within the monitoring wells show minimal to no fluctuation across the range of tidal scenarios, therefore it is considered unlikely that the increased flow rates and elevated ground gas concentrations are attributable to tidal groundwater movements.

The monitoring rounds (Rounds 2 and 5) that have given rise to the increased Characteristic Situation classifications ('worst-case' of CS4) were compared with atmospheric conditions to ascertain any correlations. Round 2 was undertaken at an atmospheric pressure of 1005mb, which had fallen approximately 20mb in a 24 hour period. Round 5 was undertaken at an atmospheric pressure of 999mb, during a 24 hour time period where atmospheric pressure had remained relatively steady below 1000mb. As referenced in guidance such as CIRIA 665 and BS8485, low (circa 1000mb) and dramatically falling (10+ in 24hr) atmospheric pressures create significant differential pressures between the atmosphere at ground level and the underlying soils, causing the release and flow of ground gases within from the soils. This mechanism has been determined as the key driver for the elevated GSVs calculated, therefore the Site is confirmed to be representative of a CS4 classification.

In accordance with BS8485:2015, the majority of the proposed development is classed as Type D, with some Type C spaces such as offices. These equate to gas protection scores of 3.5 points and 4.5 points, respectively. As a result, it is recommended that a combination of gas protection measures are implemented to attain a score of 4.5 points to ensure all section of the development are adequately protected.

7.6 Updated Conceptual Site Model

The findings of the Fairhurst ground investigation have been used to update the preliminary Conceptual Site Model discussed in Section 2.5 of this report.

Potential Contamination Sources

Based on the information available, sources of chemical impact have been identified as indicated in Table 14:

Table 14 – Contaminant Sources

Contaminants of Concern	Location	Discussion
Localised loose asbestos fibres	BH103 at 0.45m bgl (Made Ground)	<0.001% asbestos fibres were encountered within the shallow Made Ground soils. If disturbed, these may represent a potential human health risk to construction workers, residential end users and construction works. In addition, where soft landscaping is present, a clean capping cover system should be utilised.
Aggressive ground conditions	Tidal Flat Deposits	It is recommended that the Concrete Classification for the site is Design Sulfate class DS-4 and ACEC class AC-4 in order to protect it from degradation as a result of sulphate or acidic conditions.
Dirking water supply and surface water	Sewage pump	The exceedances identified on site are not considered to have a detrimental impact on the wider groundwater environment. Groundwater is expected to be limited laterally within more granular lenses, therefore it is unlikely to be in hydraulic continuity with off-site hydrological freshwater receptors. Other exceedances are identified at 1 No. location and minor elevations to the DWS and therefore are not considered representative of the Site. Elevations of ammonia are not likely a result of the existing sewage pumping station present on Site. It is likely due to background concentrations attributed to the organic matter content present within the Tidal Flat Deposits. As such, the risk to groundwater is determined a low, nevertheless, it is recommended to avoid placing water abstraction points within the site boundary.
Ground gas	Tidal Flat Deposits	6 No. monitoring rounds have classified the site as Characteristic Situation 4 (CS4) due to methane and carbon dioxide. This could potentially cause risk of asphyxiation and explosion of site end-users. The elevated concentrations of methane and carbon dioxide has been attributed to the significant organic matter identified within underlying Tidal Flat Deposits, whilst the

		increased flow rates were attributed to differential pressures caused by low/falling atmospheric pressure.
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A summary of the Generic Quantitative Risk Assessment associated with the above source is presented and further discussed in Table 15, with respect to the completed development.

Table 15 – Quantitative Risk Assessment for Identified Potential Sources of Contamination

Source	Potential Pathways	Potential Receptors	Assessment	Consequence	Probability	Risk Class	Remarks
Made Ground	Inhalation of wind-blown contaminated soils	Off-site third party site users	There is a potential risk from the inhalation of wind-blown dust/soil as a result of general construction activities.	Mild	Low likelihood	Low	The risk to human health is considered low based on the chemical results recorded however there is still potential for ACMs.
Tidal Flat Deposits	Direct contact of building fabric with contaminated soils	On-site building materials and services	There is potential for Made Ground and natural soils to contain contaminants and sulphates which may degrade building structures.	Mild	Low likelihood	Low	Concrete classification is to be specified as Design Sulfate Class DS-4 and ACEC class of DC-4 to protect buried concrete from degradation. Post demolition BRE Suite D testing of the Made Ground soils is recommended.
Groundwater	Drinking water supply and surface waters	Bedrock groundwater (Secondary B Aquifer) and subsequent migration to Twenty Acres Reen and River Usk	There is potential risk of historical land use (sewage pump) contaminating groundwater resource.	Mild	Low likelihood	Low	The Secondary B aquifer and the off-site hydrological freshwater receptors are not likely to be impacted by elevated concentration on site due to limited granular deposits providing a pathway.
Tidal Flat Deposits	Ground gas accumulation	On-site human health	GSV exceedances due to elevated methane and carbon dioxide concentrations and high flow rates which may cause asphyxiation and explosion risk.	High	Low likelihood	Medium	The ground gas regime determined at the site has given rise to a Characteristic Situation (CS) classification of CS4.

Risk Ratings:

- High - The available information indicates a significant possibility of harm to a receptor requiring further investigation, assessment or treatment.
- Moderate - The available information indicates a potential for significant harm to a receptor requiring further investigation and assessment.
- Low - The available information does not indicate a significant potential for harm to a receptor requiring further investigation. This does not indicate zero risk.

8.0 CONCLUSIONS AND RECOMMENDATIONS

The following section provides a brief summary of the ground investigation findings. However, the report text must be referred to for further details and context.

8.1 Ground Conditions

Refer to Section 4.0 of this report for details of the ground conditions encountered during the Ground Investigation undertaken. In summary, the ground conditions include:

- Hardstanding – Asphalt. Depth to base 0.08m bgl to 0.40m bgl (7.51m AOD to 6.86m AOD).
- Made Ground - Sandy gravel including anthropogenic materials. Depth to base 1.10m bgl to 2.00m bgl (6.18m AOD to 5.56m AOD).
- Tidal Flat Deposits - Very soft to firm, grey / greyish brown / blueish grey clay with occasional peat layers. Depth to base 10.50m bgl to 11.20m bgl (-3.94m AOD to -3.34m AOD).
- Gravels – Clayey, gravelly sand with sandstone and limestone gravel, and occasional cobbles. Depth to base 14.20m bgl to 15.90m bgl (-8.46m AOD to -6.94m AOD).
- Weathered Mercia Mudstone - Firm to stiff, reddish brown / blueish grey clay with mudstone inclusions and occasional gravel and rare cobbles. Depth to base 16.50m bgl to 21.20m bgl (-13.61m AOD to -17.94m AOD).
- Mercia Mudstone - Very weak to moderately strong mudstone. Depth to base 25.20m bgl to 25.50m bgl (-18.34m AOD to -17.61m AOD).

8.2 Geotechnical Conclusions and Recommendations

Refer to Section 6.0 of this report for details of the geotechnical assessment, the conclusion are provided below:

- Hardstanding / Made Ground was encountered in all exploratory borehole locations to a maximum depth of 2.00m bgl (5.56m AOD). Made Ground should not be considered a suitable founding stratum in its current state.
 - Perched groundwater is contained within the Made Ground, Tidal Flat Deposits and Gravel unit up to 1.01m bgl (6.43m AOD). Water ingress should be anticipated during excavation, therefore, it is recommended that allowances for temporary shoring and appropriate dewatering measures are made to prevent excavation collapse / flooding.
 - It is considered that the use of soakaway infiltration drainage is not be feasible for the proposed development.
 - A preliminary pile design undertaken suggests that required pile capacity would be achieved with bored piles socketing 5.00m into competent Mercia Mudstone stratum.
 - A preliminary settlement calculation undertaken suggests the settlement will be in excess of the 25mm limit under the slab. Therefore, ground improvement via Controlled Modulus Columns (CMC) or surcharging are considered appropriate remediation.
 - Liaison with a specialist ground improvement contractor should be sought for the potential for CMCs or surcharging.
-

- A Foundations Risk Assessment is recommended to ensure that the contaminated soils and pile installation do not pose a risk to the underlying aquifer within the Mercia Mudstone.
- Concrete classification of the Site is Design Sulphate DS-4 and ACEC class AC-4.

8.3 Geo-Environmental Conclusions and Recommendations

Refer to Section 7.0 of this report for details of the geoenvironmental assessment, the conclusion are provided below:

- No exceedances for soil laboratory sampling was encountered. However, there is the potential for contaminants to be present in areas not investigated. As such, a watching brief is recommended to be carried out during the development works for any visual or olfactory evidence of contaminations within the shallow soils.
- Asbestos was identified within one sample of the Made Ground at a concentration of <0.001% in the form of chrysotile and amosite. However, since the majority of the Site is covered in hardstanding, the pathway associated with the risk of inhalation is prevented. A clean/inert capping system is recommended as a precautionary measure in any areas of proposed soft landscaping. The specific design should be included within a Remediation Strategy, and will require the inclusion of an anti-dig / alert barrier layer.
- It is also recommended that dampening down of soils during periods of dry weather is undertaken when excavating, stockpiling and placing of soils during any proposed works to mitigate the potential risk of asbestos release.
- Furthermore, it is recommended that an asbestos survey is undertaken within the existing structures, with all ACM to be removed prior to demolition, and that the Principal Contractor reviews the findings of investigations to inform their working practices and method statements, engaging with an asbestos specialist if required.
- Materials requiring off-site disposal shall be tested to characterise whether it is suitable for re-use. If the materials are geotechnically or geo-environmentally unsuitable for reuse on site, they will be either sent to a waste recovery facility for recycling or a suitably licensed waste disposal facility.
- A pre-demolition asbestos surveyor should be undertaken on all buildings proposed for demolition to confirm the presence of any asbestos, with any positive identifications removed by a correctly licenced specialist contractor.
- The risk to groundwater and surface water receptors is determined as low due to limited granular deposits providing a pathway. However, it is recommended to avoid placing water abstraction points within the site boundary due to the background concentration of ammonia.
- The GSVs for CH₄ and CO₂ equate to a maximum Characteristic Situation (CS) of CS4. The elevated concentrations of methane and carbon dioxide has been attributed to the significant organic matter identified within underlying Tidal Flat Deposits, whilst the increased flow rates were attributed to differential pressures caused by low/falling atmospheric pressure. As a result, it is recommended that a combination of gas protection measures are implemented to attain a score of 4.5 points to ensure all section of the development are adequately protected.
- An Options Appraisal and Remediation Strategy giving full details of remedial measures to break the identified contaminant linkages including a Verification Plan, is required. The report shall be submitted to Newport City Council to discharge Planning Condition 3.

- The Principal Contractor should be provided with this Ground Investigation Report and develop appropriate RAMS to address the potential to encounter asbestos during the construction works. A low risk has been identified, however it is recommended that the Principal Contractor reviews the findings of investigations to inform their working practices and method statements.
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FIGURES

Figure 1 – Particle Size Distribution Chart

Figure 1 - Particle Size Distribution Chart

The chart displays the particle size distribution for various soil samples. The x-axis represents Particle Size (mm) on a logarithmic scale from 0.001 to 100. The y-axis represents Percent Passing (%) from 0 to 100. The chart is divided into four regions: CLAY (0.001 to 0.075 mm), SILT (0.075 to 0.425 mm), SAND (0.425 to 4.75 mm), and GRAVEL (4.75 to 100 mm). The legend identifies the following samples:

- Made Ground (0.60m bgl)
- Made Ground (1.00m bgl)
- Made Ground (1.40m bgl)
- Tidal Flat Deposits (7.00m bgl)
- Tidal Flat Deposit (8.50m bgl)
- Tidal Flat Deposits (10.20m bgl)
- Tidal Flat Deposits (10.20m bgl)
- Gravel (13.00m bgl)
- Gravel (15.00m bgl)

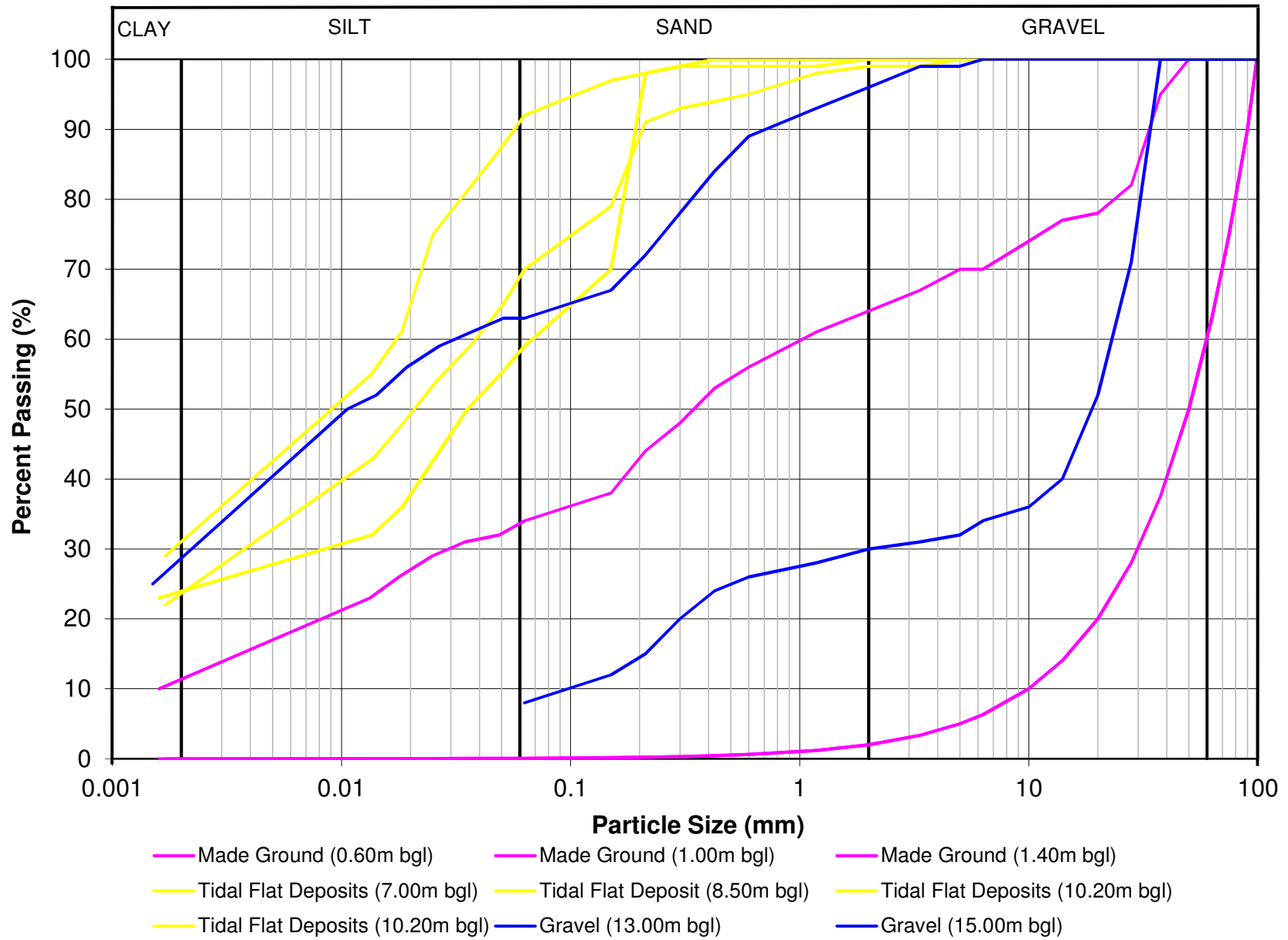


Figure 2 – Casagrande Plasticity Chart

Figure 2 - Casagrande Plasticity Chart

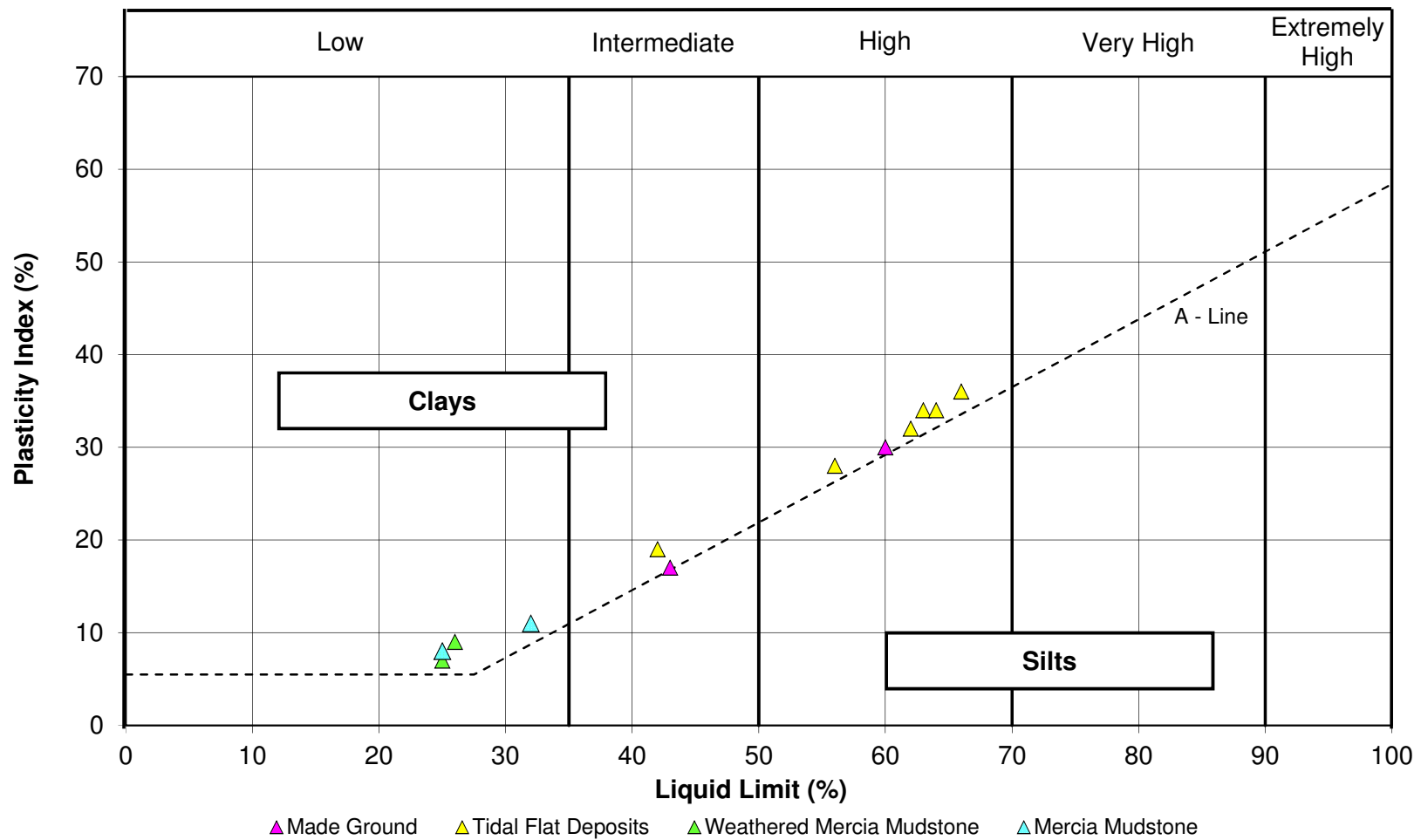


Figure 3 – SPT 'N₆₀' Vs. Depth (m bgl)



Figure 3 - SPT 'N60' Values Vs. Depth

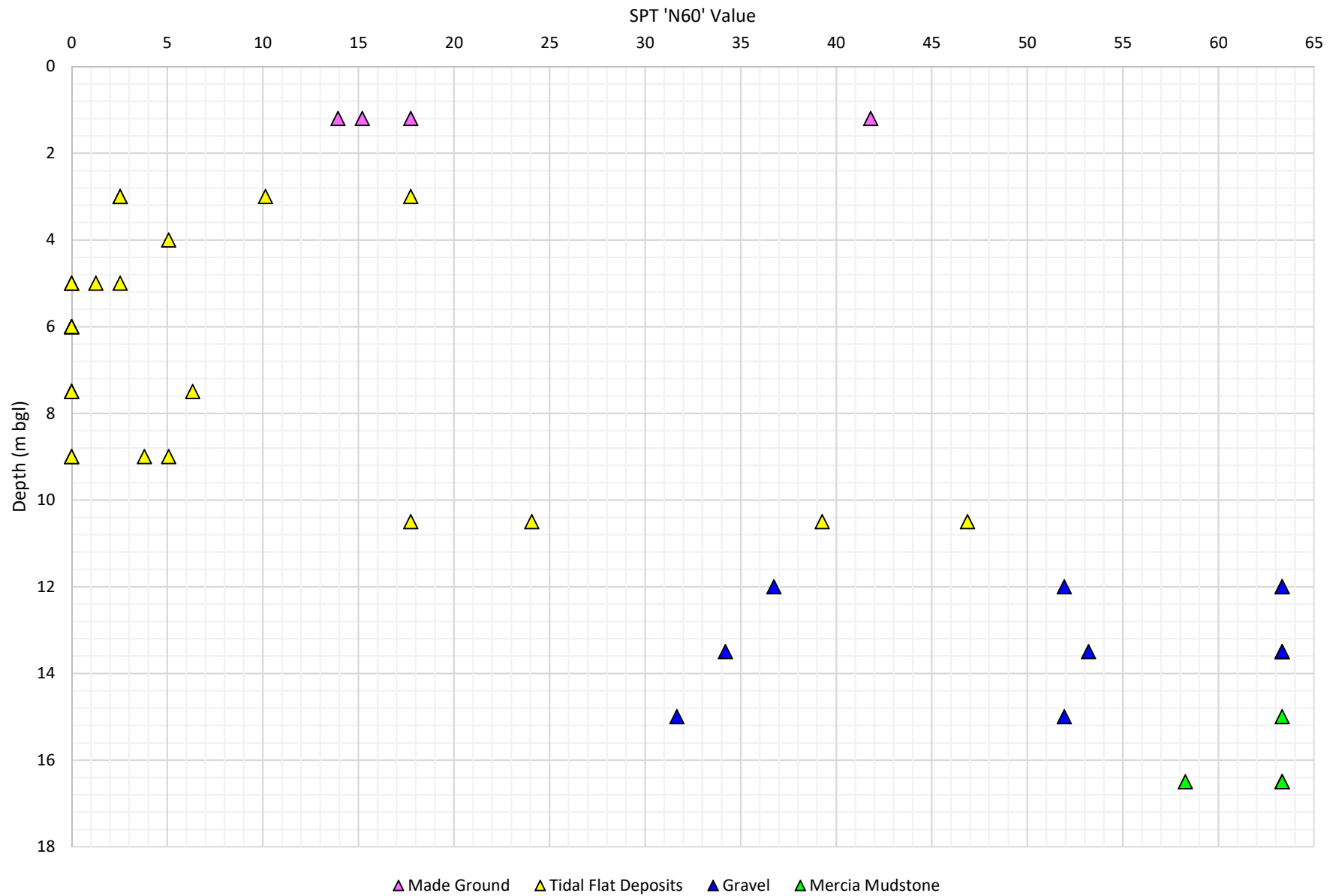


Figure 4 – SPT 'N₆₀' Vs. Elevation (m AOD)

Figure 4 - SPT N60 Values Vs. Elevation

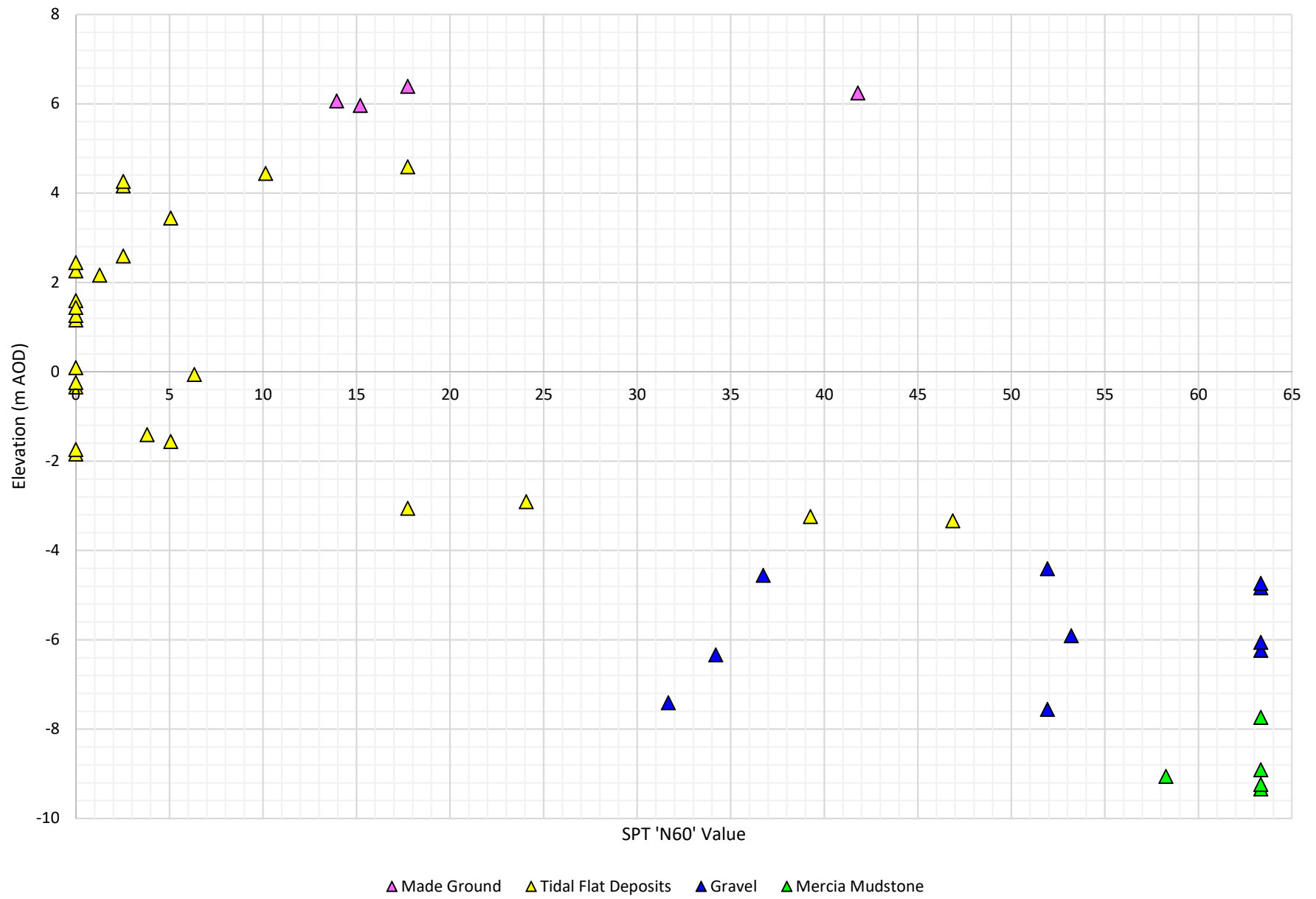


Figure 5 – Undrained Shear Strength Vs. Depth (m bgl)

Figure 5 - Undrained Shear Strength (C_u) Vs. Depth

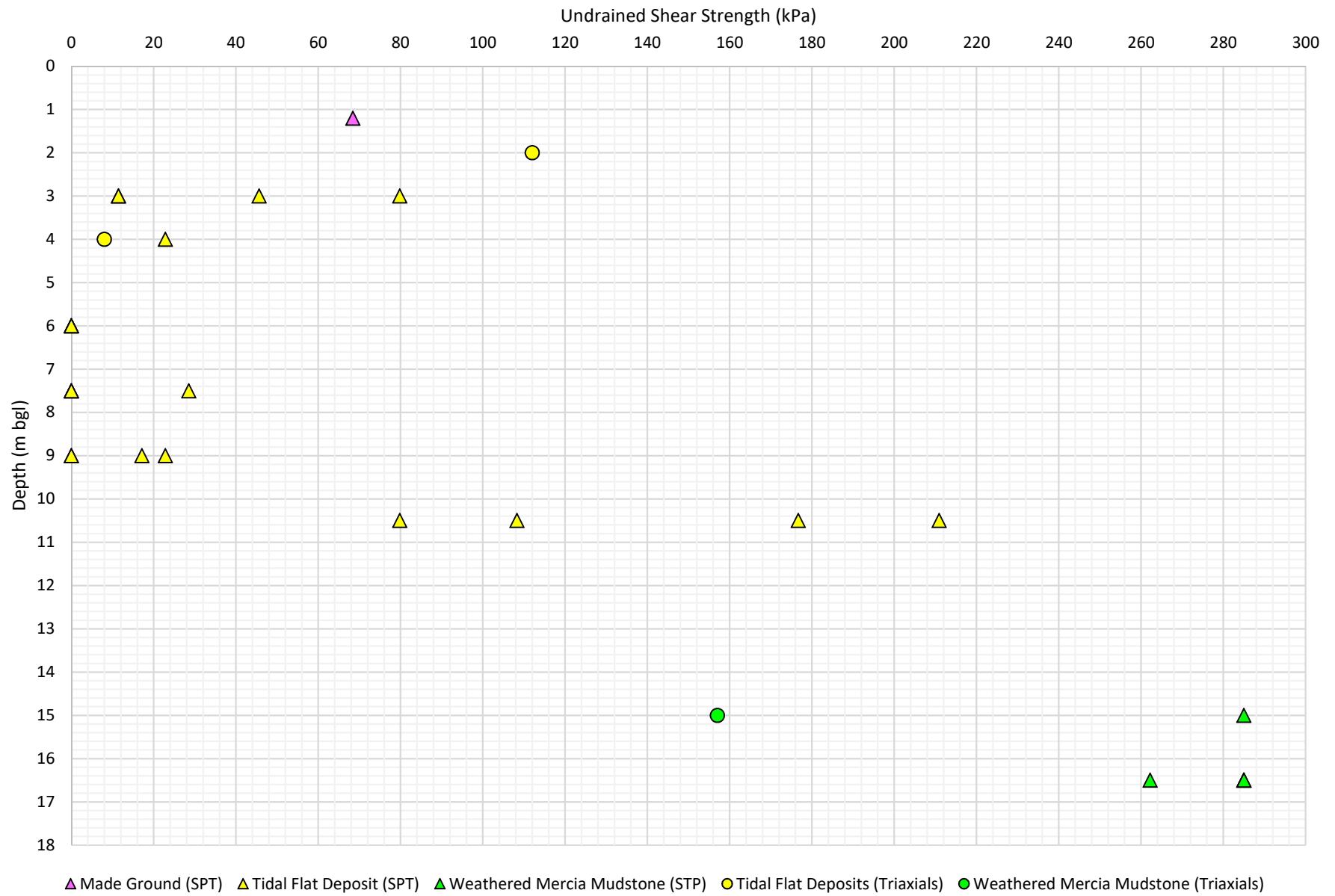


Figure 6 – Undrained Shear Strength Vs. Elevation (m AOD)

Figure 6 - Undrained Shear Strength (C_u) Vs. Elevation

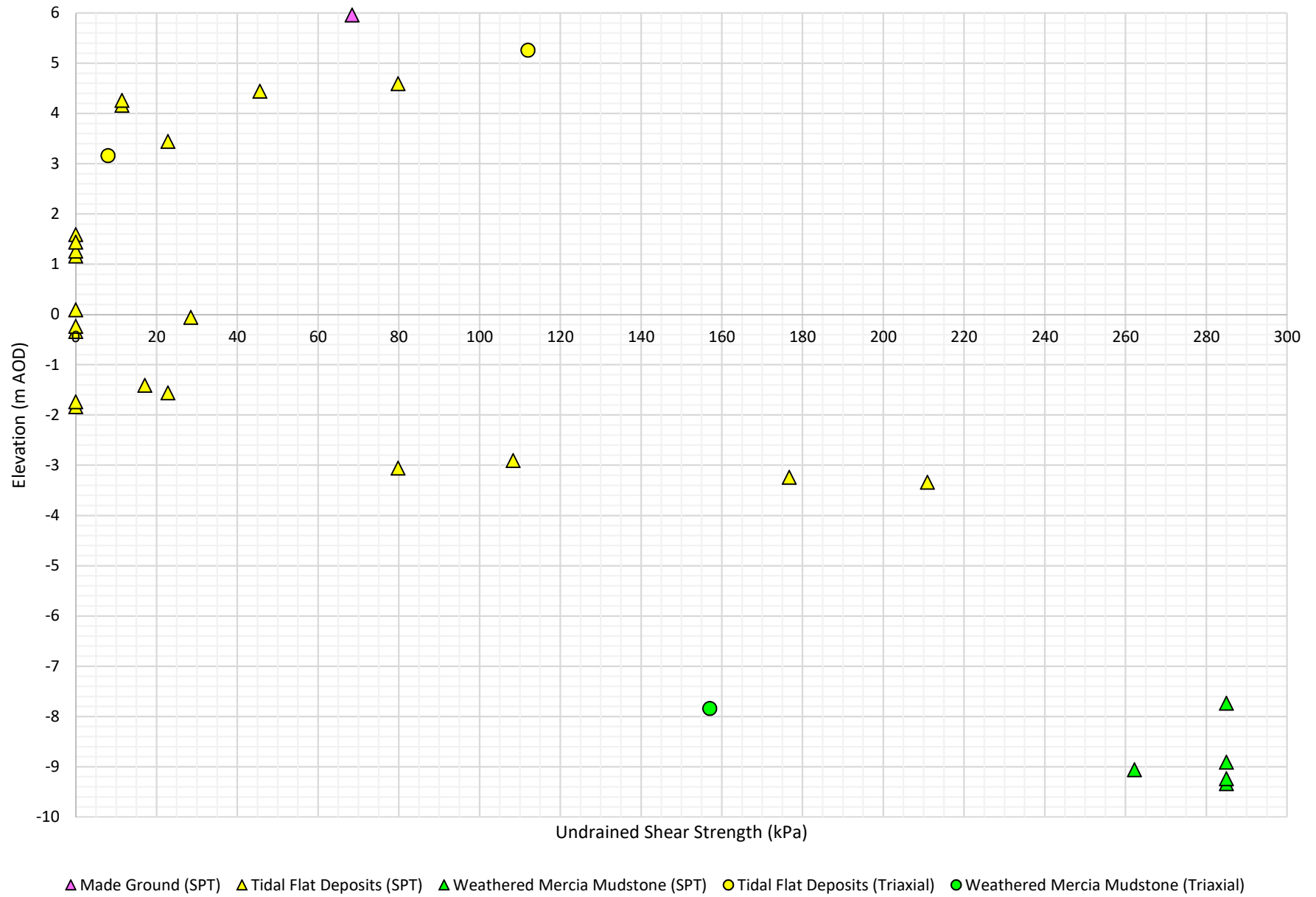


Figure 7 – Unconfined Compressive Strength Vs. Depth (m bgl)

Figure 7 - Unconfined Compressive Strength Vs. Depth

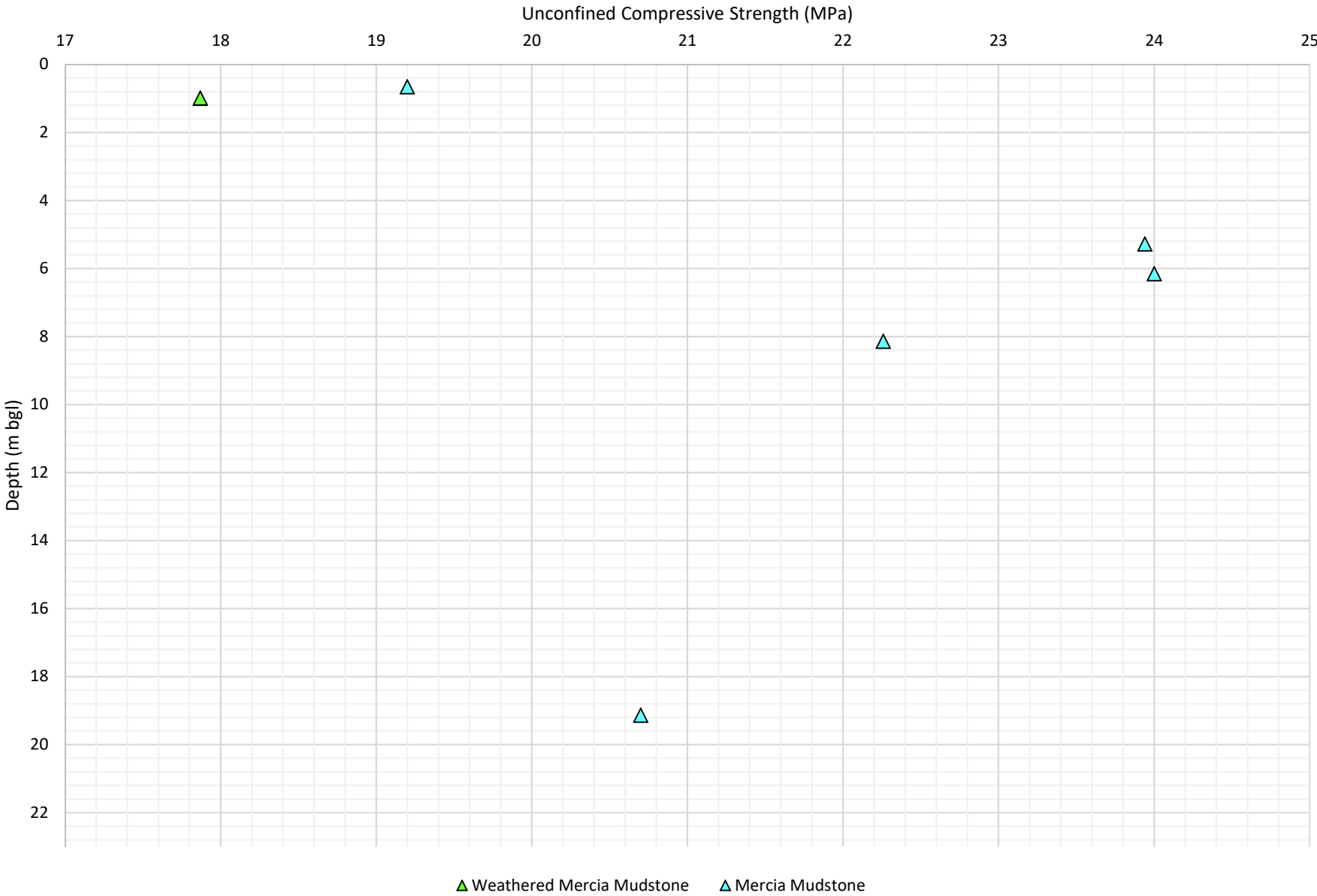
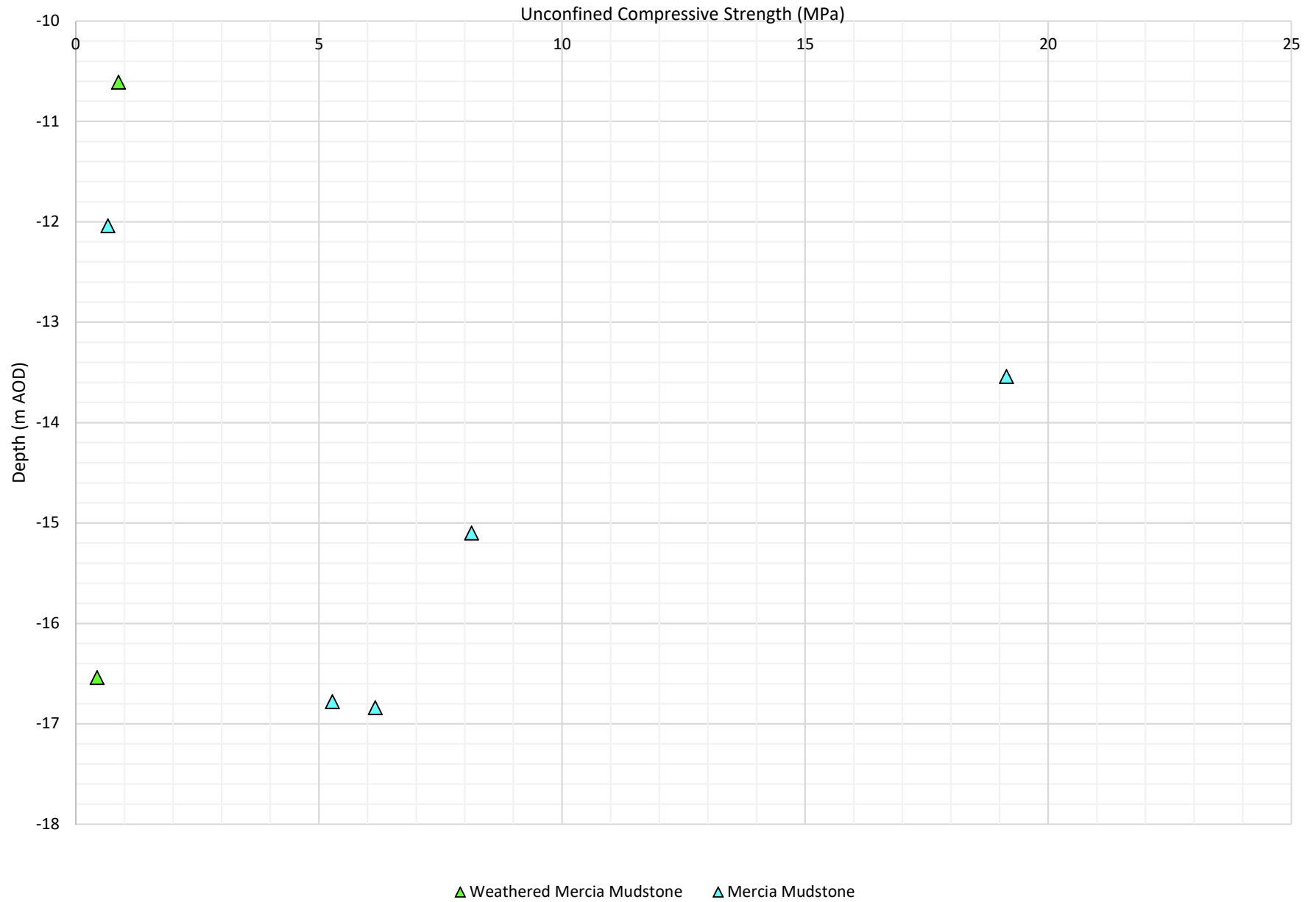


Figure 8 – Unconfined Compressive Strength Vs. Elevation (m AOD)

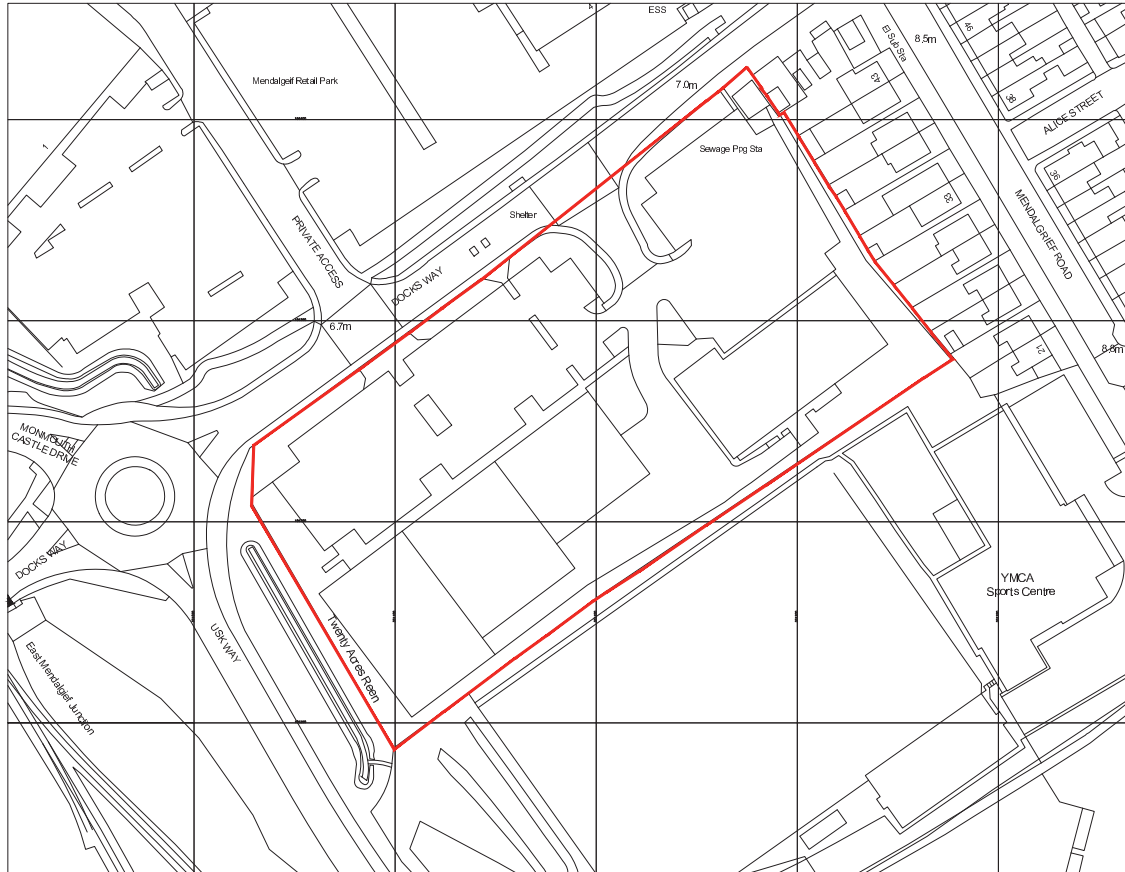
Figure 8 - Unconfined Compressive Strength Vs. Elevation



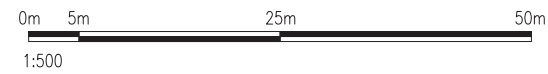
APPENDIX A

DRAWINGS

Site Location Plan

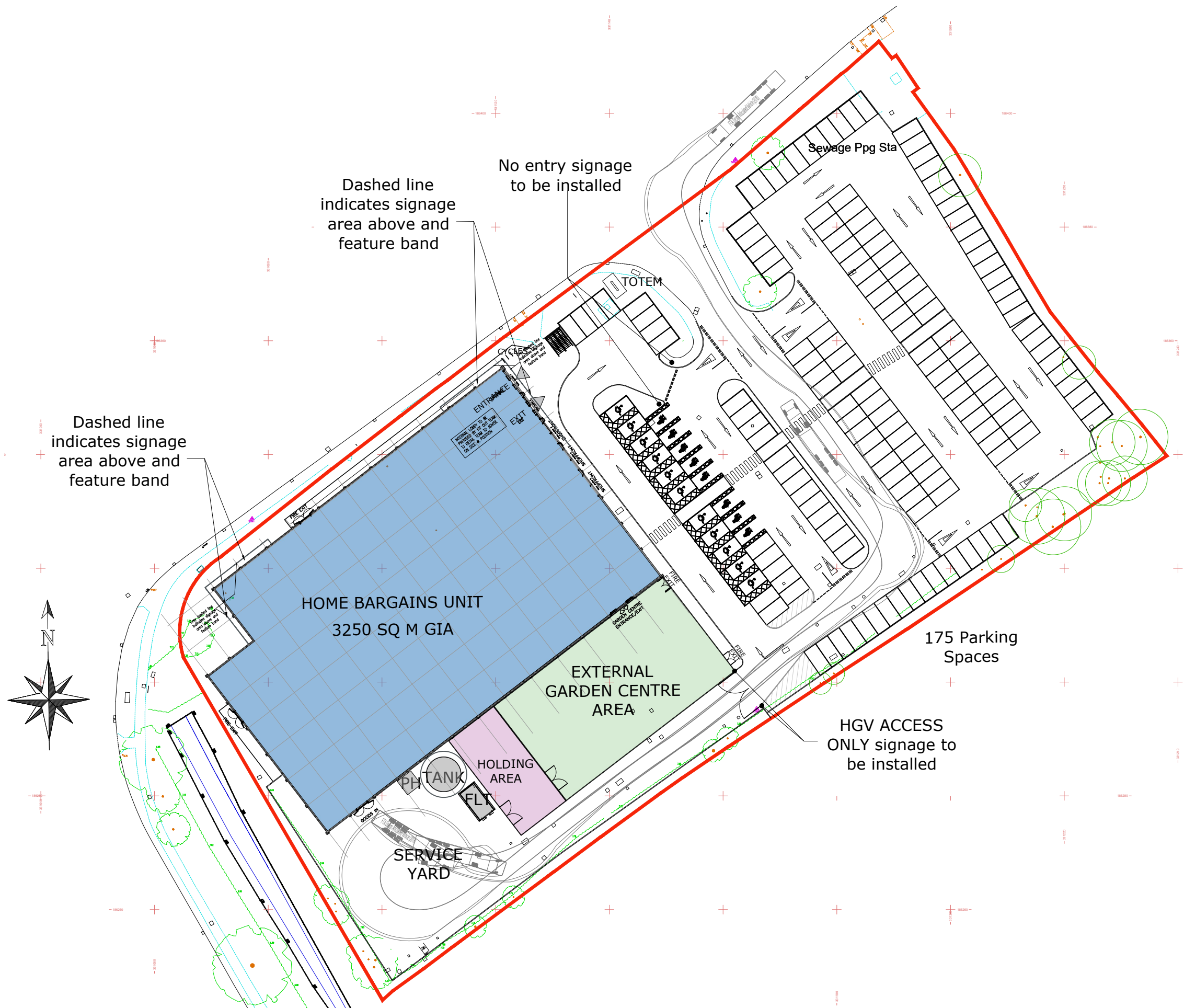


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RED LINE = OWNERSHIP BOUNDARY



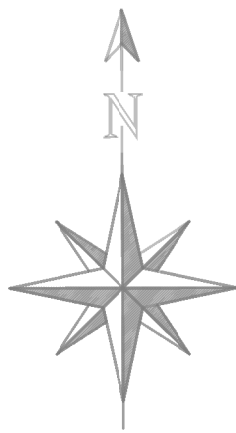
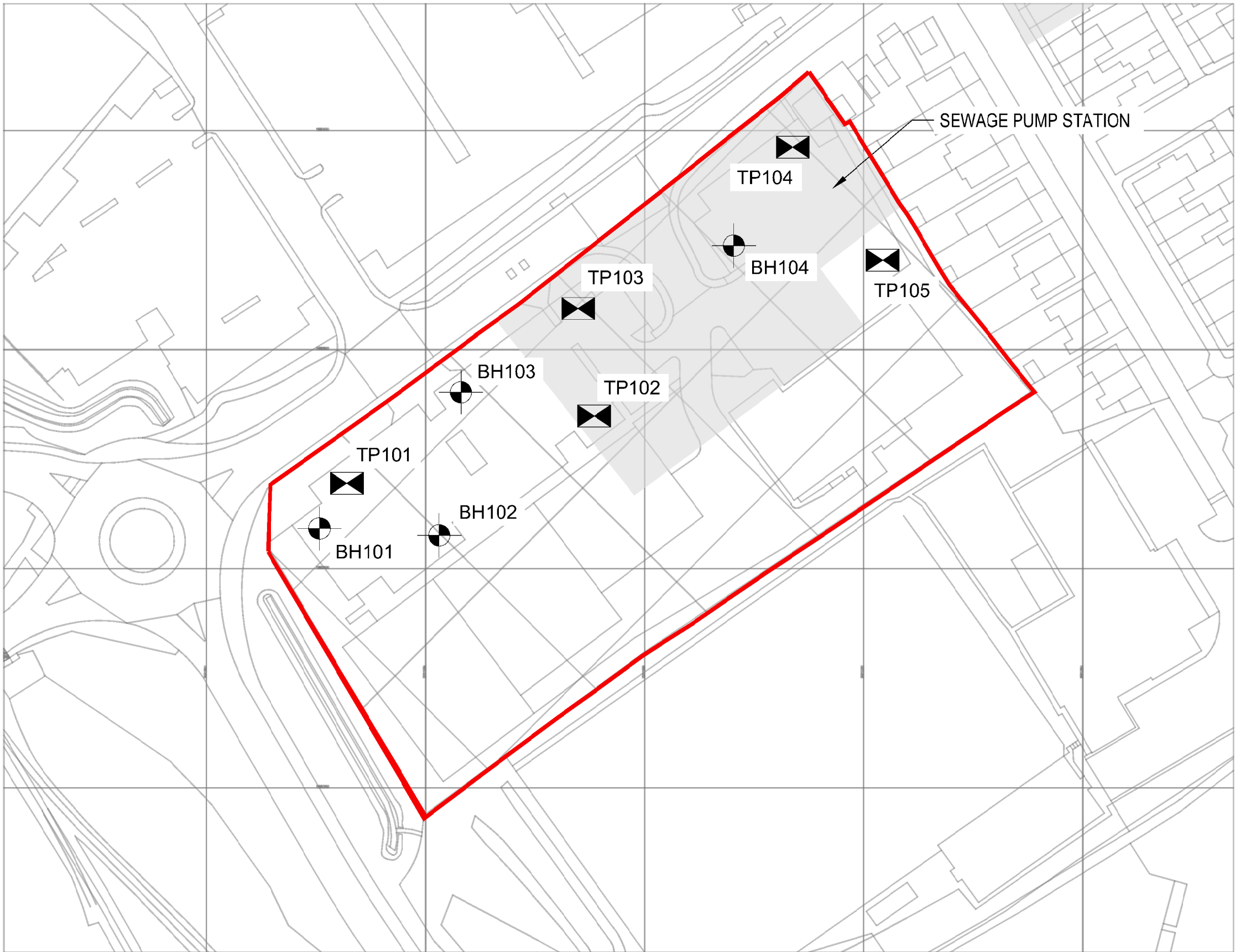
REV.	DATE	AMENDMENT
 WPL Consulting LLP 1 Airport West · Lancaster Way · Leeds · LS19 7ZA Tel: 0113 202 9444 Fax: 0113 202 9333 E-mail: mail@wplconsulting.co.uk		
PROJECT TITLE West Retail Park Docks Way Newport NP20 2NS For Home Bargains		
DRAWING TITLE Site Location Plan		
PROJECT No:	DRAWING No:	REVISION:
SCALE:	DATE:	DRAWN BY:
1:1250@A3	05.05.22	TR
CHECKED BY:		DATE:

Proposed Development Plan



A REV.		05.05.22 DATE	GIA Sq M added, holding area and garden centre areas removed AMENDMENT
WPL WPL Consulting LLP 1 Airport West Lancaster Way Leeds LS19 7ZA Tel: 0113 202 9444 Fax: 0113 202 9333 E-mail: mail@wplconsulting.co.uk			
PROJECT TITLE Newport West Retail Park			
DRAWING TITLE Sketch Proposal Proposed Site Plan			
PROJECT No: 8658		DRAWING No: PROP01	REVISION: A
SCALE: 1:500 @ A2		DATE: 22.04.22	DRAWN BY: TR
CHECKED BY:			DATE:

Exploratory Borehole & Trial Pit Location Plan



LEGEND

TRIAL PIT

BOREHOLE (CABLE PERCUSSIVE)

EXPLORATORY BOREHOLE AND TRIAL PIT PLAN

SCALE 1:500

DO NOT SCALE FROM THIS DRAWING
SAFETY HEALTH AND ENVIRONMENTAL INFORMATION
IN ADDITION TO THE HAZARD/RISKS NORMALLY ASSOCIATED WITH THE TYPES OF WORK DETAILED ON THIS DRAWING, NOTE THE FOLLOWING RISKS AND INFORMATION.
RISKS LISTED HERE ARE NOT EXHAUSTIVE. REFER TO DESIGN ASSESSMENT FORM No.
CONSTRUCTION:-
DEMOLITION:-
FOR INFORMATION RELATING TO USE, CLEANING AND MAINTENANCE SEE HEALTH AND SAFETY FILE.
IT IS ASSUMED THAT ALL WORKS WILL BE CARRIED OUT BY A COMPETENT CONTRACTOR WORKING, WHERE APPROPRIATE, TO AN APPROVED METHOD STATEMENT.

P01	27.02.24	PRELIMINARY	JM/CH/CD
Rev	Date	Revision Description	Drawn/Checked/Approved
FAIRHURST 3rd Floor, The Harlequin Building, 35 Southwark Street, London, SE1 0HR. Tel: 020 7828 8205 Fax: 084 4381 4412 Web: www.fairhurst.co.uk Email: london@fairhurst.co.uk Client: HOME BARGAINS FROME			
Project Title: NEWPORT WEST RETAIL PARK			
Drawing Title: EXPLORATORY BOREHOLE AND TRIAL PIT PLAN			
Scale @ A1 1:500	FH Project Number 151157	Purpose of Issue PRELIMINARY	Status S3
Drawn JM	Checked CH	Approved CD	
Drawn Date FEB 2024	Checked Date FEB 2024	Approved Date FEB 2024	
Drawing Number 151157-FRH-ZZ-ZZ-DR-S-3005			Rev P01

APPENDIX B

FACTUAL REPORT



LMB GEOSOLUTIONS LTD

FACTUAL REPORT FOR GROUND INVESTIGATION
HOME BARGAINS, DOCKS WAY, NEWPORT NP20

February 2024

DOCUMENT RECORD

Document Title	Factual Report for Ground Investigation
Site	Home Bargains, Docks Way, Newport NP20 2NZ
Document Date	29 th February 2024
Document Version	Issue 1
Document Authorisation	Philip Lewis BSc (Hons), MSc, CGeol, FGS  



*Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology*

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INTRODUCTION

Introduction

AUTHORISATION

LMB Geosolutions Ltd (LMB) was instructed by Fairhurst Group LLP (Consulting Engineers) on behalf of TJ Morris Ltd ((the Client) to undertake ground investigation works to support development of a proposed new retail unit at land off Docks Way, Newport NP20 2NZ (the Site).

PROJECT AND SITE DETAILS

Site Address	Land off Docks Way, Newport NP20 2NZ. A Site Location Plan is provided as Figure 1 .
Site/Building Area	The site currently comprises a retail park with associated car parking and a sewage pumping station in the north western area.
Background	The Consultant Engineers provided a specification for the proposed ground investigation works. The proposed development comprises the demolition of all current retail units on site with the construction of one large (3,250m²) two rectangular retail unit (Class E) in the west of the site. The proposed external holding area and garden centre to the south east of the retail unit is to be 988m. The proposed development also includes the below listed elements: • The construction of a new service yard and loading bay in the southern corner of the site, to the south of the retail unit (Home Bargains); • The construction of a HGV access road and turning point; • The construction of a seating area, cycle racks and a bin storage area; and • The redevelopment of the southern carpark with 175 No. car parking spaces, including 11 no. disabled bays and 8 No. parent and child bays.

SCOPE OF WORKS

The scope of works has been completed:

- Site set up including liaison with Consultant Engineers, Client and appointment of sub-contractors;
- Mobilisation to site and transport of the rig/plant to the proposed location;
- Completion of a service avoidance, level and positioning survey at proposed exploratory hole locations;
- Provision of a concrete corer for removal of hard surfacing at exploratory hole locations;

INTRODUCTION

- Completion 4no. cable percussive boreholes to depths of 16.45m bgl with insitu SPTs and collection of disturbed and undisturbed samples for laboratory testing.
- Follow-on rotary coring in two of the cable percussive locations (BH101 & BH103) to depths of 25.0m bgl with sub-sampling of core samples for laboratory testing.
- Completion of 5no. machine excavated trial pits to maximum depths of 3.30m bgl with collection of disturbed samples for laboratory testing.
- Installation of dual groundwater and ground gas monitoring wells in all exploratory hole locations;
- Supervision and geological logging (in general accordance with BS 5930) by an appropriately experienced geo-environmental engineer;
- Field headspace testing of soil samples using a photo-ionisation detector;
- Development of installed monitoring wells;
- Return monitoring of groundwater and ground gas on 3no occasions, including groundwater sampling utilising low flow techniques on 1no. occasion.
- Geotechnical and chemical laboratory testing of soil and samples;
- Completion of a factual report that includes;
 - Details of the ground and groundwater conditions encountered.
 - Geological logs (AGS format if required) and foundation sections.
 - Presentation of chemical analytical.
 - Presentation of geotechnical laboratory testing results.

PUBLISHED GEOLOGY

Reference to the relevant British Geological Survey map for the area and information and information provided by the Consultant Engineers indicates that the ground conditions at the site comprise Made Ground overlying Tidal Flat Deposits and the Mercia Mudstone Group.

LIMITATIONS

LMB has prepared this report solely for the use of the named Client and those parties with whom a warranty agreement and/or assignment has been agreed. Should any third party wish to use or rely upon the contents of the report, written approval must be sought from LMB and the Client.

LMB accepts no responsibility or liability for:

- a) the consequences of this document being used for any purpose or project other than for which it was commissioned, and
- b) issue of this document to any third party with whom an agreement has not been executed.

INTRODUCTION

The information provided, among other things, takes into consideration currently available guidance and best available techniques. No liability can be accepted for the retrospective effects of any future changes or amendments to best available techniques.

GROUND INVESTIGATION

Ground Investigation

INTRODUCTION

The ground investigation works were undertaken between 8th January and 16th January 2024 and comprised the progression of 4no. cable percussive boreholes with rotary follow-on in two locations (BH101 & BH103) and 5no. machine excavated trial pits with sampling of soil for laboratory testing and geological logging.

An exploratory hole location plan provided by the Consultant Engineers is reproduced as **Figure 2**.

Ground gas and groundwater monitoring was undertaken following completion of the fieldworks between 26th January and 28th February 2024.

Details of the ground investigation completed, along with the laboratory testing, are provided in the following sections. The exploratory hole logs and laboratory results are presented in **Appendix A, B and C** respectively.

Guidance Documents

Details of the best practice guidance documents and reference information used in undertaking the ground investigation and assessment are provided at the end of this report (see REFERENCES & GUIDANCE).

Investigation Strategy

The ground investigation was designed based on the requirements and specification from the Consultant Engineers. All works and exploratory holes were supervised and logged by an appropriately experienced geo-environmental engineer.

FIELDWORKS

Service Scanning & Exploratory Hole Positioning

Prior to commencement of exploratory hole locations, the positions were scanned by a specialist survey to avoid below ground services/utilities using techniques such as a Cable Avoidance Tool and Ground Penetrating Radar. The x,y,z co-ordinates of the exploratory hole positions were also recorded.

Concrete Breaking & Coring

Hard surfacing was removed from exploratory hole locations with the use of a concrete corer and/or hydraulic breaker.

GROUND INVESTIGATION

Cable Percussive Boreholes

Four cable percussive boreholes were completed to depths of between 16.45m bgl. Environmental, disturbed and/or bulk samples were generally collected at regular intervals.

Standard Penetration Tests (SPTs) were generally completed at alternate 1.0m intervals in the upper 5.0m and at alternating 1.50m thereafter. Undisturbed samples were typically collected at alternate 1.0m intervals in the upper 5.0m and at alternating 1.50m thereafter where cohesive soils were encountered.

Rotary Coring Follow-On Boreholes

Rotary coring follow-on was completed in two borehole locations (BH101 & BH103) using a Comachio 205 rig to depths of 25.00m bgl.

Environmental and disturbed samples were collected at regular intervals.

Class 1 core samples were collected in 1.5m runs. Samples were sub-sampled from the core runs for laboratory testing.

Machine Excavated Trial Pits

Five machine excavated trial pits were progressed using a mechanical excavator to depths of between 1.70m and 3.30m bgl. Environmental, disturbed and bulk samples were collected for laboratory testing and insitu hand shear vane tests were undertaken at regular intervals where cohesive soils were encountered within the excavations.

An exploratory hole location plan is presented as **Figure 2**.

In Situ Tests (Trial Pits)

A Pilcon hand shear vane was used to undertake insitu hand shear vane testing within trial pits. The instrument comprises a torque head with a direct reading scale which is turned by hand. The method involved pushing a 19mm or 35mm vane approximately 200mm into cohesive soils and turning the torque head until failure and then recording the value which is a direct value of the undrained shear strength measured in kN/m². The procedure is repeated three times per horizon and the average value calculated and presented as the result.

Field Headspace Testing

Field screening of soil samples was undertaken using a *mini-rae Lite* photo ionisation detector (PID). Soil arisings were collected at regular intervals and placed in sealed plastic bags, agitated by shaking and left for a minimum of 10 minutes prior to testing of 'headspace' using the PID.

GROUND INVESTIGATION

Details are provided on the exploratory hole logs presented in **Appendix A** and a calibration certificate is provided in **Appendix F**.

Well Development & Low Flow Sampling

All monitoring wells were developed using an electrical submersible pump (washed and cleaned between holes) on 26th January 2024.

Monitoring wells were sampled on 7th February 2024 using low flow sampling techniques with a peristaltic pump, so groundwater was micro-purged for a minimum period of 10 minutes prior to sampling into dedicated sampling containers.

In Situ Tests

Standard Penetration Tests (SPTs) were carried out in the rotary percussion boreholes in accordance with BS EN ISO 22476-3. A calibration certificate for the SPT hammer is provided in **Appendix E**.

Visual and Olfactory Evidence of Contamination

No visual and/or olfactory evidence of contamination was observed during the fieldworks. However, Made Ground was observed in the majority of exploratory hole locations and can be indicative of the presence of contamination.

LABORATORY TESTING

Soil samples were submitted to the UKAS and MCERTS accredited laboratories of Element and i2 Analytical for chemical and geotechnical testing respectively.

Laboratory test results are provided in **Appendix B** and **C**.

Please note there is a query with the laboratory regarding the omission of tests of a number of samples from BH102. Once resolved an updated version of the report will be issued.

SUMMARY OF GROUND & GROUNDWATER CONDITIONS

Ground Conditions

The table below provides a summary of ground conditions encountered with full descriptions provided in the associated exploratory hole logs and photographic record provided in **Appendix A** and **B** respectively:

Strata	Depth Range to Top (m bgl)	Depth Range to (Base (m bgl)
Made Ground (including hard surfacing)	Ground Level	1.10 – 2.00

GROUND INVESTIGATION

Strata	Depth Range to Top (m bgl)	Depth Range to (Base (m bgl)
Tidal Flat Deposits	1.10 – 2.00	10.50 – 11.20
River Terrace Deposits	10.50 – 11.20	14.20 – 15.90
Mercia Mudstone Formation ⁽¹⁾	14.20 – 15.90	16.45 – 25.00

(1) Base not determined.

Groundwater Observations

The following table provides a summary of groundwater strikes observed during the ground investigation works:

Location	Depth to Water Strike (m bgl)
BH101	4.20
	13.50
BH102	4.00
	5.20
	9.50
	10.60
	10.60
BH103	5.00
	5.70
	10.60
BH104	4.00
	11.00
	12.60
TP102	0.90
TP103	2.20
	3.00
TP104	1.15
	1.55
TP105	0.90
	2.50

GROUND INVESTIGATION

During return monitoring groundwater was recorded at depths of between 1.01m bgl (6.43m AOD) and 4.65m bgl (2.94m AOD).

Details are provided on the exploratory hole logs presented in **Appendix A** and the monitoring results presented in **Appendix D**.

MONITORING AND INSTRUMENTATION

Dual groundwater and/or ground gas monitoring wells were installed in all borehole locations. Details of the monitoring well installations can be viewed on the exploratory hole logs in **Appendix A**.

REFERENCES & GUIDANCE

REFERENCES & GUIDANCE

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2. Environment Agency/Defra. Contaminated Land Statutory Guidance (April 2012).
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13. NHBC (2007). Guidance on the Evaluation of Development proposals on sites where Methane and Carbon dioxide are present.
14. CL:AIRE (December 2013). Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination.
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22. Environment Agency (2009c), Updated Technical Background to the CLEA Model, Report SC050021/SR3, January 2009;

¹ This document has been withdrawn but is considered to remain useful in providing technical background for designing ground investigation works.

² This document has been withdrawn but is considered to remain useful in providing technical background for designing ground investigation works.

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23. Environment Agency (2009d), A Review of Body Weight and Height Data Used in the CLEA Model, Report SC050021/Final Technical Review 1, January 2009;
24. Nathanial et. al., (2009), The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd edition), Land Quality Press, Nottingham, ISBN 0-9547474-7-X
25. USEPA (2004), User's Guide for Evaluating Subsurface Vapour Intrusion into Buildings
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30. World Health Organisation (WHO) Petroleum Products in Drinking Water.
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33. Environment Agency (2013). Technical Guidance WM2 (v3). Interpretation of the definition and classification of hazardous waste.

FIGURES

FIGURES



Key:

Approximate site location

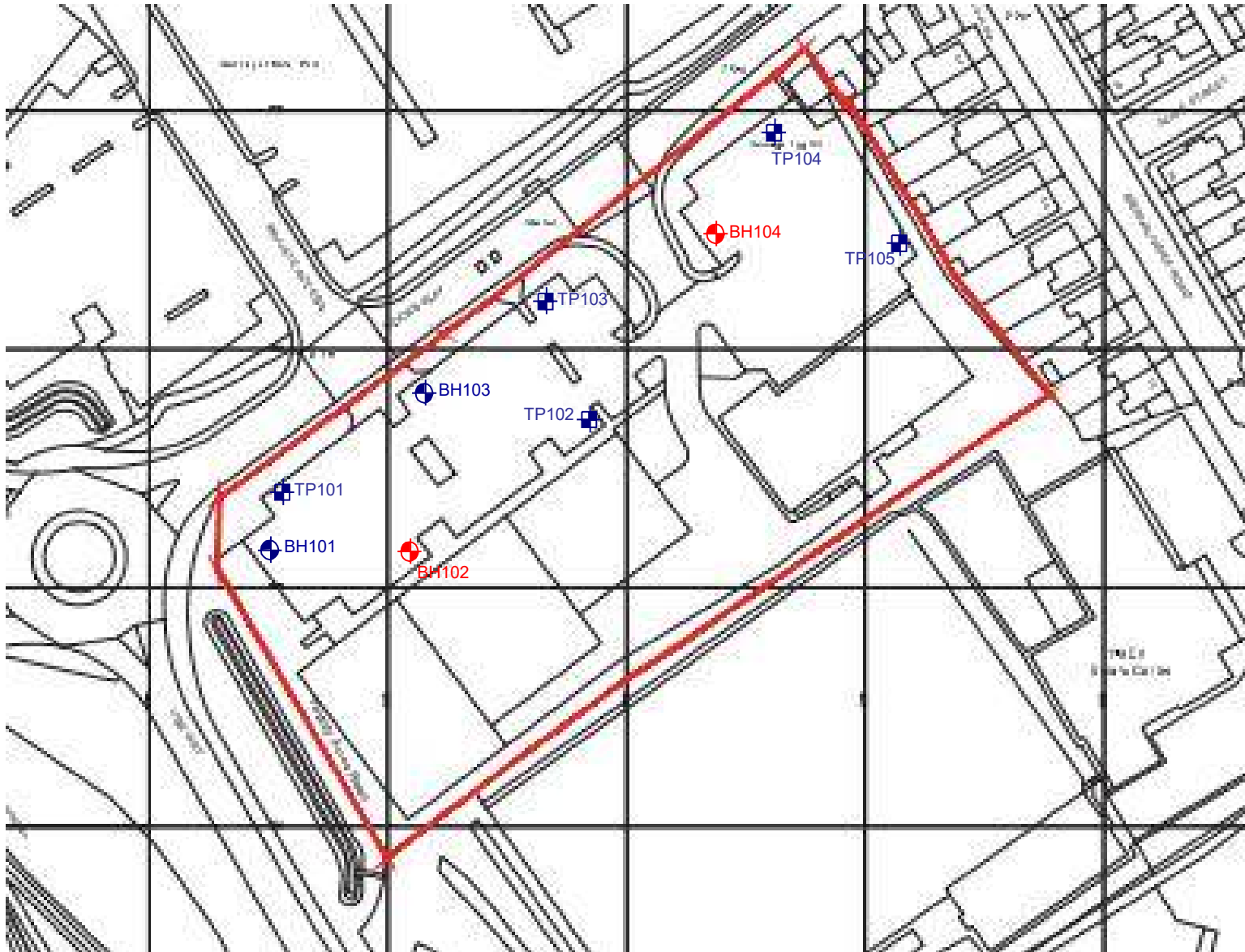
IMPORTANT – Please Read

This drawing is for illustrative purposes only and is for use only in conjunction with associated reports relating to the project details below. LMB accepts no liability for the misinterpretation or use of this illustration by any other parties.



*Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology*

Site: Home Bargains, Newport		
Figure Number: Figure 1		
Title: Site Location Plan		
Project No:	Created By: PIL	Date: February 2024
Client: TJ Morris		



Key:

-  BH Cable Percussive / Rotary Follow-on Borehole location
-  TP Machine excavated trial pit location
-  BH Cable Percussive Borehole location

IMPORTANT – Please Read

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*Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology*

Site:

Home Bargains, Newport

Figure Number: Figure 2

Title: Exploratory Location Plan

Project No:	Created By:	Date:
	PIL	February 2024
Client: TJ Morris		

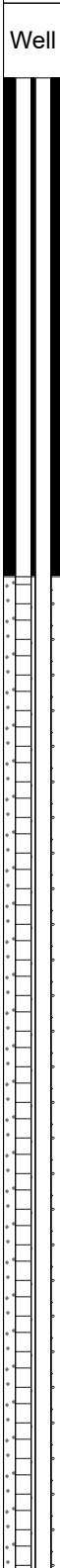
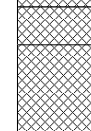
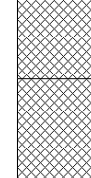
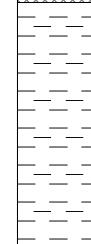
APPENDICES

Appendices

APPENDIX A EXPLORATORY HOLE LOGS

Rotary Core Log

Project Name: Home Bargains Newport		Client: TJ Morris		Date: 08/01/2024	
Location: Newport NP20		Contractor: Jacksons Drilling		Co-ords: E331074.23 N186308.05	
Project No. : LMB_Newport		Crew Name:		Drilling Equipment:	
Borehole Number BH101	Hole Type CP+RC	Level 7.16m AoD	Logged By PIL	Scale 1:30	Page Number Sheet 1 of 6

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPL)	Depth (m)	Level (m)	Legend	Stratum Description				
				TCR	SCR	RQD									
		0.10						0.10	7.06		Tarmac				
		0.25							0.25	6.91		MADE GROUND: orangish brown sandy roadstone gravel. Sub-base	1		
		0.50	ES									MADE GROUND: dark brown slightly clayey to clayey slightly sand sub angular medium to very coarse roadstone Gravel.			
		0.75	ES												
		1.00	ES						0.90	6.26		MADE GROUND: dark grey to black slightly sandy slightly gravelly Clay. Gravel sub angular roadstone with rare brick gravel and glass fragments			
		1.40	ES						1.30	5.86		Firm locally soft grey to light grey with occasional brown mottling CLAY. (TIDAL FLAT DEPOSITS).			
		2.30							2.30	4.86		Soft light grey to bluish grey CLAY with occasional very weak orangish brown mudstone inclusions. (TIDAL FLAT DEPOSITS).	2		
		2.50	ES												
															3
															4
		4.50							4.50	2.66		Brown to dark brown slightly clayey PEAT. (TIDAL FLAT DEPOSITS).			
		5.30	ES											5	
											1.86		Very soft grey to bluish grey CLAY. (TIDAL FLAT DEPOSITS).		
														6	
									(0)						

[illegible]

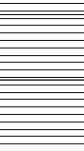
Remarks

LMB Ground Investigation Land Contamination Hydrogeology Engineering Geology Rotary Core Log																																																																
Project Name: Home Bargains Newport						Client: TJ Morris						Date: 08/01/2024																																																				
Location: Newport NP20						Contractor: Jacksons Drilling						Co-ords: E331074.23 N186308.05																																																				
Project No. : LMB_Newport						Crew Name:						Drilling Equipment:																																																				
Borehole Number BH101			Hole Type CP+RC			Level 7.16m AoD			Logged By PIL			Scale 1:30			Page Number Sheet 2 of 6																																																	
Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description																																																					
				TCR	SCR	RQD																																																										
		6.50	ES				(0)				Very soft grey to bluish grey CLAY. (TIDAL FLAT DEPOSITS).	7																																																				
		8.50	ES				(0)	8.40 8.60	-1.24 -1.44		Very soft grey to bluish grey CLAY with brown peaty CLAY bands. (TIDAL FLAT DEPOSITS). Very soft grey to bluish grey CLAY. (TIDAL FLAT DEPOSITS).	8																																																				
							(0)	9.00	-1.84		Brown slightly clayey PEAT. (TIDAL FLAT DEPOSITS).	9																																																				
								9.50	-2.34		Very soft grey to bluish grey CLAY with occasional peat bands. (TIDAL FLAT DEPOSITS).	10																																																				
		10.60	ES				(37)	10.50	-3.34		Recovered as dense grey clayey gravelly SAND with frequent sub rounded cobbles. (RIVER TERRACE DEPOSITS).	11																																																				
								10.90	-3.74		Dense, locally medium dense grey clayey sandy sub angular to sub rounded medium to coarse sandstone and occasional limestone GRAVEL with frequent cobbles. (RIVER TERRACE DEPOSITS).	12																																																				
	<table><tr><td colspan="2">Hole Diameter</td><td colspan="2">Casing Diameter</td><td colspan="4">Chiselling</td><td colspan="4">Inclination and Orientation</td><td colspan="4">Drilling Flush</td></tr><tr><td>Depth Base</td><td>Diameter</td><td>Depth Base</td><td>Diameter</td><td>Depth Top</td><td>Depth Base</td><td>Duration</td><td>Tool</td><td>Depth Top</td><td>Depth Base</td><td>Inclination</td><td>Orientation</td><td>Depth Top</td><td>Depth Base</td><td>Type</td><td>Colour</td><td>Min (%)</td><td>Max (%)</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></table>												Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush				Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)																		
	Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush																																																			
	Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)																																														
	Remarks																																																															



Rotary Core Log

Project Name: Home Bargains Newport			Client: TJ Morris			Date: 08/01/2024		
Location: Newport NP20			Contractor: Jacksons Drilling			Co-ords: E331074.23 N186308.05		
Project No. : LMB_Newport			Crew Name:			Drilling Equipment:		
Borehole Number BH101		Hole Type CP+RC		Level 7.16m AoD		Logged By PIL		Page Number Sheet 3 of 6

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description						
				TCR	SCR	RQD											
							50 (1,2/50 for 220mm)				Dense, locally medium dense grey clayey sandy sub angular to sub rounded medium to coarse sandstone and occasional limestone GRAVEL with frequent cobbles. (RIVER TERRACE DEPOSITS).	13					
							(27)					14					
			15.00	ES				14.70	-7.54		Firm to stiff reddish brown CLAY with occasional bluish grey mottling and mudstone inclusions and occasional sub rounded gravel and rare cobbles. (MERCIA MUDSTONE).	15					
								15.00	-7.84		Stiff reddish brown CLAY with occasional bluish grey mottling and mudstone inclusions and occasional sub rounded gravel and rare cobbles. (MERCIA MUDSTONE).	16					
								16.50	-9.34		NI. Recovered as reddish brown very weak MUDSTONE gravel and stiff CLAY with rare bluish grey mottling. (MERCIA MUDSTONE).	17					
			16.97 - 17.10	C			100	16.97	-9.81		Very weak to weak reddish brown MUDSTONE with occasional bluish grey mottling. FI 12: fractures primarily horizontal with open uneven surfaces with occasional clay infilling. (MERCIA MUDSTONE).	17					
			17.12 - 17.23				100	17.23	-10.07		NI. Recovered as reddish brown very weak MUDSTONE gravel and stiff CLAY with rare bluish grey mottling. (MERCIA MUDSTONE).	18					
			17.80 - 17.94	C			100	17.80	-10.64		NI. Recovered as reddish brown very weak MUDSTONE gravel and stiff CLAY with rare bluish grey mottling. (MERCIA MUDSTONE).	18					
								17.94	-10.78				18				
								18.00	-10.84				18				
	Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush				
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																	



Rotary Core Log

Project Name: Home Bargains Newport				Client: TJ Morris				Date: 08/01/2024			
Location: Newport NP20				Contractor: Jacksons Drilling				Co-ords: E331074.23 N186308.05			
Project No. : LMB_Newport				Crew Name:				Drilling Equipment:			
Borehole Number BH101		Hole Type CP+RC		Level 7.16m AoD		Logged By PIL		Scale 1:30		Page Number Sheet 4 of 6	

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
		19.20 - 19.28	C					19.03	-11.87		Very weak to weak reddish brown MUDSTONE with occasional bluish grey mottling. FI 13: fractures primarily horizontal with open uneven surfaces with occasional clay infilling. (MERCIA MUDSTONE). NI. Recovered as reddish brown very weak MUDSTONE gravel and stiff CLAY with rare bluish grey mottling. (MERCIA MUDSTONE). NI. Recovered as reddish brown very weak MUDSTONE gravel, cobbles and stiff CLAY. 18-18.2 moderately weak to moderately strong gravel and cobbles with smooth uneven surfaces and occasional bluish grey mottling. (MERCIA MUDSTONE).	19
								19.12	-11.96			
								19.20	-12.04			
								19.28	-12.12			
		20.70 - 20.84	C					20.08	-12.92		Very weak to weak reddish brown MUDSTONE. FI 20: fractures primarily horizontal with open uneven surfaces with occasional clay infilling. (MERCIA MUDSTONE). NI. Recovered as reddish brown very weak MUDSTONE gravel and stiff CLAY with rare bluish grey mottling. (MERCIA MUDSTONE). Very weak to weak reddish brown MUDSTONE. FI 18: fractures primarily horizontal with open uneven surfaces with occasional clay infilling. (MERCIA MUDSTONE). NI. Recovered as reddish brown very weak MUDSTONE gravel, rare cobbles and stiff CLAY. Cobbles moderately weak to moderately strong gravel and cobbles with smooth uneven surfaces and occasional bluish grey mottling. 19.5-19.75 cobbles with smooth surfaces and occasional bluish grey mottling. (MERCIA MUDSTONE).	20
								20.17	-13.01			
								20.70	-13.54			
								21.00	-13.84			
		21.52 - 21.63	C					21.18	-14.02		Moderately strong reddish brown MUDSTONE. FI 40: fractures horizontal and sub horizontal and tight with smooth surfaces. (MERCIA MUDSTONE). NI. Recovered as reddish brown very weak MUDSTONE gravel, rare cobbles and stiff CLAY. Cobbles moderately weak to moderately strong gravel and cobbles with smooth uneven surfaces and occasional bluish grey mottling. (MERCIA MUDSTONE). Moderately strong reddish brown MUDSTONE with some bluish grey colouration. FI14: fractures horizontal and	21
								21.77	-14.61			
								21.81	-14.65			
								22.50	-15.34			
		22.26 - 22.50	C					22.60	-15.44		NI. Recovered as reddish brown weak to moderately strong MUDSTONE gravel and cobbles. (MERCIA MUDSTONE). NI. Recovered as reddish brown weak to moderately strong MUDSTONE gravel and cobbles. (MERCIA MUDSTONE).	22
		23.26 - 23.34	C					23.15	-15.99		Moderately strong reddish brown MUDSTONE with some bluish grey colouration. FI14: fractures horizontal and	23
		23.94 - 24.00	C					23.94	-16.78			24
								24.00	-16.84			

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks



Rotary Core Log

Project Name: Home Bargains Newport				Client: TJ Morris				Date: 08/01/2024					
Location: Newport NP20				Contractor: Jacksons Drilling				Co-ords: E331074.23 N186308.05					
Project No. : LMB_Newport				Crew Name:				Drilling Equipment:					
Borehole Number BH101		Hole Type CP+RC		Level 7.16m AoD		Logged By PIL		Scale 1:30		Page Number Sheet 5 of 6			
Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description		
				TCR	SCR	RQD							
		24.08 - 24.14	C					24.08	-16.92		Moderately strong reddish brown MUDSTONE with some bluish grey colouration. FI14: fractures horizontal and occasionally sub horizontal and tight to open with smooth surfaces and some clayey gravel infilling. (MERCIA MUDSTONE).	25	
								24.21	-17.05				
								24.64	-17.48				
								24.74	-17.58				
								24.90	-17.74				
		24.90 - 24.98	C					25.19	-18.03		Moderately strong reddish brown MUDSTONE locally with some bluish grey colouration. FI12: fractures primarily horizontal and occasionally sub horizontal and with smooth surfaces. Fracture at 22.26 open and infill with gravel. (MERCIA MUDSTONE).	26	
								25.50	-18.34		Moderately strong reddish brown MUDSTONE locally with some bluish grey spotting. FI16: fractures primarily horizontal and occasionally sub horizontal and open with rough and smooth surface with some bluish grey spotting. (MERCIA MUDSTONE).	27	
											Moderately strong reddish brown MUDSTONE locally with some bluish grey colouration. FI20: fractures primarily horizontal and occasionally sub horizontal and with smooth surfaces. (MERCIA MUDSTONE).	28	
											Moderately strong reddish brown MUDSTONE locally with some bluish grey colouration. FI30: fractures primarily horizontal and occasionally sub horizontal and open with rough and smooth surface with some bluish grey spotting. (MERCIA MUDSTONE).	29	
											Moderately strong reddish brown MUDSTONE locally with some bluish grey colouration. FI30: fractures primarily horizontal and occasionally sub horizontal and open with rough and smooth surface with some bluish grey spotting. (MERCIA MUDSTONE).	30	

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks



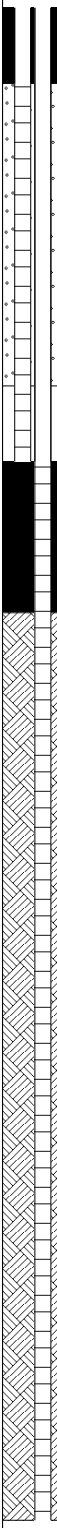
LMB Ground Investigation Land Contamination Hydrogeology Engineering Geology Rotary Core Log																	
Project Name: Home Bargains Newport						Client: TJ Morris						Date: 08/01/2024					
Location: Newport NP20						Contractor: Jacksons Drilling						Co-ords: E331074.23 N186308.05					
Project No. : LMB_Newport						Crew Name:						Drilling Equipment:					
Borehole Number BH101			Hole Type CP+RC			Level 7.16m AoD			Logged By PIL			Scale 1:30			Page Number Sheet 6 of 6		
Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description						
				TCR	SCR	RQD											
											Moderately strong reddish brown MUDSTONE locally with some bluish grey spotting. FI22: fractures primarily horizontal and occasionally sub horizontal and open with rough and smooth surface with some bluish grey spotting. (MERCIA MUDSTONE).						31
											NI. Recovered as reddish brown very weak to weak clayey MUDSTONE gravel and occasional cobbles. (MERCIA MUDSTONE).						
											End of Borehole at 25.500m						
																	32
																	33
																	34
																	35
																	36
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																AGS	



Ground Investigation
Land Contamination
Hydrogeology
Engineering Geology

Percussion Drilling Log

Project Name: Home Bargains Newport				Client: TJ Morris				Date: 11/01/2024			
Location: Newport NP20				Contractor: Jacksons Drilling				Co-ords: E331105.80 N186308.65			
Project No. : LMB_Newport				Crew Name:				Drilling Equipment:			
Borehole Number BH102		Hole Type CP		Level 7.59m AoD		Logged By PIL		Scale 1:50		Page Number Sheet 1 of 2	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.08	7.51		Tarmac	
		0.50	ES		0.45	7.14		MADE GROUND: orangish brown sandy roadstone gravel. Sub-base	
		0.50	PID	PID=0.00				MADE GROUND: compacted blackish brown slightly sandy roadstone and tarmac Gravel with numerous cemented concrete, brick and roadstone cobbles. Rare wood fragments and concrete boulders.	1
		1.20	SPT	N=14 (8,9/5,4,3,2)					
		1.50	ES						
		1.50	PID	PID=0.10					
		2.00			2.00	5.59		Firm grey to bluish grey CLAY with brown mottling. (TIDAL FLAT DEPOSITS).	2
		2.50	ES						
		2.50	PID	PID=0.00					
		3.00	SPT	N=14 (2,3/2,4,4,4)					3
	3.60	ES		3.40	4.19		Soft grey to bluish grey locally slightly sandy CLAY with rare brown mottling. (TIDAL FLAT DEPOSITS).		
	3.60	PID	PID=0.00				3.6m slight seepage	4	
	4.70	ES		4.90	2.69		Brown to dark brown slightly clayey PEAT. (TIDAL FLAT DEPOSITS).		
	4.70	PID	PID=0.10				5m Seepage	5	
	5.00	SPT	N=2 (1,0/0,1,1,0)						
	6.00	ES		5.70	1.89		Soft grey to bluish grey locally silty, sandy CLAY with rare brown mottling. Wet. (TIDAL FLAT DEPOSITS).	6	
	6.00	SPT	N=0 (0,0/0,0,0,0)						
	6.00	PID	PID=0.00					7	
	7.50	SPT	N=0 (0,0/0,0,0,0)					8	
	8.50	ES		8.30	-0.71		Very soft grey to bluish grey to greyish brown CLAY with occasional peat bands. (TIDAL FLAT DEPOSITS).		
	8.50	PID	PID=0.00						
	9.00	SPT	N=3 (1,0/1,1,0,1)	9.00	-1.41		Brown slightly clayey PEAT. (TIDAL FLAT DEPOSITS).	9	
							9m Seepage		
				10.00	-2.41			10	

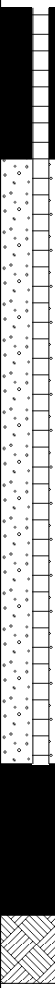
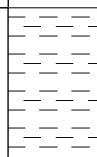
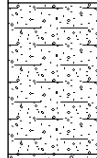
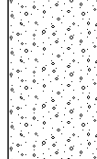
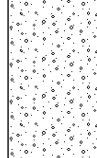
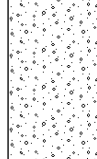
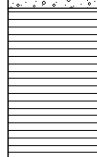
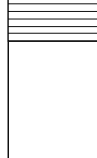
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks



Percussion Drilling Log

Project Name: Home Bargains Newport		Client: TJ Morris		Date: 11/01/2024	
Location: Newport NP20		Contractor: Jacksons Drilling		Co-ords: E331105.80 N186308.65	
Project No. : LMB_Newport		Crew Name:		Drilling Equipment:	
Borehole Number BH102	Hole Type CP	Level 7.59m AoD	Logged By PIL	Scale 1:50	Page Number Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.50	SPT	N=19 (5,4/3,3,3,10)				Very soft grey to bluish grey to greyish brown CLAY with occasional peat bands. (TIDAL FLAT DEPOSITS).	
		11.00 11.00	ES PID	PID=0.00	11.00	-3.41		Recovered as medium dense grey clayey gravelly SAND with frequent sub rounded cobbles. Wet. (RIVER TERRACE DEPOSITS).	11
		12.00	SPT	N=41 (6,6/7,9,12,13)	12.00	-4.41		Dense grey locally slightly clayey sandy sub angular to sub rounded medium to coarse sandstone and occasional limestone GRAVEL with frequent cobbles. (RIVER TERRACE DEPOSITS).	12
		13.50	SPT	N=42 (7,8/9,10,10,13)					13
		15.00	SPT	N=25 (4,3/4,5,8,8)	15.20	-7.61			14
		16.50	SPT	N=50 (1,2/50 for 285mm)	16.45	-8.86			15
								Firm to stiff reddish brown CLAY with occasional bluish grey mottling and mudstone inclusions and occasional sub rounded gravel and rare cobbles. (MERCIA MUDSTONE).	16
								End of Borehole at 16.450m	17
									18
									19
									20

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks





Rotary Core Log

Project Name: Home Bargains Newport		Client: TJ Morris		Date: 09/01/2024	
Location: Newport NP20		Contractor: Jacksons Drilling		Co-ords: E331107.17 N186340.04	
Project No. : LMB_Newport		Crew Name:		Drilling Equipment:	
Borehole Number BH103	Hole Type CP+RC	Level 7.26m AoD	Logged By PIL	Scale 1:50	Page Number Sheet 1 of 3

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
		0.45	ES					0.08 0.25 0.40 0.50	7.18 7.01 6.86 6.76		Tarmac	
											MADE GROUND: brown locally slightly clayey gravelly Sand. Gravel sub angular fine to coarse road stone and brick.	
											Concrete with brick	
											MADE GROUND: brown locally slightly clayey gravelly Sand. Gravel sub angular fine to coarse road stone and brick. Water at base	1
		1.10	ES				(11)	1.50	5.76			
		1.60	ES					1.70	5.56			
		2.00	ES								MADE GROUND: brown locally slightly clayey gravelly Sand. Gravel sub angular fine to coarse road stone and brick. Water at base	2
											MADE GROUND: grey to greyish brown Clay with occasional brick gravel.	
							(2)	2.50	4.76		Firm grey to bluish grey with occasional brown mottling CLAY. (TIDAL FLAT DEPOSITS).	3
											Very soft grey to bluish grey CLAY. (TIDAL FLAT DEPOSITS).	4
		5.00	ES				(0)	4.50	2.76		Brown to dark brown slightly clayey PEAT. (TIDAL FLAT DEPOSITS).	5
							(0)	5.20	2.06		Very soft grey to bluish grey sandy CLAY grading locally into very clayey silty fine SAND. Rare peat fragments and organic odour. Wet (TIDAL FLAT DEPOSITS).	6
												7
		7.50	ES				(0)					8
												9
								9.50	-2.24		Brown to dark brown slightly clayey PEAT. Wet (TIDAL FLAT DEPOSITS).	10

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																	



Rotary Core Log

Project Name: Home Bargains Newport				Client: TJ Morris				Date: 09/01/2024			
Location: Newport NP20				Contractor: Jacksons Drilling				Co-ords: E331107.17 N186340.04			
Project No. : LMB_Newport				Crew Name:				Drilling Equipment:			
Borehole Number BH103		Hole Type CP+RC		Level 7.26m AoD		Logged By PIL		Scale 1:50		Page Number Sheet 2 of 3	

Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description	
				TCR	SCR	RQD						
		10.50	ES				N=31 (4,3/31 for 295mm)	10.40	-3.14		Brown to dark brown slightly clayey PEAT. Wet (TIDAL FLAT DEPOSITS).	11
								11.20	-3.94		Very soft grey to bluish grey sandy CLAY grading locally into very clayey silty fine SAND. Rare peat fragments and organic odour. Wet (TIDAL FLAT DEPOSITS).	
		11.50	ES				N=50 (6,9/50 for 230mm)				Dense grey locally slightly clayey sandy sub angular to sub rounded medium to coarse sandstone and occasional limestone GRAVEL with frequent cobbles. (RIVER TERRACE DEPOSITS).	12
											13m grades into gravelly fine to medium SAND	13
							N=50 (4,5/50 for 225mm)	14.20	-6.94			14
							50 (8,16/50 for 155mm)				Firm to stiff reddish brown CLAY with occasional bluish grey mottling and mudstone inclusions and occasional sub rounded gravel and rare cobbles. (MERCIA MUDSTONE).	15
							50 (10,15/ 50 for 215mm)					16
												17
												18
												19
											20	

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)

Remarks

LMB Ground Investigation Land Contamination Hydrogeology Engineering Geology Rotary Core Log																	
Project Name: Home Bargains Newport						Client: TJ Morris						Date: 09/01/2024					
Location: Newport NP20						Contractor: Jacksons Drilling						Co-ords: E331107.17 N186340.04					
Project No. : LMB_Newport						Crew Name:						Drilling Equipment:					
Borehole Number BH103			Hole Type CP+RC			Level 7.26m AoD			Logged By PIL			Scale 1:50			Page Number Sheet 3 of 3		
Well	Water	Depth (m)	Type /FI	Coring			Diameter Recovery (SPT)	Depth (m)	Level (m)	Legend	Stratum Description						
				TCR	SCR	RQD											
		22.33 - 22.42	C					21.20	-13.94		Reddish brown clayey gravelly fine SAND grading in sandy gravelly CLAY. Gravel sub angular fine mudstone. (MERCIA MUDSTONE).	21					
											NI. Recovered as stiff reddish brown CLAY with occasional bluish grey mottling and very weak to weak mudstone inclusions and occasional sub rounded mudstone gravel and rare mudstone cobbles. Mudstone cobbles have rough surfaces. (MERCIA MUDSTONE).	22					
		23.60 - 23.68	C					23.10	-15.84		NI. Recovered as stiff bluish grey and reddish brown mottled CLAY with very weak mudstone gravel and occasional mudstone cobbles with rough surfaces. (MERCIA MUDSTONE).	23					
												24					
		24.26 - 24.34	C					24.60	-17.34		NI. Recovered as stiff reddish brown CLAY with rare bluish grey mottling and very weak to weak mudstone inclusions and occasional sub rounded mudstone gravel and rare mudstone cobbles. Mudstone cobbles have rough surfaces. (MERCIA MUDSTONE).	25					
		24.50 - 24.64	C										100				
		24.64 - 24.89	C										100				
		24.90 - 25.20	C										100				
									25.20	-17.94				End of Borehole at 25.200m	26		
															27		
												28					
												29					
												30					
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation				Drilling Flush					
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation	Depth Top	Depth Base	Type	Colour	Min (%)	Max (%)
Remarks																	



Ground Investigation
Land Contamination
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Percussion Drilling Log

Project Name: Home Bargains Newport				Client: TJ Morris				Date: 16/01/2024			
Location: Newport NP20				Contractor: Jacksons Drilling				Co-ords: E331169.31 N186375.21			
Project No. : LMB_Newport				Crew Name:				Drilling Equipment:			
Borehole Number BH104		Hole Type CP		Level 7.44m AoD		Logged By PIL		Scale 1:50		Page Number Sheet 1 of 2	

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
					0.08	7.36		Tarmac	
					0.25	7.19		MADE GROUND: orangish brown sandy roadstone gravel. Sub-base	
		0.50	ES					MADE GROUND: compacted blackish brown locally clayey, slightly sandy roadstone and tarmac Gravel with numerous cemented concrete, brick and roadstone cobbles. Rare wood fragments and concrete boulders.	1
		0.50	PID	PID=0.50					
		1.00	ES						
		1.00	PID	PID=1.70					
		1.20	SPT	N=33 (3,5/9,9,6,9)					
		2.00	ES		1.80	5.64		Firm grey CLAY with brown mottling and rare sub rounded medium sandstone gravel. (TIDAL FLAT DEPOSITS).	2
		2.00	PID	PID=0.70					
		3.00	SPT	N=8 (2,2/2,2,2,2)					3
		3.50	ES						
		3.50	PID	PID=0.30					
		4.00	SPT	N=4 (1,1/1,1,1,1)	3.80	3.64		Soft grey to bluish grey locally slightly sandy CLAY with rare brown mottling. (TIDAL FLAT DEPOSITS).	4
		4.70	ES						
		4.70	PID	PID=0.20	4.30	3.14		Brown to dark brown slightly clayey PEAT. (TIDAL FLAT DEPOSITS).	
	5.00	SPT	N=0 (1,0/0,0,0,0)					5	
				5.20	2.24		Very soft grey to bluish grey to greyish brown CLAY with occasional peat bands. (TIDAL FLAT DEPOSITS).		
	6.00	SPT	N=0 (1,0/0,0,0,0)					6	
	6.50	ES							
	6.50	PID	PID=0.60	6.40	1.04		Very soft grey to bluish grey to greyish brown locally sandy CLAY. (TIDAL FLAT DEPOSITS). 6.4m seepage with no noticeable rise in groundwater level.	7	
	7.50	SPT	N=5 (1,1/2,1,1,1)					8	
	9.00	SPT	N=4 (1,1/1,1,1,1)					9	
								10	

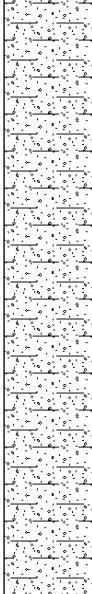
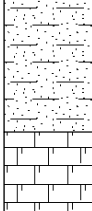
Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks



Percussion Drilling Log

Project Name: Home Bargains Newport		Client: TJ Morris		Date: 16/01/2024	
Location: Newport NP20		Contractor: Jacksons Drilling		Co-ords: E331169.31 N186375.21	
Project No. : LMB_Newport		Crew Name:		Drilling Equipment:	
Borehole Number BH104	Hole Type CP	Level 7.44m AoD	Logged By PIL	Scale 1:50	Page Number Sheet 2 of 2

Well	Water Strikes	Sample and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
		Depth (m)	Type	Results					
		10.30	ES	PID=0.40 N=14 (2,3/4,3,4,3)	10.20	-2.76		Very soft grey to bluish grey to greyish brown locally sandy CLAY. (TIDAL FLAT DEPOSITS).	
		10.30	PID		11.00	-3.56		Very soft to soft brown peaty organic CLAY with some decayed plant materials. (TIDAL FLAT DEPOSITS).	
		10.50	SPT						
		12.00	SPT	N=29 (4,5/6,7,8,8)	15.00	-7.56		Medium dense grey to greyish brown clayey gravelly SAND. Gravel sub angular to rounded fine to coarse sandstone. (RIVER TERRACE DEPOSITS).	11
			13.00	ES				PID=0.40	13
				13.00					
			13.50	SPT				N=50 (6,9/50 for 290mm)	14
		15.00	SPT	N=41 (6,6/9,10,10,12)	15.90	-8.46		Medium dense to dense reddish brown clayey SAND with occasional rounded sandstone and sub angular mudstone gravel. (RIVER TERRACE DEPOSITS).	15
			16.00	ES				PID=0.20	16
		16.00		PID					
		16.50	SPT	N=46 (6,11/46 for 230mm)	16.45	-9.01		Firm to stiff reddish brown CLAY with occasional bluish grey mottling and mudstone inclusions and occasional sub rounded gravel and rare cobbles. (MERCIA MUDSTONE).	16
							End of Borehole at 16.450m	17	
									18
									19
									20

Hole Diameter		Casing Diameter		Chiselling				Inclination and Orientation			
Depth Base	Diameter	Depth Base	Diameter	Depth Top	Depth Base	Duration	Tool	Depth Top	Depth Base	Inclination	Orientation

Remarks

