ENVIRONMENTAL STATEMENT CHAPTER 8: GROUND CONDITIONS AND CONTAMINATION

Land South of Rover Way, Cardiff CF24 5PH

Harsco Metals Group Limited

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8.1.0 Introduction

8.1.1 This Chapter of the ES has been prepared by SLR Consulting Limited and assesses the likely effects of the proposed development upon the application site and surrounding area with respect to land quality and ground contamination.

8.1.2 The Chapter describes the methods used to assess the effects, the baseline conditions currently existing at the application site; the mitigation measures that could be required to prevent, reduce or offset any significant negative effects and the likely residual effects after these measures have been adopted.

8.1.3 This Chapter has been written on the basis of the findings contained within the following supporting document:

- Geotechnical & Geo-Environmental Report, Aggregate Production Area, Celsa, Rover Way, Cardiff prepared by Terra Firma (Wales) Ltd (TFW) (ref: 15264, April 2019)

8.1.4 The above report is included as Appendix 8-1.

8.2.0 Methodology

Legislation, Guidance and Planning Policy

Legislation

Construction Design and Management (CDM) Regulations 2015

8.2.1 The Construction Design and Management Regulations 2015 (CDM 2015) are regulations governing the way construction projects are planned to ensure overall health, safety and welfare of those working in construction.

Town and Country Planning Act 1990

8.2.2 The Town and Country Planning Act 1990 is an act of the United Kingdom Parliament regulating the development of land in England and Wales.

Environmental Protection Act (EPA) 1990

8.2.3 Specific UK legislation and guidance on the assessment of contaminated land is principally provided under Part 2A of the Environmental Protection Act (EPA) 1990, as inserted by Section 57 of the Environment Act 1995.

8.2.4 Under section 78A (2) of Part 2A of the EPA, contaminated land is defined as: “any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land that (a) significant harm is being caused or there is a significant possibility of such harm being caused; or (b) significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused”.

The Contaminated Land (Wales) Regulations 2006 (No.2989 W.278)

8.2.5 These Regulations make provision, in relation to Wales, for the identification and remediation of contaminated land under Part 2A of the Environmental Protection Act 1990.

Environment (Wales) Act 2016

8.2.6 The Environment (Wales) Act 2016 is legislation introduced by the National Assembly for Wales that established necessary legislation to enable a more sustainable and coordinated approach to the planning and management of the natural resources of Wales.

Guidance

8.2.7 A key item of guidance is the Environment Agency's (EA) Model Procedures; Contaminated Land Report 11 (CLR 11), which indicates that a Conceptual Site Model (CSM) should identify those contamination sources, pathways and receptors which are “likely” to represent an “unacceptable” risk either to human health or the surrounding environment.

8.2.8 Contaminated Land Statutory Guidance 2012 (ref: WG19243) was issued by the Welsh Government and is intended to explain how Local Authorities should implement the regime as detailed by EPA

1990, including how they should go about deciding whether land is contaminated land in the legal sense of the term.

8.2.9 CIRIA C552 (Contaminated Land Risk Assessment. A guide to good practice) examines the risk assessment of contaminated land and explains the key elements of risk assessment practices and procedures.

Planning Policy

8.2.10 The following national planning policies and guidance have been considered when undertaking this section of the EIA:

Planning Policy Wales (Edition 10, December 2018)

8.2.11 Planning Policy Wales (PPW) sets out the Government's planning policies for Wales and how they are expected to be applied. PPW, Technical Advice Notes (TAN's), circulars and policy clarification letters comprise national planning policy. The PPW states that:

- Opportunities offered by the planning system to address land contamination should be maximised as part of its preference for the use of Pre Developed Land (PDL). Whenever development or re-development potential exists the planning system will be the preferred means of addressing potential land contamination.

- There are two areas of interface between the planning system and the contaminated land regime. The first is where land is already designated as contaminated land under Part 2A and the owner wishes subsequently to develop the land. The second will be where a development proposal may introduce changes to a site which may result in land potentially meeting the definition of contaminated under Part 2A, where such land would not be considered contaminated in its existing state under the provision of the regime. In both circumstances, the onus will remain with the developer to ensure that the development of the site will remove any unacceptable risks and the planning authority in making development management decisions will need to ensure that the land is suitable for its proposed use and would not meet the legal definition of contaminated land under Part 2A.

- Planning authorities should take into account the nature, scale and extent of land contamination which may pose risks to health and the environment so as to ensure the site is capable of effective remediation and is suitable for its intended use. In doing so, development management decisions need to take into account:

  - the potential hazard that contamination presents to the development itself, its occupants and the local environment; and

  - the results of a specialist investigation and assessment by the developer to determine the contamination of the ground and to identify any remedial measures required to deal with any contamination.

- Where land contamination issues arise, the planning authority will require evidence of a detailed investigation and risk assessment prior to the determination of the application to enable beneficial use of land, unless it can already be established that remedial

measures can be employed. Where it is known that acceptable remedial measures can overcome contamination, planning permission may be granted subject to conditions specifying the necessary measures and the need for their implementation, including provision for remediating any unexpected contamination which may arise during construction. If contamination cannot be overcome satisfactorily, the authority may refuse planning permission.

- Ensuring that remediation measures are implemented to required standards is essential and planning authorities will require proof, in the form of a validation/ verification report, or equivalent, that this has occurred. For example, if a property is at risk from the migration of underground gases then a validation/verification report should contain a test certificate demonstrating that it has been constructed with gas membranes which have been correctly installed, and the risks adequately mitigated.

- When planning permission is granted, a notice should be issued to inform the applicant that the responsibility and subsequent liability for safe development and secure occupancy of the site rests with the developer and/or landowner. It should also advise the applicant that, although the planning authority has used its best endeavours to determine the application on the basis of the information available to it, this does not mean that the land is free from contamination.

Technical Advice Notes (TAN)

8.2.12 No TAN documents specifically referencing contaminated land were available at the time of reporting.

Cardiff Local Development Plan (2006 – 2026)

8.2.13 The Cardiff Local Development Plan 2006-2026 was adopted in January 2016.

8.2.14 In relation to land contamination, the following are included within the objectives of the LDP:

"Objective 3 – To deliver economic and social needs in a coordinated way that respects Cardiff's environment and responds to the challenges of climate change"

- To protect, manage and enhance Cardiff's natural environmental assets, including geodiversity, the best soils, water and air quality including, the reduction of pollution"

"Objective 4 - To create sustainable neighbourhoods that form part of a sustainable city"

- To ensure that all new development areas (whether greenfield or brownfield) create sustainable neighbourhoods.

8.2.15 In relation to new development, Policy KP5: 'High Quality and Sustainable Design' states that:

"To help support the development of Cardiff as a world-class European Capital City, all new development will be required to be of a high quality, sustainable design and make a positive contribution to the creation of distinctive communities, places and spaces by promoting the efficient use of land, developing at highest practicable densities and where appropriate achieving the remediation of land contamination."

8.2.16 In relation to long term sustainable development of Cardiff, Policy KP18: 'Natural Resources' states that:

"In the interests of the long-term sustainable development of Cardiff, development proposals must take full account of the need to minimise impacts on the city's natural resources and minimise pollution, in particular remediating land contamination through the redevelopment of contaminated sites."

8.2.17 In relation to planning and design, Policy EN13: 'Air, Noise, Light Pollution and Land Contamination' states that:

"Development will not be permitted where it would cause or result in unacceptable harm to health, local amenity, the character and quality of the countryside, or interests of nature conservation, landscape or built heritage importance because of the presence of unacceptable levels of land contamination."

8.2.18 Furthermore, the purpose of the Policy is to ensure:

"Developments are suitable for the proposed end use and that any actual or potential land contamination can be overcome, thereby ensuring that there is no unacceptable harm to human health or the environment."

Scoping Opinion

8.2.19 A Scoping Opinion was sought from Cardiff City Council by way of a Scoping Request Report submitted on 4th April 2019. A formal Scoping Opinion, reference SC/19/00005/MJR, was adopted by Cardiff Council on 17th May 2019. A copy of the Scoping Opinion is provided within Appendix 5-4.

8.2.20 In respect of Ground Conditions and Contamination, the Council relied upon the consultation responses from the Council's Contaminated Land Officer. Further information regarding the content of the Scoping Opinion is provided within Table 8-1 below.

Table 8-1: Scoping Opinion

Page & Paragraph No.	Scoping Opinion	Comments	Outcome	Reference within ES
Page 4, Section 3, NRW Comments & Page 5, Section 4	Land Contamination Assessment Required	Site had history of commercial and industrial use and is likely to be impacted by contamination	Relatively low risk when presence of contamination considered in conjunction with likely end use and site's environmental sensitively	Appendix 8-1

Additional Consultation

8.2.21 No additional consultation was undertaken outside of the formal Screening and Scoping exercises undertaken with Cardiff Council.

Assessment Methodology

8.2.22 The approach to undertaking the Ground Conditions and Contamination Chapter of the EIA comprises the following:

- establish the baseline conditions for the application site with respect to ground conditions, geology, hydrogeology, surface water and the potential for any land/water contamination;
- establish the previous land uses through a review of historical maps;
- identification of potential resources and receptors and definition of their significance/sensitivity;
- identification of effects to identified resources and receptors from each of the construction, operational and decommissioning phases of the project;
- assessment of the magnitude of effects likely to result from the project;
- identification of potential measures for mitigating any effects resulting from the proposed development; and
- identification of any residual and/or cumulative effects.

8.2.23 The typical method for assessing ground conditions is by a phased approach; commencing with a "Phase 1" Desk Study where the background and site setting are reviewed to develop a preliminary Conceptual Site Model (CSM). "Phase 2" investigation comprises intrusive methods whereby the ground conditions are physically investigated and the properties described through qualitative and quantitative means. "Phase 3" has a broad connotation and can include additional monitoring, further targeted/supplementary investigation, quantitative risk assessments and potentially ground/groundwater remediation.

8.2.24 In the specific case of assessing impacts from land contamination, the CSM is based on a simple "Source-Pathway-Receptor" model as outlined in CLR11:

- Source – potential source of contamination;
- Pathway – means by which contamination can reach and impact upon a receptor; and
- Receptor – that aspect which may be adversely affected by the presence of contamination.

8.2.25 The assessment of "risk" from land contamination is a three stage process commencing with a Preliminary Risk Assessment (PRA; usually completed after a Phase 1 Desk Study and Site Walkover) comprising a qualitative assessment only. This is typically followed by the Phase 2 ground

investigation whereby the nature of the source is quantified and this can be used in a conservative Generic Quantitative Risk Assessment (GQRA). Where potentially unacceptable risks are identified, further investigation is typically required and the assessment becomes a Detailed Quantitative Risk Assessment (DQRA) requiring site specific modelling; this stage would fall under "Phase 3" works.

8.2.26 For the assessment of the proposed development, the baseline conditions have been assessed up to Phase 1 (Desk Study and Site Walkover) and Phase 2 (Ground Investigation), with the scope of work (undertaken by TFW) including the following:

- a walkover survey of the Assessment Area and surrounding land in March 2019;
- review of the published and readily available information concerning the development land;
- review of Ordnance Survey Maps;
- review of Envirocheck environmental database report purchased from Landmark Information Group;
- review of historical development land use, published geology and hydrogeology, site setting and sensitivity, and recorded ground conditions;
- define the preliminary CSM that relates the anticipated ground conditions to the proposed development;
- establish potential areas of concern based upon potential risks;
- carry out an intrusive ground investigation and programme of environmental monitoring to enable the nature and extent of identified conceptual pollutant linkages to be quantified;
- identify any further actions required to delineate and/or mitigate the risks posed by the potential areas of concern.

8.2.27 The proposed development has been reviewed against the information defining the baseline conditions and the potential effects identified; these have been assessed for their significance as detailed below.

Study Area

8.2.28 The assessment considers the application site itself and the land surrounding it up to 2km. This area is considered suitable to capture any aspects which may be affected by the proposed development or which may have an effect on the proposed development.

Sensitivity Criteria

8.2.29 The assessment of potential effects to geology, hydrogeology and surface water was undertaken using criteria set out in Table 8-2 to define the importance/sensitivity of the receptor.

8.2.30 The importance/sensitivity of a receptor depends on both the nature of the receptor and how

sensitive the receptor is with respect to potential impacts from an identified source. In the absence of quantitative definitions for the scale of sensitivity, qualitative considerations have been defined through professional judgement.

8.2.31 This qualitative measure of sensitivity makes up one metric of the calculation of the level of effect (significance) as defined within Table 8-4. Qualification and justification of each level of sensitivity is discussed below (Table 8-2) and is designed to provide a simple framework on which to base each receptor's assessment.

Table 8-2: Defining the Importance/Sensitivity of the Receptor

Receptor Importance	Type of Resource	Type of Receptor				
	Geology and Soils	End Users	Construction Workers	Surrounding Land Users	Controlled Waters	Ecological Systems
High	Designated SSSI or SPZ for geology or soils Grade 1 Agricultural Land Land supports nationally rare plant species	Residents Home owners Allotment gardeners Children in play areas	Extensive earthworks	Residential area	Principal aquifer or surface water in close proximity to site	National or international designated sites
Medium	Grade 2 / 3a Agricultural Land Currently used for important crops Land supports regionally or locally rare plant species	General Public (Amenity: landscape or public open space)	Limited earthworks	Open space Greenfield site Commercial area	Secondary aquifer with surface water in the vicinity of the site	Locally designated ecological sites
Low	Brownfield or industrial site Site of little or no agricultural value (Grades 3b to 1)	'Hard' end use (e.g. industrial, car parking)	Minimal ground disturbance	Industrial area	No surface water bodies or aquifers close to the site	No sites of ecological importance close by
Negligible	Brownfield or industrial site Site of little or no agricultural value (Grades 3b to 1)	'Hard' end use (e.g. industrial, car parking)	No ground disturbance	Industrial area	No surface water bodies or aquifers close to the site	No sites of ecological importance close by

Magnitude of Change (Impact)

8.2.32 Subsequent to the above, the assessment of potential effects to geology, hydrogeology and surface water then utilised the criteria set out in Table 8-3 to define the magnitude of change (impact).

8.2.33 The magnitude of impacts associated with the proposed development is determined by the baseline conditions and how far the conditions will deviate from this established baseline during both the construction and operational phases of the development. Consideration is also given to assessing the impact that this change in condition may have on the source-pathway-receptor model with respect to each pollution linkage.

Table 8-3: Defining the Magnitude of Change

Magnitude		Description
High	Adverse	A permanent or long term adverse effect on the integrity and value of an environmental attribute or receptor, or exposure to acutely toxic contaminants. For example, harm to human health, designated habitats or pollution to controlled waters.
	Beneficial	Large scale or major improvement of resource quality. Extensive restoration or enhancement. Major improvement of attribute quality.
Medium	Adverse	An adverse effect on the integrity and / or value of an environmental attribute or receptor, but recovery is possible in the medium term and no permanent effects are predicted.
	Beneficial	Benefit to, or addition of, key characteristics, features, or elements or improvement of attribute quality.
Low	Adverse	An adverse effect on the value of an environmental attribute or receptor, but recovery is expected in the short-term and there would be no effect on its integrity. For example, temporary effects on receptors not designated under environmental legislation.
	Beneficial	Minor benefit to, or addition of, key characteristics, features or elements or improvement of attribute quality. Some beneficial effect on attribute or a reduction in the risk of a negative effect occurring.
Negligible		No effect would be detectable, either positive or negative.

Significance of Effect

8.2.34 The assessment of the potential and residual environmental effects of the proposed development has been described according to the likely beneficial or adverse effects of the aspect involved.

8.2.35 In the absence of specific guidance on the characterisation and assignment of significance for ground conditions effects, reference has been made to the Design Manual for Roads and Bridges (DMRB) Determining Significance of Environmental Effects. Volume 11 Section 2 Part 5 (HA 205/08).

8.2.36 The receptor importance / sensitivity (Table 8-2) and subsequent magnitude of change (Table 8-3) are assessed as a function of one another to determine the significance of each effect. The significance of the effects has therefore been considered within a Significance Matrix as presented in Table 8-4 below.

Table 8-4: Significance Matrix

		Sensitivity of Receptor			
Magnitude of Effect		High	Medium	Low	Negligible
	High	Major	Major	Moderate	Negligible
	Medium	Major	Moderate	Minor/Moderate	Negligible
	Low	Moderate	Minor/Moderate	Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

8.2.37 The effects are also defined in terms of the duration and the longevity of any effects; i.e. whether they are long to medium or short-term effects; or whether the effect is temporary/reversible or permanent.

8.2.38 A "significant" effect is one which is deemed to be Moderate or Major following assessment using the above tables (i.e. those cells shaded light blue)

Limitations to the Assessment

8.2.39 The assessment of effects on ground conditions is based on a geo-environmental assessment comprising desk based information and ground investigation data.

8.2.40 The assessment includes consideration of effects from the following phases of development:

- Construction Phase;
- Operational Phase; and
- Decommissioning Phase.

8.2.41 As discussed in detail later in this Chapter, although the supplied TFW report included as Appendix 8.1 was carried out in general accordance with current guidance and best practice, when considering the size of the study site it is judged to be relatively limited in scope. Consideration should therefore be given to the potentially variability between investigation locations and that unidentified, more significantly contaminated soils could potentially exist.

8.3.0 Baseline Conditions

Current Baseline

Site Setting

8.3.1 The site is located to the south side of Rover Way, Cardiff and is centred on an approximate National Grid Reference of 321275, 176149. The proposed development occupies an approximate area of some 1.13 hectares.

8.3.2 A walkover survey undertaken by TFW in March 2019 observed the site to comprise a large relatively flat open area comprising recovered land made of slag with areas of hardstanding. The flat area was reported to extend beyond the current study site and the area was surrounded by a high metal security fence. An electricity sub-station was noted approximately 200m northeast of the site and a gantry passed over the entrance to the site and runs to the northeast of the site.

Geology, Hydrogeology & Hydrology

8.3.3 The site is mapped as being underlain by the Mercia Mudstone Group that is overlain by superficial deposits of Alluvium. Map information also indicates that the site formerly comprised a refuse tip and as such the presence of Made Ground/fill was deemed to be likely.

8.3.4 The site is reported to be located outside of the South Wales Coal Field.

8.3.5 The superficial Alluvium has been designated as a Secondary (Undifferentiated) Aquifer whereas the Mercia Mudstone Group is denoted as a Secondary (B) Aquifer.

8.3.6 The closest licensed groundwater abstraction is reported approximately 210m to the south west of the site. This abstraction is for commercial purposed, including mineral washing and cooling, and is held by Celsa Manufacturing (UK) Ltd.

8.3.7 No potable groundwater abstractions or Source Protection Zones (SPZs) were identified within a 2km radius of the site.

8.3.8 The closest surface water feature to the study site is denoted some 330m to the south east of the site (at its closest point). Map information suggests that this entry relates to the River Severn estuary.

8.3.9 No pollution incidents to Controlled Waters are recorded within a 250m radius of the site.

Radon

8.3.10 The Envirocheck report states that the site is not located in and areas where 1% of homes are above the action level and as such new structures would not require radon protection measures.

Waste

8.3.11 The study site is denoted as an historical and BGS recorded landfill site that is reported to have accepted inert and commercial waste. The TFW report provided limiting information relating to this on site landfill and no information relating to correspondence with the Local Authority to confirm

the dates of operation, the types of waste accepted and whether this site has been subject to routine monitoring.

8.3.12 Several further historical landfill sites, reported to have accepted inert, industrial household and special wastes, are recorded within a 250m radius of the site.

Sensitive Land Uses

8.3.13 The Severn Estuary, reported some 330m to the south east of the site (at its closest point), is designated as a Site of Special Scientific Interest (SSSI), a Special Areas of Conservation, a Ramsar Site and a Special Protection Area.

Site History

8.3.14 The following table supplied by TFW discusses the findings of survey performed upon purchased Ordnance Survey historical maps:

Table 8-5: Historical OS Map Survey

Date	On Site	Off Site
1880	The site is located on a salt marsh in the estuary. A channel runs to the northeast of the site. The site is situated below the mean high water mark.	Undeveloped land is located immediately northwest of the site.
1885/86	As previously.	Tharsis Copper Works is situated 1.4km southwest of the site.
1900/01	As previously.	Urban development and a railway line are present some 1km west of the site.
1919/20	As previously.	As previously.
1922	As previously.	As previously.
1938/1947	As previously.	Further urban expansion is shown 475m northwest of the site in Splott.
1947 (AP)	The site appears to comprise mud flats.	Cardiff Airport (Note: this does not relate to the current Airport site) is evident approximately 550m north of the site.
1947/1954	As previously.	Sewage outfalls are located 250m and 500m to the northeast of the site.
1952/1957	As previously	Tremorfa Rolling Mill is located 500m southwest of the site. A pumping station is shown 470m northeast of the site.
1965	The site comprises part of a large tip extending onto the former mud flats. The mean high water mark is now shown to the east of this reclaimed land.	As previously.
1975	As previously.	The tip is shown to have extended southeast. Tracks traverse the tip. A steel rolling mill and other unspecified works are present 300m southwest. Rover Works has been developed

Date	On Site	Off Site
		700m north on Pengam Moor. A school is evident 450m northwest.
1982	The study site is shown as being undeveloped.	Buildings have been constructed on the current CELSA Works site.
1989	The tips are traversed by railway/tram lines.	A substation is located 250m north of the site. Extensive development of industrial buildings are depicted at the current CELSA site.
1992	As previously.	As previously.
2003	As previously.	As previously.
2009	Study site is labelled as a scrap yard.	As previously.
2018	Site is now labelled as a recycling site and is occupied by a series of conveyors.	As previously.

Preliminary Site Conceptual Model

8.3.15 Based upon the findings of the desk study and site walkover survey, TFW prepared a preliminary site Conceptual Model that discussed potential relationships between sources, pathways and receptors of contamination.

Potential Sources of Contamination

8.3.16 The following were identified by TFW as potential sources of contamination:

- The site comprised 'recovered land, built up with imported materials, most probably from the nearby steel works (i.e. slag waste)';
- The site was more recently identified as a scrap yard and recycling site and this was 'likely to be reflected in the soils chemistry'; and
- Numerous landfill sites were report both on, and in the vicinity of, the study site.

Potential Complete Pollutant Linkages

8.3.17 TFW identified the following potentially complete pollutant linkages that could conceptually result in a risk being posed to sensitive receptors:

- Constructions workers could be exposed to contaminated soils via the direct contact, ingestion and dust inhalation exposure pathways;
- Although a commercial development of the site is proposed it was stated that 'future site users could potentially be at risk from the same pathways';
- Inhalation of vapours by both on and off site human receptors was deemed an applicable pathway;
- Neighbouring site users and passers-by were identified as potential receptors of

contaminated durst generated by the proposed development;

- The inhalation of asbestos fibres would be a risk if identified in the Made Ground; and
- Any leachable contaminants could be mobilised through groundwater. However, the relatively impermeable Alluvium mapped beneath the site was considered to have the potential to 'hinder significant migration of dissolved contaminants'.

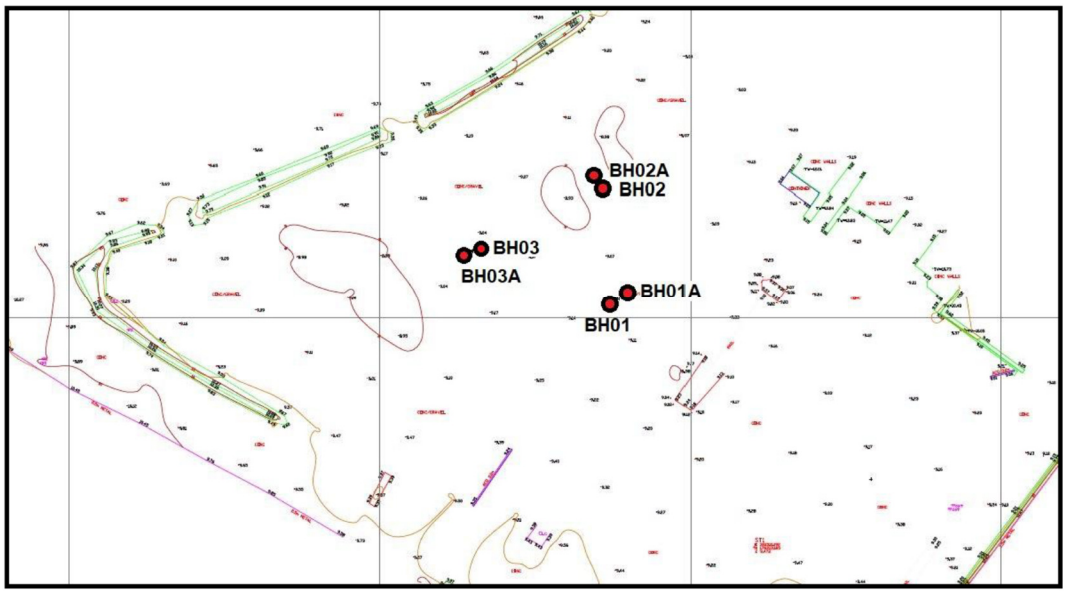
Ground Investigation & Laboratory Testing

Site Investigation

8.3.18 TFW carried out a ground investigation between the 01 and 05 April 2019 that comprised the formation of six rotary boreholes. Boreholes BH01 to BH03 were formed to depths of 21m below ground level (bgl) and penetrated into the deeper Mercia Mudstone Group. BH01A to BH03A were formed to shallower depths of 7.5m bgl to enable the recovery of samples of shallow Made Ground.

8.3.19 An exploratory hole location plan taken from the TFW report is included below:

Figure 8-1: April 2019 Exploratory Hole Location Plan



8.3.20 A summary of the ground conditions encountered in the boreholes is provided in Table 8-6 below:

Table 8-6: Summary of Ground Conditions

Depth	Description
GL – 7.3m/7.7m (provided to final depth of BH02A @ 7.5m)	Concrete over Made Ground recovered as predominately black to grey to black granular material with traces of clay. Brick and concrete fragments apparent.
7.3m/7.7m - 15.0m/16.4m	Very soft to soft Alluvial Clay.

Depth	Description
15.0m/16.4m - >21.0m	Weathered Marl (Mercia Mudstone Group).

Groundwater Observations

8.3.21 A monitoring visit carried out on the 16 April 2019 identified perched groundwater within the Made Ground at depths of between 4.59m and 4.65m bgl.

8.3.22 Sub-artesian groundwater was encountered beneath the Alluvium. This was noted to rise up the boreholes and was measured at depths of between 7.52m and 7.62m bgl during the 16 April 2019 site visit.

Sample Recovery & Analysis

Soils

8.3.23 A sample of Made Ground was recovered from each of the boreholes BH01 to BH03 at a depth of 0.5m to 1.5m bgl.

8.3.24 The three recovered samples were tested for the following suite of determinands:

- A suite of metals comprising Pb, As, Hg, Cr, Cu, Ni and Zn;
- Cyanide;
- Sulphate;
- pH;
- Organic matter;
- Asbestos;
- Phenol;
- Speciated poly aromatic hydrocarbons (PAHs); and
- Speciated petroleum hydrocarbons.

Groundwater

8.3.25 A monitoring visit was carried out on the 17 April 2019, during which groundwater samples were recovered from all six of the six installed wells.

8.3.26 These six samples, comprising three of the shallow/perched groundwater present within the Made Ground and three within the deeper natural mudstone/marl, were tested for the following suite of determinands:

- A suite of metals comprising Pb, As, Hg, Cr, Cu, Ni and Zn;

- Cyanide;
- Sulphate;
- CaCO3;
- BOD;
- COD;
- Conductivity;
- Sulphide;
- pH;
- Organic matter;
- Asbestos;
- Phenol;
- Speciated poly aromatic hydrocarbons (PAHs); and
- Speciated petroleum hydrocarbons.

Assessment of Laboratory Results

Soils

8.3.27 To assess the significance of the laboratory testing performed upon recovered soil samples the results were compared to a series of Generic Assessment Criteria (GAC) that considered a commercial/industrial end use of the site. These included Suitability 4 Use Levels (S4ULS) provided by Land Quality Management Ltd (LQM) and Chartered Institute of Environmental Health (CIEH) as well as Category 4 Screening Levels (C4SLs) issued by DEFRA.

8.3.28 In all instances the concentrations of the various determinands tested did not exceed the corresponding thresholds and as such the TFW report concluded that when considering the continued commercial end use of the site, the risks to human health were unlikely to be significant.

Ground Gases

8.3.29 During the single monitoring event carried of in April 2019 the concentrations of ground gases were measured in each of the six boreholes formed by TFW.

8.3.30 On the understanding the proposed asphalt batching plan will not include any confined spaces within which hazardous gases could accumulate, it was concluded that the risks posed by ground gases including methane and carbon dioxide were unlikely to be significant. However, for information purposes, the results of the gas monitoring were subject to an assessment that was carried out with reference to CIRIA C665.

8.3.31 Concentrations of methane in the shallow boreholes ranged from 0.2% to 4.8%. The carbon dioxide concentrations in these boreholes ranged from 0.1% to 1.4%. Recordable gas flow rates were not detected in any of the monitoring boreholes.

8.3.32 Methane concentrations were greater in the three deeper boreholes with measured concentrations ranging from 0.2% to 47.7% in BH02. Carbon dioxide concentrations were relatively low ranging from 0.0% to 0.1%. The maximum gas flow rate detected in these boreholes was 0.1l/hr.

8.3.33 The atmospheric pressure was measured at 1016mbar during the single monitoring event.

Groundwater

8.3.34 The chemical analysis performed upon the recovered groundwater samples were compared to generic screening criteria provided by the Water Framework Directive (WFD). Where these were not available for specific determinands reference was made to World Health Organisation (WHO) Drinking Water Standards (DWS).

8.3.35 The three samples of perched groundwater recovered from the wells installed within the Made Ground recorded concentrations copper, selenium, zinc, anthracene and fluoranthene in excess of the respective adopted standard.

8.3.36 The three deeper boreholes recorded elevated concentrations of arsenic, copper, selenium, zinc and chromium (III).

Risk Assessment

8.3.37 As indicated previously, current best practice for the assessment of ground contamination is to consider the significance of contamination in the context of a source-pathway-receptor linkage. For contamination to be significant, a complete linkage must be present. The presence of completed linkages requires further assessment or remedial intervention to address the issues of concern.

8.3.38 For this site, the relevant sources, pathways and receptors are considered in further detail below.

Sources

8.3.39 The three Made Ground samples tested to date did not record significant concentrations of the various organic and inorganic determinands tested. Furthermore, asbestos was not identified by the laboratory or observed during the progress of the site works.

8.3.40 Although the single round of groundwater monitoring did not identify wither the shallow of deeper groundwater present beneath the site to be grossly impacted by contamination, concentrations of metals and PAHs that exceeded the corresponding generic screening criteria were identified. However, concentrations of more mobile, organic contaminants such as petroleum hydrocarbons were not detected in any instance.

8.3.41 Elevated concentrations of methane were detected in the shallow and deep monitoring wells and as such both the Made Ground and Alluvium beneath the site could represent significant sources of hazardous ground gases. It should be noted however that in all instances the recorded gas generation rates were low and did not exceed 0.1l/hr.

Pathways

8.3.42 On Site inhalation of vapours - issues in relation to human health can arise where contamination, particularly hydrocarbons, are present on a site. Although no specific concerns have been identified from the ground investigation, as the site is understood to have been historically used as a scrap yard, there is a risk that as yet unidentified 'hot spots' of hydrocarbon with shallow soils could be present beneath the study site.

8.3.43 Offsite inhalation of vapours – if significant contamination, particularly hydrocarbons, is present on a site, this can lead to risks of impact to adjacent properties. In the absence of identified significant and widespread hydrocarbon contamination beneath the site, no specific concerns have been identified from the ground investigation.

8.3.44 Ingestion of soils and dusts – soils containing elevated concentrations of contaminants, including metals, inorganic and organic contaminants, can give rise to risks to human health from ingestion of soils or dusts. In light of the proposed commercial development as an asphalt batching plant, no specific concerns have been identified from the ground investigation with respect to future site users, but short term risks may arise during the construction phase of the development.

8.3.45 Leaching of contaminated soil and impact to aquifer beneath site - soils containing elevated concentrations of contaminants, including metals, inorganic and organic contaminants, can give rise to risks of leaching into groundwater under a site. Post development, the site will be surfaced by a new concrete pad that that will be designed to support the weight of the batching plant and associated HGV. This hardstanding is understood to cover the entire site will therefore inhibit the vertical migration of contaminants. Also, the superficial clayey Alluvium is also likely to be acting as an aquiclude, preventing shallow contamination from impacting the deeper, more sensitive bedrock aquifer.

8.3.46 Migration of contaminated groundwater into nearby rivers - groundwater containing elevated concentrations of contaminants could migrate off site and impact sensitive surface water receptors.

8.3.47 Ecological impacts - groundwater containing elevated concentrations of contaminants, including metals, inorganic and organic contaminants, can give rise to risks of migration of contaminants toward adjacent receptors, e.g. rivers, which in turn can lead to unacceptable impacts to aquatic wildlife. As a continued commercial land use is proposed no on site ecological receptors were identified. However, several off site potentially sensitive ecosystems associated with the River Severn Estuary were identified some 330m to the south east.

8.3.48 Direct contact with property materials – elevated concentrations of contaminants, e.g. sulphate attack on concrete foundations, can lead to issues in relation to building instability. No specific concerns have been identified from the ground investigation other than the need to consider ground conditions during the design of the proposed development.

Receptors

8.3.49 Humans – future site users, construction/maintenance workers, occupants of neighbouring properties and passers-by.

8.3.50 Buried structure and services – buried concrete structures and new services, in particular plastic water pipes for potable supply.

8.3.51 Surface water – the River Severn Estuary was identified approximately 330m to the south east of the site.

8.3.52 Groundwater – the Mercia Mudstone Group identified at depth beneath the site had been identified as a Secondary (B) Aquifer. However, no potable waste abstractions or Source Protection Zones (SPZs) were identified within a 2km radius of the site.

8.3.53 Ecosystems – the aforementioned River Severn Estuary is subject to several designations due to its environmental sensitivity.

Potentially Complete Pollutant Linkages

8.3.54 Post development, the hardstanding that will surface the study site will prevent future site users from being exposed to contaminated soils via the direct contact, ingestion and dust inhalation exposure pathways and as such these pollutant linkages are not deemed to be significant.

8.3.55 Significantly elevated concentrations of methane were recorded in the monitored boreholes. If, as anticipated, the proposed concrete batching plant does not include any permanent structures or confined spaces these gases would be dispersed into the atmosphere and as such not pose a risk to the development or its occupants. However, if built structures were considered it is likely that these would need to be designed to include appropriate gas protection measures and ventilation to prevent the ingress and accumulation of methane.

8.3.56 Construction workers are more likely to come into direct contact with contaminated soils. However, it is judged that the use of appropriate personal protective equipment (PPE) and health and hygiene practices would ameliorate any associated risks.

8.3.57 The use of appropriate dust suppression measures should be implemented during the construction phase to ensure that a risk is not posed to off site human receptors.

8.3.58 In the absence of a significant source of volatile organic contaminants such as petroleum hydrocarbons, the risks posed to on and off site human receptors from the volatilisation exposure pathway are deemed to be negligible.

8.3.59 Based upon the relatively low sensitivity of the study site with regards to groundwater, and the concentrations recorded by the initial round of groundwater monitoring undertaken at the site to date, the risks posed to the underlying Secondary (B) Aquifer are not likely to be significant. However, if deeper piled foundation are required, these could result in the creation of preferential migration pathways by which contaminants could be more readily transmitted from shallow soils to the deeper aquifer.

8.3.60 The River Severn Estuary was identified as a sensitive surface water body bordered by designated ecosystems including a SSSI and SAC. When considering these receptors are reported to be some 330m from the study site, and that the groundwater beneath he site was not found to be subject to significant contamination, the risks posed to this receptor are unlikely to be significant. However, if water is disposed on site via traditional shallow chamber soakaways this could potentially increase the leaching of contaminants within shallow Made Ground soils and increase the risks posed to the River Severn and associated ecologically sensitive sites.

8.3.61 The risks pose to buried structures and services could be controlled by the selection of appropriate materials that consider the identified concentration of contaminants.

Remediation Options Appraisal

8.3.62 In accordance with accepted good practice, it is appropriate to undertake an evaluation of the potential remediation techniques to address ground contamination that is considered unacceptable in terms of risks to the development, site users, adjacent property and/or the wider environment. This assessment is undertaken in the form of an options appraisal.

8.3.63 The specific requirements of the remediation options appraisal are linked to the identified contaminants; their chemical/physical character, their severity and extent of impact at the site, whilst also considering those options which provide the best value in monetary and human health/environmental benefit terms.

8.3.64 The ground investigations undertaken at the site has identified no unacceptable ground contamination that would prevent or restrict the proposed development. On the basis of the information upon the ground conditions beneath the site available at the time or reporting, it is considered that no formal programme of ground remediation will be required to facilitate the proposed development and therefore no formal remediation options appraisal is necessary.

8.3.65 Notwithstanding the above, it should be noted that the scope of the ground investigation report reviewed as part of this assessment was relatively limited and was based upon the chemical analysis of three samples of Made Ground and a single return gas/groundwater monitoring visit only. When considering the previous land uses identified by the desk study it is judged that there is a risk that further as yet unidentified 'hot spots' of contamination with the potential to pose risk to human, environmental and built receptors could be present.

8.3.66 To provide a better understanding of the nature and extent of ground contamination beneath the site it would be prudent to form further exploratory holes across the wider site to ensure a more robust spatial coverage. Further groundwater monitoring would enable the relatively low risks established to the sensitive River Severn Estuary to date to be completely discounted. Also, supplementary ground monitoring would help establish if the significantly elevated methane concentrations of up to 47.7% (albeit within the Alluvium/ Mercia Mudstone Group) is representative of the ground gas regime beneath the site.

8.3.67 With consideration to the above, it is acknowledged that brownfield sites such as this have the potential to be impacted by localised ground contamination. On this basis, it is considered prudent that the contractor undertaking the development should develop risk assessments and plans for managing such areas of contamination, if they exist, and ensure that appropriate regulatory agencies are notified as to the intended remedial actions to ensure the short, medium and long term safety of the development, site staff, visitors, adjacent properties and the wider environment.

Future Baseline

8.3.68 It is expected that should the proposed development not to proceed, the baseline conditions on Site in relation to existing ground contamination would likely remain unchanged. There is potential that certain organic contaminants such as petroleum hydrocarbons could be subject to natural attenuation in underlying soils and groundwater and as such their concentrations could reduce over time. Furthermore, soluble contaminants could migrate further from an on site source and impact sensitive groundwater and surface water receptors located at distance from the site.

8.3.69 Notwithstanding the above, when considering the nature of the ground conditions identified

beneath the site by the TFW report as well as the time elapsed since the site was used for waste disposal purposes, it is judged that any contamination remaining beneath the site is likely to comprise relatively insoluble and immobile inorganic compounds, the concentrations of which are unlikely to diminish significantly over time.

8.4.0 Assessment of Effects

8.4.1 The potential impact of the ground conditions and contamination on the proposed development have been segregated into impacts and effects that relate to the construction and operational phases of the proposed development.

8.4.2 Where a potential pollution linkage is incomplete, or a geotechnical risk is considered to be very low, an environmental impact is unlikely to exist. Where potential pollution linkages or significant geotechnical risks have been identified it is considered likely that an environmental impact may exist. The magnitude of impact has been quantified and the level of effect has been applied.

8.4.3 In this assessment the sensitivity of the potential receptors is designated as follows, based on the review of baseline conditions in Section 8.3:

- Human Health
  - Construction/maintenance worker – Medium sensitivity
  - Future site users – Low sensitivity
  - Off site human receptors – Medium sensitivity
- Controlled Waters
  - Groundwater – Low sensitivity
  - Surface waters – Medium sensitivity
- Buried structures/services – Medium sensitivity
- Ecosystem designations – Medium sensitivity

Construction Phase Effects

Potential Effects upon Human Health from Land Contamination

8.4.4 Although limited earthworks are proposed, site workers involved in the construction phase are likely to be of medium sensitivity as there are more likely to come into contact with contaminated soils via the direct contact, ingestion and dust inhalation exposure pathways. The likely magnitude of impact is be short-term medium risk. This could result in a short term effect of **moderate adverse significance**.

8.4.5 If the existing hardstanding is significantly disturbed during the construction phase dust could be generated, particularly in dry and windy conditions. Occupants of neighbouring sites as well as passers-by could temporarily be exposed through inhalation of potentially contaminated dust. Off site human receptors are judged to be of low sensitivity, whilst the magnitude of this impact would be considered medium (potential impact). This would result in a short-term effect of **moderate adverse significance**.

Potential Effects upon Controlled Waters from Land Contamination

8.4.6 When considering the physical properties of the Made Ground and superficial Alluvium encountered to depths of up to 16.4m below ground it may be necessary to adopt piled foundations at the site to support any significant plant or machinery utilised at the proposed asphalt batching plant. Such foundations have the potential to create preferential migration pathways by which any contaminants present in shallow soils could be readily transmitted to deeper groundwater. Such an effect could be deemed to have a minor to moderate adverse effect of **minor to moderate significance**.

8.4.7 To facilitate construction works, it is anticipated that new potential sources of contamination could be introduced and stored on the Site in the form of, for example, diesel fuel, oils, chemicals and construction materials. As a result, there would be a risk of leakages or spillages directly or indirectly (for example, via the surface water drainage systems) into the ground, although the likelihood and frequency of occurrence is considered to be low. The magnitude of this impact is considered low and the sensitivity of the receptor is judged to be medium. This would result in a short term effect of **minor to moderate adverse significance**.

8.4.8 The temporary removal or hardstanding during the construction phase could result in an increase in infiltration and the potential for contaminants in soils to be leached in the short term. When considering the nature of the ground contamination identified beneath the site to date the likelihood of such an occurrence is judged to be low. The magnitude of this impact is considered low and the sensitivity of the receptor is judged to be medium. This would result in a short term effect of **minor to moderate adverse significance**.

Potential Effects upon Buried Structures/Services from Land Contamination

8.4.9 Made Ground/fill underlies the site to a significant depth, and due to its potential variable and could pose a risk of instability. Without mitigation, such as the selection of an appropriate foundation solution, the magnitude of the impact from ground instability to the site, and specifically proposed structures, would be considered high and the sensitivity of the receptor (future site users) would be low. This would result in a long term effect of **moderate adverse significance**.

8.4.10 Buried structures and services laid in direct contact soils could be impacted by the direct contact pathway in the long term if reference to the ground conditions beneath the site is not made during material selection. If unsuitable materials were laid beneath the site this could have a high impact and the potential receptor could be of low sensitivity i.e. future site users consuming potable water from buried pipes. This would result in a long term effect of **moderate adverse significance**.

Potential Effects upon Designated Ecosystems from Land Contamination

8.4.11 As discussed in Sections 8.4.7 and 8.4.8, leaks and spills of contaminants during the construction phase and an increase in leaching due to the removal of the existing hardstanding could exacerbate the risks posed to sensitive ecosystems associated with the River Severn Estuary. The magnitude of this impact is considered low and the sensitivity of the receptor is judged to be medium. This would result in a short term effect of **minor to moderate adverse significance**.

8.4.12 A summary of the above effects and their significance during the construction phase is included in the following table:

Table 8-7: Construction Phase Significance of Effect Assessment

Aspect	Identified Risk	Receptor Sensitivity	Magnitude of Change	Significance of Effect
Human Health	H&S of construction workers	Medium	Medium	Moderate adverse significance
	Dust inhalation by off site human receptors	Medium	Medium	Moderate adverse significance
Controlled Waters	Migration pathways caused by piled foundations	Low	Low to Medium	Minor to Moderate adverse significance
	Leaks and spills of contaminants during construction phase	Low/medium	Medium	Minor to Moderate adverse significance
	Increase in leaching as hardstanding is temporarily removed	Low/medium	Medium	Minor to Moderate adverse significance
Buried structures and services	Instability of Made Ground and impact on new buildings	Low	High	Moderate adverse significance
	Impact upon structures and services laid in contaminated ground	Low	High	Moderate adverse significance
Designated ecosystems	Leaching to River Severn Estuary	Medium	Low	Minor to Moderate adverse significance

Operational Phase Effects

Potential Effects upon Human Health from Land Contamination

8.4.13 The proposed development would not fundamentally change the current industrial use of the site and once the new concrete hardstanding associated with the proposed development has been constructed there will be a negligible potential for future site users to be exposed to any contaminated soils or groundwater. The **significance of this effect is therefore deemed negligible**.

8.4.14 Maintenance workers are a receptor of medium sensitivity and could be exposed to contaminated soils if required to break ground. However, any such works are likely to be carried out in controlled conditions and subject to appropriate health and safety precautions and as such the effect is considered low. This would result in a short term effect of **minor adverse significance.**

Potential Effects upon Controlled Waters from Land Contamination

8.4.15 By surfacing the site with permanent hardstanding, consideration would need to be given to how surface water would be disposed. This aspect is the subject of a separate assessment by SLR (see Chapter 11).

8.4.16 During operation there is likely to be numerous products and martials stored at the site such as bitumen, chemicals, fuels, oil and lubricants etc., and these could introduce hazardous substances with the potential to contaminate the ground. In the absence of mitigation, such an effect could be deemed to be of **minor to moderate adverse significance**.

Potential Effects upon Structures from Land Contamination

8.4.17 Hazardous ground gases such as methane and carbon dioxide generated by the soils beneath the site could accumulate in confined spaces and pose a risk to the development and its occupants from asphyxiation and explosion. Although the sensitivity of the human receptor is high, as the proposed development is understood to not include any permanent structures in which gases could accumulate in the long term, the magnitude of the effect is judged to be low. This would result in an effect of **moderate adverse significance**.

Potential Effects upon Designated Ecosystems from Land Contamination

8.4.18 Leaks and spills of contaminants during the operation phase could exacerbate the risks posed to sensitive ecosystems associated with the River Severn Estuary. The magnitude of this impact is considered low and the sensitivity of the receptor is judged to be low to medium. This would result in a long term effect of **minor to moderate adverse significance**.

8.4.19 A summary of the aforementioned effects is presented in the following table:

Table 8-8: Operational Phase Significance of Effect Assessment

Aspect	Identified Risk	Receptor Sensitivity	Magnitude of Change	Significance of Effect
Human Health	Site users being exposed to contaminated soils	Medium	Negligible	Negligible significance
	Maintenance workers being exposed to contaminated soils	Medium	Low	Minor to moderate adverse significance
Controlled Waters	Leaks and spills of contaminants during operation phase	Low/Medium	Medium	Minor to Moderate significance
Built Structures	Ingress and accumulation of ground gases	Low	Low	Minor adverse significance
Designated	Leaks and spills of contaminants during	Medium	Medium	Moderate adverse

Aspect	Identified Risk	Receptor Sensitivity	Magnitude of Change	Significance of Effect
ecosystems	operation phase			significance

Decommissioning Phase

8.4.20 The proposed development has been designed for a significant operational lifetime of many decades.

8.4.21 There are no significant effects to ground conditions anticipated at the decommissioning stage, but localised impacts may arise from storage of bitumen, chemicals, fuels, oil and lubricants which would need to be investigated and remediated, if required, in accordance with the environmental standards at that time. The associated effects are therefore judged to be of **minor adverse significance**.

8.4.22 A summary of the decommissioning phase effects is presented in Table 8-9:

Table 8-9: Decommissioning Phase Significance of Effect Assessment

Aspect	Identified Risk	Receptor Sensitivity	Magnitude of Change	Significance of Effect
Human Health	Site workers being exposed to contaminated soils during decommissioning phase	Medium	Low	Minor adverse significance
Controlled Waters	Leaks and spills of contaminants during decommissioning phase	Low/Medium	Low	Minor adverse significance
Designated ecosystems	Leaks and spills of contaminants during decommissioning phase	Medium	Low	Minor adverse significance

Cumulative Effects

8.4.23 It is understood that further industrial developments are proposed in the vicinity of the study Site. It is therefore considered that the cumulative generation of dust could result in an increase in the effects to site workers and off site human receptors. This cumulative effect is therefore judged to have a **moderate adverse significance** if unmitigated.

8.4.24 A summary of the cumulative effects are presented in Table 8-10:

Table 8-10: Significance of Cumulative Effects Assessment

Aspect	Identified Risk	Receptor Sensitivity	Magnitude of Change	Significance of Effect
Human Health	H&S of construction workers	Medium	Medium	Moderate adverse significance
	Dust generated by several construction sites and inhalation by off site human receptors	Medium	Medium	Moderate adverse significance

8.5.0 Mitigation

8.5.1 This section details the mitigation measures and remediation requirements which can be employed to reduce the effects identified within the Assessment of Effects set out above.

Potential Mitigation Measures

8.5.2 For all construction activities, all workers and site visitors would be issued with appropriate Personal Protective Equipment (PPE) and will be trained how to use this correctly and effectively. The appropriate PPE, necessary to keep personnel on site safe, will be determined prior to those activities that require them. During construction, precautions will be taken to minimise the exposure of workers to potentially harmful substances. Appropriate Health and Safety Plans will need to be developed as required under the Construction (Design and Management) Regulations 2015. Attention will also need to be paid to restricting possible off-site dust emissions.

8.5.3 Specific protection is likely to include:

- Use of dust suppression techniques, including water spraying of access roads and stockpiles in dry weather;
- Avoiding the stockpiling of contaminated materials, where possible;
- Covering of stockpiled materials on the Site;
- Vehicles used to transport materials and aggregates will be enclosed; and
- Provision of fuel spill kits on all site plant, and appropriate chemical spill kits in the area where chemicals are both used and stored.

8.5.4 The mitigation measures described above are considered appropriate to address dust emission from on site sources, and the cumulative effects of these emissions on surrounding air quality.

8.5.5 In addition, the effective management of stockpiled soils would also reduce leaching of any contaminants and reduce the potential effects to controlled waters and designated ecosystems to low during the construction phase, particularly during the period between the removal of existing hardstanding and the construction of the new slab.

8.5.6 By working in accordance with appropriately robust method statements during the construction phase it is considered that the risk of significant leaks or spilled or stored hazardous liquids would be ameliorated and as such the effect would be low.

8.5.7 Adverse effects related to the storage of fuels and other hazardous substances associated with both the operation of the proposed development would be mitigated by adherence to the requirements of the Environmental Permit to be issued prior to commencement of site operations. By meeting the requirements of the Environmental Permit the effect of storage of fuels and other hazardous substances would be reduced to a negligible effect.

8.5.8 It will be necessary to consider the nature of the soils and groundwater beneath the site when devising an appropriate drainage strategy. Due to the presence of significant deposits of Made Ground up to 7.5m bgl beneath the site, coupled with a resistively high groundwater table recorded

at 4.6m bgl, the disposal of water on site via traditional shallow soakaways may not be a viable option (see Chapter 11 for further consideration of drainage at the site). The selection of an appropriate drainage strategy supported by routine monitoring of any licensed discharges from the site would result in a negligible effect.

8.5.9 By selecting an appropriate piling technique supported by a robust assessment of the soils and groundwater beneath the site it would be possible to reduce the associated potential effects upon controlled waters during the construction phase to negligible.

8.5.10 An assessment of the risks posed by hazardous ground gases that is supported by a robust programme of monitoring would enable appropriate gas protection measures to be adopted, if required. This would reduce the potential effect human and built receptors during the operation phase to negligible.

8.5.11 With regards to effects during the decommissioning phase, it is judged that the effects to human and environmental receptors are unlikely to be significant if the future works are carried out in accordance with best practices applicable at that time and therefore subject to appropriate control measures and safe working practices.

8.6.0 Residual Effects

8.6.1 Following the implementation of mitigation measures, the source-pathway receptor model has been re-applied to the previously identified effects. Table 8-11 summarises the effects, mitigation measures and residual effects during both construction and operational phases

Table 8-11: Post Mitigation Effect Assessment

Aspect	Identified Risk	Description of Mitigation Measure	Receptor Sensitivity	Residual Magnitude of Change	Residual Significance of Effect
Construction Phase					
Human Health	H&S of construction workers	Robust health and safety practices and use of PPE	Medium	Low	Minor to moderate adverse significance
	Dust inhalation by off site human receptors	Good working practices inc. dust suppression and management	Medium	Low	Minor to moderate adverse significance
Controlled Waters	Migration pathways caused by piled foundations	Use of appropriate technique supported by risk assessment	Low	Negligible	Negligible significance
	Leaks and spills of contaminants during construction phase	Appropriate site management and methods of working	Low/medium	Low	Minor significance
	Increase in leaching as hardstanding is temporarily removed	Site management inc. coving of stockpiles. Considered programme of works	Low/medium	Low	Minor significance
Buried structures and services	Instability of Made Ground and impact on new buildings	Appropriately designed foundations based upon robust ground investigation	Medium	Negligible	Negligible significance
	Impact upon structures and services laid in contaminated	Selection of appropriate materials based upon results of	Medium	Negligible	Negligible significance

Aspect	Identified Risk	Description of Mitigation Measure	Receptor Sensitivity	Residual Magnitude of Change	Residual Significance of Effect
	ground	appropriate ground investigation			
Designated ecosystems	Leaching to River Severn Estuary	Adopt appropriate controls and working practices during construction phase	Medium	Low	Minor adverse significance
Operation Phase					
Human Health	Maintenance workers being exposed to contaminated soils	Ensure site workers adopt appropriate health and safety practices and safe methods of work	Medium	Low	Minor adverse significance
Controlled Waters	Leaks and spills of contaminants during operation phase	Adopt appropriate controls and working practices during operation phase	Low	Low	Minor adverse significance
Built Structures	Ingress and accumulation of ground gases	Select appropriate gas protection measures based upon robust monitoring programme	Medium	Negligible	Negligible significance
Designated ecosystems	Leaks and spills of contaminants during operation phase	Adopt appropriate controls and working practices during operation phase	Medium	Low	Minor adverse significance
Decommissioning Phase					
Human Health	H&S of construction workers	Robust health and safety practices and use of PPE	Medium	Low	Minor adverse significance
Controlled Waters	Leaks and spills of contaminants during operation	Adopt appropriate controls and working practices	Low/Medium	Low	Minor adverse significance

Aspect	Identified Risk	Description of Mitigation Measure	Receptor Sensitivity	Residual Magnitude of Change	Residual Significance of Effect
	phase	relevant at time of decommissioning			
Designated ecosystems	Leaks and spills of contaminants during operation phase	Adopt appropriate controls and working practices during operation phase	Medium	Low	Minor adverse significance
Cumulative Effects					
Human Health	H&S of construction workers	Ensure that appropriate dust suppression measures are adopted at the study site. Notify neighbouring developments if working practices appear not to comply with current best practices	Medium	Low	Minor to moderate adverse significance
	Dust generated by several construction sites and inhalation by off site human receptors		Low	Low	Minor adverse significance

8.7.0 Summary of Effects

8.7.1 This section of the Chapter summarises the effects identified through the various assessments undertaken to form the Ground Conditions and Contamination section.

Construction Phase

8.7.2 The anticipated potential pre mitigation construction effects are summarised as follows:

- Health impact on construction workers from contact with potentially contaminated Made Ground;
- Health impact on the general public during construction via wind blown dust from contaminated Made Ground;
- Potential impact upon controlled waters from existing land contamination within the site mobilised during construction, for example during piling through contaminated ground into underlying groundwater bearing strata or due to an increase in leaching due to the temporary removal of hardstanding;
- Potential impact upon controlled waters and designated ecosystems from construction work and processes, such as potential spillage of chemicals, fuels and/or construction materials; and
- Potential impacts to built structures, and buried structures and services if laid in direct contact with unstable and/or contaminated Made Ground.

8.7.3 Mitigation measures to address construction effects have been discussed under the relevant sections above. All items above have considered that the application of relevant mitigation measures will reduce residual effects to an effect of negligible, low or moderate significance.

Operation Phase

8.7.4 The anticipated potential operational effects are summarised as follows:

- Health impact on maintenance workers posed by the presence of potentially contaminated Made Ground;
- Potential impact upon controlled waters and designated ecosystems from processes, such as storage and therefore potential spillage of chemicals, fuels etc. during the operation of the site; and
- Health impact on future users of the site posed by ground gas and its potential accumulation in confined spaces.

8.7.5 Mitigation measures to address operational effects have been discussed under the relevant sections above. All items above have considered that the application of relevant mitigation measures will reduce residual effects to an effect of negligible, low or moderate significance.

Decommissioning Phase

8.7.6 The anticipated potential operational effects are summarised as follows:

- Health impact on site workers posed by the presence of potentially contaminated Made Ground; and
- Potential impact upon controlled waters and designated ecosystems from processes, such as storage and therefore potential spillage of chemicals, fuels etc. during the decommissioning of the site.

8.7.7 Assuming that all future decommissioning works will be carried out with reference to the relevant standards and best practices at this time, and therefore subject to appropriate working and health and safety practices, the associated effects are judged to be low.

8.8.0 Conclusions

8.8.1 This chapter has considered the impact of the proposed development in terms of ground conditions and land contamination. This has been undertaken through a qualitative determination of significance of effect based on receptor sensitivity versus magnitude of impact. Both these metrics have been evidenced based on professional examination of the supplied technical report produced for the development, that is considered to generally align with current legislation, regulatory guidance and industry best practice. It should be noted however that the supplied report was based upon the assessment of a restively few number of tested samples and monitoring visits, and as such the available data set was judged to be limited.

8.8.2 While a number of receptors, considered to be of medium sensitivity, and some significant sources of risk have been identified, with regards to ground condition and contamination it is considered that potential effects can be minimised or controlled through appropriate mitigation.

8.8.3 Construction effects are predominantly controlled via adoption of responsible construction practices. Examples include:

- The use of robust health and hygiene practices and the use of PPE by site workers;
- Appropriately controlled material storage and the provision of spill kits;
- Selection of appropriate foundations that do not exacerbate the risks posed to controlled water receptors;
- The use of appropriate dust control and suppression measures; and
- Consideration of the ground conditions and potential for contaminated soils and groundwater when designing structures and selecting materials for buried structures and services (i.e. barrier pipe for potable water supply);

8.8.4 Operational effects can be minimised through accommodating for the risks in the design of the development. Examples include:

- The use of robust health and hygiene practices and the use of PPE by any maintenance workers who are required to break ground;
- Adopting appropriate control measures and working practices during operation phase to ensure that leaks and spills of any hazardous products are minimised and effectively managed; and
- Design of structures to consider potential risks posed by hazardous ground gas and the inclusion of protection measures if required.

8.8.5 Decommissioning effects can be minimised through accommodating appropriate control and management procedures for health, safety and the environment that are current at the time of the works.

8.8.6 Following the implementation of mitigation measures, the proposed development is not considered likely to result in significant adverse effects. As such, no specific constraints have been identified for the development proceeding as currently proposed.

REFERENCES

- Construction Design and Management (CDM) Regulations 2015
- Town and Country Planning Act 1990
- Environmental Protection Act (EPA) 1990
- The Contaminated Land (Wales) Regulations 2006 (No.2989 W.278)
- Environment (Wales) Act 2016
- Environment Agency's (EA's) Model Procedures; Contaminated Land Report 11 (CLR 11)
- Contaminated Land Statutory Guidance 2012 (ref: WG19243)
- CIRIA C552 (Contaminated Land Risk Assessment. A guide to good practice)
- Planning Policy Wales (Edition 10, December 2018)
- Technical Advice Notes (TAN)
- Cardiff Local Development Plan (2006 – 2026)

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