TATA STEEL UK LIMITED

EAF Project

Phase 2 Geo-environmental Investigation

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RSK GEOSCIENCES

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RSK GENERAL NOTES

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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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1 INTRODUCTION

1.1 Commissioning

RSK Environment Limited (RSK) were engaged by Tata Steel UK Limited, (18 Grosvenor Place, London, SW1X 7HS) herein referred to as the 'Client' to carry out a Phase II Geo-environmental Site Investigation at the land in Tata Steelworks, Port Talbot SA13 2NG.

The works were undertaken by means of client purchase order including terms and conditions Purchase Order number; 4200102803 dated 11 May 2024, which forms the appointment between RSK and the Client.

References in this report to 'we', 'us', or 'our' shall mean RSK Geosciences as a trading name of RSK Environment Limited (company no.SC115530) at registered address 65 Sussex Street, Glasgow, G41 1DX.

The site location is provided in **Figure 1** and the site layout boundary to which this report refers is presented in **Figure 2**.

The report should be read and used in accordance with the limitations and constraints identified in the report text, and at **Appendix A – Service Constraints**.

1.2 Objectives

The site is being considered for development for the construction of an Electric Arc furnace and associated plant and infrastructure, full details are described in section 2.2 and 2.3 The proposed development is presented in **Appendix B**.

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; and
- 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 works has designed by the Client and is 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, 2023) and in general accordance with BS 10175: 2011 + A2 2017 (BSI, 2017).

The scope of the intrusive investigation has been designed in line with the recommendations of BS5930:2015+A1:2020 Code of practice for ground investigations (BSI, 2020), which maintains compliance with BS EN 1997-1 and 1997-2 and their related standards. It has also been developed in general accordance with BS 10175: 2011 + A2 2017. Ground gas assessment has been undertaken in general accordance with BS8576: 2013 and BS 8485:2015+A1:2019.

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

Intrusive investigation:

- intrusive investigation works comprising:
    - buried service detection and avoidance
    - unexploded ordnance detection and avoidance
    - excavation of 69 trial pits
    - drilling of four light cable-percussive boreholes with rotary coring follow-on
    - drilling of 27 light cable-percussive boreholes
    - drilling of five light cable-percussive boreholes with rotary open hole follow-on
    - installation of combined groundwater/gas monitoring wells
- measurement and recording of ground gas concentrations in ten boreholes on six occasions at two monthly intervals
- measurement and recording of groundwater depth in ten boreholes on six occasions at two-monthly intervals
- groundwater sampling for laboratory analysis from ten boreholes on one occasion
- refinement of the conceptual site model (CSM) and completion of a generic quantitative risk assessment (GQRA) for relevant contaminant linkages
- preparation of this factual and interpretative report.

1.4 Existing reports

In preparation of this report, the following reports detailing previous works at the site have been reviewed:

- RSK Report; 315075 R01 Project Cronus Preliminary Risk Assessment February 2022
- RSK Report; 315075 R03 Geoenvironmental Ground Investigation Report March 2022
- RSK Report; 315075 R04 Supplementary Phase 2 Geoenvironmental Ground Investigation Report October 2022

- Wardell Armstrong 12 April 2024 ST20879-0001 Technical Note on Coal Mining Risk Assessment
- RSK Report; 315531 R01 (01) EAF Project Phase 1 Desk Study June 2024.

Pertinent information from these reports has been summarised in Section 3. The findings of the Project Cronus site investigations (where they overlap with this EAF boundary) have been included within this report for the purpose of completeness and in order to enhance the overall assessment of the proposed development area.

1.5 Limitations

This report is subject to the RSK service constraints given in **Appendix A** and limitations that may be described below and throughout this document. The location of all exploratory positions were determined by the Client and discussed with RSK.

Due to ongoing activities and on site restrictions it was not possible to investigate all the areas contained within the redline boundary, most notably the former coal yards located in the south west of the site.

This report was prepared in accordance with good practice guidance at the time of issue. Consideration should be considered in the light of changes in legislation, statutory requirements, or industry practices subsequent to the date of issue.

The study aims to principally 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.

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	EAF Project
Full site address and Post code	Port Talbot, SA13 2NG
National Grid reference (centre of site)	277396, 186217

2.2 Site description

The site boundary and current site layout are shown on Figure 2. The site covers an area of c. 157 hectares. It is currently occupied by an active steelworks operated by Tata Steel.

For the purpose of this assessment the site has been separated into two areas (Area 1 and Area 2). Area 1 is the location proposed for development and construction of the Electric Arc Furnace (EAF). The associated infrastructure for the development including the widening of existing roadways, car park and lay down areas have been considered as a separate area, referenced Area 2. Area 1 is located to the east and north of the existing manmade lagoon. The areas are shown on **Figure 3**.

The site itself is currently being used for multiple different uses. The centre of the site is being used as a scrapyard, the majority of it being scrap metal from old appliances, industrial equipment, cars, and other items. The area just north of the scrap yard is used to store and screen different aggregates such as slag and concrete. The north eastern area of the site is mainly being used as steel slab storage yards. To the south of the slab yards are the HAA stockyards, which store and sort multiple types of aggregate such as slag, concrete, and other types of industrial rubble. To the west of the slab and stock yards is an area of vegetation with bushes and grass, the northern part of it is being used to store more aggregate, waste wood and other materials. The area immediately south of this area is being used to store coal and associated infrastructure to supply Morfa Coke ovens off site to the west. Directly west of the coal storage area (disused) is cylindrical structure used to store gas which is also associated with the neighbouring coke oven. The southern end of the site is an undeveloped flat grass land area with no other current land use. The extreme northwest of the site encroaches onto the work reservoir, a water body located within the wider steelworks.

<u>Area 1</u>

The majority of the development will take place incorporating the existing areas of the HARSCO yard, Basic Oxygen Steelmaking (BOS) Plant, HRP- North Slab Yard and Continuous casting plant.

The HARSCO yard is located north of the lagoon and responsible for the processing of slag and comprises several large stockpiles. There is a central roadway for plant movement which is raised several metres above the surrounding land. During a walkover carried out by RSK evidence of

surface oil spillages were noted in some locations in the HARSCO yard and regeneration yards, predominantly in areas of soft standing / compacted stone. The HARSCO yard comprises c. 10 hectares of the proposed development area.

The BOS plant is in an approximately rectangular building with railway lines leading in from the north. The area runs north to south adjacent to the HARSCO Yard. It is used for the production of steel from raw materials. The BOS Plant and rail lines in the proximity cover c. 5.60 hectares.

The HRP-North Slab Yard is the storage yard for the steel slab postproduction and is located on the north eastern boundary of the development site. This comprises surface road stone and rough vegetation and some above ground utility pipes and covers c. 4.5 hectares.

Area 2

There are multiple roads running through the site and a several rail lines generally running north-south in the eastern part of the site. These connect the coal storage, slab and stock yards to the Paddington to Swansea main line railway to the northeast.

The area surrounding the site is predominately part of the steelworks. Directly west of the site is the Morfa Coke Ovens and associated infrastructure, where coal is blended and heated to form coke for iron production. Approximately 600m west is the Bristol Channel. South of the works reservoir and adjacent to the site boundary is a steel service centre. North of the works reservoir is the BOS plant and the Concast plant, where steel is made, treated and processed to ultimately form steel slabs. North of the BOS and Concast plants are various stock storage yards that also appear to contain aggregates such as slag, and two gas holders for the BOS plant and blast furnace. Further north of this is the Sinter plant and raw materials stock yards where iron ore, limestone, coal and coke are stored. To the east of the sinter plant are the blast furnaces and power plant where iron is produced from coke, iron ore and sinter as well as other materials.

The area directly east of the site and situated in the southeast of the wider steelworks is the Hot Mill where hot rolled products such as Hot Rolled Coils are produced from steel slabs. Again, throughout the steelworks are access roads and rail to transport products and raw materials.

Beyond the steelworks itself are residential and commercial areas to the north, residential and open fields hills to the east, a reservoir is present approximately 360 m to the southeast, moorland to the south with Morfa beach and the Bristol channel to the west.

2.3 Surrounding land uses

The site is located in Port Talbot, within a predominantly commercial and industrial setting. Immediate surrounding land uses are described in **Table 2**. The nearest residential receptor to the site is located circa 900 m east.

Table 2 Surrounding land uses

North	Industrial steelworks, River Afan and harbour (located approximately 2km to the north) with residential and commercial area further north.
East	Industrial steelworks, residential area, open fields and hills. A reservoir is also present approximately 360m to the southeast
South	Open fields and moorland, reservoir to the southeast owned by Tata Steel UK Limited
West	Coke ovens related to steelworks with beach and Bristol Channel further west

2.4 Proposed development plans

Details of the proposed ground levels have been provided by the Client and are shown below in **Table 3**.

Table 3 Proposed developments with corresponding ground levels

Description	Proposed GL (mm AOD)
Canopy Hood	8200
Consteel Conveyor	8200
Fume Treatment Plant	8200
Shredded Scrap Yard	-
Hot Briquetted Iron Dolo & Lime Bunker	8200
Ferro Alloys Bunker	8200
Fire Water Pump House	8200
Primary Pump House	8100
Secondary Pump House	7500
Main Power Centre	7000
Power Compensation Building	7000
National Grid Compound	7000
Melt Shop Power Distribution Building	7000
Incoming Scrap Yard Electrical Building	6000
Melt Shop WTP Electrical Building	8200
Melt Shop FEP Electrical Building	8200
Compressor House	8200
Scrap Storage & Processing Yard	7000
Overflow Scrapyard	7000
Non Ferrous Processing Area	6000
Scanning Facilities	5000
Railway Weigh Bridge	5000
Car Parking Area	7200
Changing & Office Block Building	7300
Emergency Tank	8200
Lagoon Water Pump House	8200
Green Walkway Extension	7300
HBI & Pig Iron Storage Area	5500
Active Carbon Injection Silos	8200

Based upon the available information provided for the southern section of the site from topographical drawings, there appears to be relatively little change between current and proposed development site levels (c.1m).

The proposed layout of the site, at the time of preparing this report, is shown in **Appendix B**.

2.5 Previous Report Summary

A summary of the Phase 1 Preliminary Risk Assessment (ref. 315531 R01 (01)) findings, salient to the site is presented below; the full report should be referred to for further details.

Information published by the British Geological Survey has indicated the following sequence to be anticipated beneath the site, refer to **Table 4**:

Table 4 Site geology – Majority of site

Strata	Description	Estimated thickness
Anticipated Made Ground	Clay, silt, sand and gravel with low to high cobble content. Made up of reworked natural and anthropogenic material such as slag, brick, and concrete with occasional scraps of metal and other anthropogenic materials	Variable. Up to 6.00 m
Tidal Flat Deposits	Tidal Flat Deposits, including mud flat and sand flat deposits, are deposited on extensive nearly horizontal marshy land in the intertidal zone that is alternately covered and uncovered by the rise and fall of the tide. They consist of unconsolidated sediment, mainly mud and/or sand. They may form the top surface of a deltaic deposit. Normally a consolidated soft silty clay, with layers of sand, gravel and peat	Approximately 15.00 m
Glacial Deposits (Boulder Clay)	Gravelly clay with cobbles	Approximately 13.00 m
Undifferentiated South Wales Coal Measures Formation	Coal-bearing mudstones/siltstones, and sandstones	Up to 300 m

2.6 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 5**.

Table 5 Summary of hydrogeological setting

Condition	Description
Aquifer characteristics	The site is underlain by a secondary aquifer relating to the South Wales Lower Coal Measures. The superficial Tidal Flat Deposits across the majority of the site are classified as Secondary (undifferentiated). The north-eastern corner of the site is classified as Secondary A aquifer relating to the 'Blown Sand' deposits. 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 may be affected by saline intrusion.

Condition	Description
Depth to groundwater and flow	Groundwater in the site area is anticipated to flow in a westerly direction, i.e. towards and in the direction of flow of the Bristol Channel. It is also likely that shallow water may be present in any Made Ground deposits present on-site.
Rising groundwater levels	The site is located in a former coal mining area and may be associated with rebounding groundwater levels following the end of mining and associated dewatering
Groundwater recharge/ attenuation	Large areas of the wider site are currently covered with buildings and hardstanding and therefore this will limit infiltration to ground and groundwater recharge, except where SUDS are present (details of which are unknown). The site under assessment in this report is large covered by soft standing or stone surfacing.
Historical implications for hydrogeology	A partially culverted stream known as the Lower Mother Ditch runs approximately north to south along the eastern edge of the site
Licensed groundwater abstractions	The environmental database report indicates that there are 2 current licensed groundwater abstractions within a 1km radius of the wider site, these are located c. 396 m and 441 m southeast of the assessment area considered in this report and are operated by the site for cooling water.
Source protection zones	Information available in the Groundsure report indicates that the site does not lie within a currently designated groundwater Source Protection Zone (SPZ).

A summary of the hydrology within the site area is summarised in **Table 6**.

Table 6 Summary of hydrology in site area

Condition	Description
Surface watercourses/features	A number of surface water features are present across the wider site. Most notably is the tidal zone running north-west to southeast approximately 50.00 m from the site. On site there is a man-made body water body (lagoon) located in centre/north of the site under assessment in this report along with number of drainage ditches located along field boundaries to the south of the development area. Lower Mother Ditch runs south to north through the site area via unmapped culverts.
Surface water abstractions	The environmental database report indicates that there is 1 current licensed surface water abstraction within a 1km radius of the site, located on site and utilised for process water.
Site drainage	Surface drainage from the site appears to be discharged into Lower Mother Ditch which runs across the site from south to north although this is not confirmed.
Preliminary flood risk assessment	The indicative floodplain map for the area, shows the risk of flooding each year has been assessed by NRW as moderate –i.e. 1.3% (1 in 75) or less, but greater than 0.5% (1 in 200). A flood risk assessment (FRA) is outside the scope of this report.

Based upon the first published map area 1 is predominately undeveloped, there are a number of buildings associated with the Morfa Colliery labelled 'Pit row', 'office row' and 'Overman's Row 'in the southern part of the site. A railway line is present serving both Grange Pit and Abbot Pit shown east and south of the area. The area is shown to mainly comprise of marsh/dunes. By 1947 colliery was reduced in size and the 2 pits are no longer present. The present day steel works is first shown from the mid 1960's extending further north from our area of investigation.

In 1876 Area 2 is also included within the colliery, there is a large pond to the northeast of the site, with marsh land around it. At the north end of the site is a colliery and associated infrastructure such as pits, shafts and unspecified tanks as well as another coal pit west of the pond. A rail line runs from the north to Abbot Pit. A disused rifle range is shown in 1965, it is not clear when it was active. At this time the steel works is shown with associated buildings, expansion further by the mid 1980's to include conveyors and pipelines, these are assumed to be associated with the Grange Coke Ovens. Several conveyor systems for coal have been constructed to the centre and west of the site that appear to service the coke ovens situated just off site to the west. A gas holder in 1991 was constructed, again to service the coke ovens just off site.

In recent times the site has shown a steady expansion and use as a steel works with numerous phases of expansion, operations, and processes with the use and decommissioning of the Morfa Coke Ovens, and a number of above and below ground tanks, which may impact the surrounding soils.

Based upon the assessment carried out by Wardell Armstrong (ref. ST20879-0001b) the risk associated as a result of coal mining has been classified as 'low to moderate'. The Morfa Colliery was present within the site and three possible mine entries are noted on the published information further south from the proposed EAF location. Up to eight coal seams may have been worked beneath the site.

2.6.1 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 7**.

Table 7 Potential sources of soil and groundwater contamination

Potential sources	Contaminants of concern
On-site	
S1 Made Ground (i.e. fill material)	Unknown fill material but potentially including brick, ash and clinker and containing toxic and phytotoxic metals, inorganics, polycyclic aromatic hydrocarbons (PAHs), asbestos
S2 Areas of former Coke Ovens, BOS plant and coal yards.	Unknown material but potentially including ash and clinker and containing toxic and phytotoxic metals, inorganics, PAHs, hydrocarbons, benzene, toluene, ethylbenzene and xylenes (BTEX) and asbestos
S3 Storage of oils/chemicals on-site	Lube oil, diesel, kerosene
S4 Warehouse/ engineering works	Petroleum hydrocarbons, toxic and phytotoxic metals, asbestos

Potential sources	Contaminants of concern
S5 Underground/ above ground storage tank and associated pipework	Petroleum hydrocarbons (petrol/diesel)
S6 Scrap Yard	Unknown material but potentially including ash and clinker and containing toxic and phytotoxic metals, inorganics, PAHs, hydrocarbon, BTEX and asbestos
S7- Railway lines/sidings	Petroleum hydrocarbons, toxic, phytotoxic metals, inorganics, PAHs and asbestos
Off-site	
S8- Railway bounds the site to the east	Petroleum hydrocarbons, toxic, phytotoxic metals, inorganics, PAHs and asbestos
S9 Industrial process associated within the wider steelwork to the north and Morfa Coke Ovens to the west	Unknown material but potentially including ash and clinker and containing toxic and phytotoxic metals, inorganics, PAHs, hydrocarbon, BTEX

The stockpiled materials for use during ongoing site operations, as observed during the walkover, most notably around the HARSCO yard have not been included on account of their understood short-term storage on site. Furthermore, they will likely be removed prior to any development as part of the enabling works.

2.6.2 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:

- **R1** future site users – industrial workers [oral, dermal and inhalation exposure with impacted soil, soil vapour and dust/fibres, ground gases]
- **R2** adjacent site users – industrial workers [migration of contamination via dust/fibre deposition, vapour or groundwater migration combined with inhalation]
- **R3** future buildings and services [direct contact with contaminated soils or groundwater and chemical attack]
- **R4** Surface water in the Bristol Channel [dissolution followed by lateral migration groundwater in secondary aquifer within superficial deposits and Lower Mother Ditch]

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

Groundwater has been considered as a pathway as opposed to a receptor on account of the historical and current industrial uses across the wider area. A degree of impact on the groundwater as a result of this regional land use is to be expected and hence the primary sensitive receptor is considered to be surface waters. Similarly, the Lower Mother Ditch which runs along the boundary of the site is understood to receive storm water from the site in addition to the condition of the culvert through the Made Ground being unknown. Based on this the Lower Mother Ditch has been considered a pathway as opposed to a receptor. This has been discussed with NRW as part of the previous Project Cronus findings.

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 Construction Design Management (CDM) Regulations.

Ecological receptors are only considered within the conceptual model in the context of statutory protected sites.

2.7 Potential ground gas linkages

2.7.1 Ground gas generation potential

Potential ground gas sources identified for the site and surrounding are shown in **Table 8**.

Table 8 Potential ground gas sources (excludes mine gas)

Potential sources	Indicative ground gas generation potential (CIEH, 2008)	Additional information
On-site		
S10 Natural soil strata with a low degradable organic content, e.g. alluvium, peat	Very low	-
S11 Made Ground with low degradable organic content (e.g. up to 5% organic material and no easily degradable waste).	Very low	-

Potential sources of ground gas generation have been identified therefore this potential issue has been taken forward.

- The offsite landfill located 263 m to the south is considered sufficient distance away so as not to pose an unacceptable risk.

2.7.2 Potential coal mine gas sources

The potential sources of mine gas associated with the area of the site are as follows:

- desorption of gas from coal and rocks – predominantly methane
- oxidation of coal – carbon dioxide and oxygen depletion, also methane and ethane and carbon monoxide at higher temperatures

Based on the evidence collected and in general accordance with the CL:AIRE guidance (2021a), the risk of gas generation from these sources is considered to be low due to the age of the coal workings (greater than 50 years), the presence of cohesive superficial deposits of considerable thickness and the shallow groundwater beneath the site and so the workings are likely to be flooded and not susceptible to oxidation.

Table 9 Risk estimation for potentially complete contaminant linkages

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
Sources on site						
S1 Made Ground **S2** Area of former Coke Ovens, BOS plant and coal yards. **S5** Underground/ above ground storage tanks and associated pipework	**R1** Future site users	**P1** Dermal contact, soil ingestion, dust and fibre inhalation, including vapour inhalation	Low	Medium	Moderate/low	Contaminants may be present in the Made Ground and shallow soils associated with past and current development and industrial uses. It is understood that the proposed development is likely to comprise of hardstanding and as such future direct contact and dust generation will be limited. Furthermore the associated new drainage will limit infiltration and throughflow.
	R2 Future adjacent site users – industrial workers	**P2** Migration of contamination via dust/fibre deposition, vapour or groundwater migration combined with inhalation.	Unlikely	Mild	Very low	
	R3 Future buildings and services	**P3** Direct contact with contaminated soils or groundwater and chemical attack	Likely	Medium	Moderate	
	R4 Surface water in the Bristol Channel	**P4** Dissolution and lateral migration in groundwater in the secondary aquifer and Lower Mother Ditch	Low	Medium	Moderate/low	
S3 Storage of oils/chemicals on-site **S4** Warehouse/ engineering works	**R1** Future site users	**P1** Dermal contact, soil ingestion, dust and fibre inhalation, including vapour inhalation	Unlikely	Medium	Low	Contaminants may be present albeit the impact is likely to be localised and relatively minimal with

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
	R2 Future adjacent site users – industrial workers	**P2** Migration of contamination via dust/fibre deposition, vapour or groundwater migration combined with inhalation.	Unlikely	Mild	Very low	respect to the proposed redevelopment.
	R3 Future buildings and services	**P3** Direct contact with contaminated soils or groundwater and chemical attack	Unlikely	Medium	Low	
	R4 Surface water in the Bristol Channel	**P4** Groundwater in the secondary aquifer and Lower Mother Ditch	Unlikely	Medium	Low	
S6 Scrap Yard **S7** Railway line	**R1** Future site users	**P1** Dermal contact, soil ingestion, dust and fibre inhalation, including vapour inhalation	Low	Medium	Moderate/low	Contaminants may be present as a result of the historical and ongoing land uses associated with the sources. It is understood that the proposed development is likely to comprise of hardstanding and as such future direct contact and dust generation will be limited. Furthermore the associated new drainage will limit infiltration and throughflow.
	R2 Future adjacent site users – industrial workers	**P2** Migration of contamination via dust/fibre deposition, vapour or groundwater migration combined with inhalation.	Unlikely	Medium	Low	
	R3 Future buildings and services	**P3** Direct contact with contaminated soils or groundwater and chemical attack	Low	Medium	Moderate/low	

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
	R4 Surface water in the Bristol Channel	**P4** Groundwater in the secondary aquifer and Lower Mother Ditch	Low	Medium	Moderate/low	
S10 Natural soil strata with a low degradable organic content, e.g. alluvium, peat. **S11** Made Ground. **S12** Coal Workings (Coal Mine Gases)	**R1** Future site users **R3** Future buildings and services	Ground gas migration, accumulation and inhalation	Low	Medium	Moderate/low	Natural strata is unlikely to give rise to significant flows of ground gas. Development history suggests a very low potential for the presence of Made Ground to be present with the potential to give rise to ground gas. RSK consider the actual risk rating to be low based on the evidence available. However, the nature of the Made Ground is unknown and may have the potential to generate low level of ground gases.
	R2 Future adjacent site users – industrial workers		Unlikely	Medium	Low	

Potential source	Potential receptor	Possible pathway	Likelihood	Severity	Potential risk	Justification
Sources off site						
S8 Railway bounds the site to the east. **S9** Industrial process associated within the wider steelwork to the north and Morfa Coke Oven to the west.	**R1** Future site users	**P2** Migration of contamination via dust/fibre deposition, vapour or groundwater migration combined with inhalation.	Unlikely	Medium	Low	The redevelopment is within a wider area of industrial activity which is regulated and controlled under best practice, environmental permits. Uncontrolled emissions and production of hazardous substances are therefore unlikely. With the exception of large scale bulk earthworks, the risk of dust and fibre inhalation is unlikely. Contact with groundwater is unlikely as is vapour migration.

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
	Very Unlikely	Low	Very Low	Negligible	Negligible

Receptors (**R**) and the associated potentially complete contaminant linkages with a potential risk of moderate to low or higher comprise:

- **R1** future site users – industrial workers [oral, dermal and inhalation exposure with impacted soil, soil vapour and dust/fibres, ground gases]
- **R3** future buildings and services [direct contact with contaminated soils or groundwater and chemical attack]
- **R4** Surface water in the Bristol Channel [dissolution followed by lateral migration in groundwater in secondary aquifer within superficial deposits]

In line with LCRM, these potentially complete contaminant linkages need to be assessed further through an appropriate scope of site investigation.

3 SITE INVESTIGATION STRATEGY & METHODOLOGY

3.1 Introduction

RSK undertook intrusive investigation works and subsequent monitoring of boreholes at the site between May 2024 and November 2024. The positions of the exploratory holes were in accordance with the Scope and intended to provide an assessment of general ground conditions and contamination status of the site. All works were initially designed by the Client and subject to review and amendment if required based upon the findings of the Preliminary Risk Assessment.

We have also included the site investigation and chemical test data from the previous works from Project Cronus carried in 2022 (where the sites overlap) for the purpose of a more complete assessment.

The ground investigations were carried out in general accordance with the recommendations of BS5930: 2015 Code of practice for ground investigations, which maintains compliance with BS EN 1997-1 and 1997-2 and their related standards. The exploratory holes were logged by an engineer in general accordance with the recommendations of BS 5930:2015 (which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1).

Prior to breaking ground each location was scanned using Ground Penetrating Radar (GPR), a CAT and Signal Generator and a hand excavated pit undertaken (boreholes only) in line with RSK's health and safety procedures.

The soil sampling and analysis strategy was designed to characterise each encountered soil strata and permit an assessment of the potential contaminant linkages identified. In addition, samples were taken to allow for geo-environmental testing to be undertaken.

Soils collected for laboratory analysis were placed in a variety of containers appropriate to the anticipated testing suite required. They were dispatched to the laboratory in cool boxes under chain of custody documentation. Samples were stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination.

The investigation strategy involved a combination of targeted and non-targeted boreholes and trial pits.

3.2 Objectives

The specific objectives of the investigation were as follows:

- to establish the ground conditions underlying the site including the extent and thickness of any Made Ground
- to investigate specific potential sources of contamination identified in initial CSM and whether there are any complete contaminant linkages present
- to determine groundwater depth and flow direction
- to determine the ground gas regime underlying the site.

3.3 Selection of investigation methods

The techniques adopted for the investigation were chosen with consideration of the objectives and site constraints, which are described below.

Cable percussion drilling was chosen based on the targeted drill depth, the anticipated geology, requirement for in-situ geotechnical data, the opportunity to collect both disturbed and undisturbed samples and install monitoring wells. Rotary methods were adopted where required to achieve the required depth and/or to assess the nature of the coal seams beneath the site using a combination of open hole drilling technique and coring.

This was supplemented by mechanically excavated trial pits at a number of investigation locations to achieve greater visibility of the made ground.

Prior to conducting intrusive works, service plans were provided by the client and buried service clearance undertaken in line with RSK's health and safety procedures.

3.4 Investigation strategy

The ground investigation was carried out using intrusive ground investigation techniques in general accordance with the recommendations of BS5930:2015+A1:2020, which maintains compliance with BS EN 1997-1 and 1997-2 and their related standards. Whilst every attempt was made to record full details of the strata encountered in the boreholes, techniques of hole formation and sampling will inevitably lead to disturbance, mixing or loss of material in some soils and rocks.

The investigation strategy involved targeted and non-targeted boreholes and trial pits focussing on the EAF development area, lay down areas were investigated at a lower density.

The constraints to the investigation were as follows:

- on-going activities on site including the BOS plant and HARSCO yard restricted access and exploratory hole locations
- compacted and dense ground resulting in slow and difficult excavation of service avoidance pits

Details of the investigation locations, installations and rationale are presented in **Table 10** and **Table 11**. An exploratory hole location plan is shown on **Figure 3**.

Table 10 Exploratory hole and monitoring well location rationale as carried out

Type	Location	Depth (m)	Installation	Rationale
Cable Percussive	BH301	25.05	Groundwater /gas	Characterise the underlying strata, sequence and carry out in-situ testing
Cable Percussive	BH302	7.30	-	Terminated due to unknown ferrous anomaly
Cable Percussive	BH302A	27.45	-	Characterise the underlying strata, sequence and carry out in-situ testing
Cable Percussive	BH303A	28.95	-	Characterise the underlying strata, sequence and carry out in-situ testing
Cable Percussive & Rotary Cored	BH304	75.00	-	Coal mining investigation borehole to identify and describe the sequence of coal seams

Type	Location	Depth (m)	Installation	Rationale
Cable Percussive	BH305	27.00	-	Characterise the underlying strata, sequence and carry out in-situ testing
Cable Percussive	BH306	2.00	-	Terminated due to concrete obstruction
Cable Percussive	BH306A	1.10	-	Terminated due to scrap obstruction
Cable Percussive & Rotary Cored	BH306B	30.12	-	Characterise the underlying strata, sequence and carry out in-situ testing
Cable Percussive	BH307	27.60	-	
Cable Percussive	BH308	28.45	-	
Cable Percussive	BH309	3012	NA	
Cable Percussive	BH310	29.70	-	
Cable Percussive	BH311	37.20	Groundwater / gas	
Cable Percussive & Rotary Cored	BH312	38.00	NA	
Cable Percussive	BH313	27.80	-	
Cable Percussive	BH314	25.00	-	
Cable Percussive	BH315	30.10	NA	
Cable Percussive	BH316	3.00	NA	Terminated due to suspected service being encountered
Cable Percussive	BH316a	28.00	NA	Characterise the underlying strata, sequence and carry out in-situ testing
Cable Percussive & Rotary Cored	BH317	66.63	-	Coal mining investigation borehole to identify and describe the sequence of coal seams: Amman Rider and Yard.
Cable Percussive	BH318	18.81	-	Identify strata, sequence and carry out in-situ testing
Cable Percussive	BH319	21.80	NA	Identify strata, sequence and carry out in-situ testing
Cable Percussive & Rotary Cored	BH320	58.00	-	Coal mining investigation borehole to identify and describe the sequence of coal seams; Yard, Middle 7 Feet and Lower 7 Feet.
Cable percussive	BH321	25.07	-	Characterise the underlying strata, sequence and carry out in-situ testing
Cable Percussive & Rotary Cored	BH322	76.00	Groundwater /gas	Coal mining investigation borehole to identify and describe the sequence of coal seams: Middle 7 Feet and Amman Rider. Located above and below the Kenfig-Tytalwyn Thrust Fault.
Cable Percussive	BH323	3.40	NA	Terminated due to steel obstruction encountered

Type	Location	Depth (m)	Installation	Rationale
Cable Percussive & Rotary Cored	BH332A	57.52	-	Coal mining investigation borehole to identify and describe the sequence of coal seams:
Cable Percussive & Rotary Cored	BH324	75.10	Groundwater / gas	Coal mining investigation borehole to identify and describe the sequence of coal seams: Upper 9 Feet, Lower 9 Feet and Bute
Cable Percussive	BH325	30.03	-	Confirm depths of silt and construction of lagoon (including liner). Identify strata, sequence and carry out insitu testing.
Cable Percussive	BH326	32.00	-	Confirm depths of silt and construction of lagoon (including liner). Identify strata, sequence and carry out insitu testing.
Cable Percussive	BH327	33.00	-	Confirm depths of silt and construction of lagoon (including liner). Identify strata, sequence and carry out insitu testing.
Cable Percussive	BH328	39.00	Groundwater / gas	Characterise the underlying strata, sequence and carry out in-situ testing
Cable Percussive	BH329	37.50	Groundwater / gas	Characterise the underlying strata, sequence and carry out in-situ testing
Cable Percussive	BH330	35.00	-	Characterise the underlying strata, sequence and carry out in-situ testing
Cable Percussive & Rotary Cored	BH331	30.00	Groundwater / gas	Characterise the underlying strata, sequence and carry out in-situ testing
Trial pitting by mechanical excavator	TP301-TP3001*	-	NA	Characterise the underlying strata, sequence
*Trial pits-304,315,16,321,322,328,329,330,338,339,340,347,348,349,351,352,354,355,356,358,359,360,361,362,363,364,369,370,373,377,378,379,380,382,385 and 394 were not carried out due to on-site restrictions.				

Table 11 Exploratory hole and monitoring well location rationale from Project Cronus Investigation works

Investigation type	Number	Designation	Monitoring well installation	Rationale examples below
Boreholes by rotary or cable percussive methods	19	BH1 to BH13 (BH6,7,9 not drilled) BH201 to BH209	Gas/ groundwater	To prove the geological succession beneath the site
Trial-pits excavated by hand/mechanical excavator	75	TP4 to TP60 (excluding TP 7,10,12,17,18,24,32-41 and 52)	n/a	To accurately log the upper strata in targeted and non-targeted locations beneath the site, principally in areas of historical or present day contaminative process. Collect

Investigation type	Number	Designation	Monitoring well installation	Rationale examples below
		TP201 to TP234 (Excluding TP 219 & 220)		samples from the shallow Made Ground soils

3.4.1 Implementation of investigation works

The exploratory holes were logged by an engineer in general accordance with the recommendations of BS5930:2015+A1:2020 (which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1).

The monitoring well construction and associated response zones are detailed on the exploratory hole records in **Appendix D**. The response zones were installed to target identified gas generation sources or migration pathways detailed in the initial preliminary CSM as well as groundwater as encountered during the investigation.

The soil sampling and analysis strategy was designed to characterise each encountered soil strata and permit an assessment of the potential contaminant linkages identified. In addition, samples were taken to allow for geo-environmental testing to be undertaken.

Soils collected for laboratory analysis were placed in a variety of containers appropriate to the anticipated testing suite required. They were dispatched to the laboratory in cool boxes under chain of custody documentation. Samples were stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination.

Selected samples were placed in polythene bags for headspace screening with a photo-ionisation detector (PID) fitted with a 10.6 eV bulb. The PID screening results are presented on the exploratory hole records.

3.5 Monitoring programme

3.5.1 Ground gas monitoring

In line with the initial CSM, response zones were installed to target the sources or pathways as detailed.

Five monitoring rounds have been undertaken to date to provide data to support refining of the CSM. The number of monitoring rounds undertaken is in general accordance with the decision matrix presented as Figure 6 of BS8576 for a very low/low source generation potential and low sensitivity development.

A calibrated infrared gas meter was used to measure gas flow, concentrations of carbon dioxide (CO_2), methane (CH_4) and oxygen (O_2) in percentage by volume, while hydrogen sulphide (H_2S) and carbon monoxide (CO) were recorded in parts per million.

Initial and steady state concentrations were recorded. In addition, during the first monitoring round, all wells were screened with a PID to establish if there are any interferences and cross-sensitivity of other hydrocarbons with the infrared gas meter.

The atmospheric pressure before and during monitoring, together with the weather conditions, were recorded. The monitoring included periods of falling atmospheric pressures and falling tides as follows:

- Visit 1 - 1.8.2024 - pressure fell over the preceding 3 days from 1009.14mbar to 1005.76mbar, tide from low to rising
- Visit 2 – 9.8.2024 - pressure fluctuating over the preceding 3 days from 1005.76mbar to 1002.37mbar, tide from high to falling
- Visit 3 – 30.9.2024 - pressure fell over the preceding 3 days from 1015.92mbar to 995.6mbar, tide rising to low and then falling
- Visit 4 – 29.10.2024 - pressure rising over the preceding 3 days from 1012.53mbar to 1015.92mbar, tide from low to rising
- Visit 5 – 14.11.2024 - pressure fell over the preceding 3 days from 1029.46mbar to 1022.69mbar, tide low to rising.

Atmospheric pressure data (average) from Port Talbot weather station records available online at https://www.wunderground.com/history/weekly/gb/barry/EGFF/date/2024-11-14. Tide data from https://www.tidetimes.org.uk/port-talbot-tide-times-20241114.

All ground gas monitoring results together with the temporal conditions are contained within **Appendix E**. Equipment calibration certificates are available on request.

3.5.2 Groundwater monitoring and sampling

In total, 5 rounds of groundwater monitoring were undertaken. One round of groundwater sampling was carried out. The monitoring field records are provided in **Appendix E.**

Development of the monitoring wells following installation was undertaken comprising the removal of three well volumes using a pump.

Groundwater samples were retrieved using low flow sampling methods where appropriate in general accordance with British Standard 5667 (2009).

Water samples were dispatched to the laboratory in cool boxes under chain of custody documentation.

3.6 Laboratory testing

Laboratory testing was undertaken at a UKAS accredited laboratory with ISO17025 and MCERTS accredited test methods specified where applicable for contamination testing and as shown in the laboratory test certificates appended.

3.6.1 Chemical analysis of soil samples

The soil sampling strategy was designed to characterise made ground and natural strata and the potential for contaminant migration from relevant sources identified within the preliminary CSM.

The programme of chemical tests undertaken on soil samples obtained from the intrusive investigation is presented in **Table 12** with the laboratory testing results contained in **Appendix F.** The programme of chemical tests for the soil samples obtained during the Cronus Project are presented in **Table 13.**

Table 12 Summary of chemical testing of soil samples

Stratum	Tests undertaken	No. of Tests
Made ground	Suite E – heavy metals, hexavalent chromium, pH, water soluble sulphate (SO4), organic matter, total petroleum hydrocarbons (TPH CWG), speciated PAHs (USEPA 16), phenol, cyanide (total), asbestos ID	71
Made ground	Semi volatile organic compounds (SVOCs) and volatile organic compounds (VOCs)	8
Natural	Suite E – heavy metals, hexavalent chromium, pH, water soluble sulphate (SO4), organic matter, TPH CWG, speciated PAHs (USEPA 16), phenol, cyanide (total), asbestos ID	1

Table 13 Summary of previously undertaken chemical testing of soil samples from Project Cronus

Stratum	Tests undertaken	No. of tests
Made Ground	Asbestos screening and ID	103
	Heavy metals	103
	Speciated PAHs	103
	TPH CWG	94
	SVOCs and VOCs	39
Natural strata	Heavy metals	12
	Speciated PAHs	12
	TPH CWG	9
	SVOCs and VOCs	9

3.6.2 Geotechnical analysis of soils

Where appropriate, disturbed, bulk and undisturbed soil samples were taken for geotechnical classification testing with the depth and nature of samples detailed within the exploratory hole records.

The programme of geotechnical tests undertaken on samples obtained from the intrusive investigation is reported under a separate report.

3.6.3 Chemical analysis of groundwater

Groundwater samples were collected in containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box to minimise volatilisation.

Chemical testing undertaken on water samples obtained during the monitoring programme is presented in **Table 14** and **Table 15**. Laboratory testing results are provided in **Appendix G**.

Table 14 Summary of chemical testing of water samples

Sample type	Tests undertaken	No. of tests
Groundwater	Suite F- Heavy metals, pH, water soluble sulphate (SO4), organic matter, total TPH (>C6-C40) , speciated PAHs (USEPA 16), phenol, cyanide (total), asbestos ID, hexavalent chromium	6

Table 15 Summary of chemical testing of water samples for Project Cronus

Sample type	Tests undertaken	No. of tests
Groundwater (Made Ground)	Heavy metals Speciated PAHs TPH CWG SVOCs and VOCs	38
Groundwater (Natural)	Heavy metals Speciated PAHs TPH CWG SVOCs and VOCs	8

4 SITE INVESTIGATION FACTUAL FINDINGS

The results of the intrusive investigation and subsequent geo-environmental laboratory analysis undertaken are detailed below.

4.1 Ground conditions encountered

The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, list of samples taken, field observations of soil and groundwater, in-situ testing and details of monitoring well installations are included on the exploratory hole records presented in **Appendix D**. Copies of the logs from Project Cronus are also included but the ground conditions have not been summarised below.

For the purpose of discussion, the ground conditions encountered during the fieldworks have been sub-divided into 2 separate areas. Area 1 focuses on the development and construction of the EAF itself, where area 2 encompasses the associated infrastructure for the development including the widening of existing roadways, car park and lay down areas.

4.2 Area 1 – EAF Main Development Zone

The exploratory holes in Area 1 showed a variable thickness of Made Ground over superficial deposits with South Wales Coal Measures encountered at depth. This corresponds to published geological maps and previous site investigations carried out by RSK; previous exploratory holes have been included within the below sections for completeness.

4.2.1 Made ground

Made Ground was encountered predominantly from ground level at all locations (with the exception of boreholes in the lagoon) up to a maximum thickness of 10.50 m below ground level (m bgl) (BH311). This summarised in **Table 16**.

Made Ground frequently contained gravel/cobbles of slag and varying amounts of other anthropogenic materials such as rubber, plastic, brick, ash, metal, clinker, tarmac and concrete.

BH326 and BH327 drilled within the active cooling lagoon encountered a thick layer of sediment at the bottom of the lagoon between 3.50 and 4.50 m below the water level. It was described as a black sandy silt with a strong hydrocarbon/sulphurous odour and sheen. This stratum is likely to have been deposited during the lifespan of the lagoon from the on site dust in the air from historical and on-going activities.

Table 16 Summary of Made Ground across Area 1

Exploratory Location	Depth (m)	Thickness (m)	Observations/obstructions
BH301	0.00	3.0	Gravelly sand with brick, concrete and rebar
BH302	0.00	3.60	Dense gravelly sand containing slag, some cobbles

Exploratory Location	Depth (m)	Thickness (m)	Observations/obstructions
BH302A	0.00	2.60	Dense gravelly sand containing slag, some cobbles
BH303	0.00	2.70	Gravel and cobbles. Slight hydrocarbon odour noted at 2.00 m
BH304	0.00	0.60	Gravelly sand containing slag and roadstone
BH305	0.00	3.20	Gravelly fill containing slag, roadstone, metal
BH306	0.00	>2.00	Concrete (0.90 m thick) onto gravel of metal and slag. Borehole terminated at 2.00 m due to suspected foundation
BH306A	0.00	>1.10	Concrete (0.90 m thick) onto gravel of metal and slag. Borehole terminated at 1.10 m due to probably scrap obstruction
BH306b	0.00	3.60	Reinforced concrete (0.90 m) onto sand and gravel of metal, and slag to 2.00 m bgl no cobbles and boulders of scrap metal and steel
BH307	0.00	1.00	Gravelly containing slag and concrete beneath a 0,40 m thick concrete later at surface
BH308	0.00	1.50	Gravelly containing slag and occasional wood
BH309	0.00	1.7	Concrete slab at 0.70 m bgl
BH310	0.00	3.00	Gravel onto clay containing slag, concrete and occasional rebar and timber
BH311	0.00	10.50	Granular fill containing slag, clinker and brick
BH312	0.00	6.00	Granular fill containing slag, clinker and brick
BH313	0.00	3.00	Granular fill containing slag, clinker and brick becoming reworked natural material from 1.20m
BH314	0.00	6.30	Granular fill containing slag
BH315	0.20	4.00	Strong hydrocarbon/creosote odour, sulphurous odour and an oil sheen present between 2.0-4.0m bgl
BH326	4.50	1.00	Musty sulphurous odour

Exploratory Location	Depth (m)	Thickness (m)	Observations/obstructions
BH327	3.50	2.00	Strong hydrocarbon odour and sheen
BH328	0.00	7.80	Granular and cohesive fill containing slag and occasional metal
BH329	0.00	4.00	Concrete obstructions at 1.40m bgl and 1.70m bgl. Large concrete slab between 1.70-2.10m, up to 7m long. Medium boulder content of concrete and brick

4.2.2 Blown Sand

A layer of fine to medium/coarse sand was often encountered directly beneath the Made Ground, up to a maximum thickness of 10.00 m (BH329). A summary is shown in **Table 17**. Standard penetration test (SPT) N-Values ranged between 2 to 50.

Table 17 Summary of Blown Sand Deposits across Area 1

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH301	3.00	6.0	Medium dense to loose dark grey fine to coarse sand
BH304	0.6	1.90	Loose yellow brown fine to medium sand
BH307	1.00	7.00	Medium dense yellow brown gravelly sand
BH308	1.50	5.00	Loose becoming medium dense yellowish brown sand
BH309	1.70	7.30	Loose to medium dense brown fine to coarse sand
BH310	3.00	4.00	Loose to very dense light brown sand
BH311	10.50	8.25	Dense grey/dark brown clayey fine to medium sand
BH312	6.00	5.50	Very dense yellow brown fine to coarse sand
BH313	3.00	4.00	Loose yellow brown fine to coarse sand
BH326	5.50	1.10	Clayey silty fine to medium sand
BH327	8.50	1.50	Greyish brown fine to medium sand
BH329	4.00	10.0	Loose dry yellow brown fine to coarse sand

4.2.3 Tidal Flat Deposits

Tidal Flat Deposits were often recorded as interbedded layers of dark organic silt, clay, peat and sand of varying strengths and densities to a maximum thickness of 20.70 m (BH328). A summary is shown in **Table 18** SPT N-values ranged between 1 – 49.

Table 18 Summary of Tidal Flat Deposits across Area 1

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH301	9.00	10.81	Firm greenish grey sandy silty clay, with occasional bands of sand and gravel
BH302	3.60	>3.70 (base not proven)	Borehole terminated due to ferrous anomaly
BH302A	2.60	17.40	Gravelly sand becoming clay with depth and occasional peat
BH303A	2.70	16.00	Sand, clay and peat
BH304	2.50	17.20	Sand, clay and peat
BH305	3.20	14.10	Sand, clay and peat
BH306B	3.60	13.40	Sand, clay and peat
BH307	8.00	12.00	Sand, clay and peat
BH308	6.50	11.00	Sand, clay and peat
BH309	9.00	7.00	Sandy silty clay or sandy clayey silt with peat
BH310	7.00	14.80	Clay and silt with occasional peat
BH311	18.75	10.75	Peat and clay becoming sand with depth
BH312	11.50	16.20	Loose silty sand, soft to firm silt, clay and layers of peat. Moderate organic odour
BH313	7.00	11.00	Firm and soft clay
BH314	6.30	10.20	Loose silty sand, soft to firm silt, clay and layers of peat. Moderate organic odour
BH315	4.00	12.80	Medium dense sand, soft to firm clay. Slight hydrocarbon odour between 4.00-7.50m bgl. Moderate organic odour between 10.80-16.80m bgl
BH325	5.00	12.50	Silty clay or clayey sandy silt and peat
BH326	6.60	12.40	Silty clay or clayey sandy silt and peat
BH327	10.00	8.00	Thick layers of peat and silty clay

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH328	7.80	20.70	Firm becoming very soft organic silts clay with layers of peat. Medium dense silty fine sand
BH329	15.45	14.55	Medium dense fine silty sand over very stiff silty clay with peat. Becomes very soft sandy silty clay with organic odour and petrified wood

As stated above, peat was encountered within the Tidal Flat Deposits as summarised in **Table 19** below.

Table 19 Summary of peat within Area 1

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH302A	10.70	2.30	Soft grey fibrous peat
BH303A	10.85	0.20	Firm orangish brown fibrous peat
BH304	11.50	0.50	Firm dark brown fibrous peat
BH305	11.00	1.50	Stiff brown peat
BH306B	10.45	2.05	Firm brown fibrous peat
BH307	11.60	13.80	Firm to stiff blackish red fibrous peat
BH308	11.90	2.50	Firm reddish brown fibrous peat
BH309	11.00	1.50	Brown fibrous peat
BH310	12.60	0.60	Firm reddish brown fibrous peat
BH311	18.75	1.25	Stiff brown fibrous peat
BH312	18.00	1.50	Stiff brown fibrous peat
BH314	10.90	2.30	Firm dark greyish brown clayey peat
BH317	8.90	0.20	Very soft dark brown peat
BH318	8.20	1.50	Firm brown peat
BH320	6.30	1.50	Firm brown fibrous peat
BH321	4.70	0.10	Brown peat
BH321	7.60	0.50	Firm dark brown fibrous peat
BH322	7.50	1.50	Soft brown fibrous peat
BH325	11.00	1.70	Firm reddish brown fibrous peat
BH326	10.50	1.10	Firm brown fibrous peat
BH327	10.00	2.00	Firm dark reddish brown fibrous peat

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH327	16.50	16.80	Firm brown fibrous peat

4.2.4 Glaciofluvial Deposits

Glaciofluvial deposits were encountered beneath the Tidal Flat Deposits, at depths of between 15.00 m bgl (BH301) and 18.70 m bgl (BH303) and predominantly contained gravels and boulders. A summary is shown in **Table 20** below. SPTs undertaken within this stratum often reached refusal (N-value = 50) and N-values were frequently recorded in the upper 30's or 40s. An outlier of N=11 was recorded in BH301.

Table 20 Summary of Glaciofluvial Deposits across Area 1

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH301	15.00	10.05	Gravelly clay or clayey sand with moderate cobble content of mudstone/sandstone
BH303	18.70	3.30	Dense sandy gravel

4.2.5 South Wales Coal Measures

The South Wales Coal Measures were encountered as mudstone and coal at depths of between 27.00 (BH309) and 37.50 m (BH328). Coal was present in BH328 between 37.50 m bgl and 39.38 m bgl (base not proven). A summary is shown in **Table 21** below.

Table 21 Summary of South Wales Coal Measures across Area 1

Exploratory Location	Depth (m)	Thickness (m)	Observations (incl coal)
BH301	19.81	>5.24	Cohesive becoming granular with depth containing sandstone and mudstone. Rockhead not proven
BH302A	20.00	>7.45	Weathered mudstone gravel becoming clay. Rockhead not proven
BH303A	22.00	>6.80 (base not proven)	Weathered mudstone clay becoming weak rock at 28.10 m
BH304	19.70	>54.50	Weathered granular horizons, mainly comprising cobbles, rock head encountered at 28.90 m predominately mudstone with some coal seams and sandstone
BH305	17.30	>9.70	Encountered weathered as granular becoming cohesive-rockhead not proven
BH306B	17.00	>13.12	Weathered cohesive becoming granular. Rockhead proven at 27.80 m

Exploratory Location	Depth (m)	Thickness (m)	Observations (incl coal)
BH307	22.00	>5.60	Encountered weathered as granular becoming cohesive. Rockhead not proven
BH308	17.50	10.95	Weathered horizons mixture of granular and cohesive horizons. Rockhead encountered at 27.90 m
BH309	16.00	14.14	Weathered horizons mixture of granular and cohesive horizons. Rockhead encountered at 27.00 m
BH310	29.70	-	Possible rockhead
BH311	36.00	1.45 (base not proven)	Mudstone (no coal)
BH312	34.70	3.75 (base not proven)	Mudstone (no coal)
BH325	17.50	12.53 (base not proven)	Weathered (recovered as gravel becoming clay) bedrock at 27.60 m
BH326	27.00	5.00 (base not proven)	Siltstone (no coal)
BH328	28.50	>10.88	Weathered granular and cohesive horizons onto Coal between 37.50 m – 39.38 m base not proven
BH329	36.40	1.37 (base not proven)	Mudstone (no coal)

4.3 Area 2 – Associated Development Zone (lay-down areas/roads/Car Parks)

The exploratory holes in Area 2 showed a variable thickness of Made Ground over several types of superficial deposits (blown sands, tidal flats and glaciofluvial) with South Wales Coal Measures encountered at depth. This corresponds to the published geological maps and previous site investigations carried out by RSK.

4.3.1 Made ground

Made Ground was encountered from ground level at all locations up to a maximum thickness of 6.50 m (BH330).

Made Ground frequently contained gravel/cobbles of slag and varying amounts of other anthropogenic materials such as ash, slag, brick, ash, metal, clinker, tarmac and concrete. A summary is shown in **Table 22** below.

Table 22 Summary of Made Ground across Area 2

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH316	0.00	3.00	Concrete obstruction/inspection chamber encountered at 3.00 m bgl
BH316a	0.00	3.30	Slight hydrocarbon odour
BH317	0.00	4.10	Gravel and sand containing brick, slag and some coal and wood
BH318	0.00	6.00	Gravelly fill containing slag, brick and coal. Sand layer between 1.30 m and 3.60 m bgl
BH319	0.00	2.50	Gravel of brick and some slag cobbles
BH320	0.00	3.00	Gravelly with ash and slag, clay between 1.50 m and 2.00 m bgl
BH321	0.00	1.00	Gravel of slag, brick and tarmac some slag cobbles an occasional metal
BH322	0.00	4.40	Large piece of steel at 1.00 m bgl (1.70 m x 0.10 m x 0.15 m)
BH323	0.0	3.40	Refused at 3.40 m bgl
BH323A	0.00	6.10	Gravel and cobbles of slag and mudstone with depth
BH324	0.00	4.00	Gravel and sand containing brick, slag and some mudstone and occasional slay cobbles
BH330	0.00	6.50	Gravel and cobbles with clay layer between 4.50 m and 5.50 m bgl
BH331	0.00	6.30	Gravel and sand with clay layer between 3.20 m and 3.80 m bgl

4.3.2 Blown Sand

A layer of fine to medium/coarse sand was often encountered directly beneath the Made Ground, up to a maximum thickness of 4.40 m bgl (BH316). A summary is shown in **Table 23** below. Recorded SPT N-values ranged between 2 to 17.

Table 23 Summary of Blown Sand Deposits across Area 2

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH316a	3.30	4.40	Medium dense greyish brown fine to medium sand
BH319	2.50	2.00	Medium dense brown fine to coarse sand

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH321	1.00	3.00	Yellowish brown fine to coarse sand.

4.3.3 Tidal Flat Deposits

Tidal Flat Deposits were often recorded as interbedded layers of dark organic silt, clay, peat and sand of varying strengths and densities to a maximum thickness of 13.50 m (BH320). A summary is shown in **Table 24** below. SPT N-Values ranged between 1 to 25.

Table 24 Summary of Tidal Flat Deposits across Area 2

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH316a	7.70	8.30	Soft clay with occasional sand
BH319	4.50	12.00	Very soft clay
BH320	3.00	13.50	Clay with peat
BH322	4.40	5.10	Soft silty clay or sandy silt with peat
BH324	4.00	9.50	Loose clayey sand, very soft to soft organic silty clay and peat
BH331	6.30	10.0	Interbedded very soft to soft sandy silty organic clay (slight to strong organic odour) with medium dense fine to medium sand

As stated above, peat was encountered within the Tidal Flat Deposits as summarised in **Table 25** below.

Table 25 Summary of peat within Area 2

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH317	8.90	0.30	Soft dark brown peat- strong organic odour
BH318	8.20	1.50	Firm brown peat
BH320	6.30	1.50	Firm brown fibrous peat
BH321	4.70	0.10	Brown peat
BH321	7.60	0.50	Firm dark brown fibrous peat
BH322	7.50	1.50	Soft brown fibrous peat

4.3.4 Glaciofluvial Deposits

Glaciofluvial deposits were encountered beneath the Tidal Flat Deposits, at depths of between 9.50 m (BH322) and 16.50 m (BH319) and predominantly contained gravels and boulders. Standard penetration tests. A summary is shown in **Table 26** below. N-Values were generally in the 30s to 50s, whilst the lowest value recorded was 6 in BH331.

Table 26 Summary of Glaciofluvial Deposits across Area 2

Exploratory Location	Depth (m)	Thickness (m)	Observations
BH316a	16.00	12.22	Dense sandy clayey gravel with high cobble content of mudstone/siltstone and sandstone
BH317	14.00	9.50	Dense sand becoming sandy clayey gravel with high cobble content of mudstone/siltstone and sandstone
BH319	16.50	4.80	Medium dense clayey gravel and cobbles of mudstone
BH321	10.00	13.50	Medium dense gravel with high cobble content
BH322	9.50	-	Medium dense gravel with high cobble content
BH323A	10.00	15.20	Very dense gravel and cobbles-clay layer present between 17.50 m and 21.00 m bgl
BH324	13.50	8.50	Dense gravel and cobbles of mudstone and sandstone. Firm to stiff very gravelly clay with high cobble content
BH331	16.30	9.40	Dense to very dense sandy silty clayey gravel/ medium dense clayey sand/ very stiff sandy gravelly silty clay

4.3.5 South Wales Coal Measures

The South Wales Coal Measures were encountered as mudstone and coal at depths of between 15.50 m bgl (weathered) (BH322) and 25.70 m bgl (BH331). Coal was present in BH320 between 48.50 m bgl and 50.70 m bgl. A summary is shown in **Table 27** below.

Table 27 Summary of South Wales Coal Measures across Area 1

Exploratory Location	Depth (m)	Thickness (m)	Observations (incl coal)
BH319	21.30	0.95 (base not proven)	Mudstone (no coal)
BH320	20.00	>38.00 (base not proven)	Coal noted between 48.50 m and 50.70 m (unweathered)
BH321	10.00	>15.07	Weathered gravel and cobbles becoming clay
BH322	15.50	26 (base not proven)	Weathered becoming weak rock Sandstone, siltstone, mudstone. Coal between 54-59 m and 74.8-76.0 m (base not proven)

Exploratory Location	Depth (m)	Thickness (m)	Observations (incl coal)
BH323	17.50	>40.02	Weathered clay becoming granular- rock head encountered ta 25.20m. Coal bands between 31.30 and 31.70 m, 32.60 and 33.30 m, 36.20 and 36.80 m and 55.00 m and 55.60 m
BH324	22.00	53.10 (base not proven)	Interbedded mudstone and siltstone/fine sandstone. Coal bands between 26.50-26.65 m, 27.40-29.50m, 44.50-46.35 m, 53.70-54.0 and 73.70-74.50 m
BH330	25.20	>9.80	Coal at 25.20 m onto siltstone at 26.00 m
BH331	25.70	4.33 (base not proven)	Mudstone (no coal)

4.3.6 Visual/olfactory evidence of soil contamination

During the most recent investigation works visual and/or olfactory evidence for soil contamination (sheens and strong hydrocarbon odours, as well as creosote odour in BH315) were encountered predominantly in the Made Ground in the storage area to the south (BH315) of the existing BOS plant/lagoon car par and in the soil beneath the lagoon (BH327). BH315 is situated in the southeast of Area 1 and BH327 in the central part of Area 1. Slight hydrocarbon odours were also noted in BH303 and BH308 to the north if the lagoon in Area 1 and BH316 in Area 2 in the vicinity of the proposed workshop. From the trial pit logs, visual and olfactory signs of contamination (hydrocarbon/asphalt odours) were predominately observed in the DLS Regeneration Yard area, with the worst impact observed in made ground in TP397, where strong hydrocarbon/asphalt odours were noted as well as sand coated in oil to a depth of 0.60 m bgl.

During the previous Project Cronus works visual and/or olfactory evidence for soil / groundwater contamination was predominately observed in the vicinity of BH202, BH204, TP207, TP208, TP210 and TP397 in the DLS Regeneration Yard, where former coke ovens were previously located. In this area, strong hydrocarbon odours and sheens were recorded on water seepages/strikes as well as the highest PID reading to date (1200ppm BH202 at 12.00 m bgl). In BH202, visual and olfactory signs of contamination were observed predominantly in the natural deposits (peat, silts and sand), with no signs of contamination observed below 15.20 m bgl at which point PID readings also reduced to 0.5ppm. Visual and olfactory signs of contamination were locally observed in other areas across the site, during Project Cronus but to a lesser extent.

Visual asbestos was not encountered in any of the exploratory holes completed during this phase of works, but ACM cement fragments were observed in made ground during Project Cronus in TP04 at 1.35 m to 1.40 m bgl.

A summary of the visual and olfactory signs of contamination encountered during this investigation are summarised in **Table 28** and from Project Cronus in Table 29. A PID meter was used during the investigation, all readings are reported in the exploratory logs.

Table 28 Summary of visual/olfactory evidence of contamination

Exploratory Location	Strata	Thickness (m)	Observations
BH303A	Made Ground	2.00- 2.70	Slight hydrocarbon odour
BH308	Made Ground	0.90-1.50	Slight hydrocarbon odour
BH315	Made Ground	2.00 - 4.0	Strong hydrocarbon/creosote odour, sulphurous odour and oil sheen
BH315	Tidal Flat deposits	4.00- 7.50	Slight hydrocarbon odour
BH316a	Made Ground	1.50-3.3	Slight hydrocarbon odour
BH325	Tidal Flat Deposits	5.00 – 6.3	Musty sulphurous odour
BH326	Made Ground (lagoon sludge)	4.50 - 5.5	Musty sulphurous odour
BH327	Made Ground (lagoon sludge)	3.50 - 5.5	Strong hydrocarbon odour and sheen
TP341	Made Ground	2.00 – 2.80	Strong hydrocarbon odour
TP371	Made Ground	0.30 – 0.80	Slight hydrocarbon odour
TP374	Made Ground	1.40-2.90	Strong hydrocarbon odour
TP375	Made Ground	1.60 – 3.10	Hydrocarbon odour
TP376	Made Ground	0.50 – 2.6	Strong hydrocarbon odour
TP397	Made Ground	0.00 – 0.60	Strong hydrocarbon/ asphalt odour
TP399	Made Ground	0.00– 0.80	Slight hydrocarbon odour

Table 29 Summary of visual/olfactory evidence of contamination from Project Cronus

Exploratory Location	Strata	Depth (m BGL)	Observation
TP06	Made ground	0.20	Moderate hydrocarbon odour noted
TP08	Made ground	1.60	Slight hydrocarbon odour noted
TP09	Made ground	2.00	Slight hydrocarbon odour noted
TP10	Made ground	0.60	Slight hydrocarbon odour noted
TP19	Made ground	From ground level	Product and hydrocarbon odour
TP22	Made ground	1.60	Slight hydrocarbon odour noted
TP26	Made ground	0.90	Slight hydrocarbon odour noted
TP201	Made ground	1.30	Strong hydrocarbon odour noted
TP202	Made ground	1.70	Sheen on water seepage. Oil slick/sheen on soil noted
TP203	Made ground	1.20	Moderate hydrocarbon odour noted
TP204	Made ground	1.80	Coal tar/ hydrocarbon odour noted
TP205	Made ground	1.40	Sheen on water noted
TP207	Made ground	0.80	Sheen on water and Coal Tar odour noted
TP208	Made ground	From ground level	Strong hydrocarbon odour noted
TP210	Made ground	0.15	Strong hydrocarbon odour noted
TP210	Made ground	0.95	Sheen on water. Extremely strong Hydrocarbon odour noted.
TP232	Made ground	1.00	Hydrocarbon odour noted
TP232	Made ground	2.00	Sheen on water noted
TP234	Made ground	1.30	Visual hydrocarbon contamination noted
BH201	Made ground	0.15	Slight hydrocarbon odour noted
BH201	Made ground	1.40	Visual contamination and moderate hydrocarbon odour noted
BH201	Tidal Flat Deposits	5.00	Slight hydrocarbon odour noted
BH202	Tidal Flat Deposits	5.00	Strong hydrocarbon odour and slight sheen on soil noted, PID 250ppm
BH202	Tidal Flat Deposits	7.20	Strong hydrocarbon odour noted, PID 300ppm
BH202	Tidal Flat Deposits	9.00	Strong hydrocarbon odour noted, PID 700ppm
BH202	Tidal Flat Deposits	12.00	Visual contamination and strong hydrocarbon odour noted, PID 1200ppm
BH203	Made Ground	From ground level	Slight hydrocarbon odour noted

Exploratory Location	Strata	Depth (m BGL)	Observation
BH203	Made Ground	1.90	Visual staining contamination and moderate hydrocarbon odour noted
BH203	Made Ground	3.00	Slight hydrocarbon odour noted
BH204	Made Ground	1.40	Strong hydrocarbon odour noted, PID 103ppm
	Tidal Flat Deposits	4.50	Slight hydrocarbon odour noted
BH205	Made Ground	5.80	Possible visual contamination noted
BH208	Made Ground	0.80	Moderate hydrocarbon odour noted
BH209	Made Ground	1.60	Moderate hydrocarbon odour noted

4.4 Groundwater

4.4.1 Groundwater encountered during intrusive works

Groundwater was encountered during these intrusive works as summarised in **Table 30**. The groundwater water encountered during Project Cronus is summarised in **Table 31**.

Table 30 Summary of groundwater results observed during fieldwork

Exploratory Location	Strata	Groundwater depth (m)	Comments
BH301	Made Ground	2.50	Strike
BH302A	Made Ground	2.18	Strike
BH303A	Made Ground	2.64	Strike
BH305	Made Ground	2.43	Strike
BH306B	Made Ground	1.50	Strike- significant flow
BH307	Made Ground	2.40	Strike
BH308	Made Ground	2.10	Strike
BH310	Made Ground	3.31	Strike
BH313	Blown Sand	5.60	Strike
BH314	Made Ground	1.20	Strike
BH315	Made Ground	1.50	Strike
BH316a	Made Ground	2.10	Seepage
BH317	Made Ground	2.30	Strike
BH318	Made Ground	3.00	Strike
BH319	Blown Sand	3.20	Strike
BH320	Made Ground	2.60	Strike

Exploratory Location	Strata	Groundwater depth (m)	Comments
BH321	Tidal Flat Deposits	9.00	Strike
BH322	Tidal Flat Deposits	9.50	Strike
BH323	Made Ground	2.50	Strike
BH324	Made Ground	2.00	Seepage
BH325	Tidal Flat Deposits	9.20	Strike
BH326	Tidal Flat Deposits	11.00	Strike
BH327	Tidal Flat Deposits	11.20	Strike
BH328	Tidal Flat Deposits	12.20	Strike
BH329	Made Ground	1.70	Seepage
BH330	Made Ground	1.80	Strike
BH331	Made Ground	4.00	Seepage
TP3001	Made Ground	2.00	Seepage
TP3002	Made Ground	2.50	Seepage
TP308	Made Ground	1.40	Seepage
TP309	Made Ground	2.10	Seepage
TP310	Made Ground	2.00	Seepage
TP311	Made Ground	2.40	Seepage
TP312	Made Ground	2.30	Seepage
TP325	Made Ground	3.30	Seepage
TP386	Made Ground	2.40	Seepage
TP392	Made Ground	3.30	Seepage

Table 31 Summary of groundwater results observed during fieldworks from Project Cronus investigation

Exploratory Location	Strata	Groundwater depth	Comments
TP06	Made Ground	1.20	Seepage
TP08	Made Ground	1.50	Seepage
TP09	Made Ground	2.00	Seepage
TP11	Made Ground	2.20	Seepage

Exploratory Location	Strata	Groundwater depth	Comments
TP13	Made Ground	2.90	Seepage
TP19	Made Ground	2.00	Seepage
TP21	Made Ground	1.80	Seepage
TP22	Made Ground	1.60	Seepage
TP23	Made Ground	1.20	Seepage
TP26	Made Ground	2.70	Seepage
TP28	Made Ground	2.20	Seepage
TP43	Tidal Flat Deposits	1.50	Seepage
TP44	Tidal Flat Deposits	2.00	Seepage
TP47	Tidal Flat Deposits	1.50	Seepage
TP48	Tidal Flat Deposits	1.50	Seepage
TP49	Tidal Flat Deposits	2.00	Seepage
TP50	Tidal Flat Deposits	1.50	Seepage
TP51	Made Ground	1.30	Seepage
TP53	Made Ground	1.00	Seepage
TP56	Made Ground	0.30 & 2.00	Seepage at 0.30m
TP57	Made Ground	2.00	Slow Inflow
TP58	Made Ground	1.80	Slow Inflow
TP59	Made Ground	1.50	Slow Inflow
TP201	Made Ground	2.60	Seepage
TP202	Made Ground	1.70	Fast Inflow
TP203	Made Ground	2.20	Seepage
TP204	Made Ground	2.00	Seepage
TP205	Made Ground	1.40	Seepage
TP206	Made Ground	2.00	Slow Inflow
TP207	Made Ground	0.90	Fast Inflow
TP208	Made Ground	1.00	Seepage
TP209	Made Ground	1.40	Seepage

Exploratory Location	Strata	Groundwater depth	Comments
TP210	Made Ground	1.80	Seepage
TP211	Made Ground	1.00	Seepage
TP227	Made Ground	2.20	Seepage

4.4.2 Groundwater encountered during monitoring

Resting groundwater levels recorded during the monitoring programme are summarised in **Table 32**. Field records are provided in **Appendix E.**

Table 32 Summary of groundwater monitoring results

Monitoring well	Response zone stratum	GL elevation (m AOD)	Min depth to water (mbgl)	Max depth to water (mbgl)	Groundwater elevation (m AOD) – min.	Groundwater elevation (m AOD) – max.
BH301	Tidal Flat Deposits	8.417	1.33	1.40	7.087	7.017
BH311	Tidal Flat Deposits	16.231	DRY	7.54	-	8.691
BH315	Tidal Flat Deposits	7.758	0.07	1.32	7.688	6.438
BH317	Tidal Flat Deposits	6.761	2.15	2.58	4.611	4.181
BH322	Tidal Flat Deposits	6.586	3.14	3.38	3.446	3.206
BH324	Tidal Flat Deposits	5.358	0.94	1.43	4.418	3.928
BH328	Tidal Flat Deposits	17.308	10.36	10.55	6.948	6.758
BH329	Tidal Flat Deposits	17.308	10.03	11.18	7.278	6.128
BH330	Tidal Flat Deposits	6.34	1.95	2.54	4.39	3.8
BH331	Tidal Flat Deposits	7.543	3.14	3.37	4.403	4.173

The findings reflect the groundwater table in the Tidal Flat Deposits, which was recorded at an elevation of 8.691 m to 3.206 m AOD. It is noted that the gauging data presented in **Table 32** was not completed within a short timeframe i.e. at the same state of the tide, therefore, a piezometric flow drawing has not been created. The groundwater monitoring results from Project Cronus are summarised in **Table 33** below.

Table 33 Summary of groundwater monitoring results from Project Cronus

Monitoring well	Response zone stratum	Min Depth to water (mb TOC)	Max Depth to water (mb TOC)
BH1 (shallow)	Made ground	2.05	2.18
BH1 (deep)	Natural ground	2.05	2.18
BH2 (shallow)	Made ground	0.35	0.53
BH2 (deep)	Natural ground	3.87	0.53
BH3 (shallow)	Made ground	0.82	0.93
BH3 (deep)	Natural ground	3.75	4.03
BH4 (shallow)	Made ground	2.045	2.28
BH4 (deep)	Natural ground	2.45	2.65
BH5	Natural ground	2.92	2.97
BH8	Natural ground	1.90	1.96
BH10	Natural ground	1.09	2.64
BH11	Natural ground	0.28	0.90
BH12 (shallow)	Made Ground	2.16	2.20
BH12 (deep)	Natural ground	2.66	2.71
BH13	Natural ground	1.07	1.38
BH201	Natural ground	1.95	2.19
BH202	Natural ground	2.97	3.27
BH203	Natural ground	0.85	1.25
BH204	Natural ground	3.82	4.75
BH205	Natural ground	2.29	2.44
BH207	Natural ground	3.20	3.74
BH208	Natural ground	2.43	2.75
BH209	Natural ground	2.00	2.30
Notes	*TOC- Top of cover* *AOD- Above Ordnance Datum*		

It should be noted that groundwater levels might fluctuate for a number of reasons including seasonal and tidal variations that is not captured in the above monitoring programme. From continual monitoring carried out during the supplementary work from Project Cronus, tidal patterns were indeed identified, these are likely to be similar in the areas of the proposed development due to the strata likely being in hydraulic continuity.

4.4.3 Visual/olfactory evidence of groundwater contamination

No visual/olfactory evidence of contamination in groundwater was noted during well development, monitoring and sampling. During the sampling of the boreholes in the area of the former Coke ovens a sheen was noted, most notable from samples obtained from BH202 and BH207.

4.5 Chemical laboratory results

The soil and groundwater testing results are presented in **Appendix F and G**.

4.6 Geotechnical laboratory results

Geotechnical testing is currently on-going and will be reported under a separate report.

4.7 Ground gas monitoring

The results of the ground gas monitoring and testing carried out to date are provided in **Appendix E.** It is noted that continuous gas and flow monitoring has previously completed at the site using Ambisense GasfluX devices installed in BH201 to BH209 excluding BH206 over an 8 week period, to investigate the organic strata (peat) deposits encountered at the site. Flow rates over the eight week period remained low with a maximum flow rate of 2.11l/hr recorded in BH203, with a maximum methane concentration of 41.01%vol and maximum carbon dioxide concentration of 3.82%vol. This data has also been considered in the ground gas assessment detailed in this report, please refer to Section 5.5.

5 GEO-ENVIRONMENTAL ASSESSMENT

5.1 Refinement of initial CSM

The nature, composition and thickness of Made Ground encountered in the areas of previous developments encountered was as anticipated from the initial CSM. However, no complete contaminant linkages with a risk of moderate or higher were identified. The findings of this investigation are in line with our initial CSM and the findings of the previous site investigation works and as such no refinement of the CSM is considered warranted.

To assess the general ground conditions analysis of soils were undertaken by RSK as part of the Phase 2 investigation.

5.2 Linkages for assessment

As described in LCRM (Environment Agency, 2023), there are two stages of quantitative risk assessment (QRA), Tier 2 generic (GQRA) and Tier 3 detailed (DQRA). The GQRA comprises the comparison of soil, groundwater, soil gas and / or ground gas results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results or following statistical analysis depending upon the sampling procedure that was adopted. This assessment relates to LCRM Stage 1, Tier 2 GQRA.

5.3 Generic quantitative risk assessment

The receptors (**R**) and the associated potentially complete contaminant linkages that require further assessment are detailed below:

- **R1** future site users – industrial workers [**H1, H2** oral, dermal and inhalation exposure with impacted soil, soil vapour and dust/fibres and **G1** ground gases]
- **R3** future buildings and services [direct contact with contaminated soils or groundwater and chemical attack]
- **R4** Surface water in the Bristol Channel [dissolution followed by lateral migration in groundwater in secondary aquifer within superficial deposits and the Lower Mother Ditch]

The potentially complete contaminant linkages that require further assessment and the methodology of assessment are presented in each section. **R3** will be reported and assessed with the separately reported geotechnical design report (GDR).

5.4 Methodology and assessment of human health linkages

The linkages pertaining to human exposure to chemical contamination are as follows:

- **H1**. Oral, dermal and inhalation exposure with impacted soil, soil vapour and dust by future site users
- **H2**. Inhalation exposure of future site users to asbestos fibres
- **G1**. Ground gases exposure.

5.4.1 H1. Oral, dermal and inhalation exposure with impacted soil by future occupants/site users

Soil contaminant concentrations have been compared against Human health GAC for a commercial land use based on 1% soil organic matter in **Appendix H.** The groundwater analysis results from this phase of works and those collected as part of Project Cronus, have been compared to the RSKs groundwater assessment criteria (GrAC), also presented in **Appendix H**, which were derived to assess potential vapour risks from volatilisation of contaminants of concern in groundwater.

In order to assess the soil results against the appropriate GAC, the soil results have been split into appropriate data sets relevant to the material identified on site.

The datasets being considered in the assessment are:

- data set 1 Made Ground
- data set 2 Natural

All soil sampling results have been compared with the commercial GAC. A soil organic matter (SOM) of 1% has been selected based on the most conservative value available for this assessment. The soil and groundwater (human health GAC and GrAC assessments) screening output spreadsheets are presented as **Appendix J**.

The exceedances in soil GACs from this phase of works are summarised in **Table 34**. None of the measured concentrations in groundwater during this phase of works were found to be in excess of the GrAC.

Table 34 Data summary table- made ground

Determinand	GAC (mg/kg)	No of exceedances	Maximum concentration (mg/kg)	
			Value	Location - depth (m bgl)
Aromatic >C10-C12	16000	1	150000	TP397- 0.00*
Benzene	27	1	43	TP397- 0.00*
Benzoanthracene	170	1	310	TP397- 0.00*
Benzo(a)pyrene	77	1	180	TP397- 0.00*
Dibenz(a,h)anthracene	3.5	2	47	TP397- 0.00* (2nd exceedance TP309 at 0.4m bgl (3.9mg/kg))
*The near surface soils were heavily stained and had a strong hydrocarbon odour				

No exceedances were noted in the natural soils during this investigation.

It is noted that the tier 1 values were also exceeded for naphthalene, fluorene, as well as aliphatic and aromatics in the range > C10-C16 in a number of locations. One or more of these determinants exceeded the tier 1 values, which are theoretical soil saturation limits in BH312, TP302, TP399, TP397, TP375, TP374 and TP341. Given that the relevant contamination pathway here is migration to indoor air and none of these locations are situated near to the proposed warehouse or office building, these tier 1 exceedances are not considered to be of concern.

The soil exceedances from Project Cronus are shown in **Table 35** and **Table 36**. None of the measured concentrations in groundwater during this phase of works were found to be in excess of the GrAC.

Table 35 Data summary table — Made Ground from Project Cronus

Determinand	GAC (mg/kg)	No of exceedances	Maximum concentration (mg/kg)	
			Value	Location - depth (m bgl)
Lead	2300	1	10600	TP19 – 0.2
Aromatic >C10-C12	16000	2	290000	TP208 - 0.2
Aromatic >C16-C21	28000	1	28200	TP208 - 0.2
Benzo(a)anthracene	170	1	866	TP208 - 0.2
Benzo(a)pyrene	77	1	464	TP208 - 0.2
Benzo(b)fluoranthene	44	4	953	TP208 - 0.2
Chrysene	350	1	1170	TP208 - 0.2
Dibenzo(ah)anthracene	3.5	5	118	TP208 - 0.2
Naphthalene	1800	2	51300	TP208 - 0.2

Table 36 Data summary table- Natural Soil from Project Cronus

Determinand	GAC (mg/kg)	No of exceedances	Maximum concentration (mg/kg)	
			Value	Location - depth (m bgl)
Aromatic >C10-C12	16000	3	80800	BH202 - 9.00
Aromatic >C12-C16	36000	3	151000	BH202 - 9.00
Benzene*	27	3	269	BH202 - 9.00
Benzene**	27	2	51.6	BH202 – 7.50
Naphthalene	1800	4	19400	BH202 – 9.00
*Benzene identified by testing through TPH CWG. **Benzene identified by testing VOCs.				

During the Project Cronus investigation, the tier 1 values (soil saturation limits) were also exceeded, however, the relevant contaminant pathway relates to indoor air migration and since none of these locations were located in the vicinity of the proposed warehouse and office building footprints the exceedances are not of concern (see 5.4.1.1 below).

5.4.1.1 Summary

On the basis of the above assessment, exceedances were recorded within the natural soils during the Project Cronus investigation. No exceedances were noted in the natural soils during the current investigation reported within.

It is considered that there are potential risks associated with the soil contamination within the Tidal Flat Deposits and the near surface soils, within the area of the former Grange Coke Ovens with respect to human health.

Based on the contaminants identified in excess of the commercial GAC, potential risks to human health are, with the exception of benzene, driven by dust inhalation pathways. As such, these contaminants are not considered to pose a risk if present in areas proposed to be covered by hardstanding, and by the inclusion of a clean cover system in soft landscaped areas which will mitigate potential risks to human health by breaking the direct contact pathways including dust inhalation.

Potential risks from benzene are driven by vapour inhalation pathways in indoor air. Potential risks from vapour inhalation have been assessed based on a lines of evidence approach as follows:

- benzene was only identified in BH202 at concentrations in excess of the commercial end-use GAC and this location is greater than 350 m to the proposed office and warehouse buildings
- none of the measured concentrations in groundwater exceeded the GrAC
- in the exploratory hole locations completed closest to the areas of the proposed office and warehouse buildings (BH316a, BH203, TP214, TP215, TP324, TP366, TP306, TP323) visual and olfactory evidence of contamination (such as hydrocarbon odours and staining, sheen and coal tar/creosote odours) were absent, except for slight hydrocarbon odours noted in BH316a at 1.50 m to 3.30 m bgl, which correspond to a PID reading of <0.1ppm
- PID readings in the exploratory holes closest to the areas of the proposed office and warehouse buildings have been reported at concentrations generally below or in the same order of magnitude as the instrument detection limit (<0.1ppm).

Based on the above there is not considered to be an unacceptable risk posed to human health via vapour inhalation.

Consideration will need to be given to any potential reuse of soils at the site during proposed redevelopment works, for instance any materials observed to contain gross contamination such as heavy staining and/or free phase product or visible ACM shall not be suitable for re-use (unless treated to render it suitable for re-use under a Remedial Strategy) or will require off-site disposal. Should levels in the vicinity of the proposed buildings be required to be raised, any materials proposed to be re-used in this area should be tested to confirm geotechnical and chemical suitability for use prior to placement.

5.4.2 H2. Inhalation exposure of future occupants/site users to asbestos fibres

Based on the 87 samples from this investigation screened for asbestos, three have tested positive; BH304 at 0.50 m (amosite and chrysotile at 0.002% quantifiable volume), TP375 at 1.60 m bgl (chrysotile <0.001% quantifiable volume) and BH319 at 0.50 m (chrysotile at 0.004% quantifiable volume) as free fibres.

In addition, during the previous Cronus investigations relevant to the EAF site area cement bonded ACM was identified within TP04 and seven samples where asbestos was present as free fibres (TP28, TP30, TP53, TP55, TP208, TP211, TP224 (0.50 m bgl and 1.10 m bgl). Of these four samples were then further analysed and quantified with between <0.001 and 0.009% by weight recorded. In all cases the asbestos was found to be present as free fibres with the maximum

(0.009%) recorded in TP53. In addition, a fragment of cement bonded ACM was confirmed within TP04. Asbestos was not recorded within samples of natural soils.

Based on the above, a potential linkage is confirmed which could present an unacceptable risk to future end workers and construction workers if not mitigated. It is recommended that in areas of soft landscaping a clean cover system is implemented using clean, imported material in order to mitigate the risk of inhalation exposure from asbestos fibres during future use of the site. Furthermore, a good working practice should be implemented by the groundworkers to mitigate the risk of asbestos during redevelopment works, this should be included in their construction environmental management plan (CEMP).

5.5 G1: Methodology and assessment of ground gas-related linkages

5.5.1 Appropriate guidance

The risks to development from ground gases have been assessed in accordance with BS8485:2015+A1:2019 (BS8485), which provides guidance on ground gas (methane and carbon dioxide) characterisation and hazard assessment, as well as providing a framework for the prescription of protection measures within new buildings.

The process involves characterising the gas hazard from combining the qualitative assessment of risk (using the CSM) with ground investigation data so that a 'characteristic situation' (CS) can be derived for the site or zones within the site. Characteristic situations range from CS1 to CS6, the higher the CS, the higher the hazard potential. Gas protection measures within new buildings can be prescribed using a point scoring system, taking into consideration the CS and the proposed building type.

BS8485 indicates that the gas hazard can be characterised using the following methods:

- an empirical semi-quantitative approach using gas monitoring data to determine the 'characteristic situation' of the site (or zones of the site) and subsequent protective measures (Wilson and Card approach).
- an empirical semi-quantitative approach using TOC data to determine the 'characteristic situation' of the site (or zones of the site) and subsequent protective measures (CL:AIRE RB17 approach).

Based on the conceptual site model, Wilson and Card approach has been used to characterise the gas hazard and aid provision of advice on the protective measures that may be required within buildings at the site.

5.5.2 Summary of the refined CSM for ground gas

In the assessment of risks and selection of appropriate mitigation measures, BS8485 highlights the importance of the conceptual model. In summary, potential sources of ground gas within influencing distance of the site identified in Section 2.5 comprise:

- organic rich natural soils (peat)
- on site made ground.

Pathways and receptors for ground gas were identified as:

- building foundations, piled foundations and vibro-stone columns
- construction joints and cracks within building structure
- utility routes and service penetrations into buildings

This assessment has been undertaken to assess risks to building structures and proposed end users. The assessment has not taken into consideration the health and safety of construction workers. 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 safe systems of work.

The risk assessment has been undertaken based on the current understanding of the CSM.

5.5.3 Empirical semi-quantitative approach using borehole monitoring data (Wilson and Card approach, BS8485)

5.5.3.1 Background

The empirical semi quantitative approach using gas monitoring data requires the designation of a gas screening value (GSV) for the entire site or zones within the site, which informs the hazard potential and associated prescribed ground gas protection measures within new buildings (where necessary). BS8485 defines the GSV as the *'flow rate (l/hr) of a specific hazardous gas* ***representative of a site or zone****, derived from assessment of borehole concentration and flow rate measurements and taking account of all other influencing factors, in accordance with a conceptual site model'.*

BS8485 Section 6.3.1 outlines the process for developing a GSV for the site or a zone as follows:

- borehole hazardous gas flow rate (Q_{hg}) is calculated for each borehole standpipe for each monitoring event. The borehole hazardous gas flow rate is defined in BS8485 as the '*flow rate of a specific hazardous gas, either methane or carbon dioxide, from a borehole standpipe'*. The Q_{hg} is calculated from individual borehole measurements of total gas flow and the concentration of the specific hazardous gas. BS8485 states in Section 6.3.4 that the **maximum** gas concentration recorded during the monitoring event should be used, together with **steady-state** values of gas flows
- the reliability of the measured gas flow rates and concentrations are assessed taking into account borehole construction
- decisions are made about how to deal with any temporal or spatial shortages in the data
- judgements are made about what GSV to designate for use for design purposes taking all relevant information and the conceptual site model into account.

Once the Q_{hg} has been calculated for methane and carbon dioxide, individual borehole measurements are compared to the thresholds presented in Table 2 of BS8485 which inform the CS that directly relates to each individual measurement. Taking into account the site data (i.e. borehole gas concentration and flow rate to calculate the Q_{hg}) and all other influencing factors in accordance with the CSM, a decision can then be made regarding the GSV that is considered to be representative of the site or a zone within it.

Typical threshold concentrations of methane (1% v/v) and carbon dioxide (5% v/v), and flow rates (>70 l/h), are also considered when designating the GSV for the site or zone, which in turn dictates the hazard potential and CS. It is important to note that the site or zone characteristic GSV and maximum concentration or flow thresholds are guideline values and not absolute. The thresholds may be exceeded in certain circumstances, if the CSM indicates it is safe to do so.

5.5.3.2 Designation of a GSV for the site or zone

The results of the ground gas monitoring and testing undertaken, alongside site conditions at the time of monitoring, are given in **Appendix E.**

Consideration has been given to the presence of flooded or partially flooded response zones at the time of monitoring, with details of unflooded or partially flooded response zones detailed in **Appendix L**.

A summary of the monitoring well field data and the maximum recorded gas concentrations and initial and steady state flow rates per borehole (or minimum for oxygen) is presented in **Table 37**.

The range of atmospheric pressure over the monitoring rounds completed was 986-1032 mbar and included periods of falling atmospheric pressures and falling tides.

Table 37 Summary of ground gas monitoring results –

Exploratory position ID	Response zone top (m bgl)	Response zone base (m bgl)	Response zone geological unit	No. of monitoring rounds	Peak CH_4 max. (%/vol)	Steady-state CH_4 max. (%/vol)	Peak CO_2 max. (%/vol)	Steady-state CO_2 max. (%/vol)	Oxygen min. (%/vol)	Steady-state gas flow max. (l/hr)	Depth to water min. (m)	Depth to water max. (m)	Atm. pressure min. (mb)	Atm pressure max. (mb)
BH301	3	24.6	Mixed Superficial Deposits	5	0.2	0.2	0.1	0.1	10.4	0	1.33	1.4	986	1032
BH311	11	36	Mixed Superficial Deposits	5	9.7	9.7	0.3	0.1	15.5	0.4	7.08	DRY	986	1032
BH315	4	30	Mixed Superficial Deposits	5	0.9	0.9	0.1	0.1	17.3	0.3	0.07	1.32	986	1031
BH317	1	20	Mixed Superficial Deposits	5	94.1	94.1	2	2	0.1	0.7	2.15	2.58	986	1032
BH322	1	21	Mixed Superficial Deposits	5	4.5	4.5	0.1	0.1	15	0.7	3.12	3.38	986	1032
BH324	1	23	Mixed Superficial Deposits inc peat	5	0.4	0.2	0.1	0.1	19.5	0.5	0.94	1.43	986	1032
BH328	8	38	Mixed Superficial Deposits	5	27.2	27	10.8	10.8	0	0.2	10.3	10.6	967	1032

Exploratory position ID	Response zone top (m bgl)	Response zone base (m bgl)	Response zone geological unit	No. of monitoring rounds	Peak CH_4 max. (%/vol)	Steady-state CH_4 max. (%/vol)	Peak CO_2 max. (%/vol)	Steady-state CO_2 max. (%/vol)	Oxygen min. (%/vol)	Steady-state gas flow max. (l/hr)	Depth to water min. (m)	Depth to water max. (m)	Atm. pressure min. (mb)	Atm pressure max. (mb)
BH329	5	37.5	Mixed Superficial Deposits	5	8	3.3	0.2	0.2	16.7	0.7	10.03	11.18	986	1031
BH330	7	35	Mixed Superficial Deposits and Coal Measures	3	1.3	1.3	0.4	0.4	19.4	0.1	1.95	2.54	987	1032
BH331	7	25	Mixed Superficial Deposits and Weathered Coal measures	5	0.4	0.4	0.5	0.3	18.5	0.6	3.14	3.56	987	1032

- Monitoring standpipes response zones installed to allow an assessment of gas generation across various strata and to allow for groundwater sampling

Table 38 Summary of ground gas monitoring results from the initial phase of Project Cronus

Exploratory position ID	Response zone top (m bgl)	Response zone base (m bgl)	Response zone geological unit	No. of monitoring rounds	Peak CH_4 max. (%/vol)	Steady-state CH_4 max. (%/vol)	Peak CO_2 max. (%/vol)	Steady-state CO_2 max. (%/vol)	Oxygen min. (%/vol)	Peak gas flow max. (l/hr)	Steady-state gas flow max. (l/hr)	Depth to water min. (m)	Depth to water max. (m)	Atm. pressure min. (mb)	Atm pressure max. (mb)
BH01 Shallow	4.00m	7.00m	Made Ground	3	91.5	91	6.6	6.6	0	3.5	2.3	1.775	1.95	1014	1019
BH01 Deep	8.00m	12.00m	Tidal Flat Deposits	3	91.5	91	6.6	6.6	0	1	0	1.78	1.6	1014	1019
BH02 Shallow	1.00m	5.00m	Blown Sand	3	16.2	0.6	0.8	0.1	9.2	2.8	1	0.53	0.53	1014	1014
BH02 Deep	7.00m	34.00m	Tidal Flat Deposits	3	16.2	0.6	0.8	0.2	11.2	0	0	0.67	1.5	1001	1014
BH03 Shallow	1.00m	4.00m	Made Ground	3	82.4	38.6	6.5	3.5	1.2	11.2	0.3	0.69	0.775	1001	1002
BH03 Deep	5.20m	30.00m	Tidal Flat Deposits	3	83.3	51	5.9	4.4	1.2	0.6	0.6	3.75	3.75	1013	1013
BH04 Shallow	1.00m	5.00m	Made Ground	3	0.1	0.1	0.3	0.3	20.7	0.1	0.1	2.08	2.4	1006	1007
BH04 Deep	14.00m	25.00m	Tidal Flat Deposits	3	0	0	0.1	0.1	20.3	0.1	0	2.445	2.445	1040	1040

Exploratory position ID	Response zone top (m bgl)	Response zone base (m bgl)	Response zone geological unit	No. of monitoring rounds	Peak CH_4 max. (%/vol)	Steady-state CH_4 max. (%/vol)	Peak CO_2 max. (%/vol)	Steady-state CO_2 max. (%/vol)	Oxygen min. (%/vol)	Peak gas flow max. (l/hr)	Steady-state gas flow max. (l/hr)	Depth to water min. (m)	Depth to water max. (m)	Atm. pressure min. (mb)	Atm pressure max. (mb)
BH05 Shallow	1.00m	5.00m	Made Ground	3	53.8	26	2.2	1	6.3	0.1	0.1	2.915	3.045	1000	1024
BH05 Deep	6.00	18.00	Tidal Flat Deposits	3	36.6	14.5	6.9	2.8	4.8	0	0	2.655	2.655	1040	1040
BH08	2.00m	19.00m	Tidal Flat Deposits	3	91.3	38.1	1	0.9	0.9	0.1	0.1	1.9	1.9	1014	1014
BH10	3.00m	23.50m	Tidal Flat Deposits	3	0	0	0.7	0.2	19.6	0.3	0.2	1.088	1.26	1012	1014
BH11	3.00	23.50m	Tidal Flat Deposits	3	0	0	0.7	0.2	20.8	0.2	0.2	0.28	0.67	1012	1014
BH12 Shallow	1.00m	3.00m	Made Ground	3	36.2	13	7.6	2.8	5.4	0	0	2.04	2.71	1006	1024
BH12 Deep	5.00m	26.50	Tidal Flat Deposits	3	0.2	0.2	0.2	0.2	17.9	0.1	0	2.16	2.16	1040	1040
BH13	2.00	16.50	Tidal Flat Deposits	3	0.2	0.2	0.4	0.4	19.5	5.6	1	1.07	1.235	1012	1014

Table 39 Summary of the continuous ground gas monitoring data from the supplementary works for Project Cronus

Exploratory position ID	Peak CH_4 min (%/vol)	Peak CH_4 max(%/vol)	Peak CO_2 min (%/vol)	CO_2 max. (%/vol)	Oxygen min. (%/vol)	Peak gas flow max. (l/hr)	Depth to water min. (m)	Depth to water max. (m)	Atm. pressure min. (mb)	Atm pressure max. (mb)
BH201	0.00	3.33	0.00	0.05	18.46	0.09	1.95	2.19	998	1030
BH202	0.01	1.64	0	0	12.9	0.04	2.97	3.27	999	1031
BH203	0.00	0.19	0.00	0.15	18.79	2.11	0.85	1.25	999	1031
BH204	0.04	30.83	0.02	1.55	10.92	0.63	3.82	4.75	999	1031
BH205	0.02	25.72	0	0	6.92	0.1	2.29	2.44	999	1031
BH207	0.00	4.95	0.00	0.04	1.2	0.14	3.2	3.74	999	1031
BH208	0.00	41.01	0.12	3.82	11.36	0.12	2.43	2.75	999	1031
BH209	0.00	0.21	0.00	0.08	19.83	0.02	2.00	2.30	999	1031

5.5.3.3 Summary of borehole hazardous gas flow rates

Borehole hazardous gas flow rates (Q_{hg}) have been calculated for each borehole standpipe, where conditions indicate the response zone to be either unflooded or partially flooded, for each monitoring round and are presented, alongside two 'worst case' checks in **Appendix L** comprising a probable 'worst case' and potential 'worst case' from the available monitoring data. Within this data gas concentrations exceeding the thresholds presented in Table 2 of BS8485 are identified, alongside the CS that could be associated with each individual borehole monitoring event.

5.5.3.4 Worst case check

In accordance with BS8485, a 'worst case' Q_{hg} has been calculated per borehole by multiplying the maximum recorded flow from any monitoring round for that borehole by the maximum recorded methane or carbon dioxide concentration in that borehole. A further worst-case Q_{hg} check across all data collected is presented in **Appendix L** for the entire site (or zone), which has been calculated by multiplying the maximum recorded flow by the maximum recorded methane or carbon dioxide concentration.

The gas monitoring carried out to date has recorded elevated CH_4 within BHs 311 and 317 with CO_2 and flow rates generally relatively low, noting that the response zone for BH317 was flooded. The origin of the elevated CH_4 is considered likely to be pockets of peat encountered within the Tidal Flat Deposits which have been oxidised as a consequence of the drilling and subsequent installation of monitoring wells. A majority of the response zones in the boreholes appear to have been flooded as a consequence of shallow groundwater and hence the results should be treated with caution and potentially discounted.

The elevated CH_4 along with the absence of significant CO_2 and flow is typical of peat, with higher initial concentrations of CH_4 normally decreasing over an extended monitoring period.

Based upon the type of Made Ground encountered it is not considered a likely source of ground gases due to the low organic content present and absence of any significant volume of degradable or putrescible material. It is noted that the elevated ground gases observed in BH01 and BH03 were from the shallow part (screening in Made Ground) of dual monitoring well installations. It is anticipated the elevated methane concentrations identified in these locations are likely to be associated with the peat deposits in the deep part of the dual installation (seals between dual installations are not always fully effective).

The data collected from the unflooded monitoring wells appears to have similar gas concentrations, most notably CH_4 and similar flow rates to those from the monitored wells installed as part of Project Cronus, during both the periodic and continuous monitoring.

5.5.3.5 Data limitations

The site investigation and subsequent gas monitoring programme was designed to provide evidence in support of a ground gas assessment. However, due to the shallow nature of the groundwater beneath the site many of the monitoring well response zones were noted to be flooded, 'true' readings may not have been recorded as part of this monitoring programme. Based upon the unflooded response zones locations a characteristic situation 1 (CS1) is indicated, except when considering the worst-case Qhg check across all data, where CS2 is indicated for both methane and carbon dioxide. There remains uncertainty around the characterisation of the ground gas regime at the site given the elevated groundwater table. Given this, it is recommended that ground gas protection measures appropriate for CS2 are implemented in the proposed buildings.

Alternatively, once enabling works are complete and the final development platform is achieved further ground gas monitoring could be undertaken to refine the ground gas assessment with a view to potentially demonstrating that ground gas protection measures are not required via the construction of additional shallow unflooded wells. The proposed foundation type(s) once finalised shall also need to be taken to account in the ground gas protection measures design (or further assessment following enabling works), to ensure no preferential ground gas migration pathways are introduced as a result of the foundations proposed.

5.6 Methodology and assessment of controlled waters-related linkages

5.6.1 R4. Migration of dissolved phase contaminants to Bristol Channel

As the primary controlled waters receptors are surface waters in the Bristol Channel, the analytical results for groundwater samples have been assessed against Environmental Quality Standards (EQS) for coastal waters for conservatism.

Screening of the results of laboratory analysis undertaken on groundwater samples collected during the current investigation indicated measured concentrations of arsenic, copper, mercury and zinc in excess of the EQS as shown in **Table 40** and presented in the screening sheet in **Appendix K**.

Table 40 Summary of groundwater exceedances

Determinand	Threshold value (µg/l) (EQS)	Location and exceedance concentration (µg/l)
Arsenic	25	BH301 (27) and BH324 (37)
Copper	1.0	BH324 (1.2)
Mercury	0.07	BH324 (0.09)
Zinc	6.8	BH331 (7.2) and BH317 (7.0)

Groundwater results from BH4 from the previous Cronus investigation (RSK, March 2022) were found to have exceeded the threshold value presented in **Appendix K** and summarised in **Table 41** and **Table 42**. BH4 was located in the area of the former Grange Coke Ovens. A dual installation was put within BH4 to screen the made ground and natural strata in order to sample groundwater from both underlying strata.

Table 41 Summary of groundwater exceedances for BH4 (shallow standpipe)

Determinand	Threshold value (µg/l) (EQS)	Exceedance concentration (µg/l)
Acenaphthylene	5.8	18.8
Anthracene	0.1	10.8
Benzo(a)pyrene	0.00017	0.02
Fluoranthene	0.0063	3.83
Naphthalene	2	4030

Determinand	Threshold value (µg/l) (EQS)	Exceedance concentration (µg/l)
Benzene	8	543
Toluene	4	190
Phenol	7.7	12
Aromatic >C5-C7	8	407
Aromatic >C7-C8	74	187

Table 41 indicates exceedances of the threshold value are present in the groundwater samples from the Made Ground in BH4.

Exceedances were also present within the deeper groundwater of the natural strata in BH4 as shown in **Table 42**.

Table 42 Summary of groundwater exceedances for BH4 (deep standpipe)

Determinand	GAC (µg/l) (DWS)	Exceedances (monitoring well and concentration µg/l)
Anthracene	5.8	0.42
Naphthalene	2	21.76
Benzene	8	228
Phenol	7.7	39
Aromatic >C5-C7	8	183

Table 43 indicates exceedances of the threshold value are present in the deeper groundwater samples in BH4.

Further groundwater sampling and testing was undertaken (RSK, October 2022) as part of the Cronus investigation following the identification of impacted groundwater from the initial phase of works (BH4) presented within RSK's March 2022 report.

Several exceedances of the threshold value were identified in intrusive locations undertaken around the former Grange Coke Ovens, most significantly in BH202. It is noted that during the drilling of BH202, strong hydrocarbon odours and elevated PID readings were recorded, which along with the elevated concentrations (in excess of pure-phase solubility) in groundwater indicated that non-aqueous phase liquid (NAPL) may be locally present in this area of the site. From groundwater gauging completed at the site it is anticipated that the screened section of the deep groundwater well at BH202 is below the groundwater surface and as such, if present, light non-aqueous phase liquid (LNAPL) would not be able to migrate into the monitoring well, however, the shallow part of the dual installation (screened 1.00 m to 5.00 m bgl) would allow the ingress of LNAPL if present.

If dense non-aqueous phase liquid (DNAPL) is locally present, associated with the possible coal tar observations in the vicinity of BH202 and in the general area of the coking works, the cohesive nature of the underlying geology is anticipated to inhibit its vertical migration. Possible evidence of this was observed in BH202 where PID values and visual/olfactory observations of contamination markedly decrease below 15.20 m bgl.

Table 43 Summary of groundwater exceedances identified during the supplementary Project Cronus investigation

Determinand	GAC (µg/l) (DWS)	Maximum recorded value concentration µg/l	Number of exceedances	Location of maximum exceedances (monitoring well and concentration µg/l)
Arsenic (dissolved)	25	222	13	BH2: 222 (21/01/2022)
Lead	1.3	6	7	BH207: 2 (30/06/2022)
Mercury	0.07	0.6	4	BH206: 0.07 (30/06/2022)
Nickel (dissolved)	8.6	30	4	BH202: 30 (06/15/2022) BH202: 30 (07/21/2022)
Zinc (dissolved)	6.8	17	12	BH8: 17 (01/24/2022) BH204: 17 (07/21/2022)
1,2-Dichloroethane	10	13	1	BH202: 13 (06/15/2022)
Acenaphthylene	5.8	121	8	BH202: 121 (07/21/2022)
Anthracene	0.1	13.9	19	BH204: 13.9 (07/21/2022)
Benzo(a)pyrene	0.00017*	0.44	10	BH204: 0.44 (07/21/2022)
Fluoranthene	0.0063*	14.7	32	BH204: 14.7 (07/21/2022)
Naphthalene	2	4380	17	BH4: 4380 (15/02/2022)
Aro >C5-C7	8	4701	12	BH202: 4701 (06/15/2022)
Aro >C7-C8	74	304	4	BH202: 304 (07/21/2022)
BTEX - Benzene	8	4701	12	BH202: 4701 (06/15/2022)
BTEX - Toluene	74	304	4	BH202: 304 (07/21/2022)
Phenols - Total by HPLC	7.7	9150	9	BH202: 9150 (06/15/2022)
*GAC below laboratory detection limits				

The full results are included within the **Appendix K**.

From the findings of the groundwater analysis results during this and the previous investigations, along with visual and olfactory evidence of contamination observed during intrusive works, there is evidence that there is impact in the soils and groundwater, particularly in the vicinity of the former coke ovens. As already mentioned, the visual, olfactory and groundwater data for BH202 are indicative of the presence of NAPL locally in this area of the site and residual NAPL may also be locally present in wider vicinity of the former coke ovens / DLS Regeneration Yard.

In order to further assess the concentration of contaminants of concern in excess of the EQS further, qualitative assessment has been completed in accordance with a 'lines-of-evidence' approach in the context of the proposed development as follows:

- The site is located in an area with a long history of industrial activity and as such the quality of groundwater in the region is known to be of poor quality. As such, groundwater in the region is considered to be of limited resource value. In accordance with this, the groundwater

underlying the site is considered a pathway rather than a receptor, with the nearest downgradient controlled waters receptor considered to be the Bristol Channel circa 600 m west of the site. Given; the distance to the Bristol Channel from the site, the cohesive nature of the underlying Tidal Flat Deposits and cohesive elements of the Coal Measures, there is considered a low risk that the COPC identified would reach this feature at sufficient concentrations to pose an unacceptable risk.

- The metals exceedances observed are typically within the same, or up to one, order of magnitude greater than the EQSs.
- The PAH compounds observed in excess of the EQSs are typically associated with relatively low mobilities in groundwater, with naphthalene considered to be the most mobile. Naphthalene concentrations were highest in BH202 and BH204 in the vicinity of the former coke ovens, and down/cross gradient at BH3, naphthalene concentrations although recorded in excess of the EQS, are within the same order of magnitude of this threshold value.
- Similarly to PAH, the elevated hydrocarbon and phenol results are predominantly associated with BH202 in the former coke ovens area. The bulk of the hydrocarbon source in this area comprises aromatic fractions in the range >C10-C16, which in accordance with CI:AIRE 2017 guidance *(Petroleum Hydrocarbons in Groundwater: Guidance on assessing petroleum hydrocarbons using existing methodologies)*, are associated with a moderate mobility in groundwater. It is also noted that the hydrocarbon concentrations measured in groundwater from BH202 in some cases are in excess of pure phase solubility limits, this suggest the NAPL may be entrained in the groundwater sample exaggerating the dissolved phase concentrations reported.
- As part of the redevelopment works the majority of the site is proposed to be covered by hard standing, this shall reduce infiltration to ground, and hence reducing leaching of remaining contaminants from soils.
- During enabling works any gross visual signs of contamination (such as free product in unsaturated soils) should be removed and treated prior to being re-used or disposed of off-site at a suitably licenced landfill/treatment facility. By doing this, betterment in groundwater quality over the medium to long term would be expected by reducing contaminant load.

Based on the above lines of evidence, although a potentially complete pollutant linkage has been identified in relation to contaminants of concern in groundwater - migrating laterally to the Bristol Channel, the risk that concentrations shall reach this feature at sufficient concentrations to pose an unacceptable risk is considered low.

Careful consideration will need to be given to any dewatering and disposal of contaminated groundwater as part of the construction of the proposed EAF facility from the area of the former coke ovens.

5.7 Uncertainties and implications in refined CSM and GQRA

In accordance with good practice, data gaps and uncertainties have been identified at this stage and are summarised in **Table 44** along with likely implications. The findings of this investigation are in line with our initial CSM and the findings of the previous site investigation works and as such no refinement of the CSM has been required.

Table 44 Data gaps and uncertainties

Data gap/ uncertainty	Details	Implications
Limited access to some of the site	No access to former coal yard	Ground conditions and any contamination unknown. Extent of potential groundwater impact also unknown.
Due to the shallow nature of the groundwater beneath the site the response zones in a number of the ground gas monitoring wells were flooded	Based upon the unflooded response zone a characteristic situation 1 (CS1) is indicated, except when considering the worst-case Qhg check across all data, where CS2 is indicated for both methane and carbon dioxide. There remains uncertainty around the characterisation of the ground gas regime	It has been recommended that ground gas protection measures appropriate for CS2 are implemented in the proposed buildings. Alternatively, once enabling works are complete and the final development platform is achieved further ground gas monitoring could be undertaken to refine the ground gas assessment with a view to potentially demonstrating that ground gas protection measures are not required via the construction of additional shallow unflooded wells.

6 CONCLUSIONS AND RECOMMENDATIONS

6.1 Geo-environmental assessment

Based on the results of the recent site investigation, consideration of data from previous investigations at the site and GQRA, contaminant linkages have been identified to be potentially complete and require further action with respect to human health. This is as a result of asbestos being present in a number of tested samples as well as the presence of aromatic hydrocarbon fractions >C10-C16, benzene, toluene, a number of PAHs and lead. Based on this, a potential linkage is confirmed which could present an unacceptable risk to future end workers and construction workers if not mitigated in relation to inhalation of asbestos fibres and inhalation of contaminated dust.

The hydrocarbon contamination identified in the area of the former coke ovens during this and the Project Cronus investigations is not considered to present an unacceptable risk to future end workers via vapour inhalation since the proposed buildings are to be constructed some distance away from this area. Should the proposed development plan alter, this report shall need to be reviewed by RSK and updated if deemed necessary.

The Made Ground is not considered to be a viable source of ground gases due to the absence of any significant degradable or putrescible material as shown by the intrusive investigation. The elevated methane identified on site is likely due to the peat within the Tidal Flat Deposits although the monitoring wells were shown to be flooded in a number of instances. Ground gas monitoring data collected to date from unflooded locations suggests a CS1 characterisation situation except when considering the worst-case Qhg check, across all data, where CS2 is indicated for both methane and carbon dioxide. However, due to the shallow nature of the groundwater beneath the site the response zones in a number of the ground gas monitoring wells were flooded, as such ground gas protection measures appropriate for CS2 are implemented in the proposed buildings.

A potentially complete pollutant linkage was identified in the initial conceptual model in relation to contaminants of concern in groundwater - migrating laterally to the Bristol Channel.

Whilst evidence of impacted groundwater and visual and olfactory signs of contamination indicative of the potential presence of NAPL have been identified in the area of the former coke ovens, based on a 'lines-of-evidence' approach there is considered a low risk that the contaminants identified could reach the Bristol Channel at sufficient concentrations to pose an unacceptable risk. This conclusion has largely been reached given the distance from this area of site to the Bristol Channel (c. 600m) allowing attenuation through dilution, degradation and retardation of contaminants prior to reaching this receptor. Further to this, the proposed development requires increasing the proportion of hardstanding across the site which will reduce infiltration and hence reduce the leaching of remaining contaminants in soils to the underlying groundwater. Similarly, removal of any unexpected gross visual signs of contamination (such as free product in unsaturated soils) identified during construction would be expected to further reduce contaminant load. The actions listed would be expected to achieve localised betterment in groundwater quality over the medium to long term.

6.2 Recommendations- ground contamination (human health)

Based upon the findings of this and previous investigations the elevated concentrations of metals, PAH, hydrocarbon fractions and asbestos pose a potential risk to human health via fibre/dust

inhalation, as such mitigation measures are required. A majority of these GAC exceedances are located away from the principal development area of the EAF and are recorded in the near-surface soils in the proposed yard areas. Construction in these yard areas is understood to comprise a cover of either thick concrete and/or granular imported material. As such these proposals will mitigate risk to the future users of the site in these areas. Given the discrete nature of asbestos there is the potential for it to be present within the Made Ground. It is therefore recommended that to mitigate this residual risk, areas of soft landscaping underlain by Made Ground be subject to an appropriate clean cover system. This could be further limited, through liaison with the regulatory body, to soft landscaped areas within close proximity to structures/buildings requiring access by future workers.

It is recommended that ground gas protection measures appropriate for CS2 are implemented in the proposed buildings. However, once enabling works are complete and the final development platform is achieved further ground gas monitoring could be undertaken to refine the ground gas assessment with a view to potentially demonstrating that ground gas protection measures are not required, via the construction of additional shallow wells placed in unsaturated soils.

Consideration will need to be given to any potential reuse of soils at the site during proposed redevelopment works, for instance any materials observed to contain gross contamination such as heavy staining, free phase product or visible ACM shall not be suitable for re-use (unless treated and rendered suitable for re-use under a Remedial Strategy) or will otherwise require off-site disposal. Should levels in the vicinity of the proposed buildings be required to be raised any materials proposed to be used in this area should be tested to confirm geotechnical and chemical suitability for use prior to placement.

6.3 Recommendations - groundwater contamination

It is not considered that any further assessment or active groundwater remediation is required as part of this proposed development, however, should redevelopment or further construction be proposed further west additional work would be required. It is anticipated that a piling risk assessment will be required for the proposed development.

6.4 Recommendations - general

Should any unexpected contaminated soils, or contaminated groundwater be encountered (not previously identified) during construction works work in that area should stop and advice sought from an appropriately qualified Environmental Consultant.

Contaminated soil disposed of off-site will be taken to a soil treatment facility/ landfill appropriately permitted to take that material.

A Soil Management Plan (SMP) would be developed prior to construction (to be secured by planning condition), which will include methods to protect soil resources. These should conform to the Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (Defra, 2009).

Careful consideration will need to be given to any dewatering and disposal of contaminated groundwater as part of the construction of the proposed development, particularly from the area of the former coke ovens, as well as careful consideration of soils proposed to be reused.

Should there be any changes to the development layout as they are understood at the time of writing this report then these recommendations would need to be reviewed.

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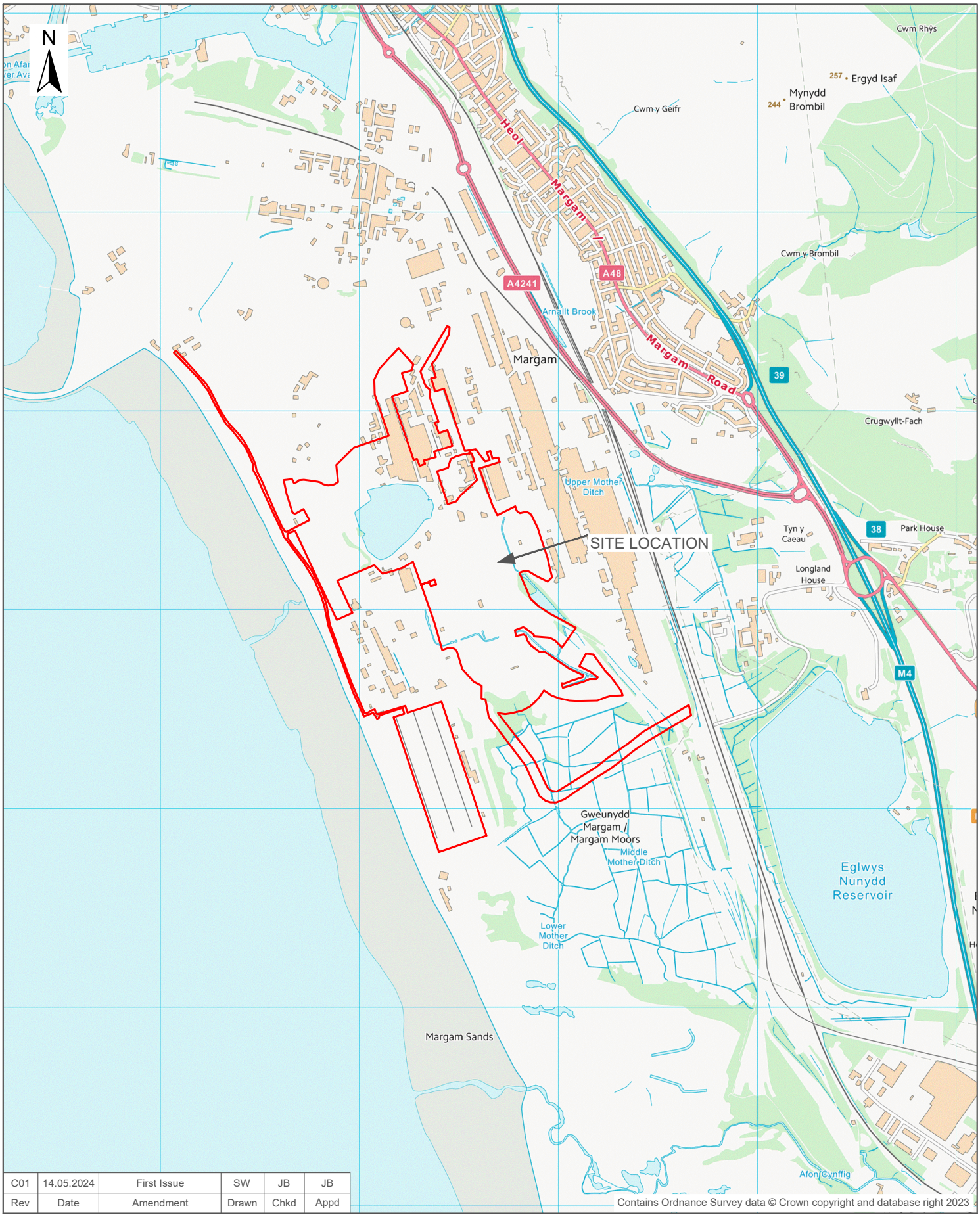
FIGURES

Figure 1 SITE LOCATION PLAN



Rev	Date	Amendment	Drawn	Chkd	Appd
C01	14.05.2024	First Issue	SW	JB	JB

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Client: Tata Steel

Project Name: EAF Project

Description: Site Location Plan

Dimension	Size	Scale	Geolocation	Project ID	Drawing no.	Rev	File name
m	A4	1:25,000	278154,186921	315531	11101	C01	315531-BL-111-XX-D-G-11101-C01

Figure 2 SITE LAYOUT PLAN

LEGEND

Site boundary

Notes:

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C01	14.05.2024	First Issue	SW	JB	JB

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Project Name
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Description
Site Layout Plan

Project ID	Drawing no.	Revision
315531	11201	C01

File name
315531-BL-112-XX-D-G-11201-C01

Dimensions	Scale	Size
m	1:5000	A1

0 100 200 300 400 500m

Figure 3 EXPLORATORY HOLE LOCATION (BOREHOLES ONLY) PLAN WITH DEVELOPMENT AREAS

LEGEND

- Site boundary
- Area 1
- Area 2

Notes:

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C01	17.06.24	First Issue	LS	JB	JB

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Project Name
EAF Project

Description
Plan Showing Areas 1 and 2

Project ID	Drawing no.	Revision
315531	11202	C01

File name
315531-BL-112-XX-D-G-11202-C01

Dimensions	Scale	Size
m	1:5000	A1

0 100 200 300 400 500m

Figure 4 EXPLORATORY HOLE LOCATION PLANS- BOREHOLES

LEGEND

- Site boundary
- Borehole location

Notes:

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C01	21.08.24	First Issue	LS	JB	JB

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Project Name
EAF Project

Description
Exploratory Hole Location Plan - West Boreholes

Project ID	Drawing no.	Revision
315531	22213	C01

File name
315531-BL-222-XX-D-G-22213-C01

Dimensions	Scale	Size
m	1:1250	A1

0 20 50 75 100m

LEGEND

- Site boundary
- Borehole location

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C01	21.08.24	First Issue	LS	JB	JB

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Project Name
EAF Project

Description
Exploratory Hole Location Plan - North Boreholes

Project ID	Drawing no.	Revision
315531	22210	C01

File name
315531-BL-222-XX-D-G-22210-C01

Dimensions	Scale	Size
m	1:1250	A1

0 20 50 75 100m

LEGEND

- Site boundary
- Borehole location

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C01	21.08.24	First Issue	LS	JB	JB

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Project Name
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Description
Exploratory Hole Location Plan - East Boreholes

Project ID	Drawing no.	Revision
315531	22211	C01

File name
315531-BL-222-XX-D-G-22211-C01

Dimensions	Scale	Size
m	1:1250	A1

0 20 50 75 100m

LEGEND

Site boundary

Borehole location

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C01	21.08.24	First Issue	LS	JB	JB

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Project Name
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Description
Exploratory Hole Location Plan - South Boreholes

Project ID	Drawing no.	Revision
315531	22212	C01

File name
315531-BL-222-XX-D-G-22212-C01

Dimensions	Scale	Size
m	1:1250	A1

0 20 50 75 100m

Figure 5 EXPLORATORY LOCATION PLANS- TRIAL PITS

LEGEND

Site boundary

Trial pit location

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Project Name
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Description
Exploratory Hole Location Plan - North Trial Pits

Project ID	Drawing no.	Revision
315531	22206	C01

File name
315531-BL-222-XX-D-G-22206-C01

Dimensions	Scale	Size
m	1:1250	A1

0 20 50 75 100m

LEGEND

Site boundary

Trial pit location

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C01	21.08.24	First Issue	LS	JB	JB

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Project Name
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Description
Exploratory Hole Location Plan - East Trial Pits

Project ID	Drawing no.	Revision
315531	22207	C01

File name
315531-BL-222-XX-D-G-22207-C01

Dimensions	Scale	Size
m	1:1250	A1

0 20 50 75 100m

LEGEND

Site boundary

Trial pit location

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Rev	Date	Amendment	Drawn	Chkd	Appd
C01	21.08.24	First Issue	LS	JB	JB

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Project Name
EAF Project

Description
Exploratory Hole Location Plan - South Trial Pits

Project ID	Drawing no.	Revision
315531	22208	C01

File name
315531-BL-222-XX-D-G-22208-C01

Dimensions	Scale	Size
m	1:1250	A1

0 20 50 75 100m

LEGEND

Site boundary

Trial pit location

Notes:

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Rev	Date	Amendment	Drawn	Chkd	Appd
C01	21.08.24	First Issue	LS	JB	JB

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Project Name
EAF Project

Description
Exploratory Hole Location Plan - West Trial Pits

Project ID	Drawing no.	Revision
315531	22209	C01

File name
315531-BL-222-XX-D-G-22209-C01

Dimensions	Scale	Size
m	1:1250	A1

0 20 50 75 100m

Figure 6 EXPLORATORY LOCATION PLAN- PROJECT CRONUS

LEGEND

- Trial Pit Location
- Borehole Location

Rev.	Date	Amendment	Drawn	Chkd.	Appd.
01	03.03.2022	Positions updated	MW	JB	-
00	26.01.2022	-	MW	JB	-

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Project Title
Project Cronus

Drawing Title
Exploratory Hole Location Plan

Drawn	Date	Checked	Date	Approved	Date
MW	26.01.22	JB	26.01.22	-	-

Dimensions	Scale	Original Size
m	1:6000	A3

Project Number	Drawing Number
315075	Figure 3

Drawing File	Rev
315075 - Fig 3 - rev 01 - EHLP	01

0 100 200 300m

Figure 7 EXPLORATORY HOLE LOCATION PLAN- EXCEEDANCES IN HUMAN HEALTH GACS (SOILS)

LEGEND

- Site boundary
- Trial pit location
- Borehole location
- Exceedance - Asbestos
- Exceedance - TPH
- Exceedance - PAH
- Exceedance - Metals

Notes:

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Rev	Date	Amendment	Drawn	Chkd	Appd
C02	03.02.25	Second Issue	LS	JB	JB
C01	21.01.25	First Issue	LS	JB	JB

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Client
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Project Name
EAF Project

Description
Exploratory Hole location Plan - Exceedances in Human Health GACs (Soils)

Project ID	Drawing no.	Revision
315531	22215	C02

File name
315531-BL-222-XX-D-G-22215-C02

Dimensions	Scale	Size
m	1:5000	A1

0 100 200 300 400 500m

APPENDICES

APPENDIX A
SERVICE CONSTRAINTS

1. Service Constraints for all Reports

1.1. This Report (the “Report”) and any study, inspection, investigation, sampling, testing and or interpretation carried out in connection with the Report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) trading as Carbon Zero Consulting, Leap Environmental or RSK Geosciences, for the Client named in the first paragraph of the Report (the "Client") in accordance with the terms of an RSK Fee Proposal including RSK Environment Standard Terms and Conditions (the “Appointment”) between RSK and the Client, unless otherwise stated in the first paragraph of the Report. The Services were performed by RSK with the reasonable skill and care ordinarily exercised by a geo-environmental consultant at the time the Services were performed. Nothing in this Report shall be construed as imposing any fitness for purpose obligation. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the Client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the Client.

1.2 Other than that, expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services. RSK shall not be liable in respect of any action or proceedings arising out of or in connection with this Report whether in contract, in tort, for breach of statutory duty or otherwise after the expiry of six (6) years from either (i) the date of the Report or (ii) such earlier date as prescribed by law, unless varied in the terms of the Appointment.

1.3 Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the Client. RSK is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent, or condone any party, other than the Client relying upon the Services. Should this Report or any part of this Report, or details of the Services or any part of the Services, be made known to any such party, and such party relies thereon, that party does so wholly at its own and sole risk, and RSK disclaims any liability to such parties. Any such party would be well advised to seek independent advice from a competent geo-environmental consultant and/or lawyer.

1.4 The Client shall not, without the prior written consent of RSK, assign, transfer, charge, mortgage, subcontract, or deal in any other manner with all or any of the benefits provided in this Report. Unless specified in the Appointment, RSK shall not be obliged to assign the benefit of the Report whether by collateral warranty, third party rights pursuant to the Contracts (Rights of Third Parties) Act 1999, letter of reliance or otherwise. If RSK agrees to any assignment of the benefit of this Report, in whatever form, benefits to third parties through collateral warranties, third party rights or letters of reliance shall not be provided unless a fee for each right, warranty or letter is agreed. The form of wording used in the warranty or letter shall be provided by RSK for agreement by the Client. Any reasonable changes to the form of wording will be implemented by mutual agreement, however the terms in the warranty or letter cannot offer the third party any greater benefit than the Appointment offered to the Client.

1.5 It is the understanding of RSK that this Report is to be used for the purpose described in the introduction to the Report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the Report is used, or the proposed use of the site change, this Report may no longer be valid and any further use of or reliance upon the Report in those circumstances by the Client without the review and advice of RSK shall be at the Client's sole and own risk. RSK shall not be liable for any use of this Report for any purpose other than that for which it was provided.

1.6 The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the Report inaccurate or unreliable. The information and conclusions contained in this Report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the Report in the future shall be at the Client's own and sole risk.

1.7 The observations and conclusions described in this Report are based solely upon the Services which were provided pursuant to the agreement between the Client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out, or required by the Appointment between the Client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this Report, RSK did not seek to evaluate the presence on or off site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas, fuel storage, persistent bio-accumulative or toxic chemicals (including PFAS and related compounds) or other radioactive or hazardous materials, unless specifically identified in the Services.

1.8 The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection of the site together with RSK's interpretation of desk based publicly available information, including documentation, obtained from third parties and from the Client on the history and usage of the site, unless specifically identified in the Services and the limitations below:

a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.

b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.

c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the Client or third parties, including laboratories and information services, during the performance of the Services.

d. The Client has identified in writing to RSK, the information, reports, findings, surveys and preliminary works RSK may not rely upon when providing the Services.

RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK, and including the doing of any independent investigation of the information provided to RSK, save as otherwise provided in the terms of the Appointment between the Client and RSK.

1.9 Any site drawing(s) provided in this Report is (are) not meant to be an accurate base plan for scale measurement but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for accurate setting out and should be considered indicative only.

1.10 Should RSK be requested to review the Report after the date of issue of this Report, RSK shall be entitled to additional payment at the existing rates, or such other terms as agreed between RSK and the Client.

2. Service Constraints where the Report provides an intrusive assessment of ground conditions:

2.1 The intrusive environmental ground investigation aspects of the Services are a limited sampling of soil from the site, at pre-determined locations based on the known historic / operational configuration of the site. The conclusions given in this Report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the properties of the materials adjacent and local conditions, together

with the position of any current structures and underground utilities and facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters (as stipulated in the scope agreed between the Client and RSK, based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species (not tested) are not present.

2.2 The comments given in this Report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. The extent of the exploratory holes, laboratory testing and monitoring undertaken may have been restricted due to a number of factors including accessibility, the presence of buried or overhead services, current development, site usage, timescales or the Client's specification. The exploratory holes only assess a small proportion of the site area with respect to the site as a whole, and as such may only provide an indicative assessment of ground conditions on site. There may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised. The presence of hotspots of undisclosed contamination or exceptional and unforeseen ground conditions cannot be discounted.

2.3 Where the Services include Investigation of an exploratory nature or relating to physical ground works, any costings and prices provided in the Report are estimated and provided for guidance purposes only. The actual cost and time quantities shall be remeasured and shall be dependent upon the ground or other conditions, constraints present, and number and depth of the investigation locations, which shall influence the number of samples and tests required, and the quantities of soil being classified.

2.4 Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works. However, this Report does not constitute an asbestos survey. On this basis, the presence of asbestos on site cannot be discounted and a full asbestos survey should be undertaken.

2.5 Unless stated otherwise, only preliminary geotechnical recommendations are presented in this Report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed. Eurocode 7 gives guidance on the type of sampling, sample quality, number and spacing of intrusive investigations, and number of laboratory tests required. It is intended that the Geotechnical Information section of this Report will fulfil the general requirements of the Ground Investigation Report as set out in section 6 of Eurocode7, although this is subject to the restrictions imposed on the investigation, as listed above. For geotechnical design, Eurocode 7 requires the Geotechnical Design Report to address both the geotechnical and structural aspects of the geotechnical design for both the limit and serviceability states. The Geotechnical Appraisal section of this Report will not meet the requirements of a Geotechnical Design Report (GDR) and should therefore be used for preliminary guidance only.

3. Service Constraints where the Report relates to Surface Water Management:

3.1 The Surface Water Management Inspection (SWMI) Report, documents provided, observations, actions, and recommendations, with respect to the management of potential pollution issues to surface waters, made during the site Inspection visit, are those present at the time of the visit, and may not represent those recorded by others on the same day.

3.2 The comments given in this Report and the opinions expressed are based on the weather, ground and ground water conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not