



ASSOCIATED BRITISH PORTS

HILL & SMITH COMPOUND OFFICE DEVELOPMENT

GROUND INVESTIGATION REPORT

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PREPARED BY:

Zoe Devaney Geo-environmental Engineer

REVIEWED BY:

Alec Ovens Principal Engineering Geologist

APPROVED BY:

Liam Price Technical Director

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DRAWINGS	TITLE	SCALE
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CA13057-009	As-Built Ground Investigation Locations	1:500

EXECUTIVE SUMMARY

Site location	The Site is located on land off Tom Lewis Way at Alexandra Docks in Newport, NP20 2WF, centred at E 331173, N 184616.
Site Investigation	A ground investigation (GI) was undertaken over a 1no. day period on the 4 th of December 2024. The GI comprised of 3no. windowless sample boreholes to a maximum depth of 6.0mbgl. All boreholes were installed as monitoring boreholes to monitor the groundwater and ground gas within the Made Ground deposits. Suspected asbestos containing materials were identified within the Made Ground materials within borehole WS04 at 1.40mbgl (recovered as a singular tile fragment). Groundwater strikes were recorded at 1.30mbgl, 1.35mbgl, and 1.50mbgl during the ground investigation.
Ground Conditions	Made Ground deposits were recorded across the entire site underlying the tarmac hardstanding from to a maximum depth of 4.0mbgl. The Made Ground was recorded as varying layers of cohesive silt and clay and granular sand and gravel deposits. The granular Made Ground deposits consisted of sandstone, shale, concrete, clinker, slag, wood, plastic fragments, metal fragments, and brick fragments. Superficial Alluvium deposits were recorded at depths ranging from 3.70mbgl to 6.0mbgl. The superficial deposits were predominantly recorded as very soft or soft slightly sandy gravelly clay, very soft slightly sandy clay, and very soft sandy slightly gravelly silt. Depth to bedrock and therefore, the thickness of the superficial deposits was not determined during the ground investigation.
Asbestos	Potential asbestos containing material (ACM) was encountered within borehole WS04 at 1.40mbgl, recovered as a tile fragment. Geoenvironmental testing of the collated soil samples returned one positive identification of amosite & chrysotile asbestos in the form of loose fibres within borehole WS01 (0.3m-1.0mbgl).
Unexploded Ordnance (UXO)	The site is classified as a low risk from unexploded ordnance (UXO) and no evidence of UXO was recorded during the ground investigation works.
Gas and Groundwater monitoring	A total of 6no. rounds ground gas and groundwater monitoring were undertaken within the 3no. monitoring boreholes across the site. Groundwater levels were recorded at 1.43mbgl to 1.63mbgl. Maximum concentrations of methane across the site range from 1.0% to 5.0% and maximum concentrations of carbon dioxide varied from 0.3% to 3.7%. A maximum positive flow rate of 0.1 l/hour was recorded across all 6no. monitoring rounds. Based upon the measured concentrations of methane and carbon dioxide and the derived GSVs, the site is classified as Gas Characteristic Situation 1 (CIRIA 665). Due to consistent concentrations of methane being recorded beneath the Site, it is recommended that ground gas mitigation measures are considered (see recommendations below). Consideration should be given to encountering organic/peat horizons which have the potential to generate gas within alluvium deposits beneath the site if deep excavations/piling are required as part of the proposed development.
Contamination	A total of 7no. soil samples were collected across the 3no. boreholes from depths between 0.3mbgl and 4.7mbgl for geoenvironmental testing. The chemical analysis did not return any exceedances in concentrations of heavy metals, total petroleum hydrocarbons or polycyclic aromatic hydrocarbon when compared to commercial land use guideline values.
Geotechnical Considerations	Based on the results of the ground investigation and geotechnical data, the following geotechnical constraints have been identified: • Made Ground – variable thickness, unstable, variable strength/engineering properties, potential for creep settlement, and expansive properties.

	• Alluvium – potentially thick (depth to bedrock not proven), soft/low strength and potential for highly compressible deposits, potential for ground gas generation, and high volume change potential. • Shallow groundwater. • Vibration from piling should pile foundations be required. Shallow excavations may become unstable and as a result, shoring of excavations may be required as well as the need for dewatering due to shallow groundwater conditions.
Environmental Risk Prior to Mitigation	Moderate/Low to Low
Environmental Risk Following Mitigation	Low to Very Low
Conclusions and Recommendations	Asbestos fibres (amosite and chrysotile) and suspected asbestos containing material (ACM) was identified in the Made Ground materials during the site investigation works. Therefore, it is recommended that specific asbestos awareness elements are included in the general environmental induction for all Site personnel, and an asbestos specific toolbox talk is conducted during the construction works. In accordance with CIRA C655, a Gas Characteristic Situation 1 does not require any additional gas protection measures as part of the proposed development. However, due to consistent concentrations of methane being recorded beneath the Site, it is recommended that a void is designed beneath the proposed development to mitigate the risk of any ground gas generation. It is recommended that a piling risk assessment (PRA) and a noise and vibration assessment is undertaken should piling be required as part of the proposed development to ensure that local fauna are not significantly affected during piling, where required. WA LLP recommend further testing to verify whether the Made Ground materials are suitable for reuse within any proposed landscaping where required across the site.

1 INTRODUCTION

Instructions

- 1.1 Wardell Armstrong ('WA LLP') was instructed by Associated British Ports ('the Client') to undertake a Site Investigation in relation to the proposed construction of a new office compound at the Hill and Smith Site at Alexandra Docks, Newport.
- 1.2 The report has been prepared in line with our proposal (Ref. ZD/GC/CA13057/COS-003) and WA LLP Standard Terms of Engagement dated 13th September 2024. The Standard Terms and Limitations to this report are presented in **Appendix A**.

Site Location

- 1.3 The Site is located on land off Tom Lewis Way at the Alexandra Docks in Newport, NP20 2WF. The Site is 0.163 Ha and centred at E 331173, N 184616, shown below in **Figure 1** and on **Drawing CA13057-007**.

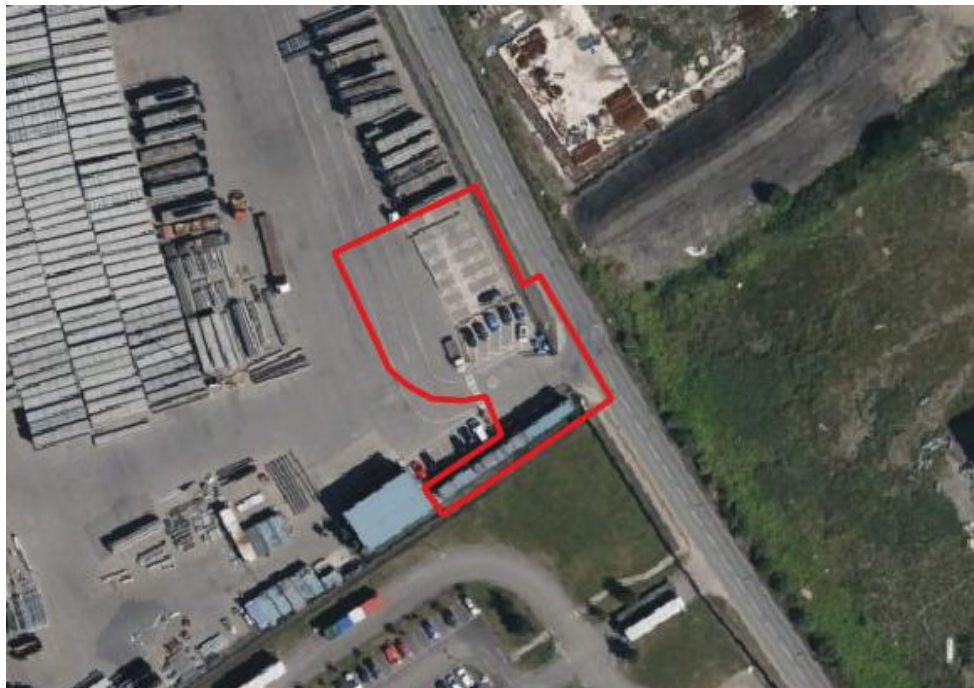


Figure 1 – Site boundary (Bing aerial imagery).

- 1.4 The Site comprises the existing two-storey container offices and welfare facility in the south, car park spaces in the centre of the Site, and outside storage are for wagons managed by Hill & Smith Infrastructure. The Site is covered entirely by hardstanding typically comprising of Tarmacadam with small areas of concrete hardstanding in the northeast of the Site.

- 1.5 The Site is bounded by Tom Lewis Way in the east, and land owned by Hill & Smith Infrastructure Limited to the north and west. To the south, the Site is bounded by soft landscaping, hardstanding car park, and fencing surrounding the Speedy Newport Docks building.
- 1.6 The Site is accessed off Tom Lewis Way.
- 1.7 This report presents the findings from the intrusive ground investigation (GI) works and follow up monitoring undertaken to define potential contamination and determine relevant geotechnical information relating to the proposed development.
- 1.8 The purpose of this report is to present the findings of intrusive GI carried out at the Site to:
- 1) Obtain further information on the ground conditions/geology, hydrogeology, and hydrology of the Site and in relation to potential sources of contamination, pathways, and receptors.
 - 2) Reduce uncertainty in the knowledge of the Site enabling the initial conceptual site model(s) to be refined, comprising reassessment of risk/significant pollution linkages and early indications of potential remedial requirements.
 - 3) Reduce uncertainty in knowledge of the Site enabling the initial ground model to be refined, comprising reassessment of geotechnical risk, stratum type, geotechnical characteristics, and recommendations for foundation/engineering options.
 - 4) Provide further information to assist in the design of environmental monitoring if required.
 - 5) Provide health and safety information relevant to construction.

Proposed Use

- 1.9 The proposed development and end use of the Site includes for a new compound office development consisting of a two-storey portacabin, removal of the existing storage container offices, installation of sustainable drainage features, and provision of parking spaces.
- 1.10 At the time of writing this report, the proposed development plans have included the design of pad foundations, however, it is noted that this is conceptual. The proposed foundation solutions are discussed further in Chapter 10.15.

- 1.11 Plans of the proposed development is presented in **Appendix B**.

Limitations

- 1.12 This report is provided for the stated purpose and for the sole use of the client in accordance with the Terms and Conditions of Appointment under which the services were performed. This Report may not be disclosed by the Client nor relied upon by any other party without the prior and express written agreement of WA LLP.
- 1.13 This report has been prepared for the exclusive benefit of the Applicant for the purpose of providing geo-environmental recommendations for the Site, with specific focus on establishing the potential risks associated with contaminated land. The report contents shall only be used in that context. Furthermore, new information, changes in practice or new legislation may necessitate revised interpretation of the report after the date of its production.
- 1.14 The purpose of the ground investigation was to target the potential presence of contamination on Site (e.g. Made Ground) identified within the Desk Study and Preliminary Risk Assessment' (Ref: CA13057-003, prepared November 2024), and Site walkover survey, rather than target features of the proposed Project. Geotechnical testing was limited to Standard Penetration Testing (SPTs) for the purposes of this investigation. SPT testing was undertaken to provide characteristic values for the in-situ density of the strata on Site.
- 1.15 All ground investigations rely upon the determination of information from 'point sources' such as the windowless sample and the interpretation of data between investigation points.
- 1.16 The actual conditions between investigation points may vary generally or seasonally, and impact upon the future development, and it is the responsibility of the developer to determine whether further ground investigation may be needed to support detailed design of the construction works.
- 1.17 The ground investigations were restricted in places due to site activities and current land uses/activities. Exploratory hole locations were positioned at locations to avoid these constraints or minimise disruption to the current land uses and were based on the information provided in the Desk Study and Preliminary Risk Assessment' (Ref: CA13057-003, prepared November 2024).
- 1.18 WA LLP has carried out an appropriate level of checking third party supplied information, however WA LLP cannot be held liable for any inaccuracies,

inconsistencies or omissions in such information (should there be any). The information has been accepted and used in good faith and unless otherwise stated, no attempt has been made to verify the information supplied. Should any of these factors or information change then the conclusions of the report may need to be amended.

- 1.19 WA LLP has used reasonable skill and care in the design of the ground investigation work for the proposed Project area to comply with currently available industry guidance and to meet the requirements of the commission.
- 1.20 Should any third party wish to use or rely upon the contents of this report, written approval must be sought, and a charge may be levied accordingly.
- 1.21 WA LLP accepts no responsibility or liability for the consequences of this document being used:
 - 1) For any purpose or project other than for which it was commissioned; and
 - 2) By any third party with whom an agreement has not been executed.
- 1.22 The report is based on information available at the time of writing. Additional information may become available in the future which may have a bearing on the conclusions of this report and for which WA LLP cannot be responsible.

2 PREVIOUS WORK

Desk Study and Preliminary Risk Assessment

- 2.1 WA LLP completed a Tier 1 assessment (in accordance with Land Contamination Risk Management) for the Hill & Smith Site, entitled 'Desk Study and Preliminary Risk Assessment' (Ref: CA13057-003, prepared November 2024). The Desk Study and Preliminary Risk Assessment should be read in conjunction with this report.
- 2.2 The Conceptual Site Model (CSM), prepared as part of the Desk Study and Preliminary Risk Assessment, concluded that several potential contaminant linkages (source-receptor pathways) are present across the Site from contaminants associated with the historical landfill, dockyard, and industrial land use of the Site and surrounding the Site.
- 2.3 The CSM identified the following potential receptors:
- Receptor 1: Human health – Construction workers, maintenance workers, and future site users.
 - Receptor 2: Controlled waters – Surface water features (Afon Ebwy (Ebbw River).
 - Receptor 3: Controlled waters – Groundwater aquifer (Secondary B Bedrock Aquifer)
 - Receptor 4: Built Environment – Proposed storage container offices/welfare facility, drainage strategy, and associated infrastructure.
- 2.4 The Site was identified to be at a negligible risk of collapsible ground and ground dissolution, a very low risk of landslides, a low risk of shrink-swell clays, and a moderate risk of running sand and compressible ground conditions.
- 2.5 Additional geotechnical constraints identified at the Site through the Desk Study include thick superficial deposits with the potential of for unstable non-cohesive horizons.
- 2.6 A Qualitative Risk Assessment deemed the Site to pose a potential low to moderate risk to potential future human health, controlled water and built environment receptors based on former and current uses of the Site, and the surrounding area prior to mitigation.
- 2.7 The Qualitative Risk Assessment classified the Site as a potential Moderate to Moderate/Low risk to human health the built environment receptors in relation to the risk of ground gas generation from any backfill material on or surrounding the Site.

- 2.8 Furthermore, the Desk Study and Preliminary Risk Assessment identified that the high water tide mark of the former Afon Ebwy (Ebbw River) meander extended across the northern boundary of the site in 1882-1901 (1:2,500).
- 2.9 A ground investigation was recommended at the Site with associated environmental analysis of collected soil samples to assist in reducing existing uncertainties and inform engineering requirements of the proposed development.

Soakaway Soil Infiltration Testing (2023)

- 2.10 Intégral Géotechnique undertook a series of soil infiltration testing across the wider Hill & Smith site in June 2023 (Ref. 14227/FG). The ground investigation works comprised 7no. trial pits excavated using a JCB 3CX to a maximum depth of between 1.6mbgl to 2.0mbgl for soakaway testing, carried out in accordance with BRE 365.
- 2.11 Based upon the georeferenced ground investigation plan (June 2023), exploratory hole TP01 was assumed to be located in the northeast corner of the Site. Trial pit TP01 recorded 1.85m of Made Ground deposits underlying 0.15m of tarmac/asphalt. The Made Ground comprised of a granular horizon from 0.15mbgl to 0.30mbgl consisting of vesicular slag and clinker overlying a cohesive horizon of silt and clay to 2.0mbgl. The ground investigation encountered gravels of brick, concrete, vitreous and vesicular slag and sandstone with inclusions of cloth, fabric, and suspected asbestos containing material in the form of corrugated tiles within the silt Made Ground horizon at 0.30mbg-1.90mbgl.

3 GROUND INVESTIGATION WORKS

Description of Works

- 3.1 The intrusive ground investigation (GI) works were undertaken on the 4th of December 2024 over a period of 1no. day.
- 3.2 The investigation comprised windowless sample boreholes and hand-dug pits, as well as geotechnical and geoenvironmental testing of soil, and post-GI environmental monitoring (gas and groundwater).
- 3.3 The GI works and exploratory hole locations were designed to consider the proposed development layout, the findings of the desk study and preliminary risk assessment, and the limited working area provided by the site managers (Hill & Smith Infrastructure).
- 3.4 At the time of writing this report, 6no. post-works ground gas and groundwater monitoring visit have been completed. These visits included the monitoring of groundwater levels and ground gas concentration.
- 3.5 All exploratory holes were cleared for services using a Cable Avoidance Tool (CAT) scan, Ground Penetrating Radar survey, and hand-dug pits to 1.2m below ground level (mbgl) prior to machine excavating.
- 3.6 All exploratory holes were completed under the full-time supervision of a WA Geo-environmental Engineer.
- 3.7 In total, the GI comprised:
- Three windowless sampling boreholes (WS01, WS02 & WS04) to a maximum depth of 6.0mbgl and Standard Penetration Testing within each borehole.
 - WS01 – progressed to 4.0mbgl.
 - WS02 – progressed to 6.0mbgl.
 - WS04 - progressed to 3.0mbgl.
- 3.8 The target depth of the ground investigation boreholes was 5.0mbgl, where ground conditions allowed. However, borehole WS01 was terminated at 4.0mbgl due to collapsible deposits and borehole WS04 was terminated at 3.0mbgl due to encountering potential asbestos containing material (ACM). Borehole WS02 was excavated to a greater depth than 5mbgl due to the favourable ground conditions to obtain additional samples for geochemical and geotechnical testing.

- 3.9 The investigation, including sampling techniques, was carried out in general accordance with BS-5930:2015+A1:2020, Code of Practice for Ground Investigations and BS-10175:2011+A2:2017 Investigation of potentially contaminated sites – Code of Practice.
- 3.10 The investigation was completed in accordance with Construction (Design and Management) (CDM) Regulations 2015. Jackson Drilling were appointed as the Principal Contractor to undertake the windowless sampling drilling.
- 3.11 One WA LLP engineer provided full time site supervision during the ground investigation and undertook environmental sampling. The site engineer from Jackson Drilling undertook the logging and geotechnical sampling of all the intrusive works.
- 3.12 Envirolab was appointed as the geoenvironmental laboratory for the works in relation to geochemical soil testing. Envirolab is accredited by the United Kingdom Accreditation Service (UKAS) and Environment Agency (EA) Monitoring Certification Scheme MCERTS.
- 3.13 Geo Site & Testing Services (GSTL) was the appointed laboratory to undertake the geotechnical testing under the supervision of Jackson Drilling. The laboratory is accredited by the United Kingdom Accreditation Service (UKAS).
- 3.14 The general objectives of the windowless sampling boreholes were to:
- Assess the nature of the shallow ground conditions including soil type, composition, and estimation of relative density/strength etc.
 - Determine the presence of, and depth to, groundwater level.
 - Identify key indicators for ground contamination.
 - Collect disturbed geochemical and geotechnical samples for laboratory analysis for geotechnical testing.
 - Utilise geotechnical results to provide engineering information to assist future foundation design.
- 3.15 WA LLP note that there was no clear evidence on site with regards to the position/reinstatement of any trial pits excavated as part of the Intégral Géotechnique soakaway investigation in June 2023.

Number and Location of Exploratory Points

3.16 Exploratory locations were surveyed in by Jackson Drilling following the completion of the GI works. The confirmed locations of the as-built exploratory holes are presented on **Drawing CA13057-009**.

3.17 The exploratory holes were positioned with consideration of various constraints relating to the position of existing utilities, accessibility, site traffic, areas of hardstanding, as well as the proposed development layout.

Windowless Sampling Boreholes

3.17.1 A total of three windowless sampling boreholes were completed to a maximum depth of 6.0mbgl and installed using a windowless Dart rig.

3.17.2 In-situ Standard Penetration Tests (SPTs) were undertaken at 1m intervals to the base of the boreholes.

3.18 Disturbed samples of soil were obtained for geochemical testing and collected in accordance with relevant standards.

3.19 All three windowless sampling boreholes were installed with a single 50mm ground gas-groundwater monitoring well in order to allow for the identification of ground gas generation and groundwater levels.

3.20 All borehole logs are presented in **Appendix C**.

Ground Gas and Groundwater Monitoring Installations

3.21 Three windowless sampling boreholes were installed as ground gas and groundwater monitoring boreholes, the construction details of which are provided in **Table 3.1** below.

TABLE 3.1 – SUMMARY OF MONITORING BOREHOLE CONSTRUCTION DETAILS				
Borehole ID	Monitoring Well Diameter (mm)	Top of Screening Zone (mbgl)	Bottom of Screening Zone (mbgl)	Screening Horizon
WS01	50	1.00	3.00	Made Ground
WS02	50	1.00	4.00	Made Ground
WS04	50	1.00	3.00	Made Ground

Environmental Monitoring

3.22 At the time of writing this report, a total of 6no. rounds of gas and groundwater monitoring has been undertaken.

3.23 The monitoring equipment was calibrated and suitable for use. A dip meter was also used to check both the depth of water and the depth to the base of the standpipe for each borehole monitored.

- 3.24 Gas monitoring recorded the concentrations of methane, carbon dioxide, carbon monoxide, oxygen, and hydrogen sulphide. The weather conditions, barometric pressure and gas flow rate were recorded at the same time.

Sampling and Testing

Soil Sampling

- 3.25 Within exploratory holes, small disturbed environmental samples were taken at specific points such as consistent depths, changes in strata and any discrete horizons with visual/olfactory evidence of contamination or a high potential to retain contaminants, where encountered. The exploratory holes were logged in general accordance with BS-5930:2015+A1:2020.
- 3.26 Both small and bulk disturbed geotechnical samples were recovered from exploratory holes at specific points such as changes in strata type or material properties, where encountered.
- 3.27 All soil samples were collected in general accordance with best guidance.

Chemical Analysis of Soils

- 3.28 The scheduled laboratory analyses were selected to establish the type, level and distribution of the possible harmful contaminants present on the Site given its past and current uses. The analysis was also scheduled to supplement the historical chemical sampling undertaken.
- 3.29 Soil samples were analysed for a range of substances depending on depth and their position relative to potential historical contaminative sources.
- 3.30 The scheduled brownfield suite test analyses is presented in **Table 3.2**.
- 3.31 The results of the soil geochemical analyses are attached within **Appendix D**.

TABLE 3.2 - SUMMARY OF SOIL SAMPLE BROWNFIELD SUITE ANALYSIS SCHEDULE	
Substances	No. Soil Samples
Asbestos identification, Moisture, pH, Boron (Hot Water soluble), Sulphate (2:1 Water soluble), Sulphide, Cyanide (total), Sulphate (Acid Soluble), Arsenic, Cadmium, Chromium, Copper, Mercury, Nickel, Lead, Selenium, Zinc, Organic Matter, Total TPH >C5-C35, BTEX compounds, Total Of 16 PAH's, Total Phenols, Sulphur (Total).	7
Speciated PCB-EC7	5

Geotechnical Sampling and Testing

- 3.32 The geotechnical testing strategy was planned to obtain information to further classify site materials and their engineering properties.
- 3.33 A total of 6no. samples were collected for geotechnical testing. The scheduled analysis is presented in **Table 3.3** and geotechnical results are attached within **Appendix E**.

TABLE 3.3 - SUMMARY OF GEOTECHNICAL TESTING SCHEDULE	
Geotechnical Testing	No. Samples
Moisture Content	5
Particle Size Distribution (Wet Sieve Method)	2
Atterberg Limits	4

- 3.34 All tests were performed by an accredited geotechnical laboratory (GSTL) and all samples were tested in accordance with the appropriate British Standard; BS1377: 1990 and the International Society for Rock Mechanics (ISRM) Methods:1985.

Quality Assurance and Quality Control

- 3.35 The soil samples were collected, transferred to the laboratory under chain of custody and analysed to ensure traceability and reliability of analytical results. Based on the laboratory QA data, the analytical results are considered acceptable for interpretative use.

4 GROUND CONDITIONS

Overview

- 4.1 This section of the report considers the results of the ground investigation undertaken on the 4th of December 2024. The drillers and engineer borehole logs can be viewed in **Appendix C**.
- 4.2 The general site conditions comprised Made Ground and superficial Alluvium deposits. The depths and thicknesses of the observed strata are shown in **Table 4.1**.

TABLE 4.1 – SUMMARY OF GROUND CONDITIONS				
Strata	Exploratory hole locations	Min. depth to top of strata (mbgl)	Max. observed depth strata (mbgl)	Max. thickness (m) observed
Made Ground	All	Ground Level	4.0mbgl	4.0m
Alluvium*	WS01 & WS02	3.70mbgl	6.0mbgl*	2.0m
*Base of strata not proven during ground investigation.				

- 4.3 The Preliminary Risk Assessment identified that the Site is underlain by the Hughes Member (Mudstone, Siltstone and Sandstone). However, bedrock was not encountered during the ground investigation, therefore, it is assumed to be predominantly >6.0mbgl.
- 4.4 The boreholes drilled have not provided any clear evidence with regards to the extent of the infilled River Ebbw meander, as identified within the Preliminary Risk Assessment and Desk Study (Chapter 2).
- 4.5 The made ground deposits identified within the windowless sample boreholes appeared to be of a similar nature and consistency to the material within trial pits excavated as part of the Intégral Géotechnique soakaway investigation in June 2023.

Made Ground

- 4.6 The Made Ground deposits were encountered within all exploratory positions, from ground surface (including tarmacadam hardstanding) to depths of between 3.7mbgl (WS01) to 4.0mbgl (WS02). However, the base of the Made Ground deposits was not determined within borehole WS04 because of potential asbestos containing materials terminating the borehole earlier than target depth.
- 4.7 The maximum recorded thickness of Made Ground was 4.0m in borehole WS02.
- 4.8 The Made Ground was recorded as varying layers of cohesive silt and clay and granular sand and gravel deposits. The cohesive Made Ground deposits were predominantly recorded as firm sandy silt and soft to firm slightly sandy and slightly gravelly clay. The

granular Made Ground deposits were predominantly recorded as slightly silty gravelly sand with low cobble content within the first 2.0m or sandy angular to subrounded, fine to coarse gravels. The gravel and cobble content comprised sandstone, shale, concrete, clinker, slag, wood, plastic fragments, metal fragments, and brick fragments.

- 4.9 Suspected asbestos containing materials (ACM) were recorded within the Made Ground materials within borehole WS04 at 1.40mbgl in the form of a singular tile fragment (bound asbestos).
- 4.10 No malodours were recorded throughout the duration of the works.

Alluvium

- 4.11 The top of the Superficial Alluvium deposits were encountered within boreholes WS01 and WS02 from depths between 3.70mbgl (WS01) and 4.00mbgl (WS02)..
- 4.12 The maximum observed thickness of the superficial deposits was 2.0m within borehole WS02. However, the base of the Alluvium deposits was not proven during the ground investigation. Therefore, it is assumed that the Alluvium deposits are >2.0m thick.
- 4.13 The superficial deposits were predominantly recorded as very soft and soft slightly sandy gravelly clay, very soft slightly sandy clay, and very soft sandy slightly gravelly silt. The gravel content predominantly comprised angular to subrounded, fine to medium gravels of sandstone and slate.

Groundwater and Ground Gas Monitoring

- 4.14 The groundwater strikes recorded during the ground investigation works are presented below in **Table 4.2**.

TABLE 4.2 – DEPTH TO GROUNDWATER DURING GROUND INVESTIGATION	
Exploratory Hole	Depth to Groundwater
WS01	1.35mbgl
WS02	1.50mbgl
WS04	1.30mbgl

- 4.15 At the time of writing this report, 6no. rounds of environmental monitoring have been undertaken and the depths to groundwater recording during these monitoring rounds are presented below in **Table 4.3**.

TABLE 4.3 – DEPTH TO GROUNDWATER DURING MONITORING ROUNDS

Exploratory Hole	Depth to Groundwater (mbgl)					
	11/12/2024	20/12/2024	02/01/2025	10/01/2025	22/01/2025	28/02/2025
WS01	1.56	1.57	1.60	1.58	1.63	1.56
WS02	1.46	1.49	1.50	1.47	1.52	1.47
WS04	1.43	1.47	1.49	1.46	1.49	1.46

Ground Gas

4.16 The ground gas results from the 6no. rounds of monitoring are attached at **Appendix F** and the results are discussed in Chapter 6.13.

5 GUIDANCE ON CONTAMINATION RISK ASSESSMENT

Introduction

5.1 The following section aims to assess the magnitude and significance of potential risks to human health, surface water, groundwater, ecosystems and buildings from contaminated soil and groundwater. The assessment provides information that is fit for purpose given the regulatory context and is completed in accordance with UK best practice. A summary of the risk assessment process is presented below. More detailed information on risk assessments is contained in various reports published by the EA and Department of Environment, Food and Rural Affairs (DEFRA) including:

- Land Contamination Risk Management (LCRM)
- Contaminated Land Science Reports (SR2 to 4)

General Soil Contamination Guidance

- 5.2 The EA has a statutory duty to ensure the protection of the environment and the remediation of contaminated land and groundwater. To achieve this, the EA employ the risk assessment principle – outlining the risk of a contaminant source causing harm or pollution via a given pathway to an identified receptor.
- 5.3 If one of the *source-pathway-receptor* linkages is not considered to be present, then there is deemed to be no risk. However, if a contaminant source is present and there is a pathway for that contaminant to reach a receptor, then there is a potential risk of significant harm to the receptor. Therefore, if *the source-pathway-receptor* linkages are complete, there is a requirement to undertake a risk assessment related to the receptor of concern, be it human health, surface water, groundwater, buildings (or other property) or ecological issues.
- 5.4 The first stage in the assessment of a site is development of a conceptual model. This includes consideration of all possible sources of contamination on the site, the potential receptors and whether there is a plausible pathway between linking the two. This allows evaluation of whether an additional, more complex, risk assessment for an identified receptor is necessary.
- 5.5 The initial site-specific conceptual model presented within the Wardell Armstrong Desk Study and Preliminary Risk Assessment (Ref: CA13057-003, prepared November 2024) was reviewed and forms the basis of the revised model.
- 5.6 A revised model is presented in Chapter 8 based on the findings of the most recent WA LLP ground investigation.

Generic Assessment Criteria

Soils Criteria

- 5.7 In March 2002, the EA and DEFRA released a package of guidance to assess the health risks posed by contaminated land as part of the relevant statutory framework.
- 5.8 The Contaminated Land Exposure Assessment (CLEA) model is a framework for estimating the likely exposure to contaminants in soil as part of the wider approach of the UK's assessment of risk and suitability for use. The methodology adopted for CLEA builds upon the source-pathway-receptor model for the assessment of risk. Following the CLEA model, generic Soil Guideline Values (SGVs) were developed to act as triggers for intervention in a number of end-use scenarios. The EA commenced a programme looking at 55no. contaminants. The CLEA methodology has been updated and the SGVs were withdrawn from use in August 2008. New SGVs have been published by the EA since March 2009 onwards.
- 5.9 The CLEA SGVs are derived using specific parameters, which may not be relevant to each site. The CLEA software allows parameters to be changed and subsequently, site-specific assessment criteria (SSAC) can be developed. The CLEA methodology also uses a statistical evaluation of all the data collected in order to give an overall impression of the site and therefore the exposure to a modelled receptor rather than using individual contaminant values, which may vary dramatically across the site.
- 5.10 The SGVs derived from the CLEA model are intended for use in assessing the risk to long-term human users of the site. There is also a requirement to consider the potential for harm from short-term exposure to contaminants at the site, e.g., to construction workers who may be exposed to risk via inhalation of dust or dermal contact with the contaminated material.
- 5.11 In the absence of SGVs published under the new CLEA methodology, Land Quality Management (LQM) and the Chartered Institute of Environmental Health (CIEH) published their third edition of generic assessment criteria (GAC) for 82no. inorganic and organic substances (with the exception of lead) in January 2015 which are termed Suitable 4 Use Levels or S4ULs.
- 5.12 Category 4 Screening Levels (C4SLs) were published in 2014 which adopt a "low level of toxicological concern" (LLTC) as the toxicological benchmark. WA LLP have adopted the C4SL criteria for lead for this site and adopted S4ULs for all other determinants.

5.13 In addition, GAC values for 30no. separate organic compounds were published in December 2009 by the Environmental Industries Commission (EIC), the Association of Geotechnical and Geo-environmental Specialists (AGS) and CL:AIRE. These GAC values have been derived in the same vein as SGVs and are intended to be used in the same manner. Additionally, the GAC values have been produced for varying soil organic matter content (i.e., 1%, 2.5% and 6%).

5.14 Whilst a failure against a screening target value does not necessarily present a “significant possibility of significant harm”, the screening provides an indication of the level of additional assessment/remediation that may be required should high levels of contaminants be detected.

Ground Gas

5.15 Soil gases were analysed and assessed in general accordance with the following guidance:

- BS-8485:2015+A1:2019, Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings (2015).
- CIRIA C665, Assessing Risks Posed by Hazardous Ground Gases to Buildings (2007).

6 LABORATORY CHEMICAL TEST ANALYSIS

Introduction

- 6.1 A total of seven soil samples were collected and tested from the Made Ground materials and superficial during the ground investigation.
- 6.2 All samples were placed in laboratory supplied containers and kept in a cool box with freezer packs in order to preserve the samples' integrity.
- 6.3 The collected samples were delivered to Envirolab for analysis in relation to a suite of contaminants as detailed in **Table 3.2**.
- 6.4 The proposed redevelopment comprises a new compound office development consisting of a two-storey portacabin, removal of the existing storage container offices, installation of sustainable drainage features, and provision of parking spaces.
- 6.5 The principal pathways of concern for human health are dermal contact, ingestion, and inhalation. Generally, in the assessment of risk to site users, only samples taken in the top 2-metres are considered, as contact with deeper samples is unlikely.
- 6.6 The GAC values derived using a 1% Soil Organic Matter (SOM) content have been selected based on the soil organic matter percentage ranging from 1.7% to 5.7% for the analysis data set. The pH of the soil during this investigation ranged from 8.29 to 9.03. The average pH across the Site was recorded as 8.57.
- 6.7 The Envirolab laboratory certificates are presented in **Appendix D**.

Soil Results

Asbestos

- 6.8 Out of the seven soil samples scheduled for asbestos identification (ID) testing, one soil sample returned a positive ID for amosite & chrysotile asbestos in the form of loose fibres within borehole WS01 (0.3m-1.0mbgl). Subsequent asbestos quantification testing resulted in a composition of 0.004%.
- 6.9 It should be noted that the deepest sample obtained from WS04 (terminated due to suspected asbestos cement) did not identify any asbestos fibres within the soils analysed by the laboratory. However, the potential for bound asbestos across the Site cannot be ruled out.

Heavy Metals

- 6.10 All seven soil samples were tested for heavy metals and none of the samples resulted in concentrations exceeding available commercial GAC's.

Total Petroleum Hydrocarbons

- 6.11 All seven soil samples were tested for Total Petroleum Hydrocarbons (TPH's) and none of the samples resulted in concentrations exceeding available commercial GAC's.

Polycyclic Aromatic Hydrocarbons

- 6.12 All seven soil samples were tested against all 16 individual PAH's and none of the samples resulted in concentrations exceeding available commercial GAC's

Polycyclic Biphenyls (PCB's)

- 6.13 Five out of the seven samples were tested for Polycyclic Biphenyls (EC7) and three samples resulted in concentrations below the detection limits.

Ground Gas

- 6.14 A summary of 6no. rounds of gas monitoring results are presented in **Table 6.1**.

TABLE 6.1: SUMMARY OF GAS MONITORING DATA SHOWING CHARACTERISTIC SITUATION NUMBER.							
Borehole Location	No. of monitoring visits	Max CH ₄ (%)	Max CO ₂ (%)	Flow Rate (l/hr)	GSV (l/hr)		Characteristic Situation Number
					CH ₄	CO ₂	
WS01	6	5.0	0.5	0.1	0.0050	0.0005	1
WS02	6	1.0	3.7	0.1	0.0010	0.0037	1
WS04	6	4.7	0.3	0.1	0.0047	0.0003	1

- 6.15 Maximum concentrations of methane across the Site range from 1.0% to 5.0% and maximum concentrations of carbon dioxide varied from 0.3% to 3.7%. A maximum positive flow rate of 0.1 l/hour was recorded across all 6no. monitoring rounds.
- 6.16 Using CIRIA C655 and based on the gas monitoring results for WS01, WS02, and WS04 the maximum gas screening value (GSV) of methane is calculated as 0.005 l/hr and the maximum GSV of carbon dioxide is calculated as 0.0037 l/hr.
- 6.17 Based upon the measured concentrations of methane and carbon dioxide and the derived GSVs, the Site is classified as Gas Characteristic Situation 1, using the Modified Wilson and Card classification (CIRIA 665).
- 6.18 However, it is noted that despite the low flow rate, methane has been recorded at a steady and maximum concentrations of 4.0%-5.0% during the 6no. monitoring visits.

Preliminary Ground Gas Protection Measures

- 6.19 Procedures set out in CIRIA C665 '*Assessing Risks Posed by Hazardous Ground Gases to Buildings*' have been used to determine the requirements for gas protection measures to effectively mitigate any identified risks.
- 6.20 In accordance with CIRA C655, a Gas Characteristic Situation 1 does not require any additional gas protection measures. However, due to the consistent concentrations of methane recorded beneath the Site, it is recommended that a void is designed beneath the proposed development to mitigate the risk of any ground gas generation.

7 REVISED CONCEPTUAL SITE MODEL

Introduction

- 7.1 In line with EA guidance, LCRM 2020, plausible source, pathway and receptor linkages must be identified. The information collected during the ground investigation works should be used to create an outline conceptual site model (CSM) and or refined conceptual site model (RCSM). The CSM/RCSM is a representation of the characteristics of the Site and shows the possible relationships between contaminants, pathways, and receptors.
- 7.2 The source-pathway-receptor scenario is a valuable method to generate a conceptual site model, which can be used to identify contaminative pathways. The first stage of the process is to determine the presence or absence of any contaminant(s) of concern at the Site, followed by the most likely pathways that these contaminants would take in the environment and finally the potential receptors of concern.
- 7.3 If one of the source-pathway-receptor linkages is not considered to be present, then there is deemed to be very low risk. However, if a contaminant source is present and there is a pathway for that contaminant to reach a receptor then there is a potential risk of significant harm to the receptor. Therefore, if the source-pathway-receptor linkages are complete, there is a requirement to undertake a risk assessment related to the receptor of concern, be it human health, surface water, groundwater, buildings or other property or ecological issues.
- 7.4 A preliminary conceptual site model was presented in the Wardell Armstrong Preliminary Risk Assessment Desk Study Report (Ref: CA13057-003, prepared November 2024). An updated CSM is therefore presented below which is based on the findings of the WA ground investigation works and associated geochemical testing.

Source

- 7.5 The list of potential sources of contamination identified in the Phase I Desk Study are summarised below:

On-Site:

- Historical landfill and backfill material (Old Coal Sidings).
- Historical spoil heap (1992 historical mapping 1:2,500).
- Dockyard land use.
- Organic peat horizons (Alluvium).

Off-Site:

- Historical landfill and backfill material (Old Coal Sidings).
- Historical spoil heap (1992 historical mapping 1:2,500).
- Dockyard land use.
- Historical railway tracks and the activities associated with coal transportation through the dockyard.

Made Ground

- 7.6 The GI identified Made Ground across the whole Site at variable depths, with a maximum observed depth of 4.0m. Ground conditions encountered during the ground investigation included gravels of clinker, plastic and metal fragments, brick, slag, concrete, and wood.
- 7.7 Samples collected during the WA LLP GI were analysed in the laboratory for a suite of brownfield contaminants, including but not limited to toxic metals, inorganics and hydrocarbons. The resulting chemical analysis did not return any exceedances in concentrations of heavy metals, total petroleum hydrocarbons or polycyclic aromatic hydrocarbon when compared to commercial land use guideline values.
- 7.8 All seven soil samples were screened for asbestos. One sample from borehole WS01 returned a positive identification for amosite/chrysotile asbestos at a composition of 0.0004%. Furthermore, potential asbestos containing material was noted on-Site within borehole WS04 at 1.40mbgl.

Ground Gas

- 7.9 The Made Ground materials present across the Site have the potential to generate hazardous ground gases such as methane and carbon dioxide, as well as volatile vapours.
- 7.10 An assessment of the ground gas regime across the proposed development indicates a designation of Characteristic Situation 1.
- 7.11 WA LLP note that Alluvium deposits were encountered beneath the Site. The Alluvium deposits in the area are known to contain organic/peat horizons which are a potential source of ground gas. Whilst no organic/peat material was encountered during the GI, organic/peat material cannot be ruled out as a source for generating ground gas.

Groundwater

- 7.12 Groundwater was noted within all boreholes during the initial ground investigation works and during each of the 6no. monitoring rounds, ranging from depths of 1.43mbgl to 1.63mbgl.

Potential Contamination Pathways

Human Health Receptors

- 7.13 Current site users are likely to be at risk from three potential pathways whilst working on the Site i.e., dermal contact, ingestion, and inhalation.
- 7.14 Any planned cut-fill works, and formation of any foundations or service trenches as part of the development works may allow for direct dermal contact and/or accidental ingestion of contaminated soil arisings by construction workers and/or future maintenance staff working in the service trenches.
- 7.15 Any groundworks progressed as part on the proposed development of the Site could enable particulate and/or vapour inhalation due to dust generation and vapour release respectively during construction works.
- 7.16 The formation of service trenches as part of the development works may allow for the migration and accumulation of ground gases originating from the Made Ground and underlying superficial deposits leading to asphyxiation and/or an explosive risk.
- 7.17 During construction, man-made pathways may be created. For example, if a piled foundation solution is proposed, the ground will be disturbed and a vertical pathway to the surface may exist. In addition, surcharging works could lead to increased ground gas levels/migration of gas during loading and as the soil mass consolidates.

Controlled Waters

- 7.18 Leaching and vertical migration of contaminants present within the Made Ground poses a risk to the underlying Secondary B Bedrock Aquifer.
- 7.19 Surface drains/dykes and any existing and/or future service trenches could become potential conduits for the rapid transportation of contaminated surface water run-off into ground water and surface water bodies.
- 7.20 Another pathway by which contaminants are likely to reach the surface water is through lateral migration of groundwater providing base flow to surface water receptors in hydraulic connectivity.

Built Environment

- 7.21 Aggressive ground conditions, namely low pH, and high sulphate concentrations or elevated TPH or PAH concentrations, within the shallow soils that are in direct contact with building materials (concrete foundation or PVC pipes) can result in corrosion.

Potential Receptors

- 7.22 Several sensitive receptors have been identified on or in close proximity to the Site. These receptors are:

- Receptor 1: Human health – Construction workers, maintenance workers, and future site users.
- Receptor 2: Controlled waters – Surface water features (Afon Ebwy (Ebbw River)).
- Receptor 3: Controlled waters – Groundwater aquifer (Secondary B Bedrock Aquifer)
- Receptor 4: Built Environment – Proposed storage container offices/welfare facility, drainage strategy, and associated infrastructure.

8 REVISED QUANTITATIVE RISK ASSESSMENT

Introduction

- 8.1 In line with EA LCRM guidance, plausible source, pathway, and receptor linkages have been identified through the refined CSM. The information gathered in the CSM can now be used to carry out a revised Quantitative Risk Assessment (QRA), **Table 8.1**.
- 8.2 The methodology used to carry out the QRA is outlined in **Appendix G**.

TABLE 8.1 – QUALITATIVE ENVIRONMENTAL RISK ASSESSMENT

Source	Contaminants	Pathway	Receptor	Risk (before mitigation)	Justification	Risk
On-Site: Source 1 – Historical landfill and backfill material Source 2 - Historical Spoil Heap Source 3 – Dockyard Source 4 – Organic peat horizons Off-Site: Source 1 – Historical landfill and backfill material Source 2 - Historical spoil heap Source 3 – Dockyard Source 5 – Railway tracks & coal transportation	Source 1 - Heavy metals, organic compounds, inorganic compounds (ammonia, asbestos), polycyclic aromatic hydrocarbons & ground gas generation. Source 2 - Heavy metals, polycyclic aromatic hydrocarbons, spent oxide (sulphur), foul lime, inorganic compounds (ammonia) & organic compounds (phenols, coal tar). Source 3 - Heavy metals, acids, organic compounds (phenols, chlorinated solvents, polychlorinated biphenyl's), inorganic compounds (dissolved nitrate, dissolved sulphate, asbestos) & polycyclic aromatic hydrocarbons.	• Ingestion of dust, soils and/or ground water. • Dermal contact with dust, soil and/or groundwater. • Inhalation of dust, gases and/or vapour.	Human Health – Construction workers (high sensitivity).	Consequence: Mild Probability: Low Likelihood Risk: Low	The chemical analysis of soil samples did not return any concentrations of heavy metals, total petroleum hydrocarbons or polycyclic aromatic hydrocarbon exceeding available commercial land use guideline values. One sample resulted in a positive identification of amosite & chrysotile asbestos within borehole WS01 (0.3m-1.0mbgl) at a composition of 0.004%. There is potential for construction workers to encounter contamination and ground gas during the construction works and excavations. Associated risks to construction workers can be mitigated through the use of standard Personal Protection Equipment (PPE) including gloves and Respiratory Protective Equipment (RPE) i.e., masks to break the potential pathways. Risks to construction workers from asbestos can be mitigated through the use of wetting to reduce production of airborne dust and ensuring staff keep upwind of any works with all dusts regarded as potentially harmful.	Consequence: Mild Probability: Unlikely Risk: Very Low

TABLE 8.1 – QUALITATIVE ENVIRONMENTAL RISK ASSESSMENT

Source	Contaminants	Pathway	Receptor	Risk (before mitigation)	Justification	Risk
	Source 5 - Heavy metals, inorganic compounds (phenols, asbestos), organic compounds (fuel oils), polycyclic aromatic hydrocarbons, sulphates, ash ballast.					

TABLE 8.1 – QUALITATIVE ENVIRONMENTAL RISK ASSESSMENT

Source	Contaminants	Pathway	Receptor	Risk (before mitigation)	Justification	Risk
On-Site: Source 1 – Historical landfill and backfill material Source 2 - Historical Spoil Heap Source 3 – Dockyard Off-Site: Source 1 – Historical landfill and backfill material Source 2 – Historical spoil heap Source 3 – Dockyard Source 5 – Railway tracks & coal transportation	Source 1 - Heavy metals, organic compounds, inorganic compounds (ammonia, asbestos), polycyclic aromatic hydrocarbons & ground gas generation. Source 2 - Heavy metals, polycyclic aromatic hydrocarbons, spent oxide (sulphur), foul lime, inorganic compounds (ammonia) & organic compounds (phenols, coal tar). Source 3 - Heavy metals, acids, organic compounds (phenols, chlorinated solvents, polychlorinated biphenyl's), inorganic compounds (dissolved nitrate, dissolved sulphate, asbestos) & polycyclic aromatic hydrocarbons.	- Ingestion of dust, soils and/or ground water. - Dermal contact with dust, soil and/or groundwater. - Inhalation of dust, gases and/or vapour.	Human Health – Maintenance workers, and future site users (low sensitivity).	Consequence: Mild Probability: Low Likelihood Risk: Low	The chemical analysis of soil samples did not return any concentrations of heavy metals, total petroleum hydrocarbons or polycyclic aromatic hydrocarbon exceeding available commercial land use guideline values. One sample resulted in a positive identification of amosite & chrysotile asbestos within borehole WS01 (0.3m-1.0mbgl) at a composition of 0.004%. It is assumed that the proposed development will include either hardstanding or a clean capping layer across soft landscaped areas, therefore eliminating the S-P-R link for future site uses. Additional protective measures for maintenance workers include following safe working procedures and use of appropriate PPE (i.e., gloves) and Respiratory Protective Equipment (RPE) during maintenance works within closed spaces. Additionally, it may be prudent to consider the use of clean materials as backfill in service trenches in order to protect future maintenance workers.	Consequence: Mild Probability: Unlikely Risk: Very Low

TABLE 8.1 – QUALITATIVE ENVIRONMENTAL RISK ASSESSMENT

Source	Contaminants	Pathway	Receptor	Risk (before mitigation)	Justification	Risk
	Source 5 - Heavy metals, inorganic compounds (phenols, asbestos), organic compounds (fuel oils), polycyclic aromatic hydrocarbons, sulphates, ash ballast.					

TABLE 8.1 – QUALITATIVE ENVIRONMENTAL RISK ASSESSMENT

Source	Contaminants	Pathway	Receptor	Risk (before mitigation)	Justification	Risk
On-Site: Source 1 – Historical landfill and backfill material Source 4 – Organic peat horizons Off-Site: Source 1 – Historical landfill and backfill material Source 5 - Railway tracks & coal transportation	Artificial deposits - Ground Gas generation.	Ground gas migration onto site through natural strata (Inhalation/Asphyxiation Risk).	Human Health – Construction workers (high sensitivity). Human Health – Maintenance workers, and future site users (low sensitivity).	Consequence: Medium Probability: Low Likelihood Risk: Moderate/Low	Based on the measured low flow rate and the calculated Gas Situation 1 classification of the site, the risk can be reduced from Moderate to Moderate/Low. However, it is noted that despite the low flow rate, methane has been recorded at a steady and maximum concentration of 4.0%-5.0% during the 6no. monitoring visits. Although peat was not recorded during the ground investigation, there is a potential of organic peat horizons elsewhere and at deeper depths than the intrusive investigation. It is assumed that the proposed development will be raised off the ground to create a void to separate the development and the ground level. Therefore, any gas generated and exposed to the surface would dissipate into open air. If piled foundations are proposed, a piling risk assessment should be undertaken to assess the risk of migrating ground gas risk during piling. During construction, workers will be provided gas monitors and respiratory protective equipment (RPE) within excavations and confined spaces.	Consequence: Medium Probability: Unlikely Risk: Low

TABLE 8.1 – QUALITATIVE ENVIRONMENTAL RISK ASSESSMENT

Source	Contaminants	Pathway	Receptor	Risk (before mitigation)	Justification	Risk
On-Site: Source 1 – Historical landfill and backfill material Source 2 – Historical Spoil Heap Source 3 – Dockyard	Source 1 - Heavy metals, organic compounds, inorganic compounds (ammonia, asbestos), polycyclic aromatic hydrocarbons & ground gas generation. Source 2 - Heavy metals, polycyclic aromatic hydrocarbons, spent oxide (sulphur), foul lime, inorganic compounds (ammonia) & organic compounds (phenols, coal tar). Source 3 - Heavy metals, acids, organic compounds (phenols, chlorinated solvents, polychlorinated biphenyl's), inorganic compounds (dissolved nitrate, dissolved sulphate, asbestos) & polycyclic aromatic hydrocarbons.	Lateral migration of leachate and contaminated surface water run-off.	Controlled Waters – Afon Ebwy (Ebbw River)	Consequence: Medium Probability: Low Likelihood Risk: Moderate/Low	Limited levels of contamination have been identified in the Made Ground and superficial deposits. However, the consequence that any contamination could pose a risk to controlled water is classified as Medium, therefore, the overall risk cannot be reduced from Moderate/Low (before mitigation). The proposed development will be covered by hardstanding and/or clean capping materials that will limit the infiltration rate of surface waters and therefore reduce the potential for contaminants leaching into nearby watercourses. The construction phase of the proposed development will be carried out following the best practices and guidance outlined within the Construction Environmental Management Plan (CEMP) to avoid potential pollution to controlled waters. The proposed development includes the construction of a sustainable drainage strategy which is expected to be designed to reduce surface run-off.	Consequence: Medium Probability: Unlikely Risk: Low

TABLE 8.1 – QUALITATIVE ENVIRONMENTAL RISK ASSESSMENT

Source	Contaminants	Pathway	Receptor	Risk (before mitigation)	Justification	Risk
On-Site: Source 1 – Historical landfill and backfill material Source 2 – Historical Spoil Heap Source 3 – Dockyard	Source 1 - Heavy metals, organic compounds, inorganic compounds (ammonia, asbestos), polycyclic aromatic hydrocarbons & ground gas generation. Source 2 - Heavy metals, polycyclic aromatic hydrocarbons, spent oxide (sulphur), foul lime, inorganic compounds (ammonia) & organic compounds (phenols, coal tar). Source 3 - Heavy metals, acids, organic compounds (phenols, chlorinated solvents, polychlorinated biphenyl's), inorganic compounds (dissolved nitrate, dissolved sulphate, asbestos) & polycyclic aromatic hydrocarbons.	Vertical migration of leachate into the underlying aquifer.	Controlled Waters – Secondary (B) bedrock aquifer.	Consequence: Medium Probability: Low Likelihood Risk: Moderate/Low	Limited levels of contamination have been identified in the Made Ground and superficial deposits. However, the consequence that any contamination could pose a risk to controlled water is classified as Medium, therefore, the overall risk cannot be reduced from Moderate/Low (before mitigation). The proposed development will be covered by hardstanding or clean capping materials that will limit the infiltration rate of surface waters and therefore reduce the potential for contaminants leaching and/or migrating into the groundwater body. The construction phase of the proposed development will be carried out following the best practices and guidance outlined within the Construction Environmental Management Plan (CEMP) to avoid potential pollution to controlled waters. The proposed development includes the construction of a sustainable drainage strategy which is expected to be designed to reduce surface run-off.	Consequence: Medium Probability: Unlikely Risk: Low

On-Site: Source 1 – Historical landfill and backfill material Source 2 – Historical Spoil Heap Source 3 – Dockyard Off-Site: Source 1 – Historical landfill and backfill material Source 2 – Historical spoil heap Source 3 – Dockyard Source 5 – Railway tracks & coal transportation	Source 1 - Heavy metals, organic compounds, inorganic compounds (ammonia, asbestos), polycyclic aromatic hydrocarbons & ground gas generation. Source 2 - Heavy metals, polycyclic aromatic hydrocarbons, spent oxide (sulphur), foul lime, inorganic compounds (ammonia) & organic compounds (phenols, coal tar). Source 3 - Heavy metals, acids, organic compounds (phenols, chlorinated solvents, polychlorinated biphenyl's), inorganic compounds (dissolved nitrate, dissolved sulphate, asbestos) & polycyclic aromatic hydrocarbons. Source 5 - Heavy metals, inorganic compounds (phenols, asbestos), organic compounds (fuel oils), polycyclic aromatic	Aggressive ground conditions.	Built Environment (proposed storage container offices/welfare facility foundations, drainage strategy structures, and associated infrastructure).	Consequence: Mild Probability: Low Likelihood Risk: Low	Based on the BRE analysis, a design sulphate class of DS-2/AC-2 should be assumed for the Made Ground materials and DS-1/AC-1 for the superficial deposits. Any sub-surface concrete structures should be designed in line with the concrete classification detailed in Table 9.3 and Table 9.6 to reduce the risk of aggressive ground conditions.	Consequence: Mild Probability: Unlikely Risk: Very Low
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TABLE 8.1 – QUALITATIVE ENVIRONMENTAL RISK ASSESSMENT

Source	Contaminants	Pathway	Receptor	Risk (before mitigation)	Justification	Risk
	hydrocarbons, sulphates, ash ballast.					

TABLE 8.1 – QUALITATIVE ENVIRONMENTAL RISK ASSESSMENT

Source	Contaminants	Pathway	Receptor	Risk (before mitigation)	Justification	Risk
On-Site: Source 1 – Historical landfill and backfill material Source 4 – Organic peat horizons Off-Site: Source 1 – Historical landfill and backfill material Source 5 – Historical landfill and backfill material	Artificial deposits - Ground Gas generation.	Ground gas – Explosive Risk	Built Environment (proposed storage container offices/welfare facility foundations, drainage strategy structures, and associated infrastructure).	Consequence: Medium Probability: Low Likelihood Risk: Moderate/Low	Based on the measured low flow rate and the calculated Gas Situation 1 classification of the site, the risk can be reduced from Moderate to Moderate/Low. However, it is noted that despite the low flow rate, methane has been recorded consistently throughout the monitoring period at a maximum concentration of c.4.0%-5.0% during the 6no. monitoring visits. Although peat was not recorded during the ground investigation, there is a potential of organic peat horizons elsewhere and at deeper depths than the intrusive investigation. It is assumed that mitigation measures can be implemented as part of the design to reduce the risk of ground gas affecting the development. The proposed development can potentially be raised off the ground to create a void to separate the development and the ground level. Therefore, any gas generated and exposed to the surface would dissipate into open air. In accordance with CIRA C655, a Gas Characteristic Situation 1 does not require any additional gas protection measures within the proposed development.	Consequence: Medium Probability: Unlikely Risk: Low

9 GEOTECHNICAL RESULTS

Introduction

- 9.1 The geotechnical results from the ground investigation works have been summarised below into a geotechnical ground model. Geotechnical results and laboratory testing certificates are attached within **Appendix E**.

Made Ground – Engineering Properties

- 9.2 The majority of the Site is covered by variable Made Ground, observed thicknesses varying between 3.70m and 4.0m.
- 9.3 The Made Ground was recorded as varying cohesive clay and, granular sand and gravel horizons. The cohesive horizons were predominantly recorded as grey silty fine to medium gravelly clay.
- 9.4 The granular horizons were recorded as black slightly silty/clayey fine to coarse sandy fine to coarse gravel or brown slightly silty/clayey fine to coarse gravelly fine to coarse sand. The granular Made Ground deposits consisted of sandstone, shale, concrete, clinker, slag, wood, plastic fragments, metal fragments, and brick fragments.
- 9.5 A summary of the derived engineering parameters for the Made Ground are shown in **Table 9.4**.

Particle Size Distribution Test

- 9.6 Particle Size Distribution (PSD) tests were performed on two samples from the Made Ground deposits, the results of which are presented within **Table 9.1** below. Due to sample size no cohesive Made Ground material was subject to PSD testing.

TABLE 9.1 – MADE GROUND PSD TEST RESULTS			
Exploratory Hole	Strata Range (mbgl)	General Soil Description	% Particle Size
WS01	0.3-1.0	Black slightly silty/clayey fine to coarse sandy fine to coarse GRAVEL	Cobbles – 0% Gravels – 49% Sand – 43% Silt & Clay – 8%
WS02	1.20-1.65	Brown slightly silty/clayey fine to coarse gravelly fine to coarse SAND	Cobbles – 0% Gravels – 30% Sand – 64% Silt & Clay – 6%

Material Classification

- 9.7 PSD results for the Made Ground have been classified as Class 1B (uniformly graded granular material) in accordance with Table 6/2 of the Series 600 Classification.

- 9.8 It is WA LLP's understanding that any Made Ground excavated on-Site will be removed from the Site and not used as part of any earthworks. WA LLP recommend further testing to verify if Made Ground material can be reused as general fill beneath landscaped areas.

Moisture Content

- 9.9 The moisture content was tested on three samples from the Made Ground deposits, resulting in moisture contents of 7.5%, 31%, and 35%.

Plasticity Limit

- 9.10 Atterberg Limit testing was undertaken on two cohesive samples from the Made Ground deposits, the results of which are presented below in **Table 9.2**.

TABLE 9.2 – ATTERBERG LIMIT TEST RESULTS								
Sample ID	Sample Depth (mbgl)	Casagrande Classification	Moisture content (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 0.425mm (%)	Modified Plasticity Index (%)	Volume Change Potential
WS02	2.25-2.65	CH	35	24	28	100	28	Medium
WS04	2.00-2.45	CH	31	25	26	90	23	Medium

- 9.11 The Modified Plasticity Index indicates that the volume change potential (VCP) of the samples from the Made Ground deposits is Medium. Therefore, where cohesive Made Ground material is found on the Site, a Medium VCP should be considered until further testing is undertaken.

Undrained Shear Strength/Internal Angle of Friction

- 9.12 The SPT values within the Made Ground materials ranged from 3 to 13 and their corrected SPT N_{60} values range from 3 to 22.
- 9.13 The undrained shear strength for the cohesive Made Ground has been calculated as 22.5-27kPa based upon Stroud, utilising the N values and results from the Atterberg test results.
- 9.14 The internal angle of friction for the granular Made Ground has been calculated as 30° in accordance with BS 8002, utilising N values, PSDs, and material descriptions.

Building Materials – Concrete Assessment

- 9.15 The results of the BRE analysis undertaken on 6no. samples from the Made Ground materials are presented in **Table 9.3**.

TABLE 9.3 – SUMMARY OF BRE RESULTS AND CONCRETE CLASSIFICATION FOR THE MADE GROUND DEPOSITS	
Test	Made Ground Samples Results
pH	8.7-9.03
Water Soluble 2:1 Sulphate (mg/l)	0.02-0.14
Total Sulphate (%)	0.067-0.11
Total Sulphur (%)	0.005-0.158
Total Potential Sulphate Content (%)	0.0015-0.474
Design Sulphate Class	DS-2
ACEC Class*	AC-2
*Using the assumption of mobile groundwater	

Summary of Engineering Properties

9.16 **Table 9.4** summarises the general engineering properties encountered within the soil samples taken from the Made Ground deposits.

TABLE 9.4 – SUMMARY OF ENGINEERING PARAMETERS OF THE MADE GROUND	
Soil Parameter	Range
Series 600 Classification	Class 1B/2
Moisture Content	7.5%-35%
Plasticity Index (%) (Cohesive Only)	26-28
Volume Change Potential (Cohesive Only)	Medium
SPT N ₆₀ value	3-22
Undrained Shear strength (kPa) (Cohesive Only)	22.5-27
Internal Angle of Friction (°)(Granular Only)	30
Design Sulphate Class	DS-2
ACEC Class*	AC-2

Superficial Deposits – Engineering Properties

9.17 Alluvium superficial deposits were encountered in two boreholes (WS01 & WS02), with a maximum observed thickness of 2.0m in borehole WS02. However, the base of the Alluvium deposits was not encountered therefore WA cannot record the exact thickness of superficial deposits or the depth to bedrock.

9.18 The superficial deposits predominantly comprise of brown to grey silty, fine to coarse gravelly clay. Therefore, in terms of their engineering properties, WA have assumed that the Alluvium will behave as a cohesive material.

9.19 A summary of the derived engineering parameters for the superficial deposits are shown in **Table 9.7**.

Moisture Content

- 9.20 The moisture content was tested on two samples from the superficial deposits, resulting in moisture contents of 25% and 41%.

Plasticity Limit

- 9.21 Atterberg Limit testing was undertaken on two samples from the superficial deposits, the results of which are presented below in **Table 9.5**.

TABLE 9.5 – ATTERBERG LIMIT TEST RESULTS								
Sample ID	Sample Depth (mbgl)	Casagrande Classification	Moisture content (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 0.425mm (%)	Modified Plasticity Index (%)	Volume Change Potential
WS01	4.0 - 4.45	CH	25	20	31	83	26	Medium
WS02	5.7 - 6.0	CI	41	21	44	100	44	High

- 9.22 The Modified Plasticity Index indicates that the volume change potential (VCP) of the samples from the Made Ground deposits range from Medium to High.
- 9.23 The results indicate that where granular superficial deposits are found on the Site, a High VCP should be considered until further testing is undertaken.

Undrained Shear Strength/Internal Angle of Friction

- 9.24 The SPT values within the Alluvium materials ranged from 1 to 6 and their corrected SPT N_{60} values range from 1 to 10.
- 9.25 The undrained shear strength for the Alluvium has been calculated as 4-17kPa based upon Stroud, utilising the N values and results from the Atterberg test results.

Building Materials – Concrete Assessment

- 9.26 The results of the BRE analysis undertaken on the 1no. sample from the superficial deposits are presented in **Table 9.6**.

TABLE 9.6 – SUMMARY OF BRE RESULTS AND CONCRETE CLASSIFICATION FOR THE SUPERFICIAL DEPOSITS	
Test	Made Ground Samples Results
pH	8.47
Water Soluble 2:1 Sulphate (mg/l)	0.04
Total Sulphate (%)	0.04
Total Sulphur (%)	0.056

TABLE 9.6 – SUMMARY OF BRE RESULTS AND CONCRETE CLASSIFICATION FOR THE SUPERFICIAL DEPOSITS	
Test	Made Ground Samples Results
Total Potential Sulphate Content (%)	0.1677
Design Sulphate Class	DS-1
ACEC Class*	AC-1
*Using the assumption of mobile groundwater	

Summary of Engineering Properties

9.27 **Table 9.7** summarises the general engineering properties encountered within the soil samples taken from the superficial deposits.

TABLE 9.7 – SUMMARY OF ENGINEERING PARAMETERS OF THE SUPERFICIAL DEPOSITS	
Soil Parameter	Range
Moisture Content	25%-41%
Plasticity Index (%)	31-44
Volume Change Potential	Medium - High
SPT N ₆₀ value	1-10
Undrained Shear strength (kPa)	4-17
Design Sulphate Class	DS-1
ACEC Class	AC-1

10 GEOTECHNICAL CONSTRAINTS

10.1 Based on review of the available data discussed within this report and taking due consideration of the proposed development, the following geotechnical constraints have been identified:

- Made Ground:
 - Variable thickness.
 - Unknown level of ongoing creep settlement potential.
 - Variable strength/ engineering properties.
 - Potential Expansive properties.
- Alluvium:
 - Thick and soft/low strength superficial deposits (depth to bedrock not proven during ground investigation).
 - Potential for highly compressible Alluvium deposits (including peat).
 - Potential for ground gas generation within organic/peat horizons.
 - High volume change potential.
- Shallow groundwater.
- Vibration from piling should pile foundations be required.

Site Preparation

- 10.2 All areas of hard standing should be broken out from beneath the development area(s).
- 10.3 WA LLP note that the Site is currently operational and therefore should any utilities be located or present during site preparation works, allowances should be made for rerouting any buried services and the isolation and cutting back to the boundary of any non-essential or redundant services.
- 10.4 Any requirement for backfilling should be engineered and compacted in accordance with Series 600 of the Specification for Highway Works (SHW).
- 10.5 For any material destined for off-Site landfill disposal, the guidance should be used to identify the correct waste code for their waste and determine whether the waste is hazardous or not based on its chemical composition.
- 10.6 There is a low risk from unexploded ordnance (UXO) with no additional measures considered essential to reduce the Site risk to As Low As is Reasonably Practicable (ALARP).

Earthworks/Enabling Works

- 10.7 WA LLP are not aware of any major earthworks required as part of the proposed development. However, it is noted that excavations and backfilling may be required to satisfy any foundation design, the requirement for hardstanding areas, and drainage/utilities (SUDs). The appointed designer should ensure finished floor levels are not affected by any potential settlement (total and differential) caused by earthworks.
- 10.8 WA LLP note that the proposed material to be imported and to be used as fill has not been assessed at this stage and an earthworks specification will be required and assessed in accordance with Series 600 Earthworks.
- 10.9 WA LLP note anecdotal evidence that previous trial pits undertaken as part of a soakaway ground investigation by Intégral Géotechnique in June 2023 were backfilled with concrete. The presence of mass concrete should therefore be considered as part of the enabling works. Additionally, mass concrete associated with the foundations of the current offices should be considered if excavations are required in this area.

Foundations

- 10.10 Anticipated loadings of the proposed development have not been provided and have therefore not been assessed as part of this report.
- 10.11 It is assumed that there is no requirement to raise levels for the development, and as such, it is assumed that there will be no settlement within the underlying materials due to raising levels.
- 10.12 At the time of writing this report, the proposed foundations solution has not been provided and will be assessed during the detailed design stage.
- 10.13 Based on the preliminary geotechnical results of the ground investigation, the Site is underlain by thick Made Ground deposits with varying N values, with N values in excess of 10 in the upper layers and low N values at the base of the Made Ground.
- 10.14 Generally, Made Ground would not be considered as a suitable founding horizon for permanent buildings/structures, due to likely differential settlement or inundation settlement within the material. This should be considered at the detailed design stage, when more information is available about the development, such as loadings, settlement criteria for structures etc.

- 10.15 To understand the compressibility of the Made Ground, WA LLP have undertaken preliminary bearing capacity and settlement analysis. This analysis indicates that the Made Ground could be a suitable founding horizon based on a structure on a standard strip footing, 500mm deep and 600mm wide with an allowable bearing of 75kPa, inducing settlements from loading of less than 25mm.
- 10.16 WA LLP have also undertaken preliminary bearing capacity and settlement analysis of 500mm deep and 600mm wide pad foundations for the proposed structure based on the loadings upon 18 no. pads. The analysis results show that Made Ground could be a suitable bearing horizon for the stated pad foundations with an allowable bearing capacity of 75kPa that gives less than 25mm of settlement.
- 10.17 Based on the available window sampling boreholes, the Made Ground appears to be relatively uniform within the upper two metres. However, below this depth, it should be noted that Made Ground is likely to have variable strength parameters due to its variable make up, and alternative options to founding on the Made Ground should be considered.
- 10.18 It is unknown whether there is any ongoing settlement within the existing Made Ground material on the Site, and with this in mind it is recommended that to allow for the implementation of a shallow foundation solution, a dig-out and replace earthworks ground improvement should be implemented to provide a uniform-strata directly beneath the foundations (pads and/or strips). Subject to detailed design, it is considered that the dig out and replace solution should be implemented to approximately 2.5m below the base of the proposed shallow foundation. However, consideration should be given to the recorded presence of shallow ground water during detail design.
- 10.19 Given the properties of the Made Ground, replacement stone should be Class 6N in accordance with the Specification for Highways Works, Series 600, and be placed in accordance with an Earthworks Specification. It is assumed that the Made Ground would be removed from the Site.
- 10.20 The risk of expansive soils based on the slag content recorded during the ground investigation will have to be considered during the detail design stage and further expansion testing may be required.

Existing Site Services

- 10.21 Due care shall be given to any existing services on-Site and how settlement may affect these services during the construction process.

Concrete Class

- 10.22 Based on the BRE analysis, it is estimated that the design sulphate class of the Made Ground material is DS-2/AC-2 and the superficial deposits is DS-1/AC-1. WA LLP note that this is based on a limited number of samples and further testing is recommended as part of the construction phase.

Excavations and Groundwater

- 10.23 Shallow excavations should be possible with normal-hard soil excavating machinery. However, hydraulic attachments will be required to break out hard standing surface across the Site and any buried obstructions should they be present.
- 10.24 During the ground investigation, shallow granular horizons were recorded within Made Ground deposits. WA LLP note that boreholes WS01 collapsed due to unstable ground conditions. There is a potential for excavations to become unstable and as a result, shoring of excavations may be required.
- 10.25 Shallow excavations have the potential to encounter perched water/groundwater flows. It should be noted that during times of heavy rainfall a higher water table will be encountered. Groundwater levels were recorded during the ground investigation between 1.30mbgl to 1.50mbgl and 1.43mbgl to 1.63mbgl during the 6no. rounds of post-GI monitoring. Therefore, the potential requirement of dewatering shallow excavations cannot be discounted. The potential for shallow groundwater should also be considered with regards to design of any proposed drainage strategy across the Site. Additionally, should any structures be buried beneath the ground level, consideration should be given to the effects of any hydrostatic pressures due to the presence of shallow groundwater.

Ground Gas

- 10.26 A total of 6no. rounds of gas monitoring have been carried out and a Gas Characteristic Situation 1 has been designated for the Site. However, it is noted that despite the low flow rate, methane has been recorded at a steady and maximum concentration of 4.0%-5.0% during the 6no. monitoring visits.
- 10.27 Should any upfilling or piling be required, consideration should be given to the increase of ground gas release and migration to the surface. Ground gas during construction should be considered further through additional environmental

monitoring before, during and post construction, and reassessment of the gas protection measures required.

- 10.28 Any piling works will need to give consideration to encountering ground gas within organic/peat horizons which may be present within the Alluvium. Consideration should also be given to the risk to human health and the built environment due to the potential for creating ground gas migration pathways to surface during piling. It is recommended that a piling risk assessment is undertaken should piling be required.

Unforeseen Ground Conditions

- 10.29 Furthermore, WA LLP note the potential of unforeseen or unexpected ground conditions associated with the unknown infill material of the historical Afon Ebwy (Ebbw River) meander which extended across the northern boundary of the site, as identified within Chapter 2.

11 CONCLUSIONS AND RECOMMENDATIONS

Land Use

- 11.1 The Site is located on land off Tom Lewis Way at the Alexandra Docks in Newport, NP20 2WF. The proposed development comprises a new compound office development consisting of a two-storey portacabin, removal of the existing storage container offices, installation of a sustainable drainage system, and provision of parking spaces.

Ground Investigation

- 11.2 The WA LLP ground investigation comprised 3no. windowless sample boreholes excavated to depths between 3.0mbgl and 6.0mbgl. All boreholes were installed as monitoring boreholes to monitor the groundwater levels and ground gas regime of the Site.
- 11.3 The ground investigation identified granular and cohesive Made Ground deposits underlying the tarmac hardstanding to a maximum depth of 4.0mbgl. Gravels and cobbles of sandstone, shale, concrete, clinker, slag, wood, plastic fragments, metal fragments, and brick fragments were recorded within the Made Ground deposits.
- 11.4 The superficial deposits were encountered underlying the Made Ground materials from at least 3.70mbgl to a maximum depth of 6.0mbgl and predominantly comprised of silty gravelly clay.
- 11.5 The depth to bedrock was not established during the ground investigation and therefore, the thickness of the superficial deposits is assumed to be >6.0m.
- 11.6 As part of the ground investigation works, a total of 7no. soil samples were collected and subsequently scheduled for geochemical testing for a variety of determinants.
- 11.7 In addition to the geochemical soil testing, a total of 6no. soil samples were collected for geotechnical testing including moisture content, Atterberg limits and particle size distribution.
- 11.8 A total of 6no. rounds of groundwater and ground gas monitoring have been undertaken at the time of writing this report.

Contamination Assessment

- 11.9 The chemical analysis did not return any exceedances in concentrations of heavy metals, total petroleum hydrocarbons or polycyclic aromatic hydrocarbon when compared to commercial land use guideline values.

- 11.10 All seven soil samples were screened for asbestos and one sample from borehole WS01 returned a positive identification for amosite/chrysotile asbestos in the form of loose fibres. Subsequent quantification testing resulted in a composition of 0.004%. Furthermore, potential asbestos containing material was noted on-Site within WS01.
- 11.11 Based upon the results of the soil sample testing, it is considered that there is a low risk to human health without any mitigation, and the recommended mitigation measures summarised in **Table 8.1** would reduce the risk to very low.

Groundwater

- 11.12 Groundwater strikes during the ground investigation works ranged from 1.30mbgl to 1.50mbgl. Across the 6no. rounds of post-GI monitoring, groundwater levels were recorded between 1.43mbgl to 1.63mbgl.

Ground Gas

- 11.13 Based upon the measured concentrations of methane and carbon dioxide and the derived GSVs, the Site is classified as Gas Characteristic Situation 1. Organic/ peat horizons were not encountered during the ground investigation works within the Alluvium. However WA LLP note that organic/ peat horizons may be present at depths greater than the ground investigation (>6.0mbgl) and elsewhere across the Site.
- 11.14 However, it is noted that despite the low flow rate, methane has been recorded at a steady and maximum concentration of 4.0%-5.0% during the 6no. monitoring visits.
- 11.15 Furthermore, the Site is situated in an area within which less than 1% of properties exceed the Radon Action Level, and therefore no radon protection measures are required.

Proposed Site Structures

- 11.16 Based on the BRE analysis, a design sulphate class of DS-2/AC-2 should be assumed for the Made Ground materials and DS-1/AC-1 assumed for the superficial deposits. Prior to development, the concrete classification and the concrete class should be confirmed by a structural engineer.

Geotechnical Constraints and Considerations

- 11.17 The key geotechnical constraints identified include:
- Made Ground:
 - Variable thickness.
 - Unknown level of ongoing creep settlement potential.

- Variable strength/ engineering properties.
 - Potential Expansive properties.
- Alluvium:
 - Thick and soft/low strength superficial deposits (depth to bedrock not proven during ground investigation).
 - Potential for highly compressible Alluvium deposits (including peat).
 - Potential for ground gas generation within organic/peat horizons.
 - High volume change potential.
- Shallow groundwater.
- Vibration from piling should pile foundations be required.

11.18 WA LLP have undertaken bearing capacity and settlement analysis to understand the compressibility of the Made Ground. This analysis indicates that the Made Ground would be a suitable founding horizon based on a structure on a standard strip footing, 500mm deep and 600mm wide with an allowable bearing of 75kPa, inducing settlements from loading only of 25mm. WA LLP have also undertaken bearing capacity and settlement analysis of 500mm deep and 600mm wide pad foundations (18no.) for the proposed structure. The analysis results show that Made Ground could be a suitable bearing horizon for the stated pad foundations with an allowable bearing capacity of 75kPa that gives less than 25mm of settlement.

11.19 It is unknown whether there is any ongoing settlement within the existing Made Ground material on the Site, and with this in mind it is recommended that to allow for the implementation of a shallow foundation solution, a dig and replace earthworks ground improvement should be implemented to provide a uniform strata directly beneath the foundation. Subject to detailed design, it is considered that the dig out and replace solution should be implemented between 1.0m and 2.5m below the base of the proposed shallow foundation.

11.20 Given the properties of the Made Ground, replacement stone should be Class 6N in accordance with the Specification for Highways Works, Series 600, and be placed in accordance with an Earthworks Specification.

11.21 If a piled foundation solution is proposed, the safe working loads, negative skin friction, type and length of piles should be confirmed by the specialist piling contractor and a piling risk assessment should be undertaken.

Recommendations

- 11.22 The geochemical analysis of collected soil samples did not result in any exceedances compared to available commercial criteria values. Therefore, at this stage, a remediation strategy and follow-on verification report is not required based on the findings of the ground investigation.
- 11.23 If any contamination is identified in the construction phase of the proposed development, the Construction Environmental Management Plan (CEMP) should be used to address this risk.
- 11.24 Asbestos fibres (amosite and chrysotile) and suspected asbestos containing material (ACM) was identified in the Made Ground materials during the site investigation works. Therefore, it is recommended that specific asbestos awareness elements are included in the general environmental induction for all Site personnel, and an asbestos specific toolbox talk is conducted during the construction works.
- 11.25 Using the guidance set out in CIRA C655, the Site has been classified as a Gas Characteristic Situation 1 and does not require any additional gas protection measures as part of the proposed development. However, due to the consistent concentrations of methane recorded beneath the Site, it is recommended that a void is designed beneath the proposed development to mitigate the risk of any ground gas generation.
- 11.26 Generally, Made Ground would not be considered as a suitable founding horizon for permanent buildings/structures, due to likely differential settlement or inundation settlement within the material. Therefore, further site investigation is likely to be required to determine the suitability of the shallow Made Ground due to the variability of the materials encountered within the Made Ground as part of the ground investigation. The requirement for further ground investigation and the scope of investigation works should be considered at the detailed design stage, when more information is available about the development, such as loadings, and settlement criteria for structures etc.
- 11.27 Due to the variability and Further site investigation, including CBR testing, is likely to be required to determine the suitability of the shallow Made Ground.
- 11.28 WA LLP recommend further testing to verify whether the Made Ground materials are suitable for reuse within any landscaped areas, where required.
- 11.29 It is recommended that a piling risk assessment (PRA) and a noise and vibration assessment is undertaken should piling be required as part of the proposed development to ensure that local fauna are not significantly affected during piling. The

specific mitigation measures identified as part of the PRA and noise and vibration assessment should be approved and outlined within the Construction Environmental Management Plan (CEMP) prior to the works, where required.

11.30 If a piled foundation solution is considered, a deeper ground investigation is recommended to determine the ground conditions beneath the Made Ground and consideration should be given to the following:

- Pile Type – bored or driven.
- Depth to rockhead.
- Depth to suitable granular deposits.
- Negative Skin Friction – negative skin friction from made ground (upfill material) and underlying compressible deposits requires consideration at detailed design stage.
- The safe working loads, type and length of piles should be confirmed by the specialist piling contractor.
- Allowances should be made for monitoring levels of vibrations and monitoring local structures should driven piles be used.

Appendix A

Standard Terms and Limitations

STANDARD TERMS AND CONDITIONS AND LIMITATIONS TO REPORTS

This Report is provided for the stated purpose and for the sole use of the client in accordance with the Terms and Conditions of Appointment under which the services were performed. The Report is confidential to the client and no other warranty, expressed or implied, is made as to the professional advice included in the Report or any other services provided by Wardell Armstrong LLP. This Report may not be disclosed by the Client nor relied upon by any other party without the prior and express written agreement of Wardell Armstrong LLP.

The conclusions and recommendations contained in this Report are based upon information provided by others including details supplied by the client and/or professional advisors on the assumption that all relevant information from whom it has been requested and/or supplied is accurate. Information so provided and/or supplied has not been verified independently by Wardell Armstrong LLP, unless otherwise stated in the Report.

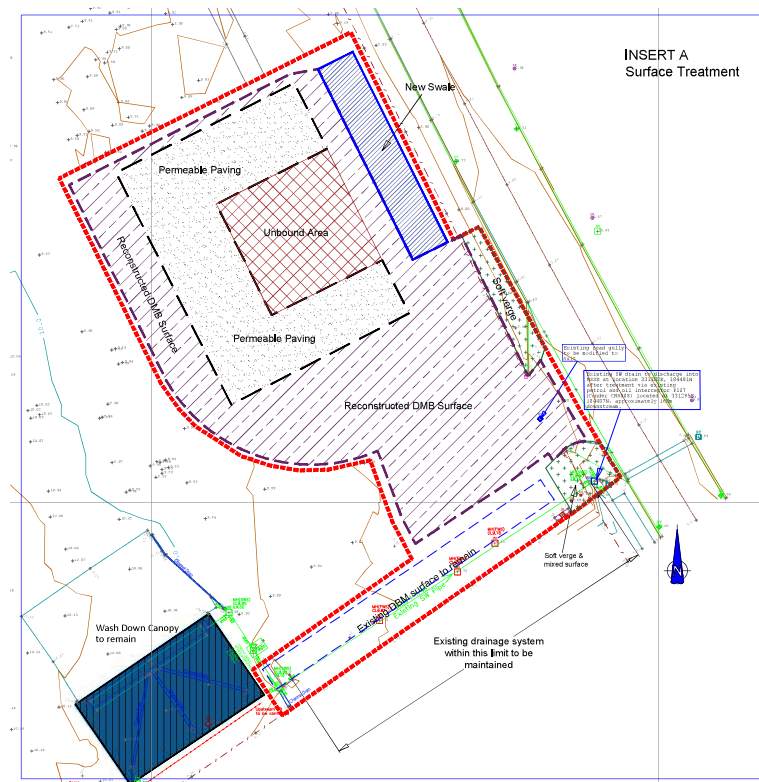
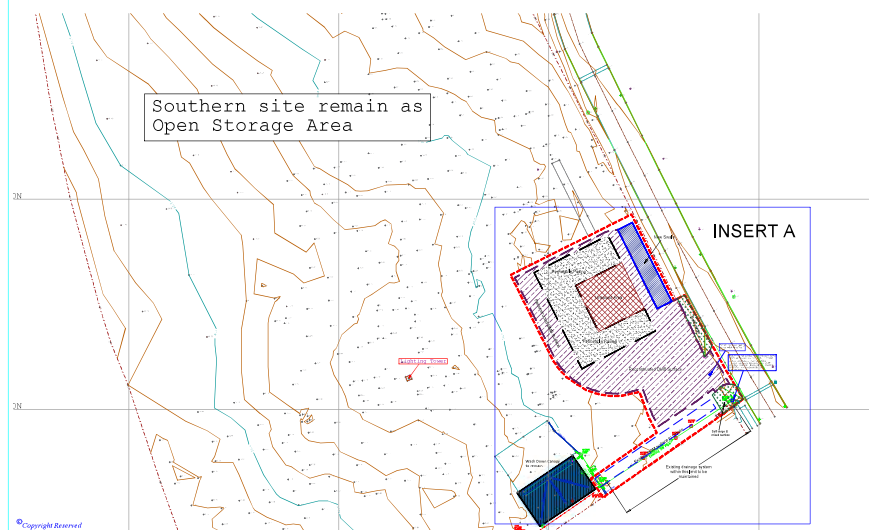
The methodology adopted and the sources of information used by Wardell Armstrong LLP in providing the services are outlined in this Report. The work described in this Report is based on the conditions and information as stated at the date the Report was completed. The scope of this Report and the services are accordingly limited by these circumstances. The findings outlined in the Report together with any opinions expressed and recommendations made are considered to be valid and appropriate at the time of preparation and for the specific purpose or purposes intended. Whilst a walk over site visit may have been carried out as part of the work this has been limited to observations only and no other physical investigations, sampling and testing work has been carried out as part of this work.

Wardell Armstrong LLP disclaim any undertaking or obligation to advise any person of any change in any matter affecting the Report which may come or be brought to Wardell Armstrong LLP's attention after the date of the Report. Unless otherwise stated in this Report, the assessments made assume that the sites and facilities will continue to be used for their current purpose without significant changes.

Where any site observations have been carried out, these have been restricted to a level of detail required to meet the stated objectives of the services. The results from any site observations made may vary and further confirmatory work should be made after the issuance of this Report. Wardell Armstrong LLP does not guarantee or warrant any estimates or projections contained in this Report.

Appendix B

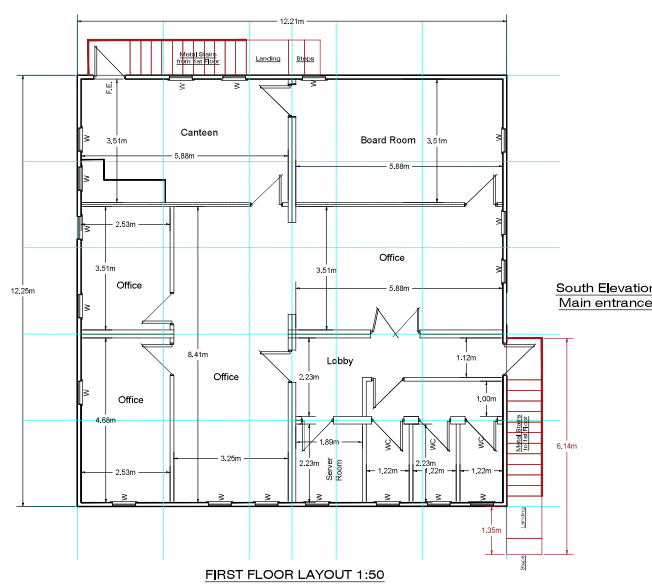
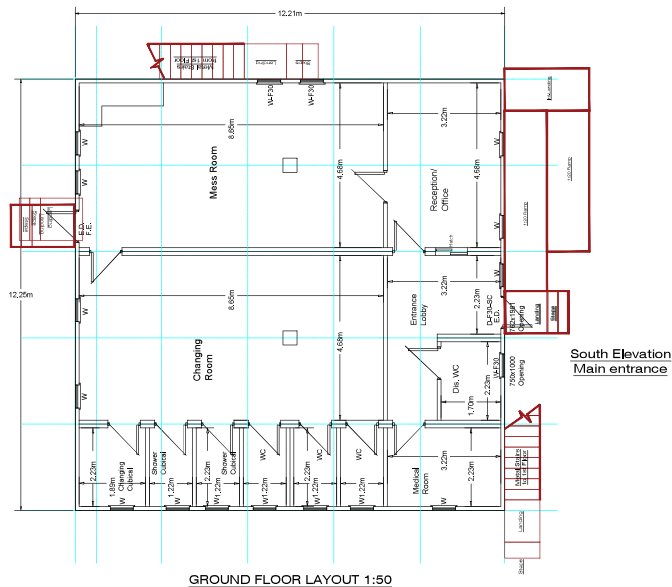
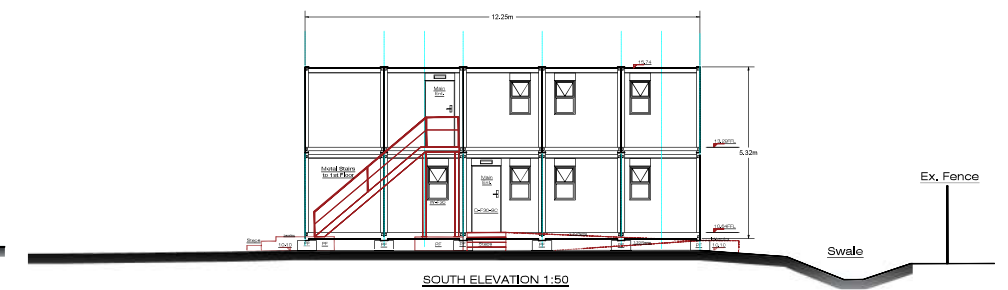
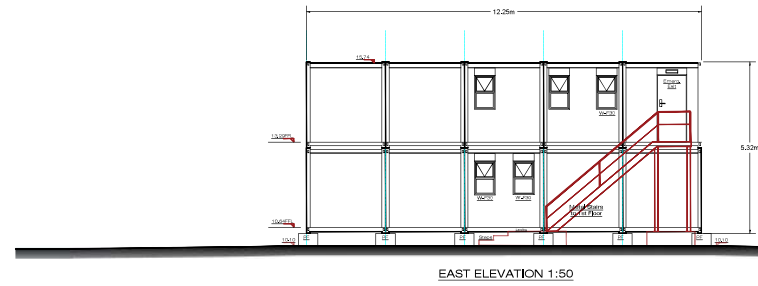
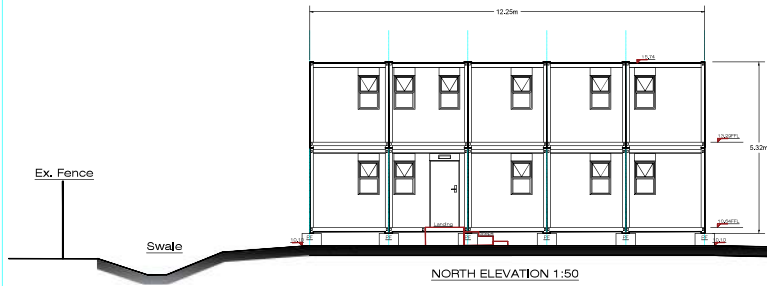
Proposed Site Development Layout



1. This drawing is to be read in conjunction with the following Plans -
CA13057-001 Site Location and Application Boundary
CA13057-002 Existing Site Layout & Elevations
CA13057-004 Office and Amenities Building Layout and Elevations
CA13057-005 Proposed Drainage Layout

- | | |
|---|--|
|  | Application area (0.183ha) |
|  | 3m, double stacked 40 steel container offices and amenity to be removed (total floor area 150sqm) |
|  | Existing DBM surface to be removed, migrated and reconstructed as detailed at post infrastructure insulation (1195sqm) |
|  | Area of new permeable paving (350sqm) |
|  | Area of new unbound paving beneath new office building (100sqm) |
|  | Area of new 50mm to manage surface water runoff from permeable surface and office building roof (81sqm) |
|  | Area of road verge permanent reinstatement to match existing (85sqm) |

A	Planning Application Issue				LOCAL	YES	NO
10.000	10.000				1000	0.000000	0.000000
ABP South Wales and Shortsea							
PROJECT Alexandra Docks, Newport Hill & Smith Compound Development							
CPA01001010 Proposed Site General Arrangements and Elevations							
CRG Ref.		CA13057 - 003			REV		
CRG Desc		A1	SCALE	As Shown	DATE		27.06.24
DRAWN BY		PP	CHECKED BY	SJ	APPROVED BY		SW
		STUDY FOR THE PROPOSED DEVELOPMENT IMPROVEMENTS AND ELEVATIONS 1. SITE PLAN 2. SECTION 3. ELEVATION 4. SECTION 5. SECTION 6. SECTION 7. SECTION 8. SECTION 9. SECTION 10. SECTION 11. SECTION 12. SECTION 13. SECTION 14. SECTION 15. SECTION 16. SECTION 17. SECTION 18. SECTION 19. SECTION 20. SECTION 21. SECTION 22. SECTION 23. SECTION 24. SECTION 25. SECTION 26. SECTION 27. SECTION 28. SECTION 29. SECTION 30. SECTION 31. SECTION 32. SECTION 33. SECTION 34. SECTION 35. SECTION 36. SECTION 37. SECTION 38. SECTION 39. SECTION 40. SECTION 41. SECTION 42. SECTION 43. SECTION 44. SECTION 45. SECTION 46. SECTION 47. SECTION 48. SECTION 49. SECTION 50. SECTION 51. SECTION 52. SECTION 53. SECTION 54. SECTION 55. SECTION 56. SECTION 57. SECTION 58. SECTION 59. SECTION 60. SECTION 61. SECTION 62. SECTION 63. SECTION 64. SECTION 65. SECTION 66. SECTION 67. SECTION 68. SECTION 69. SECTION 70. SECTION 71. SECTION 72. SECTION 73. SECTION 74. SECTION 75. SECTION 76. SECTION 77. SECTION 78. SECTION 79. 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GENERAL:

1. All dimensions are in millimetres. All levels are in metres.
2. All structural elements, foundation pads and DCB walls are indicative only.
3. The design, installation and commissioning of the modular offices and amenities building to be responsibility of the specialist modular offices Contractor.
4. External finishes and trim colour to be determined in due course to meet with Hill & Smith's requirement.
5. W-F30 denote window with 30 minutes fire resistance construction.
6. D-F30-SC denote door with 30 minutes fire resistance construction, self-closing.

Notes:-

1. This drawing is to be read in conjunction with the following Plans:-
 - CA13057-001 Site Location and Application Boundary
 - CA13057-002 Existing Site Layout & Elevations
 - CA13057-003 Proposed Site General Arrangement and Elevations
 - CA13057-005 Proposed Drainage Layout

A Planning Application Issue		12/04/24	10	10	10
CLIENT	ABP South Wales and Shorthead	DATE	12/04/24	10	10
PROJECT	Alexandra Docks, Newport Hill & Smith Compound Development	DATE	12/04/24	10	10
DRAWING TITLE	Office & Amenities Building Layout and Elevations	DATE	12/04/24	10	10
DWG NO.	CA13057-004	REV	A	10	10
DWG SIZE	A1	SCALE	As Shown	DATE	27.06.24
DRAWN BY	PP	CHECKED BY	SJ	APPROVED BY	SW



Proposed Permeable Paving
perforated Surface Water Drainage
System were applicable

← — ← ○ — ← —

Proposed Roof Water Drainage
System

1. **Swale** to be designed and constructed in accordance with Part 7 CIRIA C753 SuDS Manual V6, **Swale** to be sown with species rich meadow seed mix suitable for seasonally wet soils, such as Emergrose Seeds EM8 Meadow Mixture for Wetlands, or similar and approved
2. **Permeable Paving** to be designed and constructed in accordance with Part 20 CIRIA C753 SuDS Manual V6.
3. **Drainage systems** to be designed and constructed in accordance with 'Sewers for Adoption 8th Edition 2018,
4. **Package Sewage Treatment plant** to have the following performance parameters -

Discharge Standard (95% ile)
20mg/l BODB5
30MG/L SS
20MG/L NH3-N

Design maximum population 30no.
Dry Weather Flow (DWF) 6cu.m/day
Peak Flow Max. for 10 minutes 0.21L/S

CA13057-001 Site Location and Application Boundary

CA13057-002 Existing Site Layout & Elevations

CA13057-003 Proposed Site General Arrangement and Elevations

CA13057-004 Office & Amenities Building Layout and Elevations

A	Planning application issue				H07-CA-2	No	No
V-809B					YES	REMOVED	NO
CLENT							
ABP South Wales and Shortsea							
PROJECT Alexandra Docks, Newport Hill & Smith Compound Office Development							
DRAWING TITLE Proposed Drainage Layout							
DWG No.	CA13057 - 1'00				REV	A	
DWG SIZE	A1	SCALE		1:50	DATE	28.05.24	
DRAWN BY	PP	CHECKED BY	SJZ	APPROVED BY		BW	
		☒ I agree we need this drawing. ☒ I agree we can delete it. ☐ I don't know. ☐ I have no comment. ☐ I disagree. ☐ I am unsure. ☐ I cannot say.					

Appendix C

Borehole Logs

JACKSON GEO SERVICES						DYNAMIC SAMPLING EXPLORATORY HOLE LOG						Exploratory Hole Progress by Time				Exploratory Hole	
												Date and Time		Depth	Casing Depth	Water Depth	WS01
Project		Newport Docks				Equipment		Dart 554/Insulated Handtools and concrete breaker						Sheet 1 of 2			
Client		Wardell Armstrong				Method		WLS/IP						Scale 1:20			
Project No		G24139		Level		Inclination				90 degrees				Drilled LE			
Easting				Northing		SPT Hammer Serial Number				DART554				Logged IR			
Termination Reason		Terminated due to collapse				SPT Hammer Energy Ratio				71 %				Checked			
Samples	Sampling and Testing Depths		Insitu Testing and Depth Related Remarks			Depth (Thickness)	Level (mAOD)	Legend	Description						Scale	Backfill	
1 B 6 D 7 ES	0.30 - 1.00 0.30 - 1.00 0.30 - 1.00					0.00 (0.08) 0.08 (0.22) 0.30			MACADAM (MADE GROUND) Light grey sandy angular to subrounded fine to coarse GRAVEL of sandstone and macadam. Sand is fine to coarse. (MADE GROUND)								
									Medium dense dark brown slightly silty gravelly fine to coarse SAND with low cobble content. Gravel is angular to subrounded of sandstone, concrete, clinker, slag, wood, plastic fragments and metal fragments. Cobbles are angular to subrounded of clinker,concrete and metal fragments. (MADE GROUND)						0.50		
2 D	1.00 1.20 - 1.65		SPT(S) N=13 (4,2/4,4,3,2) Casing: 0.00 Water: 0 SPT			(1.70)									1.00		
3 D	2.00 - 2.45 2.00		SPT SW: 0mm SPT(S) N=3 (2,0/1,0,1,1) Casing: 0.00 Water: 1.3 SPT			2.00 (0.40)			NO RECOVERY						2.00		
8 ES	2.40 - 2.90					2.40 (0.60)			Light grey fine to medium SAND. (MADE GROUND)						2.50		
4 D	3.00 - 3.45 3.00 3.00 - 4.00		SPT SW: 0mm SPT(S) N=2 (1 for 225mm/2 for 225mm) Casing: 0.00 Water: 1.3 Hole collapsed			3.00 (0.70)			Very loose dark grey gravelly fine to medium SAND. Gravel is subangular to subrounded fine to coarse of sandstone, shale, concrete and rare clinker (MADE GROUND)						3.00		
9 ES	3.70 - 4.00					3.70 (0.30)			Firm Light grey slightly sandy gravelly CLAY.. Sand is fine. Gravel is angular to subangular fine to medium of shale. (ALLUVIUM)						3.50		
5 D	4.00 - 4.45		SPT SW: 0mm						Continued on next Sheet						4.00		
Dynamic Sampling Run Details						Hole Diameter		Casing Diameter		Water Strikes							
Test No.	Depth Top	Depth Base	Diameter	Duration (hh:mm:ss)	Recovery	Depth Base	Diameter	Depth Base	Diameter	Date and Time	Casing	Strike	Sealed	Rising to	Time	Remarks	
1	1.20	2.00	87mm	00:05:00	100%	1.20	300mm			04/12/2024 12:30		1.35		1.35	20mins		
2	2.00	3.00	77mm	00:01:00	100%	2.00	102mm										
3	3.00	4.00	67mm	00:01:00	100%	3.00	87mm										
Remarks																	
Hand excavated inspection pit from GL to 1.20m depth. Dynamic windowless sampling from 1.20m to 4.00m depth.																	

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		DYNAMIC SAMPLING EXPLORATORY HOLE LOG						Exploratory Hole Progress by Time					Exploratory Hole				
								Date and Time		Depth	Casing Depth	Water Depth	WS01				
Project		Newport Docks		Equipment		Dart 554/Insulated Handtools and concrete breaker		04/12/2024 11:15 04/12/2024 13:15		0.00 4.00			Wet	Sheet 2 of 2			
Client		Wardell Armstrong		Method		WLS/IP								Scale	1:20		
Project No		G24139		Level				Inclination		90 degrees				Drilled	LE		
Easting				Northing				SPT Hammer Serial Number		DART554				Logged	IR		
Termination Reason		Terminated due to collapse		SPT Hammer Energy Ratio		71 %								Checked			
Samples	Sampling and Testing Depths	Insitu Testing and Depth Related Remarks		Depth (Thickness)	Level (mAOD)	Legend	Description						Scale	Backfill			
	4.00	SPT(S) N=4 (1,1/1,1,1,1) Casing: 0.00 Water: 1.3 SPT					End of Exploratory Hole at 4.00m										
															4.50		
															5.00		
															5.50		
															6.00		
															6.50		
															7.00		
															7.50		
															8.00		
Dynamic Sampling Run Details										Hole Diameter		Casing Diameter		Water Strikes			
Test No.	Depth Top	Depth Base	Diameter	Duration (hh:mm:ss)	Recovery	Depth Base	Diameter	Depth Base	Diameter	Date and Time	Casing	Strike	Sealed	Rising to	Time	Remarks	
1	1.20	2.00	87mm	00:05:00	100%	1.20	300mm			04/12/2024 12:30		1.35		1.35	20mins		
2	2.00	3.00	77mm	00:01:00	100%	2.00	102mm										
3	3.00	4.00	67mm	00:01:00	100%	3.00	87mm										
Remarks																	
Hand excavated inspection pit from GL to 1.20m depth. Dynamic windowless sampling from 1.20m to 4.00m depth.																	
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		EXPLORATORY HOLE PHOTOGRAPHS				Exploratory Hole
						WS01
Project	Newport Docks	Easting		Equipment	Dart 554/Insulated Handtools and concrete breaker	
Client	Wardell Armstrong	Northing		Method	WLS/IP	
Project No	G24139	Level		Termination Reason	Terminated due to collapse	

Sheet 1 of 2

Jackson Geoservices

Unit B3, Fram Enterprise Centre

Parc Busnes Edwards, Llantrisant

Pontyclun, CF72 8QZ

Email: team@jacksongeo.co.uk

Telephone: 02920 099 769



Project Name

NEWPORT DOCKS

Project Number

G24139

Client

WARDELL ARMSTRONG

Date

04/12/24

Exploratory Hole Number

WS01

Box / Face Number

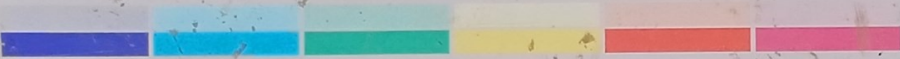
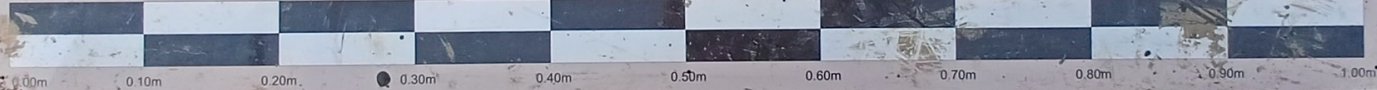
LINER

Depth (m) from

1.20 to 2.00

Engineer

IR


WS01 1.20 m to 2.00 m

Jackson Geoservices

Unit B3, Fram Enterprise Centre

Parc Busnes Edwards, Llantrisant

Pontyclun, CF72 8QZ

Email: team@jacksongeo.co.uk

Telephone: 02920 099 769



Project Name

NEWPORT DOCKS

Project Number

G24139

Client

WARDELL ARMSTRONG

Date

04/12/24

Exploratory Hole Number

WS01

Box / Face Number

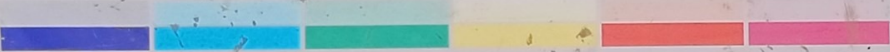
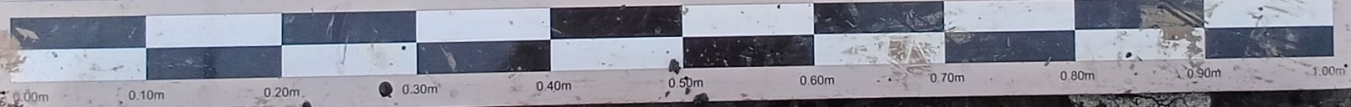
LINER

Depth (m) from

2.00 to 3.00

Engineer

IR


WS01 2.00 m to 3.00 m

		EXPLORATORY HOLE PHOTOGRAPHS				Exploratory Hole
						WS01
Project	Newport Docks	Easting		Equipment	Dart 554/Insulated Handtools and concrete breaker	Sheet 2 of 2
Client	Wardell Armstrong	Northing		Method	WLS/IP	
Project No	G24139	Level		Termination Reason	Terminated due to collapse	

Jackson Geoservices
Unit B3, Fram Enterprise Centre
Parc Busnes Edwards, Llantrisant
Pontyclun, CF72 8QZ

Email: team@jacksongeo.co.uk
Telephone: 02920 099 769



Project Name

NEWPORT DOCKS

Project Number

G24139

Client

WARDELL ARMSTRONG

Date

04/12/24

Exploratory Hole Number

WS01

Box / Face Number

LINER

Depth (m) from

3.00 to 4.00

Engineer

IR

0.00m

0.10m

0.20m

0.30m

0.40m

0.50m

0.60m

0.70m

0.80m

0.90m

1.00m



WS01 3.00 m to 4.00 m



Remarks
Hand excavated inspection pit from GL to 1.20m depth. Dynamic windowless sampling from 1.20m to 6.00m depth.

JACKSON GEO SERVICES		DYNAMIC SAMPLING EXPLORATORY HOLE LOG				Exploratory Hole Progress by Time				Exploratory Hole						
						Date and Time		Depth	Casing Depth	Water Depth	WS02					
Project		Newport Docks		Equipment	Insulated Handtools and concrete breaker/Dart 554				06/12/2024 04:09 06/12/2024 04:11		0.00 6.00		1.51	Sheet 2 of 2		
Client		Wardell Armstrong		Method	IP/WLS									Scale	1:20	
Project No		G24139	Level		Inclination		90 degrees							Drilled	LE	
Easting			Northing		SPT Hammer Serial Number		DART554							Logged	IR	
Termination Reason		Terminated at scheduled depth			SPT Hammer Energy Ratio		71 %							Checked		
Samples	Sampling and Testing Depths	Insitu Testing and Depth Related Remarks		Depth (Thickness)	Level (mAOD)	Legend	Description				Scale	Backfill				
9 D	4.00	SPT(S) N=6 (1,2/1,1,2,2) Casing: 0.00 Water: 1.3		(0.70)			Loose dark grey silty fine to coarse SAND. Very wet. (ALLUVIUM)				4.50					
	5.00	SPT SW: 0mm SPT(S) N=2 (1,0/1,0,0,1) Casing: 0.00 Water: 1.3	4.70			Very soft light grey slightly sandy CLAY. Sand is fine. (ALLUVIUM)				5.00						
			(0.40)													
			5.10			Very soft sandy slightly gravelly SILT. Sand is fine to medium. Gravel is angular to subrounded fine to medium of sandstone. (ALLUVIUM)				5.50						
	5.70 - 6.00			(0.40)												
5.50						Soft becoming firm brownish grey slightly gravelly CLAY. Gravel is subangular to subrounded medium of sandstone. (ALLUVIUM)				6.00						
	6.00	SPT SW: 75mm SPT(S) N=1 (0,1/0,0,1,0) Casing: 0.00 Water: 1.3		(0.50)			End of Exploratory Hole at 6.00m				6.50					
											7.00					
											7.50					
											8.00					
Dynamic Sampling Run Details						Hole Diameter		Casing Diameter		Water Strikes						
Test No.	Depth Top	Depth Base	Diameter	Duration (hh:mm:ss)	Recovery	Depth Base	Diameter	Depth Base	Diameter	Date and Time	Casing	Strike	Sealed	Rising to	Time	Remarks
1	1.20	2.00	87mm	00:08:00	100%	1.20	300mm			06/12/2024 09:05		1.50		1.50	20mins	Slow
2	2.00	3.00	77mm	00:02:00	100%	2.00	102mm									
3	3.00	4.00	67mm	00:02:00	100%	3.00	87mm									
4	4.00	5.00	57mm	00:01:00	100%	4.00	76mm									
5	5.00	6.00	45mm	00:01:00	90%	5.00	66mm									
Remarks																
Hand excavated inspection pit from GL to 1.20m depth. Dynamic windowless sampling from 1.20m to 6.00m depth.																
Printed 09/12/2024 14:27																