

7 GEOTECHNICAL CONDITIONS & CONTAMINATED LAND

7.1 INTRODUCTION

- 7.1.1 This chapter supports the Environmental Statement in respect of the outline planning application for the development of the site for industrial use which will require the accommodation of the constraints provided by the historical ground conditions that prevail on the site.
- 7.1.2 It therefore assesses both the existing geotechnical conditions and contamination, and considers how these will be affected by the proposed development during construction and operational phases. Strategies for mitigating the impacts are also described in respect of contamination, geotechnical conditions and radon gas.
- 7.1.3 The chapter summarises the legislation, guidance and planning policy and describes the assessment methodology used. The baseline conditions are described based on detailed desk study and the ground investigation incorporating the chemical analysis of the recently deposited (2007) overburden materials. Mitigation measures are proposed to reduce the impact of contamination with consideration also given to residual effects. Details on the impact of the proposed development to controlled water receptors are also considered.
- 7.1.4 Risks associated with water resources, drainage and flood risk are included in the Vectos Report.
- 7.1.5 Whilst assessed afresh, this element of the scheme proposals is common to, and consistent with, the previous (approved) development for the site. The principal conclusions drawn and set out in the consideration and determination (approval) of the previous (bio-mass and related development) scheme for the site record the following:
- land contamination has been carefully considered;
 - further surveys (and permit approvals under other legislation) will be required as the development progresses; and
 - subject to compliance with relevant conditions, pollution through land contamination can be avoided.

7.2 PLANNING POLICY CONTEXT

7.2.1 Current UK legislation on contaminated land is principally contained in Part IIA of the Environmental Protection Act 1990 and the Environment Act 1990. The WAG Contaminated Land - Statutory Guidance 2012 was published in 2013 and the guidance at 5.6 states that:

7.2.2 "There are four possible grounds for the determination of land as contaminated land (with regards to non-radioactive contamination):

- (a) *Significant harm is being caused to a human, or relevant non-human receptor*
- (b) *There is a significant possibility of significant harm being caused to a human, or relevant non-human receptor*
- (c) *Significant pollution of controlled waters is being caused*
- (d) *There is a significant possibility of significant pollution of controlled waters being caused"*

7.2.3 The legislation requires that the identification of contaminated land is undertaken within a risk assessment framework. The Statutory Guidance 2012 describes a risk assessment methodology in terms of a source-pathway-receptor ("significant pollution linkage") model of the site, comprising : -

- The **source** of pollutant hazards associated with the site (the sources);*
- The **receptors** at risk from the identified hazards;*
- The existence, or absence, of plausible **pathways** between the identified hazards and targets;*

7.2.4 For land to be identified as contaminated land all three elements of a "significant pollution linkage" must be present.

7.2.5 The contamination levels evident on the site have therefore been established in order to assess the degree of contamination, and assessment of what are the likely receptors and what pathways could exist to provide the linkage.

7.2.6 National, regional and local planning policies that are applicable to this chapter and the Application Site include:

- Part IIA of the Environmental Protection Act 1990 and the Environment Act 1990;
- WAG Contaminated Land - Statutory Guidance 2012;
- Cardiff Local Development Plan (2016).

Cardiff County Council Local Development Plan (LDP)

7.2.7 Cardiff Council LDP 2006 -2026 was adopted in January 2016. The LDP includes specific policies on contamination such as EN13 which accords with PPW. It aims to protect the natural and built environment and states that development proposals should encompass the principles of sustainable development.

7.2.8 Relevant policies in relation to geotechnical conditions & contaminated land included in the LDP are:

Policy EN13 – Air, Noise, Light Pollution and Land Contamination

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 air, noise, light pollution or the presence of unacceptable levels of land contamination.

Policy KP18 – Natural Resources

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 the following elements:

- i. Protecting the best and most versatile agricultural land;*
- ii. Protecting the quality and quantity of water resources, including underground surface and coastal waters;*
- iii. Minimising air pollution from industrial, domestic and road transportation sources and managing air quality; and*
- iv. Remediating contaminated land through the redevelopment of contaminated sites.*

Consultation

7.2.9 Initial discussions took place as part of the previous planning application and scheme with Environment (Enterprise and Specialist Services) who form part of the Shared Regulatory Services during 2013. Further discussions took place earlier in 2017 and a Planning Pre-Application was submitted on 31st May 2017.

7.3 ASSESSMENT METHODOLOGY

7.3.1 The assessment of effects of ground conditions and contaminated land have considered the current guidance on this subject. Potential environmental impacts have been considered by understanding the sensitivity of geological, hydrogeological, hydrological conditions in the area, historical sites uses and the general environmental setting of the site. The approach has been to undertake a 'source-pathway-receptor' analysis of the potential effects.

Impact Significance

7.3.2 The provisions for dealing with contaminated land are made under Part IIA of the Environmental Protection Act 1990 and the Environment Act 1995. The background to the contamination risk, in accordance with this legislation is defined in Section 7.2 of this chapter.

7.3.3 Guidance on the assessment of contamination risk advocates the use of a conceptual risk assessment model to establish connections between a hazardous source and a sensitive receptor through an exposure pathway. The principle is that there can be no significant contamination risk without all of the three elements (source, pathway and receptor) being present. The presence of a contamination hazard at a particular site does not necessarily imply the existence of associated risks.

7.3.4 There are no published standard criteria for assessing the significance of the potential effects that may arise from land contamination. The significance of effect (where a contamination risk has been identified) has been determined from criteria developed from **Assessing** best practice techniques and professional judgement. Criteria describing the magnitude or scale of effect and the importance or sensitivity of the resource affected have also been used and are identified in the tables below.

7.3.5 This chapter assesses the impact of the proposed development to ground conditions and receptors for the application site during site preparation, construction and operation of the proposed development.

Valuation of the Receptor

Value	Criteria	Example Receptors
High	Resources/features which are unique and if lost cannot be replaced or relocated. Receptors of greatest sensitivity.	Human Health, including, that of construction and maintenance workers, future site users/occupants and third party neighbours Sites of Special Scientific Interest with geological features
Medium	Resources/features of important consideration at a regional or district scale. Receptors vulnerable to changes in land quality/contamination levels	Built development – business/residential Land use where contaminant uptake by plants used in food production may alter health risks: Agricultural land holdings Allotments and gardens Amenity/open green space areas
Low	Features important at a local scale. Receptors with a moderate sensitivity to changes in land quality/contamination levels	Other land uses where contaminant uptake by plants is unlikely to alter health risks: Woodland/forestry Derelict/vacant land
Negligible	Features of minor importance or with a low sensitivity to changes in land quality/contamination levels	

Impact Magnitude

Contamination has been assessed by the identified presence of specific potential sources of contamination, pathways and sensitive receptors. The categories below are used in assessing the impact magnitude.

Magnitude	Criteria
High	<p>Loss of existing/creation of new source; Extensive, long term deterioration/improvement in conditions or circumstances (either local or widespread), such as:</p> <p>Construction phase release of contaminants which causes a significant impact on identified receptors; Elimination and/or mitigation of existing large scale impacts upon identified receptors during the operational phase</p>
Medium	<p>Significant material (but not fundamental) change in conditions or circumstances, including long term impacts, such as:</p> <p>a. Minor release of contaminants during the construction phase; b. Elimination and/or mitigation of limited existing impacts upon identified receptors during the operational phase.</p>
Low	<p>Measurable (but not material) change in conditions or circumstances, generally in the short term, such as:</p> <p>a. Limited, temporary contaminant release associated with construction phase; b. Temporary creation/elimination of pollution pathways during the construction phase.</p>
Negligible	<p>No measurable or perceptible change in conditions or circumstances affecting identified receptors.</p>

Impact Significance of Effects

7.3.6 The significance of the impact has been defined using the scale in the matrix below:

		Sensitivity of Receptor/Receiving Environment to Change/Effect			
		High	Medium	Low	Negligible
Magnitude of Change/Effect	High	Major	Major to moderate	Moderate to minor	Negligible
	Medium	Major to moderate	Moderate	Minor	Negligible
	Low	Moderate to minor	Minor	Minor to negligible	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

7.4 BASELINE CONDITIONS

History

- 7.4.1 The circa 16 hectare development site sits in the industrial part of Cardiff Bay and has played a role in the long steel making history of the region. The site was reclaimed from the River Severn estuary in the 1970's by the placing of a layer of circa 8m of blast furnace slag generated by the adjacent steel making processes. The site was then used to support the scrap metal feedstock required by the adjacent Celsa steel making plant (formerly Allied Steel & Wire) which included the processing of scrap motor vehicles. The site was abandoned during the 90's with large quantities of non-ferrous automotive shredded residue (ASR) and other fill evident on the site. The shredded residue was contained to the south west of the site in a formal cell but the residue deposits to the north east of the site were not contained and believed to be interspersed in a random fashion with general non-domestic fill of the era.
- 7.4.2 ASR was produced in developed countries throughout the world from the 1970s through and beyond the 1990s. The shredding process of vehicles allowed with the use of electro- magnets the recovery of substantial quantities of ferrous residue. The remaining substantive residue constituents were:
- PVCs
 - PCBs
 - Heavy metals
 - Duff which comprised of fines including dirt
- 7.4.3 Whilst the materials would generally be inert if undisturbed, there were previous recordings of elevated levels of gas being generated from the ASR.
- 7.4.4 The site was then subject to a major landscaping and remediation scheme at the turn of the century which converted the site to a rich tract of grassed amenity land. The scheme essentially provided a containment solution of the ASR with importation of fill from the adjacent Dwr Cymru Sewage Treatment Works (STW) site and re-profiled the land with gentle gradients which were capped with imported sub and topsoils before the implementation of a substantive landscaping and planting scheme. Potential risks for the site prior to remediation were essentially seen as:
- Combustion of the ASR by the self-ignition of gas pockets; and
 - Leachate containing contaminants being generated by the passage of ground water through the ASR and mobilizing contaminants.

- 7.4.5 The remediation proposals mitigated these effects by:
- The introduction of a passive gas venting system; and
 - A site wide MDPE membrane overlaid with a drainage blanket to interrupt potential pathways and intercept and shed any ground water to the foreshore before it could percolate through to the lower horizons of the ASR and mobilize contaminants
- 7.4.6 During 2006 Cardiff County Council developed a scheme to place substantive quantities of subsoils and blast furnace slags and re-profile the site for use as motor cross track. As developer, CCC applied for planning permission and implemented the scheme during 2007. There are no records of an Engineering Risk Assessment being carried out and these works could have compromised the mitigation measures previously carried out during the then recent landscaping and remediation as the works:
- Capped the passive gas vents; and
 - Surcharged the existing overburden materials causing further settlements of the compressible ASR with potentially consequential tensile tears in the MDPE membrane. This could allow pathways to be created for groundwater allowing ground water to pass through the ASR and generate contaminated leachate.
- Further minor re-profiling works for the motor cross track was carried out by a lessor circa 2010.
- 7.4.7 The information gathered includes the historical archive desk study information available together with various key documents listed under reference documents.

Geotechnical Conditions

- 7.4.8 The site currently comprises a motor cross track with some supporting infrastructure, formed of imported fill material from the Cardiff environs which overlays the previously landscaped site, engineered by Laing on behalf of Dwr Cymru. These landscaping works overlay the ASR which was deposited at or above +8.00 AOD which in turn was the man made platform (comprising primarily of blast furnace slag) following the reclamation of the site from the estuary.
- 7.4.9 Prior to the deposition of the slag the estuarial alluvium would have been visible as evidenced elsewhere in the estuary. Channel Gravels are situated beneath the alluvium over the rock head which is a stratum of the Triassic Mercia Mudstone Group (formerly known as Keuper Marl). A fuller description of the underlying conditions is included in Reference Document - *Hyder Consulting - Environmental Assessment 1999 – support document to Planning Application 97/02263/R*

Motor Cross Track Construction – (2007 to Date)

- 7.4.10 This was formed during 2007 with fill being sourced from St David's 2 construction site, the Leckwith out of town development and sports facilities and Celsa steel works which is located adjacent to the site. The fill material comprised of sub soils and furnace slag.
- 7.4.11 Whilst there was a planning application made to carry out this development it seems as previously stated no environmental risk assessment was made with respect to both the ecology that had established and flourished on the site since completion of the remediation works in 2000 nor to the impact on the adjacent sensitive Severn estuary which is designated as a Site of Special Scientific Interests (SSSI) and a European Site (Special Protection Area and RAMSAR, Special Area of Conversation).



View looking north east circa 2010 with motor cross track formed from imported fill

- 7.4.12 Under CCC's stewardship, remodelling of the track took place circa 2010. There is no record of an environmental risk assessment being carried out for these works.
- 7.4.13 This material has been sampled in June 2017 and appropriate chemical analysis carried out.

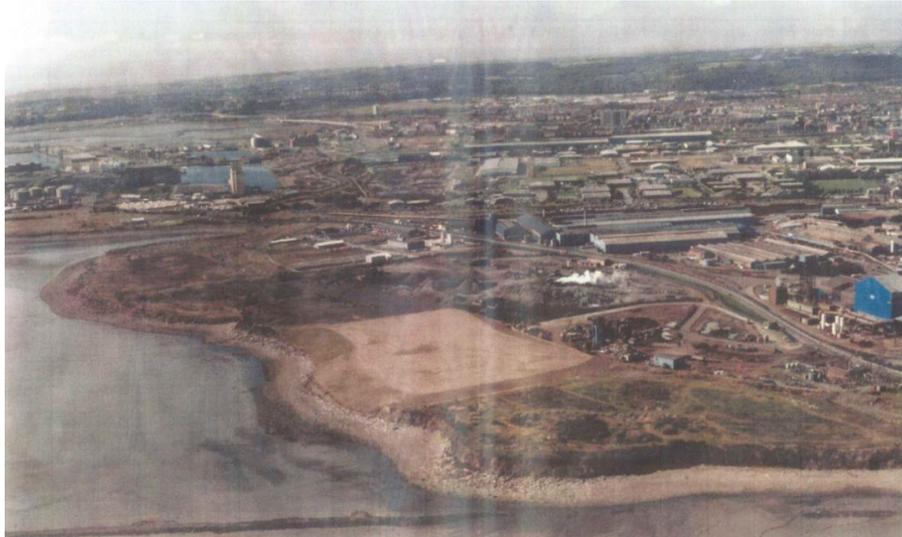
Recreational and Nature Conservation Area – (2000 To 2007)

- 7.4.14 This was a comprehensive scheme to remediate the abandoned site which had a capped ASR tip occupying circa 50% of the south western end of the site and an uncapped randomly filled area to the northern eastern end of the site. Full details are available from the CCC planning portal under Application No. 97/02263/R.



View post 2000 showing the completed and maturing amenity land.

- 7.4.15 This engineering work created a substantive lens of imported fill from the excavations associated with the construction of the adjacent Dwr Cymru STW which overlays the ASR and other unverified materials. As part of the scheme a MDPE membrane was laid over the newly imported fill with a drainage blanket laid on the membrane. A passive gas venting scheme was also installed to prevent build-up of gases below the membrane.
- 7.4.16 Below is a view looking west circa 1990 with the capped ASR cell clearly visible, prior to the implementation of the reclamation scheme.



View looking west circa 1990 with the capped ASR

Reclamation of the Site from the River Severn Estuary (1970s)

- 7.4.17 The majority of the site was reclaimed from the Severn Estuary by dozing surplus furnace slag from adjacent steel making plants into the channel and creating a level platform at circa +8.00 AOD for expansion of associated industrial processes to the adjacent steel making activities.

Ground Gas

- 7.4.18 A comprehensive gas monitoring programme was completed in 1997 before the implementation of the planning permission to remediate the site.
- 7.4.19 The full report including mitigation measures and is included in the ES which is referenced as Document 2 at the end of this chapter.
- 7.4.20 The outcome was that an effective passive gas venting scheme was installed that was subsequently destroyed in 2007 when the motor cross track was constructed.

Radon Gas

- 7.4.21 Radon is a naturally occurring radioactive gas produced by the radioactive decay of radium (which, in turn, is derived from the radioactive decay of Uranium). Uranium is found in small quantities in all soils and rocks, although the amount varies from place to place. Radon released from rocks and soils is quickly diluted in the atmosphere. Concentrations in the open air are normally very low and do not present a hazard. However, Radon entering enclosed spaces such as some buildings (particularly basements), caves, mines, and tunnels may reach elevated concentrations in some circumstances. Construction methods and degree of building ventilation will influence radon levels in individual structures.

7.4.22 Advice on Radon protection is detailed in 'BR211 Radon: Guidance on protective measures for new buildings (2007 edition)' which also provides guidance on what to do if the result indicates that protective measures are required.

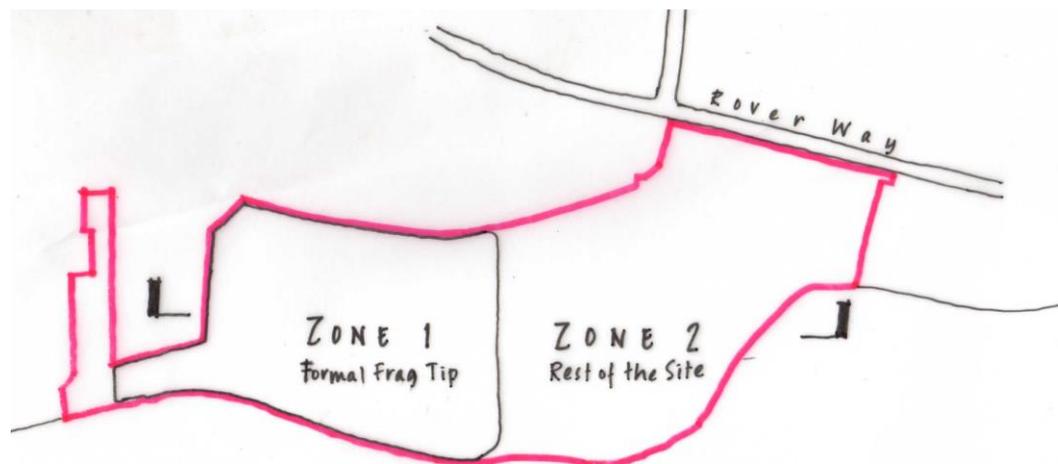
7.4.23 BR211 Radon Reports will be sought for the site at the detailed planning stage but it is assumed from records of this part of South Wales that the site will be affected by Radon and this has been addressed in the mitigation proposals.

7.4.24

Development and Construction Methodology

7.4.25 It has been established that site has a substantive amount of overburden comprising subsoils and blast furnace slag. These overlay the ASR which historically was arranged in

- A capped cell with a clay type of capping material and believed to be 100% ASR located towards the southwest end of the site – Zone 1;
- An uncapped cell and believed to be 60% ASR located towards the north east end of the site. The remaining 40% is believed to be general building waste and rubble – Zone 2.



Part Plan showing the zoning – see Profile Make-up – Appendix 1

7.4.26 Part of the reclamation scheme was to provide for the full containment of the ASR over the site and to ensure that no pathways were created for groundwater to pass through the ASR and mobilize contaminants. This would prevent the production of contaminated leachate.

7.4.27 The capping details included an MDPE membrane overlain with a drainage blanket which prevented groundwater percolation and the creation of 'pathways' between 'sources' of contamination (the ASR) and 'receptors' (the adjacent protected estuary).

7.4.28 In tandem with the MDPE membrane a passive gas venting system was also installed at this time

7.4.29 As previously noted it is possible that following the surcharging of the site during the creation of the motor cross track in 2007, the MDPE membrane has been ruptured as the ASR is compressible and if compressed would have created substantial tensile forces within the MDPE.

7.4.30 The proposed development therefore proposes:

- To remove circa 1,000,000 tonnes of the overburden material to local development schemes that require general up-filling;
- The removal of the ASR in the Zone 1 cell by a specialist re-processor;
- re-profiling of the site to give an interesting setting for development;
- the installation of a new gas venting system;
- the installation of a sealed membrane laid to positive falls overlaid with a drainage blanket to all unpaved areas to Zone 2;
- monitoring of potential leachate pathways
- 'pathway' interception at +8.00 AOD of leachate with extraction wells
- soil washing of any leachate that has elevated levels of contaminants

Earthworks and Foundations

7.4.31 There are 2 distinct geotechnical conditions prevalent on the site giving rise to the 2 Zones as referenced in 7.4.23.

7.4.32 Zone 1 will accommodate some of the LZC industrial units and it is anticipated that the foundations will be founded on the underlying fused slag bed or piled down to bedrock depending on the competency of the slag following the completion of the ASR removal.

7.4.33 Zone 2 will accommodate the remaining LZC industrial units and it is anticipated that the foundations will be of a raft construction founded on consolidated fill which will have its load bearing capacity enhanced through ground improvement techniques.

7.4.34 Some indicative sketches showing the sequence of work are attached at Appendix 1

7.5 POTENTIAL IMPACTS

Introduction

7.5.1 The source-pathway-receptor linkage model has been used to identify the potential impacts with respect to contamination risks during construction and during operation after the completion of the proposed development.

7.5.2 Key receptors are:

- Humans during the construction and operation of the development; and
- Non-human habitats provided by the adjacent protected estuary, including Special Area of Conservation (SAC); Special Protection Area (SPA); Ramsar; and Site of Special Scientific Interest (SSSI).

Impacts During Site Preparation and Construction

Impact to the Health of Construction Workers and the General Public from Contaminated Soils and Materials

7.5.3 The site investigations undertaken on the site have identified the existence of considerable quantities of ASR on the site over laid by the overburden material which is substantially free of contamination. The results of this analysis are included at Appendix 2. It is anticipated that the overburden material will be removed by a civil engineering contractor but the removal of the ASR will be performed by a specialist material re-processing contractor.

7.5.4 Excavation of potentially contaminated materials may pose a health risk to site workers through dermal contact (ie direct skin contact with contaminated soils), ingestion (ie via the transfer of contaminated soils from unwashed hands during eating) and inhalation (ie breathing in contaminated dusts, vapours and fibres generated by excavation activities).

7.5.5 Excavation of potentially contaminated materials may also pose a health risk to the general public in the immediate vicinity of the site through inhalation of contaminated dusts and particulate matter/fibres generated by excavation activities.

7.5.6 The impact of contaminated soils and materials during the construction phase on construction workers and possibly the general public is considered to be of **major adverse** significance prior to the implementation of mitigation measures. The valuation of the receptor is **high** and the impact is considered to be **high magnitude** due to the nature and extent of contamination identified.

Impacts on Neighbouring Sites from Disturbance/Mobilization of Contaminated Materials

- 7.5.7 The overburden material will be transported via vehicles and windblown dusts generated by construction activities and excavation of materials also have a potential to directly impact neighbouring sites, particularly during periods of dry, windy weather; further details are provided within the supporting Air Quality Consultants report.
- 7.5.8 The site has substantial quantities of ASR encapsulated in the 2 cells previously referred to in 7.4.22. The ASR is not dust laden so it is anticipated that the removal of the Zone 1 cell will be carried out by a specialist re-processing contractor. However there is a possibility of rainwater ingress creating pathways during the removal process and the possible production of contaminated leachate.
- 7.5.9 The impact from mobilisation of contaminated materials is likely to be of **minor to moderate adverse** significance prior to the implementation of mitigation measures due to the **medium** valuation of the receptor and **low magnitude** of the impact.

Impact to the Health of Construction Workers and the General Public from Ground Gas

- 7.5.10 Slightly elevated methane and carbon dioxide gas has been identified within the site during the 1995 monitoring. A CIRIA Characteristic Situation 1 and 2 classifications have been assigned to this part of the site based on that data.
- 7.5.11 Construction workers working in confined and semi-confined spaces on the development site are at risk of being exposed to elevated levels of gas which could lead to a risk of explosion and/or asphyxiation.
- 7.5.12 Excavation and disturbance of fill during construction may release odours which could affect the construction workers and the general public.
- 7.5.13 The impact on construction workers and other human health receptors from the effect of ground gases is likely to be of **minor to moderate adverse** significance prior to the implementation of mitigation measures due to the **high** valuation of the receptor and **low magnitude** of the impact.

Impacts After Completion

Impact to the Health of Future Site Workers and Occupants from Contaminated Soils and Materials

- 7.5.14 The intrusive site investigations undertaken on the site have identified minor contamination within the overburden materials
- 7.5.15 There remains a potential for residual minor contamination to remain on-site following development of the land.

- 7.5.16 Potentially contaminated soils can pose a direct health risk to maintenance workers through dermal contact (i.e. direct skin contact with contaminated soils), ingestion (i.e. via the transfer of contaminated soils from unwashed hands during eating) and inhalation (i.e. the breathing in of contaminated dusts, vapours and particulate matter/fibres generated by excavation activities) should the need for maintenance work involving the excavation of ground, e.g. maintenance of underground services, arise.
- 7.5.17 Without mitigation measures, there is a clear risk to future site occupants/users. Whilst the presence of hard standing, building footprints will offer some protection, there remains significant risk to site users without mitigation measures. There are also potential risks exist associated with the permeation of water supply pipes by organic contaminants.
- 7.5.18 The impact on future site users from contaminated soils and materials is likely to be of **major adverse** significance, prior to the implementation of mitigation measures due to the **high** valuation of the receptor and **high magnitude** of the impact.

Impact to the Health of Site Occupants and Maintenance Workers from Ground Gas

- 7.5.19 Post completion, ASR within Zone 2 has the potential to release ground gas which could have the potential to accumulate in confined spaces within the development and within confined service trenches.
- 7.5.20 The impact on human health receptors from the effect of landfill gases remaining after development is likely to be of **moderate to major adverse** significance prior to the implementation of mitigation measures due to the **high** valuation of the receptor and **medium magnitude** of the impact.

Impact on the Health of Site Occupants from Radon Gas

- 7.5.21 Natural emissions of radon gas may accumulate within buildings in those areas of the site where a risk could be identified from BGS data; prolonged exposure to high levels of radon can result in an increased incidence of lung cancer.
- 7.5.22 The impact on human health receptors from radon gas is considered to be of **moderate to major adverse** significance prior to the implementation of mitigation measures due to the **high** valuation of the receptor and **medium magnitude** of the impact.

7.6 PROPOSED MITIGATION AND ENHANCEMENT

Introduction

- 7.6.1 A number of adverse impacts have been identified, associated with the site preparation, construction and operational phases of the scheme. These can be managed through the implementation of appropriate mitigation measures as detailed below.

Impacts During Site Preparation and Construction

Impacts to the Health of Construction Workers and the General Public from Ground Gas

- 7.6.2 The risks posed to the health and safety of site workers during the site preparation and construction phases may be mitigated by the following measures:

- The provision and use of suitable Personal Protective Equipment (PPE)
- Dust suppression measures and wheel washing facilities
- The provision of health and safety training and warning signs

- 7.6.3 Risk Assessed Method Statements and working plans will be prepared in accordance with good site practices to avoid/minimise the likely significant effects at source, will be discussed and agreed with the appropriate Regulatory Authorities and included within the Construction Environmental Management Plan (CEMP) and Site Waste Management Plan (SWMP) and enforced throughout the construction phase.

Impact to the Health of Construction Workers and the General Public from Contaminated Soils and Materials

- 7.6.4 The effects to the health of construction workers and the general public from potentially contaminated soils and materials will be controlled under the Construction (Design & Management) Regulations 2015, Construction Phase Management Plan. Risk Assessed Method Statements will need to be prepared and remediation will be subjected to environmental permitting. These will ensure the protection of workers and the general public during the construction phases and specify appropriate safe working practices. Personal protective equipment (PPE) will be specified and used, particularly during ground works. Other protective measures will be incorporated to mitigate impacts posed to the general public.
- 7.6.5 All persons engaged in site redevelopment will be made aware of the findings of the geo-environmental site investigation. For the identified contamination, the associated hazards of handling potentially contaminated materials will be conveyed to all site workers and all works will be conducted in accordance with the Health and Safety Executive publication entitled 'Protection of Workers and the General Public during the Development of Contaminated Land', 1991.

Impacts on Neighbouring Sites from Disturbance/Mobilization of Contaminated Materials

- 7.6.6 A variety of good environmental site practices shall be implemented whilst undertaking construction activities, in order to avoid or minimise impacts at the source. There are likely to be a number of contractors operating on different parts of the site during construction, detailed mitigation measures will be developed as part of the construction plan in accordance with appropriate best practice.
- 7.6.7 A site CEMP will be prepared, including a site environmental and health and safety management policy to mitigate construction risks. The position and extent of working areas shall reflect surrounding areas and works being carried out. The contractor shall appraise the suitability of such working areas in this respect as part of working method statements.
- 7.6.8 Best practice recommendations for the prevention of contamination will be outlined in the CEMP and SWMP, both of which will be developed and discussed with the Local Authority and Environment Agency, prior to commencing construction following the granting of a detailed planning permission for these further works.

Impacts After Completion

Impact to the Health of Future Site Workers and Occupants from Contaminated Soils and Materials

- 7.6.9 The risks to future site occupants will be minimal as the contaminants in Zone 1 will have been removed as part the site preparation works. It is intended that the contaminants within Zone 2 will remain, but a protective MDPE membrane overlain with a drainage blanket will ensure no pathways will exist between the source of contaminants and receptors, either human or to the adjacent protected sites including the Special Area of Conservation (SAC); Special Protection Area (SPA); Ramsar; and Site of Special Scientific Interest (SSSI).

Impact to the Health of Site Occupants and Maintenance Workers from Ground Gas

- 7.6.10 The provision of a passive gas venting system as part of the mitigation works will protect site occupants and maintenance workers from ground gas in Zone 2 of the completed site.
- 7.6.11 Passive venting measures will be incorporated into the development, measures associated with CIRIA Characteristic Situation 2 are considered appropriate for the site, these involve the provision of the MDPE membrane and passive venting measures, all joints and penetrations would be sealed.

Impact on the Health of Site Occupants from Radon Gas

- 7.6.12 Where present, risks to human health associated with radon gas can be mitigated by the incorporation of radon gas protection measures within the proposed building design in line

with BRE publication 211 (Radon: Guidance on protective measures for new buildings, 2015), as appropriate. This will be reviewed following the survey.

Impact on Neighbouring Sites from Future Contaminated Material

- 7.6.13 Provided the remediation measures are undertaken including the provision of the appropriate membranes, the risk of contamination migrating to adjacent areas will be effectively mitigated.

7.7 RESIDUAL IMPACT ASSESSMENT

7.7.1 Following the implementation of the mitigation measures, the source-pathway receptor linkage model has been reapplied to identify potential impacts with respect to ground conditions and contamination and the significance reassessed. The effects of contamination and the impact of the site preparation, construction and the operational use of the site on ground conditions, mitigation measures and the residual effects of these impacts are summarised below.

Site Preparation and Construction			
Receptor/Risk Description	Initial Impact	Residual Impact	Mitigation Measures
	Significance	Significance	
Health of construction workers and the general public affected by contaminated soils	Major Adverse	Minor to moderate adverse	Compliance with CDM (Design & Construction) Regulations 2015 and adherence with published guidance and best practice. Construction Phase Management Plan will incorporate risk assessed method statements
Impacts on soils and neighbouring sites from contaminated soils and materials	Minor to Moderate Adverse	Negligible	Ensure that new pathways are not established between inert contaminants and receptors. Use of good environmental site practices and adoption for pollution prevention guidelines
Impact of health of construction workers and the general public from ground gas	Minor to Moderate Adverse	Negligible	Further gas monitoring and mitigation if required to be carried out in line with CIRIA guidelines and best practice. Use of generic safe working practices and confined spaces procedures
Operational			
Impact on human health from residual contaminated soils and materials	Major adverse	Negligible	Mitigation measures implemented during site preparation and construction including removal of inert contaminants and capping of residual contaminants
Impact to health of site occupants and maintenance workers from ground gas	Major to moderate adverse	Negligible	Mitigation Measures implemented during design, site preparation and construction which includes a gas membrane and passive venting measures to areas of residual contaminants
Impact to health of site occupants from radon gas	Major to moderate adverse	Negligible	Mitigation measures implemented during design and construction of new buildings which will include appropriate radon protection measures.

Impact on soils and neighbouring sites from future contaminated materials	Moderate to minor adverse	Negligible	Mitigation measures within development design - appropriate drainage to all hard surface areas with drainage medium and impermeable barrier to soft landscape areas
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7.8 SUMMARY AND CONCLUSIONS

- 7.8.1 The site is a disused industrial site that had substantial quantities of ASR left in 2 distinct zones, one of which was in a formal capped cell and the other in an uncapped cell and intermingled with other waste thought to be mostly building related. The site was subjected to a comprehensive reclamation scheme at the turn of the century but was subsequently turned into a motor cross site with addition of substantial overburden materials in 2007.
- 7.8.2 The geology of the area typically comprises of the made ground associated with the history outlined in 7.8.1 sitting over estuarial alluvium. Channel Gravels are situated beneath the alluvium which overlays the rock head comprising a stratum of the Triassic Mercia Mudstone Group (formerly known as Keuper Marl).
- 7.8.3 The proposal assumes a reduction by circa 1,000,000 million tonnes of the overburden material and the reprocessing off site of the ASR from Zone 1 of the development site. The surpluses of overburden from Zone 2 will then be used by consolidating them over the whole of the site to form the development plateau.
- 7.8.4 The main impacts of the development with respect to ground conditions and contamination during the delivery and the operation of the development are:
- i) Health of construction workers
 - ii) Creation of pathways between source and receptor for leachate to become contaminated and initially to reach the foreshore and possibly reach the tidal flow of the River Severn
 - iii) Health of future site users from contaminants and landfill gas in the Zone 2
 - iv) Migration of radon from the natural geology of the area
- 7.8.5 Mitigation measures to be implemented in response to 7.8.4 are:
- i) include the use of safe working procedures and good environmental practices, the Construction (Design and Management) Regulations 2015 and Pollution Prevention Guidelines
 - ii) Monitor the underlying slag 'plate' at +8.00am to look for evidence of perched contaminated leachate during the construction process and ensure interception and remediation measures are put in place should the situation arise
 - iii) Provide similar measures to those that were installed circa 2000 for the retained contaminants in Zone 2
 - iv) Provide radon protection to vulnerable areas of the development that could be vulnerable to a build of radon gases.
- 7.8.6 Following the implementation of mitigation measures, it is considered that a minor to moderate adverse impact remains for the health and safety of construction workers but other impacts are considered negligible following mitigation.

References

Relevant Legislation

- The Construction (Design and Management) Regulations 2015
- Environmental Permitting (England & Wales) regulations 2010
- Environmental Protection Act 1990
- The Environment Act (1995)
- The Land drainage Act (1999)
- The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017
- The Water Act (2014)
- The Private Water Supplies Regulations (2016)
- The Water Supply (Water Quality) Regulations 2016
- Water Resources (Environmental Impact Assessment) Regulations 2003
- Water Resources (Abstraction and Impounding) Regulations 2006
- Environmental Impact Assessment (Land Drainage Improvement Works) Regulations 1999
- Land Drainage Act 1991
- Public Health Act 1848
- Pollution Prevention and Control Act 1999
- Pollution Prevention and Control (England and Wales) Regulations 2000
- Anti-Pollution Works Regulations 1999
- 2006/11/EC Dangerous Substances Directive

Relevant Codes of Practice:

- BS5930: Code of Practice for ground investigations 2015
- BS EN 1997 Eurocode 7 Geotechnical Design
- BS1377-9 (1990) Methods of testing soils for civil engineering purposes
- ISRM (1985) Rock characterisation methods
- BS6031: 1981 Code of Practice for earthworks
- BS8004: 1986 Code of Practice for foundations
- Policy and Practice for the Protection of Groundwater, 1992, Environment Agency.

Relevant Guidance Documents:

- Environment Agency - Pollution Prevention Guidance Notes (PPG series)
- Environment Agency – Model procedures for the Management of land Contamination 2004
- Welsh Government - Contaminated Land – Statutory Guidance 2012
- Good Practice Guide for Handling Soils (MAFF 2000)
- CIRIA REP R 113 (1986) Control of Groundwater for Temporary Works
- CIRIA C630 (2006) Sustainable water management in land use planning
- CIRIA C741 (2006) Environmental Good Practice on Site
- CIRIA C665 (2007) – Assessing risks posed by hazardous ground gases to buildings
- BRE 211 (2007), Radon, Guidance on Protective Measure for New Buildings, UK

Planning Policy

- Planning Policy Wales (PPW) (2021) -11th Edition
- Technical Advice Note (TAN) 15: Development and Flood Risk (2004)
- Adopted Cardiff County Council Local Development Plan (LDP) (2006 – 2026)

Reference Documents

- **Document 1*** Cardiff County Council - Planning Permission granted in respect of Planning Application 97/02263/R
- **Document 2*** Hyder Consulting - Environmental Assessment 1999 – support document to Planning Application 97/02263/R
- **Document 3*** Cardiff County Council - Planning Permission granted in respect of Planning Application 06/02538/E
- **Document 4** Craddys – Desk study and Report pre 2006 Study - 2013
- **Document 5** Cardiff County Council - Cardiff Motorcycle Track Investigation Report – 2010
- **Document 6** Cardiff County Council - Contamination Sampling and Assessment – letter 2017
- **Document 7** Integral Geotechnique - Chemical Analysis of overburden - 2017

Notes:

* *These documents are available on the CCC Planning Portal*