



Cemminerals NV

Proposed Cemminerals Facility, South Dock, Alexandra Docks, Newport

Phase 1 Desk Study

315426 R01 (01)

RSK GENERAL NOTES

Project No.: 315426 R01 (01)

Title: Phase 1 Desk Study: Proposed Cemminerals Facility, South Dock, Alexandra Docks, Newport, NP20 2WF

Client: Cemminerals NV

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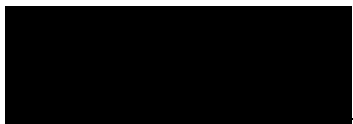
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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

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Site Name	Proposed Cemminerals Facility	NGR	ST 31894 84389
Site Address	South Dock, Alexandra Docks, Newport, NP20 2WE	Site area (ha.)	Approx 6.5 ha

1 INTRODUCTION

1.1 Commissioning

RSK Environment Limited (RSK) was commissioned by Cemminerals NV to carry out a Phase 1 Desk Study Report of land at South Dock, Alexandra Docks, Newport, NP20 2WE (the site). The project was carried out to an agreed brief as set out in RSK's proposal (Ref. 315426 T01 (01), 25th July 2023).

RSK's service constraints are shown in **Appendix A**.

The site in question is being considered for development for industrial use and that Cemminerals are considering to lease the site from Associated British Ports (ABP).

1.2 Objectives

The objective of the work is:

- to identify any land contamination and/or geotechnical constraints to the proposed development and to support discharge of relevant planning conditions and relevant building control requirements
- to identify the need for any additional investigation or remediation works to demonstrate that the site is suitable for its proposed use.

1.3 Scope of works

The scope of this assessment has been developed in accordance with relevant British Standards and authoritative technical guidance as referenced through the report. The assessment of the contamination status of the site is in line with the technical approach presented in Land Contamination Risk Management (LCRM) (Environment Agency, 2021a) and in general accordance with BS 10175: 2011 + A2 2017 (BSI, 2017). It is also compliant with relevant planning policy and guidance.

A brief summary of relevant legislation and policy relating to land contamination is given in **Appendix C**.

The scope of works for the assessment has included the following:

- a site reconnaissance survey
- a study of local geology and hydrogeology, including the provision of historical BGS boreholes
- the identification of potential geological hazards, including Radon
- a study of the land-use, development history and environmental data on and around the site and its surroundings from local authority correspondence, an environmental database report and archival Ordnance Survey mapping
- the identification of aquifer vulnerability rating beneath the site and local water abstraction points from Natural Resources Wales records held within the environmental database

- contact with the LPA Contaminated Land Officer for any relevant details that they might hold pertaining to the site
- liaison where possible with current/previous owners/occupiers of the site
- the identification of potential targets at risk from possible contamination
- production of a Preliminary Conceptual Site Model.

This report will include the following elements:

- preliminary Risk Assessment, including desk-based review, site walkover information and the production of an outline Conceptual Site Model including the identification of potential targets at risk from possible contamination
- an assessment of potential pollutant linkages with the identification of potentially unacceptable risks
- outline geotechnical constraints to any future development
- recommendations for further assessment works (intrusive investigations) or potential remedial requirements and control measures.

1.4 Existing reports

The following reports detailing previous works at the site were made available for review:

- Integral Geotechnique (2011). ABP Newport, NRFT Shed - Site Investigation Factual Report. Reference 10887/TD/11 dated September 2011
- BACTEC (2014). Explosive Ordnance Threat Assessment in respect of M4 Corridor Around Newport for Hyder Consulting (UK) Limited. Reference 5750TA dated 21 November 2014
- Extracts of site investigation logs and location plans from RPS (2018a) M4CaN: Docks Enabling Works. Reference JFR8707, dated June 2018
- RPS (2018b) Newport Docks: Port Redevelopment Plan 3D Unexploded Ordnance Contamination Assessment. Reference ABPDK-DJV-EGT-ZG_GEN-AX-EN-0001 Draft dated 19 October 2018.

Pertinent information from these reports has been summarised in **Section 3**.

1.5 Limitations

This report is subject to the RSK service constraints given in **Appendix A** and limitations that may be described through this document.

2 SITE DETAILS

2.1 Site location

Site location details are presented in **Table 1** and a site location plan is provided on **Figure 1**.

Table 1 Site location details

Site name	Proposed Cemminerals Facility
Full site address and Post code	South Dock, Alexandra Docks, Newport, NP20 2WE
National Grid reference (centre of site)	ST 31894 84389

2.2 Site description

The site boundary and current site layout are shown on **Figure 2**. The Site covers an area of c. 6.5 hectares. It is currently used for the storage of bulk aggregates transported by ship.

The site is approximately rectangular in shape with a projection to the north-east. The site is relatively level and lies at an approximate elevation of 8 m AOD. Access is via East Way Road from the east with a railway siding also giving access to the site. The site is immediately bound to the north by Alexandra Docks and industrial units and open ground to the east. To the south and west are industrial units and areas for bulk storage of materials with the Usk Estuary and lock gates to the south and west respectively.

2.3 Surrounding land uses

The site is located in Alexandra Docks, Newport within a predominantly industrial setting. Immediate surrounding land uses are described in **Table 2**.

Table 2 Surrounding land uses

North	Bulk aggregate storage and South Dock forming part of Alexandra Docks with industrial units beyond
East	Industrial units and a combination of woodland, a pond and open un-developed land
South	Industrial units with the River Usk and foreshore beyond
West	Bulk aggregate storage and industrial units with lock gates beyond forming the entrance to the docks

2.4 Development plans

A similar development has been constructed at the Port of Gent with a photograph of that facility included as **Appendix B** as an example.

The proposed development will comprise industrial plant for the manufacture of cement substitute from recycled waste products. The operation involves the importing of raw materials (slag / clinker / fly ash) which are crushed, ground/milled to a very fine powder and then blended to produce a cementitious product which can then be sold to market in bulk.

The construction will include additional dockside unloading equipment, storage of bulk raw materials, vertical roller mill and storage silos.

No details of the proposed ground levels have been provided therefore for the purpose of this report it has been assumed that the current levels will remain unchanged.

A search of Newport City Council's planning portal has not found any recent planning applications relating to the site.

3 DESK-BASED ASSESSMENT

The desktop study was designed generally to meet the objectives of a preliminary (phase 1) investigation, as defined by BS 10175:2011 + A2 2017 (BSI, 2017) and this assessment relates to LCRM Stage 1, Tier 1 preliminary risk assessment. The "vicinity" of the site for the purposes of this report is defined as locations situated within an approximate 250 m radius of the site, although certain sources and/ or sensitive targets further than 250 m may also have been considered.

The study aims principally to identify and assess the potential risks and liabilities associated with contamination of the ground, on and in the vicinity of the site. While this includes consideration of current operations and housekeeping on the site, the report does not constitute a comprehensive environmental audit of the site, as covered under ISO 14001.

3.1 Site history

3.1.1 Historical development record

The development history of the site and surrounding area based upon assessment of historical plans and records is detailed in **Table 3**. The historical maps reviewed are shown within the environmental database report in **Appendix D**.

South Dock formed an extension of the Alexandra Dock and in 1893, and covered an area of nearly 20 acres; the dock was further expanded in 1907 and again in 1914.

Table 3 Summary of historical development

Date from	Date to	Historical Land Use (on-site)	Area of site
General: South Dock formed an extension of the Alexandra Dock and was opened in 1893 covering an area of approximately 20 acres; the dock was further expanded in 1907 and again in 1914.			
1882	1900	The site is largely occupied by the channel of the tidal Ebbw River. In the far south and north are areas of open ground. In the far east of the site is a possible flood defence/ levee with possible agricultural land beyond. No significant contaminative uses are noted on site.	Entire
1920	1950	South Dock has been developed and the site is shown to be occupied by a number of structures. The southern half of the site is occupied by large warehousing labelled 'Central Store Depot'. To the north are two transit sheds (Numbers 7 and 8). A number of railway lines cross the site. The possible flood defence/ levee is no longer shown in the east of the site.	Entire
1956	1992	No significant changes are noted although the 'Central Store Depot' has been divided into two along the southern site boundary. On-site the	Entire

		building appears to have been further subdivided into three and is labelled as an 'Export Packing Works'. Transit shed No. 8 appears to have been demolished between 1968 and 1992.	
2001	2010	No significant changes are noted. The transit sheds have been demolished by 2001.	Entire
2023	-	The buildings previously labelled as an 'Export Packing Works' have been demolished.	Entire
2001	2023	Recent aerial photography shows the 'Export Packing Works' to have been demolished between 2006 and 2009. Prior to the demolition of the 'Export Packing Works' the area to the north was being used for the bulk storage of material (likely coal). Following the demolition of buildings on site, the entire area appears to have been used for the storage of bulk materials (possibly coal) until around 2018 when the southern part appears disused and overgrown in places with occasional ponds.	Entire
Date from	Date to	Historical Land Use (off-site)	Distance (m) and orientation
1882	1900	To the west is the Ebbw River, to the north and south are areas of level ground protected by a possible flood defence/ levee. To the east is open ground (possibly agricultural). No significant contaminative uses are noted in the vicinity of the site.	-
1920	1950	South Dock basin has been developed and is immediately adjacent to the site to the north. To the south is the remainder of the 'Central Store Depot' with railway line and the River Usk beyond. To the west an elevated platform is shown with a number of small buildings including an Electric Power Station ((Alexandra Docks Co) 200 m south-west) with South Lock beyond. To the east are further transit sheds and railway lines with rough ground beyond. 200 m to the north east an engine house and hydraulic ram are shown.	-
1956	1994	No significant changes are noted although the 'Central Store Depot' has been divided into two along the southern site boundary. Adjacent to the southern site boundary the building is labelled as the 'Monmouthshire Board Mills' that possibly produced paper products. A number of tanks (contents not specified) are located to the east of the board mills. A building to the south-west of the board mills has been demolished and a series of flats have been constructed approximately 100 m to the south of the site. A	-

		dry dock is shown approximately 150 m to the south-east with an associated travelling crane and electricity sub-station from 1956 to 2010. A roundabout is shown in 1994 adjacent to the north-eastern corner of the site.	
2001	2010	No significant changes are noted. The flats to the south-west are no longer shown.	-
2001	2023	Recent aerial photography shows the new buildings constructed to the east and west of the board mills.	
Relevant information sources: Historical OS maps ☒ Town plans ☐ Information from the Local Planning Authority ☐ Aerial photography ☒ Additional information ☐ Previous reports ☐			
<i>Note: Reference to published historical maps provides invaluable information regarding the land use history of the site, but historical evidence may be incomplete for the period pre-dating the first edition and between successive maps.</i>			

Aerial photography available from the website 'Britain from Above' <https://www.britainfromabove.org.uk/en/> shows photographs of the South Dock area dating between 1926 and 1947. The photographs show the Central Store Depot covering the south of the site with the transit sheds in the north. The power station to the south-west is shown with an associated chimney and there are a significant number of railway lines crossing the site.

No specific contaminative uses associated with the site have been identified however the following is considered:

- the potential for Made Ground to be present as a result of the construction of South Dock
- the potential for metalliferous contaminants to be present as a result of the use of the site for the reconditioning of shell casts during World War 1 (see Section 3.1.2)
- the potential for contaminants to be present e.g. asbestos as a result of the demolition of historical buildings
- spills and leaks from any on-site tanks e.g. heating oil tanks.

3.1.2 Unexploded ordnance

A review of publicly available unexploded ordnance (UXO) risk maps indicates that the site is located in an area with low potential for wartime bombs to be present (Zetica, 2023). However, the docks are noted to have been a strategic Luftwaffe target during the second World War and therefore a preliminary UXO report has been obtained and is included as **Appendix E**.

A summary of the preliminary UXO report is given as follows:

"During WWII, the site was located within the County Borough of Newport. According to official Home Office bombing statistics, this area sustained an overall low density of bombing, with an average of 12.9 items of ordnance per 1,000 acres. Comprehensive records for the County Borough of Newport are not held in-house,

however online accounts have been located that reference several incidents of bombing across Alexandra Docks, to which the site belongs.

Furthermore, according to online information, the 'Central Store' depot building previously on site was utilised in WWI for the reconditioning of shell casts and ammunition boxes and in WWII by the RAF."

The preliminary UXO report concluded:

Given these references, further research is required to advance the understanding of the site area and fully assess the potential risk of both Allied and German-delivered UXO. OR add specific details with reference to UXO desk study report.

3.2 Information from environmental database report

Relevant environmental permits and incidents detailed within the environmental database report (see **Appendix D**) are summarised below in **Table 4**.

Table 4 Summary of environmental permits, landfills and incidents

Data type	Entries on-site	Entries <250 m from site	Entries >250 m from site of relevance	Details
Agency and hydrological				
Environmental permits – incorporating Environmental Permitting Regulations (EPR) and/ or Pollution Prevention and Control (PPC) permits; former Integrated Pollution Controls (IPC), Local Authority Pollution Control (LAPC)	0	0	1	1 No. 325 m south-west Severn Sands Ltd, extant licensed pollutant release (Part A(2)/B) permit for use of bulk cement under permit type B
Enforcement and prohibition notices	0	0	0	None noted
Pollution incidents to controlled waters, Prosecutions relating to controlled waters, Substantiated pollution incident register, Water Industry Act referrals	0	2	None of relevance	157 m south-east, Water Impact Category 2 (Significant) from oils and fuel (03/01/2018) 248 m east, Land Impact category 4 (No Impact) Air Impact category 3 (Minor) from construction and demolition materials and wastes

Data type	Entries on-site	Entries <250 m from site	Entries >250 m from site of relevance	Details
Discharge consents	0	12	None of relevance	54 m north-east to 212 m east. Extant consents are associated with the docks or premises at the docks with effluent types stated as Unspecified, Sewage, Trade Discharges and not given. The receiving waters include South Dock, River Usk (Usk Estuary) and the Severn Estuary.
Registered radioactive substances	0	0	0	None noted
Landfill and waste				
Active landfills	0	0	0	None noted
Historical / closed landfills	0	2	None of relevance	132 m to 239 m east a number of Refuse Tips are noted. 167 m east a historical landfill is noted that was permitted to take industrial and household waste under site reference 039/86. The licence was first recorded 30/04/1986 and last recorded 30/04/1990.

Data type	Entries on-site	Entries <250 m from site	Entries >250 m from site of relevance	Details
Other waste management licences	0	1	None of relevance	83 m west, a Physical Treatment Facility is recorded under EPR Licence CB3295FG for South West Wood Products Ltd issued on 29/09/2021.
	Several waste exemptions are recorded within 250 of the site including Storage of waste in a secure place, Use of waste in construction, Manual treatment of waste, Use of waste for a Specified Purpose, Use of waste to manufacture finished goods, Use of mulch and Recovery of scrap metal.			
Potentially in-filled land (pit, quarry, pond, marsh, river, stream, dock etc)	The site and it's immediate surroundings have been subject to ground workings to infill the historical course of the Ebbw River and construct South Dock.			
Hazardous substances/ industrial land uses				
Control of Major Accident Hazards (COMAH) sites	0	0	0	None noted
Explosives sites, Notification of Installations Handling Hazardous Substances (NIHHS), Planning hazardous substance consents/ enforcements	0	0	0	None noted
Contaminated land Part 2A register entries and notices	0	0	0	None noted

Data type	Entries on-site	Entries <250 m from site	Entries >250 m from site of relevance	Details
Contemporary trade directory entries	0	15	-	35 m south-east - electricity sub-station 64 m north-east - electricity sub-station 80 m south-east - WEEE recycling plant 82 m south-west – tank 118 m south-east – tank 140 m south-west - electricity sub-station 199 m east - electricity sub-station.
Fuel station entries	0	0	0	None noted
<i>Note: Entries have only been included within the table where they are located within a 250 m radius of the site or, where they fall outside of this radius but are considered to comprise a significant entry.</i>				

The data contained in **Table 4** has not highlighted any specific contaminative uses of the site or its immediate surroundings. A number of electrical sub-stations that contain oil have been identified with the closest being 35 m to the south-east. Historically, oils used in electrical equipment could have contained polychlorinated biphenyls (PCB). Also noted are a number of historical waste tips and landfill to the east of the site. These could have the potential to give rise to contaminated leachate and generation of bulk gases (carbon dioxide and methane).

3.3 Information from regulatory authorities

3.3.1 Planning records

A search of Newport City Council's planning portal has not found any recent planning applications relating to the site.

3.3.2 Local Authority environmental health department information

The Environment & Public Protection department of Newport City Council has been contacted for records of contamination in connection with the site. Their response was received on the 23 October 2023 and is included in **Appendix E**. In summary:

- the site is in proximity to other former dock transit sheds and an infilled meander the contents of which are unknown

- there are no official records of landfilling, but they identify the infilled meander of the Ebbw River
- they hold no details of petroleum storage at the site
- they confirm that there are no private water supplies within 2km of the subject site
- they note the presence of two batching plants in the locality of the site that hold environmental permits.

3.3.3 Site services

Buried utility services and their backfill can provide preferential pathways for gas, vapour or groundwater to migrate along to another part of the site or to a receptor. They can also represent significant constraints to development.

Obtaining a full set of service plans was outside the scope of this report. However, recent (2020) drawings provided by ABP indicate the presence of water mains, electrical cables, communications, foul drainage along with a number of unknown utilities.

3.4 Summary of previous investigations

A summary of pertinent information from previous investigations is included below in **Table 5**. Relevant information relating to the identified ground and groundwater conditions has not been included within the table below but has been incorporated into the relevant parts of Sections 3.4 - geology and 3.6 – mining and quarrying.

Table 5 Summary of previous investigation reports

Report Details	1. Integral Geotechnique (2011). ABP Newport, NRFT Shed - Site Investigation Factual Report. Reference 10887/TD/11 dated September 2011
Site coverage	The report provides desk based information covering the majority of the site with the exception of the far east. The report also presents intrusive investigation information in the area of the historical No. 7 Transit Shed, located adjacent to South Dock in the north-east of the site.
Summary scope of works	The scope comprised: • Presentation of an Environmental Database • six window sample boreholes • two cable percussion boreholes • seven cone penetrometer tests • Laboratory chemical analysis of soil samples for heavy metals, pH, PAH, total cyanide, total sulphate, water soluble sulphate, sulphide and phenol index.
Does the client have reliance upon the report?	No. Report was commissioned by ABP.

Key factual findings	• Made Ground comprising generally granular (sand or gravel) layers with anthropogenic input including concrete, ash, slag, wood and coal to depths of between 1.0 m bgl and 2.0 m bgl • up to 0.9 m of tarmac over concrete encountered in BH8 • in window sample boreholes the Made Ground was underlain by grey brown slightly sandy silty Clay occasional layers/pockets/lenses of gravel or sand, with a proven thickness of 3.3 m • in the cable percussion boreholes: - o BH3 encountered a gravel and cobbles layer of 2.5 m in thickness at 9.1 m bgl - o a basal layer of sandy Gravel with occasional cobbles and boulders was encountered at 16.1 m bgl in boreholes BH3 and BH5 proven to 19.8 and 20.3 m bgl respectively • no significant olfactory or visual evidence of contamination was noted within the logs • groundwater was not encountered in the window sample boreholes but was encountered in the cable percussion boreholes: - o BH3 struck at 9.10 m bgl rising to 1.60 m bgl - o BH5 struck at 14.8 m bgl rising to 12.2 m bgl. • Bedrock was not proven.
Report Details	2. BACTEC (2014). Explosive Ordnance Threat Assessment in respect of M4 Corridor Around Newport for Hyder Consulting (UK) Limited. Reference 5750TA dated 21 November 2014
Site coverage	The report covers the site along with the wider port area and proposed motorway corridor to the east and west.
Summary scope of works	Desk based Explosive Ordnance Threat Assessment.
Does the client have reliance upon the report?	No. Report commissioned by Hyder Consulting (UK) Limited.
Key findings	The area of site covered by the report is considered to lie within the 'Medium-High Risk Zone' for UXO.
Report Details	3. Extracts of site investigation logs and location plans from RPS (2018a) M4CaN: Docks Enabling Works. Reference JFR8707, dated June 2018
Site coverage	Investigation work covered the southern half of the site.
Summary scope of works	Records of three boreholes, one window sample borehole, one trial pit and one CPT undertaken in the southern half of site were made available
Does the client have reliance upon the report?	No. The investigation was commissioned by the Welsh Government
Key factual findings	• Made Ground comprising variably granular or cohesive layers with anthropogenic input including brick, concrete,

	ash, slag, coal and wood to depths of between 1.2 m bgl and 4.0 m bgl • TFD comprising grey silty Clay or clayey Silt with occasional slightly sandy layers and occasional organic material with a proven thickness of approximately 12 m • Glaciofluvial Deposits comprising sandy Gravel, Sand and Gravel, gravelly Sand and rarely sandy gravelly Clay. A low cobble content was noted in some horizons. This stratum had proven thicknesses of between 6 m and 8 m • MMG comprising stiff or very stiff red brown silty Clay proven to a maximum of 1.4 m thickness • a strong hydrocarbon odour in WS-M4ABP-Z05-04 was noted between 2.0 and 2.8 m bgl above the TFD • perched water was noted in two locations within the Made Ground • groundwater was generally struck in the boreholes at the top of the Glaciofluvial Deposits.
Report Details	4. RPS (2018b) Newport Docks: Port Redevelopment Plan 3D Unexploded Ordnance Contamination Assessment. Reference ABPDK-DJV-EGT-ZG_GEN-AX-EN-0001 Draft dated 19 October 2018.
Site coverage	The report covers the wider dock area including the majority of the subject site with the exception of the western quarter of the site.
Summary scope of works	Desk based 3D Unexploded Ordnance Contamination Assessment.
Does the client have reliance upon the report?	No. Report commissioned by the Welsh Government.
Key findings	The area of site covered by the report is considered to have 'Low UXO Risk'.

3.5 Site geology

3.5.1 Anticipated geological sequence

Published records (British Geological Survey (BGS) website <https://geologyviewer.bgs.ac.uk/> (2023)) for the area indicates the geology of the site to be characterised by the succession recorded in **Table 6**. There are no publicly available BGS historical boreholes located on or within 250 m of the site.

As noted by the BGS, the site is indicated to be underlain by Tidal Flat Deposits over bedrock of the Mercia Mudstone Group. The Tidal Flat Deposits are described by the BGS as 'unconsolidated sediment, mainly mud and/ or sand'. However, RSK's experience of working in this area indicates that bands of Peat may be present in the fine grained soils and a basal layer of sand, gravel and cobbles is likely to be present above the bedrock.

The two previous investigations (Integral Geotechnique (2011) and RPS (2018a)) identified a basal layer of granular material (sand, gravel and cobbles) up to 8 m thickness. RPS (2018a) have interpreted this material as Glaciofluvial Deposits. Based on the

existing site investigation data RSK have initially considered the Tidal Flat Deposits described in **Table 6** to comprise a cohesive layer underlain by granular (basal) material.

Table 6 Site geology

Strata	Description	Estimated thickness	Permeability
Made Ground	Variable but upper layers could comprise granular material as a result of prior uses of the site including possible demolition material from the removal of buildings. Beneath this layer Made Ground may comprise natural material used to raise site levels when South Dock was constructed.	2 m to 5 m	-
Tidal Flat Deposits (TFD)	Unconsolidated sediment, mainly mud and/ or sand above a basal layer of sand gravel and cobbles. Peat may also be present in the fine grained soils.	18 m to 20.3 m	Very low to high
Mercia Mudstone Group (MMG)	Dominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite-bearing units in some basin areas. Thin beds of gypsum/ anhydrite are widespread; thin sandstones are also present.	Up to 1350 m	Low
Relevant information sources: BGS Geoindex ☒ BGS borehole logs ☐ Previous SI reports ☐			

With reference to the historical data there have clearly been several phases of construction and demolition on the site and therefore the presence of Made Ground should be expected.

ABP have confirmed that a number of investigations have been carried out at the site, brief details of ground conditions from those investigations are given below with copies of the investigation logs included in **Appendix E**.

3.5.1.1 *Integral Geotechnique (2011). ABP Newport, NRFT Shed - Site Investigation Factual Report. Reference 10887/TD/11 dated September 2011*

Records of two cable percussion boreholes, six window sample boreholes and seven CPT's were undertaken in the north-eastern quadrant of the site. In summary:

- Made Ground comprising generally granular (sand or gravel) layers with anthropogenic input including concrete, ash, slag, wood and coal to depths of between 1.0 m bgl and 2.0 m bgl

- up to 0.9 m of tarmac over concrete encountered in BH8
- in window sample boreholes the Made Ground was underlain by grey brown slightly sandy silty Clay occasional layers/pockets/lenses of gravel or sand, with a proven thickness of 3.3 m
- in the cable percussion boreholes:
 - o BH3 encountered a gravel and cobbles layer of 2.5 m thickness at 9.1 m bgl
 - o a basal layer of sandy Gravel with occasional cobbles and boulders was encountered at 16.1 m bgl in boreholes BH3 and BH5 proven to 19.8 and 20.3 m bgl respectively
- no significant olfactory or visual evidence of contamination was noted within the logs
- groundwater was not encountered in the window sample boreholes but was encountered in the cable percussion boreholes:
 - o BH3 struck at 9.10 m bgl rising to 1.60 m bgl
 - o BH5 struck at 14.8 m bgl rising to 12.2 m bgl.
- Bedrock was not proven

3.5.1.2 *Extracts of site investigation logs and location plans from RPS (2018a) M4CaN: Docks Enabling Works. Reference JFR8707, dated June 2018*

Records of three boreholes, one window sample borehole, one trial pit and one CPT undertaken in the southern half of site were made available. In summary:

- Made Ground comprising variably granular or cohesive layers with anthropogenic input including brick, concrete, ash, slag, coal and wood to depths of between 1.2 m bgl and 4.0 m bgl
- TFD comprising grey silty Clay or clayey Silt with occasional slightly sandy layers and occasional organic material with a proven thickness of approximately 12 m
- Glaciofluvial Deposits comprising sandy Gravel, Sand and Gravel, gravelly Sand and rarely sandy gravelly Clay. A low cobble content was noted in some horizons. This stratum had proven thicknesses of between 6 m and 8 m
- MMG comprising stiff or very stiff red brown silty Clay proven to a maximum of 1.4 m thickness
- apart from noting a strong hydrocarbon odour in WS-M4ABP-Z05-04 between 2.0 and 2.8 m bgl above the TFD there were no other visual or olfactory evidence of contamination
- perched water was noted in two locations within the Made Ground
- groundwater was generally struck in the boreholes at the top of the Glaciofluvial Deposits.

3.5.2 Radon

The environmental database report indicates that the site is not located within an 'Affected Area'. An 'Affected Area' is one with 1% or more homes above the radon Action Level of

200 Bq m⁻³, and therefore the risk of significant ingress of radon into structures on-site is considered low and protection measures are not necessary in the construction of non-domestic buildings.

Although the radon data used in production of the ukradon indicative atlas comes from measurements in homes, the maps indicate the likely extent of the local radon hazard in all buildings.

3.6 Mining and quarrying

Evidence has been sought to identify any mining, quarrying, landfilling and land reclamation operations, past and present, which have taken place within 500m of the site. An initial site appraisal has been carried out based on the information provided on the Coal Authority Interactive Viewer of the UK Coalfield areas and the commercial environmental databased report for information on non-coal mining.

Use of the Coal Authority interactive viewer indicates the site lies outside their Coal Mining Reporting Area and therefore no further assessment of coal mining issues is required within this report.

There is no known history of quarrying or mining at the site. However, the site is recorded as an area of 'surface ground workings'. These surface workings are likely to be associated with the construction of South Dock and the raising of site levels to create wharves. The Environmental Database also indicates the presence of a landfill located 167 m to the east of site.

3.7 Hydrogeology

A summary of the hydrogeological setting of the site, with respect to the anticipated geological sequence set out in Section 3.4 is presented below in **Table 7**.

Table 7 Summary of hydrogeological setting

Condition	Description
Aquifer characteristics	The site is underlain by unproductive strata relating to the TFD and secondary B aquifer of the MMG. The presence of low permeability clay at relatively shallow depths beneath the site, while restricting downwards migration, may increase the potential for lateral migration of shallow groundwater (and therefore mobile contamination, if present). Groundwater quality beneath the site is likely to be affected by saline intrusion.
Depth to groundwater and flow	The anticipated depth to the groundwater table is in the order of 2 m to 4 m below ground level based on local experience. Shallow groundwater in the site area is anticipated to flow in a southerly direction towards the River Usk but is likely to be tidally influenced. Shallow water may be present in any Made Ground deposits present on-site.
Groundwater recharge/attenuation	The majority of the site is hardstanding although that in the south of the site is in places in poor condition. This will limit infiltration to ground and groundwater recharge, except where SUDS are present.

Condition	Description
Historical implications for hydrogeology	The site lies directly above the former course of the Ebbw River. The Ebbw River was re-routed at the time the docks were constructed. There is the potential that the former course of the Ebbw River could provide a preferential pathway for groundwater movement.
Licensed groundwater abstractions	The environmental database report indicates that there are no groundwater abstractions within a 1 km radius of the site.
Source protection zones	Information available in the Environmental Database indicates that the site does not lie within a currently designated groundwater Source Protection Zone (SPZ).

3.8 Hydrology

A summary of the hydrology within the site area is summarised in **Table 8**.

Table 8 Summary of hydrology in site area

Condition	Description
Surface watercourses/features	There are no ponds, streams or drainage ditches on site although transient ponds have been noted on historical mapping and aerial photography in the north-east of the site, a possible indication of slightly lower topography. The nearest identified surface water feature is the South Dock that lies immediately adjacent to the northern site boundary. Water in the dock is held at around 7.23 m OD but can fluctuate dependent on the draft of vessels, wet weather and volume impounded. The dock is connected to the River Usk via lock gates approximately 200 m to the south-west. The River Usk (tidal) is located approximately 250 m to the south-south-east.
Surface water abstractions	There are no surface water abstractions identified by the environmental database, within a 1 km radius of the site.
Site drainage	It is not clear where surface water drains to with transient ponds evident from recent aerial photography. Evidence from historical maps indicates that the Ebbw River formerly crossed the site. This feature has been infilled as part of the construction of the docks and the raising of site levels. A preferential pathway for the migration of contamination in the sub-surface may therefore exist beneath the site.
Preliminary flood risk assessment	The indicative floodplain map for the area (https://flood-risk-maps.naturalresources.wales/?locale=en) shows that the site is at low risk with respect to flooding from the sea. It should be noted that a flood risk assessment (FRA) is outside the scope of this report.

3.9 Sensitive land uses

Table 9 provides a summary of any environmentally sensitive areas identified within 250 m of the site based on the environmental database report.

Table 9 Environmentally sensitive areas

Feature	Present within 250 m of site?	Details	Likely pathways from site?
International designations – Ramsar wetland, Special Area of Conservation (SAC), Special Protection Area (SPA)	Yes	River Usk is a designated SAC 150 m to the south of the site.	Potentially located hydraulically down gradient of the site.
National designations – Site of Special Scientific Interest (SSSI), National Nature Reserve (NNR), ancient woodland	Yes	River Usk is a designated SSSI 150 m to the south of the site.	Potentially located hydraulically down gradient of the site.
Local designations – Local Nature Reserve, Site of Importance for Nature Conservation (SINC)	No	-	-
Nearest high sensitivity development, e.g. residential	n/a	-	-

4 SITE RECONNAISSANCE FINDINGS

A site reconnaissance survey was completed on 05 October 2023 by RSK. The characteristics of the site observed during the walkover and from current ordnance Survey maps are summarised in **Table 10**.

A site plan is provided in **Figure 2** with photographic records included in **Appendix F** detailing the main features identified below.

Whilst the walkover summary includes consideration of current operations and housekeeping on the site as potential sources of contamination, it does not constitute a comprehensive environmental audit of the site, as covered under ISO 14001.

Table 10 Site reconnaissance findings

Feature observed	Presence Y/N	Description
Physical characteristics		
1. Are there any access constraints?	N	There were no access constraints. There were a number of stockpiles (coal, sand, expanded clay) so the entire site surface could not be seen. In addition there was a significant amount of ponded water on site that obscured the view of the surface.
2. Is the site approximately level?	N	The site is generally level lying between 8.00 m and 9.00 m AOD. Lower lying areas were denoted by ponded water. In general the northern half of site falls gently to the south away from the dock edge.
3. Any evidence of subsidence, landslip or slope erosion?	N	None noted.
4. Any changes in level between the site and adjacent sites?	N	No significant changes in level were noted with the exception of the northern boundary that is formed by the dock. Water in the dock is understood to be maintained at around 7.23 m AOD, approximately 1.75 m lower than that the site on the northern boundary.
5. Surface cover	-	Approx. 90 % hard surfacing mainly comprising tarmac with some concrete. In the south of the site the hard surfacing was in poor condition.
	-	Approx. 10 % appears to be soft standing (although could be underlain by hard surfacing) mainly located in the far east of the site.
Environmental characteristics		
6. Vegetation on site	Y	Some sparse vegetation, mainly restricted to the far east of the site including some semi-mature trees on the eastern site boundary.

Feature observed	Presence Y/N	Description
7. Evidence for vegetation stress	N	Vegetation present is sparse and of low quality.
8. Invasive species	N	Based upon the walkover survey obvious evidence of Japanese Knotweed or other invasive species has not been identified on-site. However, it should be noted that a detailed survey of the possible presence or absence of invasive species is outside of the scope of investigation and consideration should be given to commissioning a specialist survey, as necessary. It should also be noted that the walkover was undertaken in October and that invasive species may not be as visible due to die back.
9. Surface water features	N	There are no formal surface water features on site. South Dock forms the site's northern boundary and the River Usk is present approximately 150 m to the south.
10. Site drainage	-	No obvious drainage is present on site. Drainage was noted in the road running adjacent to the southern site boundary. It is understood that the northern part of the site (adjacent to the dock) was slightly raised to prevent run-off entering the dock. Ponded water was noted in a number of locations and a transient pond at the east of the site is shown in aerial photographs. It is understood that ponded water in the east of the site is occasionally pumped away but that any drainage in that area is non-functional.
Structures and services		
11. Existing buildings on-site	Y	There are no permanent buildings on site. two temporary steel cabins are located at the aggregates berth in the north-east of the site. A derelict portacabin is located in the south-east of the site. In the south-west of the site the floor slab of a former structure is visible and it is understood that there could be floor slabs of former structures elsewhere on site.

Feature observed	Presence Y/N	Description
12. Buried and overhead services present	Y	An electricity sub-station is located halfway along the southern boundary with cables passing northwards beneath the site. Occasional inspection hatches were noted in the roadway running from east to west through the centre of the site although it was not clear what service these relate to. Electrical cables are assumed to be present on site serving flood lights. Spray dust suppression (non-operational) means that a water service is present. No overhead services were noted.
13. Underground structures	N	None observed.
Geotechnical characteristics		
14. Evidence of damage to existing building structures on site?	N	No permanent buildings present
15. Remains of building structures present on or adjacent to site?	Y	Floor slab of former building noted in the south-west. Further floor slabs of former buildings maybe present at shallow depth.
16. Retaining walls and adjacent buildings on or close to site boundary?	Y	The dock wall on the northern boundary retains the site.
17. Any abrupt changes in ground level present on or adjacent to site?	Y	No abrupt changes in level were noted, although shallow ponded water suggests some settlement due to consolidation of soft sediments possibly as a result of loading by mineral stockpiles.
18. Any potentially unstable slopes/ exposed ground present on or adjacent to site?	N	None noted.
19. Any mature trees on site?	N	A few semi-mature trees are present at the eastern boundary.
20. Any visual evidence of infilled basements on site?	N	None noted.
Potential evidence for contamination		
21. Underground/ above ground storage tanks and pipework	N	None noted.

Feature observed	Presence Y/N	Description
22. Potentially hazardous materials storage and use	N	None noted.
23. Waste storage	Y	None noted on site but a scrap metal berth is located against the western site boundary with stockpiles of waste metal and smaller stockpiles of undefinable waste.
24. Fly-tipping	N	None noted.
25. Electricity sub-stations/ transformers	Y	A sub-station is noted off-site adjacent to the southern boundary. There were no obvious signs of oil leakage.
26. Asbestos-containing materials (ACM)	N	There were no obvious signs of ACM observed at the ground surface noting that not all the ground surface was not visible as a result of ponded water and presence of material stockpiles.
27. Fire suppression	N	No permanent buildings are present.
28. Fire history	N	There is no recent history of fires on the site as confirmed by ABP.
29. Is there any visual evidence of potential contamination on site?	N	There were no obvious signs of contamination at the surface noting that not all the ground surface was not visible as a result of ponded water and presence of material stockpiles.
30. Is there any visual evidence of potential contamination on adjacent sites?	Y	Orange coloured water was noted on the surface in places on the adjacent scrap metal berth, likely as a result of rusting.

No potentially significant land contamination or geotechnical issues were identified during the site reconnaissance survey.

However, the site has had a history of commercial/industrial development that could have resulted in leaks and spills to the ground. More recently the site has been used for the stockpiling of coal and aggregates which in themselves are unlikely to have caused contamination, however, use of machinery to move material could have led to leaks and spills of fuels and oils. An electrical sub-station is located adjacent to the southern site boundary. Therefore the presence of contaminants in the ground cannot be discounted.

The ponded water noted on site shows where settlement may have occurred as a result of stockpiling of materials resulting in long term consolidation of soft sediments. In addition, below ground structures including floor slabs maybe present from the historical use of the site.

5 PRELIMINARY GEOTECHNICAL CONSTRAINTS

5.1 Design class

BS EN 1997-1 defines three different Geotechnical Categories that structures may fall into, which are summarised as follows:

- Category 1: Small and relatively simple structures for which it is possible to ensure that the fundamental requirements will be satisfied on the basis of experience and qualitative geotechnical investigations; with negligible risk
- Category 2: Conventional types of structure and foundation with no exceptional risk or difficult ground or loading conditions
- Category 3: Structures or part of structures, which fall outside limits of Geotechnical Categories 1 and 2. Examples include very large or unusual structures; structures involving abnormal risks, or unusual or exceptionally difficult ground or loading conditions; structures in highly seismic areas; structures in areas of probable site instability or persistent ground movements that require separate investigation or special measures.

Based on the information provided above on the proposed development and in view of the anticipated ground conditions, a Geotechnical Category of Category 2 has been assumed for the purposes of designing the geotechnical investigation. This should be reviewed at all stages of the investigation and revised where necessary.

5.2 Preliminary geotechnical hazards assessment

A summary of commonly occurring geotechnical hazards associated with the anticipated geology outlined in Section 3.4 above is given in **Table 11** together with an assessment of whether the site may be affected by each of the stated hazards.

Table 11 Summary of preliminary geotechnical risks that may affect site

Hazard category	Hazard status based on desk study findings and proposed development		Engineering considerations if hazard affects site
	Could be present and/or affect site	Unlikely to be present and/or affect site	
Sudden lateral changes in ground conditions	☒	☐	Likely to affect ground engineering and foundation design and construction.
Shrinkable clay soils	☒	☐	Clayey TFD deposits present beneath site likely to be shrinkable.

Hazard category	Hazard status based on desk study findings and proposed development		Engineering considerations if hazard affects site
	Could be present and/or affect site	Unlikely to be present and/or affect site	
			Design to NHBC Standards Chapter 4 or similar.
Highly compressible and low bearing capacity soils, (including peat and soft clay)	☒	☐	The site is underlain by soft clays of the TFD potentially containing peat. Likely to affect ground engineering and foundation design and construction.
Silt-rich soils susceptible to rapid loss of strength in wet conditions	☐	☒	Weathered MMG may give rise to silt rich soils but unlikely to be present at shallow depth. Likely to affect ground engineering and foundation design and construction.
Running sand at and below water table	☒	☐	Sands may be present as a basal layer of the TFD with the potential to be running sand. Likely to affect ground engineering and foundation design and construction.
Karstic dissolution features (including 'swallow holes' in Chalk terrain)	☐	☒	TFD and weathered MMG is not generally carbonate bearing and therefore will not lead to karst features.
Evaporite dissolution features and/or subsidence	☒	☐	MMG may contain thin beds of gypsum/anhydrite that could lead to dissolution features. May affect ground engineering and foundation design and construction.
Ground subject to or at risk from landslides	☐	☒	Site is relatively level and not considered to be at risk of landslide.
Ground subject to peri-glacial valley cambering with gulls possibly present	☐	☒	Site is not situated on a valley side, risk not present.
Ground subject to or at risk from coastal or river erosion	☐	☒	Whilst site is situated adjacent to South Dock, protection is provided by the existing dock wall.

Hazard category	Hazard status based on desk study findings and proposed development		Engineering considerations if hazard affects site
	Could be present and/or affect site	Unlikely to be present and/or affect site	
			Likely to require special protection/stabilisation measures.
High groundwater table (including waterlogged ground)	☒	☐	Groundwater anticipated to be at relatively shallow depth given the constant depth of water retained in the lock. May affect temporary and permanent works.
Rising groundwater table due to diminishing abstraction in urban area	☐	☒	Site is not situated in an area subject to rising groundwater table.
Geological faults, fissures and break lines	☐	☒	Faults fissures and break lines not shown on site within geological mapping.
Underground mining including shafts and adits (e.g. coal, mineral)	☐	☒	Desk study shows that underground mining is absent beneath the site.
Effects of extreme temperature (e.g. cold stores or brick kilns/furnaces)	☐	☒	Recent site uses (mineral and aggregate storage) unlikely to have created widespread extremes of temperature.
Existing sub-structures (e.g. tunnels, foundations, basements, and adjacent sub-structures)	☒	☐	Site has previously been developed (hospital) and historical foundations will be present. Likely to affect ground engineering and foundation design and construction
Filled and made ground (including embankments, infilled ponds and quarries)	☒	☐	Made Ground likely to be present as a result of the construction of the docks and subsequent phases of development. Likely to affect ground engineering and foundation design and construction.
Adverse ground chemistry (including expansive slags and weathering of sulphides to sulphates)	☒	☐	MMG may contain sulphates (gypsum). Nature of Made Ground not known, a previous report notes the presence of slag as a component of Made

Hazard category	Hazard status based on desk study findings and proposed development		Engineering considerations if hazard affects site
	Could be present and/or affect site	Unlikely to be present and/or affect site	
			Ground and therefore this should be taken into account. May affect ground engineering and foundation design and construction
Site topography	☐	☒	Site is relatively level and unlikely to pose issues to re-development.
Note: Seismicity is not included in the above table as this is not normally a design consideration in the UK.			

6 INITIAL CONCEPTUAL SITE MODEL

In the UK land contamination is assessed using a risk-based approach taking account of the magnitude (severity of the hazard) and likelihood (probability) of occurrence. A 'receptor' is something that could be adversely affected by contamination (e.g. people, an ecological system, property or a water body). A 'pathway' is a route or means by which a receptor is or could be exposed to or affected by a contaminant. A 'contaminant source' is a hazard but it can only pose a risk to a receptor where a pathway is present. The relationship between sources, pathways and receptors are referred to as a conceptual site model. A risk can only be realised where a contaminant source, pathway and receptor are all in place, referred to as a 'pollutant or contaminant linkage'.

In line with LCRM (Environment Agency, 2021a) and BS 10175: 2011 + A2 2017 (BSI, 2017), RSK has used information in the preceding sections to identify hazards (sources of contaminants), receptors that may be impacted and plausible linking pathways. Where all three are present this is termed a potentially complete contaminant linkage and a qualitative risk estimation is made.

6.1 Potential soil, soil vapour and groundwater linkages

6.1.1 Potential sources of contamination

Potential sources of soil and groundwater contamination identified from current activities and the history of the site and surrounding area are presented in **Table 12**. Ground gas sources are addressed in the next section.

Table 12 Potential sources of soil and groundwater contamination

Potential sources	Contaminants of concern
On-site	
Made ground (i.e. fill material) Associated with construction of the dock and historical uses including railway lines crossing the site.	Unknown fill material but potentially including brick, ash and clinker and containing toxic and phytotoxic metals, inorganics, polycyclic aromatic hydrocarbons (PAHs), asbestos. Lube oil, diesel, kerosene, chlorinated solvents.
Historical (former warehousing) storage/ use of oils/ chemicals on-site. Current use of site for aggregate mineral storage - leaks and spills from vehicles/ machinery during maintenance/ re-fuelling	
Shallow/ perched groundwater contaminated by deleterious material in Made Ground and leaks/ spills of hydrocarbons.	
Off-site	

Potential sources	Contaminants of concern
Historical landfill (167 m east) mid-1960s to early 1990s	Industrial/ municipal waste. Landfill leachate including ammoniacal nitrogen, chloride, inorganic and organic contaminants, PFAS and other POPs.

Historical adjacent industrial uses including above ground storage tanks noted to the east of site (1950's) have been considered but are not specifically included within the conceptual model detailed in **Table 14**. Risk from historical adjacent sites are only likely to be realised through the migration of contaminants via groundwater. On site groundwater is considered a potential source in its own right and therefore the migration onto site of contaminants is deemed to be covered by the on-site linkages.

6.1.2 Sensitive receptors and linking exposure/ migration pathways

Sensitive receptors identified at or in the vicinity of the site that could be affected by the potential sources identified above comprise:

- future site users – industrial workers [oral, dermal and inhalation exposure with impacted soil, soil vapour and dust, inhalation of vapours from groundwater and / or NAPL if present]
- current adjacent site users – industrial users [migration of contamination via dust/fibre deposition, vapour or groundwater migration combined with inhalation]
- future buildings and services [direct contact with contaminated soils or groundwater and chemical attack]
- groundwater in secondary B aquifer within the MMG bedrock [leaching from soils/ percolation to aquifer/ lateral migration of dissolved phase/ NAPL]
- surface waters of South Dock and River Usk situated adjacent and 150 m to the south respectively [lateral migration of dissolved phase/ LNAPL / site run-off/ drainage]
- ecological receptors – the River Usk approximately 150 m to the south is designated a SAC and SSSI [lateral migration of dissolved phase/ NAPL / site run-off/ drainage/ dust deposition].

Potential linking pathways are show in brackets for each item above.

Please note that construction workers and future maintenance workers have not been identified in the conceptual model as receptors because risks are considered to be managed through health and safety procedures according to the CDM Regulations.

Where there are potential instances that construction methods may result in short term environmental impacts, these will need to be assessed at design stage, within a construction phase environmental management plan and where required, mitigation measures put in place.

6.2 Potential ground gas linkages

6.2.1 Ground gas generation potential

Potential ground gas sources identified for the site and surrounding are shown in **Table 13**.

Table 13 Potential ground gas sources (excludes mine gas)

Potential sources	Indicative ground gas generation potential (CIEH, 2008)	Additional information
On-site		
Natural soil strata with a low degradable organic content, e.g. alluvium, peat	Very low	Site is underlain by TFD which could contain peat deposits.
Made ground with low degradable organic content (e.g. up to 5% organic material and no easily degradable waste).	Very low	Site is likely to be underlain by a significant thickness of Made Ground.
Off-site		
Historical landfill mid-1960s to early 1990s	High	Landfill located approximately 167 m to the east of the site.

Given the anticipated ground conditions set out above, significant potential sources of ground gas have been identified in the form of the historical landfill.

6.2.2 Radon

The site is not in a radon affected area with an estimated percentage of homes exceeding the action level of <1% as indicated on available radon potential mapping (UKHSA & BGS, 2022).

In accordance with BRE 211 guidance (2015) no protection measures are considered to be required in new developments.

6.2.3 Preferential pathways for ground gas migration

Credible preferential pathways potentially connecting the source and receptor through vertical and lateral migration are:

- Made Ground that could be permeable
- building foundations, piled foundations and vibro-stone columns
- construction joints and cracks within building structure
- utility routes and service penetrations into buildings.

6.2.4 Sensitive receptors and linking pathways

Sensitive receptors identified at or in the vicinity of the site that could be affected by the potential ground gas sources identified above comprise:

- future site users – industrial workers [migration and ingress of ground gases into buildings, build-up in confined spaces and explosion/ asphyxiation]
- adjacent site users – industrial workers [migration and ingress of ground gases into buildings, build-up in confined spaces and explosion/ asphyxiation]

- future buildings and services [migration and ingress of ground gases into buildings, build-up in confined spaces and explosion].

The assessment has identified receptors to include building structures and proposed end-users.

Construction workers have not been identified as receptors for the purposes of this assessment. Risks may still be present to construction workers especially where works include the entry into excavations within the ground. Construction workers should undertake appropriate risk assessments and risks should be managed through health and safety procedures and the use of PPE.

6.3 Preliminary risk assessment

The preliminary risk assessment findings and potentially complete contaminant linkages are shown in **Table 14** overleaf. The risk classification based on the combination of hazard consequence and probability using a risk matrix from CIRIA C552 (Rudland et al., 2001), a summary of which is included in **Appendix G**. This relates to Tier 1 preliminary risk assessment in LCRM (Environment Agency, 2021a).

Table 14 Risk estimation for potentially complete contaminant linkages

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
On-site: Made ground (i.e. fill material) including that contaminated by hydrocarbons. Brick, ash and clinker and containing toxic and phytotoxic metals, inorganics, PAHs, asbestos, lube oil, diesel, kerosene, chlorinated solvents	Future site users – industrial workers	Oral, dermal and inhalation exposure with impacted soil and dust	Unlikely	Medium	Low	Made Ground is likely to be present on site to a significant depth with the potential to contain deleterious contaminants. Future industrial development likely to comprise hard standing mitigating the potential for direct contact with contaminants.
		Inhalation exposure with impacted soil vapour	Low likelihood	Medium	Moderate/low	Made Ground is likely to be present on site to a significant depth with the potential to contain deleterious contaminants that could give rise to soil vapour. However, there is no evidence of bulk fuel storage or similar although strong hydrocarbon odours were noted in one historical investigation location. Future industrial development likely to comprise hard standing that will help to mitigate vapour migration.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
	Current adjacent site users – industrial users	Oral, dermal and inhalation exposure with impacted soil and dust	Unlikely	Medium	Low	Made Ground is likely to be present on site to a significant depth with the potential to contain deleterious contaminants. Future industrial development likely to comprise hard standing mitigating the potential for off-site migration of fugitive contaminated dust.
		Inhalation exposure with impacted soil vapour	Low likelihood	Medium	Low	Made Ground is likely to be present on site to a significant depth with the potential to contain deleterious contaminants that could give rise to soil vapour. However, there is no evidence of bulk fuel storage or similar although strong hydrocarbon odours were noted in one historical investigation location.
	Future buildings and services	Direct contact and permeation of potable water supply pipes	Likely	Medium	Moderate	Made Ground is likely to be present on site to a significant depth with the potential to contain deleterious contaminants with the potential to permeate potable water supply pipes.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
		Direct contact with in ground concrete and sulphate attack	Likely	Mild	Moderate/low	Made Ground and natural soils (MMG) are likely to contain sulphates with the potential to attack in ground concrete. Suitable geotechnical chemical testing to confirm concrete class should be undertaken. The risk should then reduce to low or very low.
	Groundwater in secondary B aquifer	Leaching and downward migration of contaminants	Low likelihood	Mild	Low	Made Ground is likely to be present on site to a significant depth with the potential to contain deleterious contaminants with the potential to leach. However, up to 12 m thickness of TFD (silt/ clay) is likely to retard any significant downward migration of contamination. As piles are likely to be a foundation solution then these may provide preferential pathways to the downward migration of contaminants.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
	Surface waters of South Dock	Leaching and downward migration to water table followed by lateral migration	Unlikely	Mild	Very low	Made Ground is likely to be present on site to a significant depth with the potential to contain deleterious contaminants with the potential to leach. However, lateral migration of groundwater is likely to be inhibited by the clayey TFD with the waters of South Dock further protected by the dock wall construction.
	Surface waters of the River Usk		Low likelihood	Mild	Low	Made Ground is likely to be present on site to a significant depth with the potential to contain deleterious contaminants with the potential to leach. However, lateral migration of groundwater is likely to be inhibited by the clayey TFD with the waters of the River Usk being over 150 m distant from the site.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
	Ecological receptors (SAC and SSSI associated with the River Usk)	Leaching and downward migration to water table followed by lateral migration	Low likelihood	Mild	Low	Made Ground is likely to be present on site to a significant depth with the potential to contain deleterious contaminants with the potential to leach. However, lateral migration of groundwater is likely to be inhibited by the clayey TFD with the waters of the River Usk being over 150 m distant from the site.
		Direct contact with contaminated wind-blown dust migrating from site.	Unlikely	Mild	Very low	Made Ground is likely to be present on site to a significant depth with the potential to contain deleterious contaminants. Future industrial development likely to comprise hard standing mitigating the potential for migration of dust off-site.
Groundwater containing toxic and phytotoxic metals, inorganics, polycyclic aromatic hydrocarbons (PAHs), petroleum hydrocarbons and chlorinated solvents as dissolved phase or	Future site users – industrial workers	Oral, dermal and inhalation exposure with impacted groundwater	Unlikely	Medium	Low	Groundwater is likely to be present at shallow depth with the potential to contain contaminants to contain deleterious contaminants. Future industrial development likely to comprise hard standing mitigating the potential for direct contact with groundwater.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
non-aqueous phase liquids (NAPL).		Inhalation exposure with vapour from impacted groundwater	Low likelihood	Medium	Moderate/low	Groundwater is likely to be present at shallow depth with the potential to contain contaminants to contain deleterious contaminants that could give rise to vapour. However, there is no evidence of bulk fuel storage or similar although strong hydrocarbon odours were noted in one historical investigation location.
	Current adjacent site users – industrial users	Inhalation exposure with vapour from impacted groundwater migrating from site	Unlikely	Medium	Low	Groundwater is likely to be present at shallow depth with the potential to contain contaminants to contain deleterious contaminants that could give rise to vapour. However, there is no evidence of bulk fuel storage or similar although strong hydrocarbon odours were noted in one historical investigation location. However, lateral migration of groundwater is likely to be inhibited by the clayey TFD that will help to mitigate groundwater and vapour migration.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
	Future buildings and services	Direct contact and permeation of potable water supply pipes	Low likelihood	Medium	Moderate	Groundwater is likely to be present at shallow depth with the potential to contain contaminants to contain deleterious contaminants with the potential to permeate potable water supply pipes.
		Direct contact with in ground concrete and sulphate attack	Likely	Mild	Moderate/low	Groundwater is likely to be present at shallow depth with the potential to contain sulphates derived from either Made Ground or natural soils. Suitable geotechnical chemical testing to confirm concrete class should be undertaken. The risk should then reduce to low or very low.
	Groundwater in secondary B aquifer	Downward and lateral migration of contaminants to the wider aquifer	Low likelihood	Mild	Low	Groundwater is likely to be present at shallow depth with the potential to contain contaminants leached from Made Ground. However, up to 12 m thickness of TFD (silt/ clay) is likely to retard any significant downward migration of contamination. As piles are likely to be a foundation solution then these may provide preferential pathways to the downward migration of contaminants.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
	Surface waters of South Dock	Lateral migration of contaminated groundwater	Unlikely	Mild	Very low	Groundwater is likely to be present at shallow depth with the potential to contain contaminants leached from Made Ground. However, lateral migration of groundwater is likely to be inhibited by the clayey TFD with the waters of South Dock further protected by the dock wall construction.
	Surface waters of the River Usk		Low likelihood	Mild	Low	Groundwater is likely to be present at shallow depth with the potential to contain contaminants leached from Made Ground. However, lateral migration of groundwater is likely to be inhibited by the clayey TFD with the waters of the River Usk being over 150 m distant from the site.
	Ecological receptors (SAC and SSSI associated with the River Usk)		Low likelihood	Mild	Low	Groundwater is likely to be present at shallow depth with the potential to contain contaminants leached from Made Ground. However, lateral migration of groundwater is likely to be inhibited by the clayey TFD with the waters of the River Usk being over 150 m distant from the site.

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
Off-site: Historical landfill (167 m east) mid-1960s to early 1990s.	Future site users – industrial workers	Inhalation exposure with impacted soil vapour	Low likelihood	Medium	Low	Given the clayey nature of the TFD there is considered a low likelihood for leachate to migrate beneath the site.
Landfill leachate including ammoniacal nitrogen, chloride, inorganic and organic contaminants, PFAS and other POPs	Groundwater in secondary B aquifer beneath the site	Migration via groundwater to impact aquifer beneath the site	Low likelihood	Mild	Very low	Given the clayey nature of the TFD there is considered a low likelihood for leachate to migrate beneath the site.
Ground gas (carbon dioxide and methane): Made Ground on site and natural soils containing organic material	Future site users – industrial workers	Migration of ground gas into enclosed spaces with the potential for asphyxiation/ explosion	Unlikely	Severe	Moderate low	Made Ground and natural soils are considered to have a very low generation potential for ground gas.
	Future buildings and services	Migration of ground gas into enclosed spaces with the potential for explosion				
	Current adjacent site users – industrial users	Migration of ground gas into enclosed spaces with the potential for asphyxiation/ explosion				
Historical landfill (167 m east) mid-1960s to early 1990s.	Future site users – industrial workers	Migration of ground gas into enclosed spaces with the potential for asphyxiation/ explosion	Low likelihood	Severe	Moderate	Landfill is considered to have a high generation potential for ground gas. Ground gas migration likely to be mitigated

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
	Future buildings and services	Migration of ground gas into enclosed spaces with the potential for explosion				through the presence of clayey TFD.

Risk matrix		Consequences			
		Severe	Medium	Mild	Minor
Probability	Highly likely	Very high	High	Moderate	Moderate/low
	Likely	High	Moderate	Moderate/low	Low
	Low likelihood	Moderate	Moderate/low	Low	Very low
	Unlikely	Moderate/low	Low	Very low	Very low

Potentially complete contaminant linkages with a potential risk of moderate to low or higher identified in **Table 14** comprise:

- inhalation exposure with impacted soil vapour/ vapour from impacted groundwater by future site users
- direct contact by potable water supply pipes with contaminated soils and groundwater
- risk to future users, adjacent users and buildings from asphyxiation/ explosion risk through the migration and build-up of ground gases (carbon dioxide and methane) in enclosed spaces
- risk to in ground concrete by direct contact with sulphate bearing soils and groundwater.

These potentially complete contaminant linkages need to be assessed further through appropriate site investigation to target the identified sources of potential contamination and assess the feasibility of identified pathways. It is also recommended that investigations are undertaken to confirm the very low or low risk ranking apportioned to the majority of linkages.

6.4 Data gaps and uncertainties

Key data gaps and uncertainties identified in the CSM at desk study stage include:

- gaps in available historical OS maps
- not all the site surface could be viewed due to the presence of ponded water and stockpiles
- although some investigation information is available for the site there is no recent information on concentrations of contaminants in soil and groundwater or ground gas at this stage
- groundwater depth and flow direction are conceptual at this stage.

7 CONCLUSIONS AND RECOMMENDATIONS

7.1 Geo-environmental assessment

Based on the results of the Preliminary Risk Assessment the contaminant linkages that have been identified to be potentially complete (relevant contaminant linkages) and to require further action are:

- inhalation exposure with impacted soil vapour/ vapour from impacted groundwater by future site users
- direct contact by potable water supply pipes with contaminated soils and groundwater
- risk to future users, adjacent users and buildings from asphyxiation/ explosion risk through the migration and build-up of ground gases (carbon dioxide and methane) in enclosed spaces
- risk to in ground concrete by direct contact with sulphate bearing soils and groundwater.

Construction workers were not considered in the conceptual model as potential receptors because risks are considered to be managed through recognised health and safety procedures according to CDM regulations.

Basic radon protective measures are not required for the proposed development.

Data gaps and uncertainties have been considered and further assessment is considered to be required.

Should unforeseen contamination be encountered during redevelopment then specialist advice should be sought to determine the appropriate course of action.

7.2 Geotechnical assessment

The key findings of the initial geotechnical assessment are as follows:

- based on the published geological records, the site is underlain by Made Ground of between 1.2 m and 4.0 m thickness overlying superficial deposits comprising up to 12 m of cohesive (clayey) strata over 6 m to 8 m thickness of granular strata.
- in turn the superficial deposits are underlain by bedrock of the MMG

Based upon the available information and anticipated geology it is thought likely that piled foundations would be suitable for a commercial development, however, this will be subject to confirmation following a thorough intrusive ground investigation.

It is recommended that ground investigation works are carried out based on the proposed layout in order to inspect the competency of both superficial and bedrock strata.

7.3 Recommendations

It is recommended that a ground investigation is undertaken to confirm the ground conditions for geotechnical and geo-environmental purposes, and to confirm the relative risks that might be present and provide data to confirm suitable foundation solutions for

the proposed redevelopment of the site. The investigation is likely to comprise the following but may alter dependent on the nature of the proposed development and its layout. Investigations can also be phased:

- commission a desk based detailed UXO assessment report prior to any intrusive investigation
- a provisional programme of trial pits and window sample boreholes providing general coverage across the site to allow for sample collection and in-situ geotechnical testing. This will help determine the nature of the Made Ground, shallow superficial deposits and presence/ absence of perched water and facilitate assessment of soil gas
- a number of deeper cable percussion boreholes to investigate the full depth of the superficial deposits and determine the top of the MMG rock head, and facilitate the installation of deeper wells targeting the granular superficial deposits to allow groundwater levels and, if encountered, quality to be determined
- an initial small number of deeper cable percussion boreholes to be continued by rotary means to investigate the MMG and provide data to support pile design
- an appropriate suite of geotechnical soil and rock analysis; in particular consideration should be given to the classification (particle size and plasticity index) and moisture content of near surface cohesive and granular deposits and density, porosity, moisture content and strength of rock, as well as chemical analysis for concrete design
- shallow soil samples should be collected from the Made Ground across the site to assess the potential for contaminants including asbestos to be present within the soils with an appropriate suite of chemical soil analysis
- installation of monitoring wells across the site to investigate groundwater table(s) and to monitor ground gas within the superficial deposits and facilitate the collection of groundwater samples to be tested for an appropriate suite of chemical soil analysis.

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FIGURES

Figure 1 SITE LOCATION PLAN