South Industrial Zone

Environmental Statement

July 2020

Volume 2

Chapter H - Ground Conditions and Remediation

Contents

H1.0 Introduction

H1.1 This Chapter of the Environmental Statement ('ES') has been prepared by Arcadis (UK) Ltd on behalf of the applicant, South Tees Development Corporation ('STDC'). It assesses the proposed development described in Chapter B and it considers the effects of the proposed development on the site's ground conditions and the need for remediation.

H1.2 The baseline situation is considered before the potential environmental effects of the proposed development are identified, both during construction and operational phases of the development. Mitigation measures to reduce any negative environmental effects are identified as appropriate, before the residual environmental effects are assessed.

H1.3 This Chapter is supported by the following technical appendices: -

1 Appendix H1: Former Steelworks Land, South Tees Outline Remedial Strategy, Prepared for South Tees Development Corporation by Wood, Ref. 41825-wood-XX-XX-RP-OC-0001_S0_P01 dated 25th June 2019 [Wood 2019];

2 Appendix H2: Scoping Correspondence with Redcar and Cleveland Borough Council ('RCBC');

3 Appendix H3: Site Layout and Areas Plan;

4 Appendix H4: The Former SSI Steelworks, Redcar: Former SLEMS Landfill, Intrusive Investigation Report, prepared by Arcadis for South Tees Site Company Ltd., Ref Redcar Steelworks-AUK-XX-XXRP-GE-001-P1-SLEMS_BOS_Oxide_Assessment dated January 2019 [Arcadis 2019];

5 Appendix H5: The Former SSI Steelworks, Redcar: Replacement CLE3/8 Landfill Boreholes, CQA Validation Report, prepared by Arcadis for South Tees Site Company Ltd., Ref 37774100007_01, dated January 2019 [Arcadis 2018];

6 Appendix H6: TS4 South Bank – Phase 1 Environmental Desk Study, prepared by CH2M Hill for the Homes and Communities Agency, Ref. 678079_TS4_001 dated August 2017 and marked Final [CH2M 2017];

7 Appendix H7: First Phase Reporting of the Site Protection and Monitoring Programme, prepared by Corus Group Plc (Corus [2008];

8 Appendix H8: Design of a Site Protection and Monitoring Programme for Cleveland Works, Teesside, prepared by Corus Group Plc [Corus 2004];

9 Appendix H9: Soil and Groundwater Baseline Characterisation Study, Teesside Works, prepared by Enviros for Corus UK Ltd [Enviros 2004], Comprising:

   a Volume 1 – Factual Report, Ref. Rlp250604corusteessidefactual.Doc dated 25th June 2004 and marked Final;

   b Volume 2 – Interpretive Report Ref. Mwicorusdraftinterpretivemmdv#2. Doc dated 25th June 2004 and marked Final; and,

   c Volume 3 – Summary Report dated June 2004.

10 Appendix H10: South Tees Industrial Area – Site C – Ground Investigation, prepared by Allied Exploration and Geotechnics Ltd. for English Partnerships, Ref. 1715H dated 12th July 1999 and marked Draft [AEG 1999].

About the Authors

H1.4 Prepared by Jake Hurst BSc (Hons), MSc, CEnv, Principal Consultant Arcadis UK Ltd. Jake has over 15 years' experience in contaminated land assessment, chemical analysis and remediation including the preparation of Environmental Statements for Environmental Impact Assessments (EIA) and other regulatory, permitting and planning support across a range of commercial, industrial and residential development projects.

H1.5 Reviewed by Chris Piddington PhD, BEng (Hons), Technical Director Arcadis UK Ltd. Chris has over 18 years' experience in delivering bespoke contaminated land solutions and brownfield regeneration schemes. His work includes the preparation of Environmental Statements to support Environmental Impact Assessments in addition to providing support and guidance in relation to regulatory, permitting and planning challenges across a diverse range of development projects.

H1.6 Arcadis is a member of the IEMA EIA Quality Mark.

H2.0 Policy Context

National Policies and Legislation

H2.1 The legislation, policy and documentation applicable to Land Quality and Soil Contamination at the national level are listed in Section H10 (References) and shown below. These documents are used to guide the assessment of potential risks posed by contamination, the significance of potential impacts as well as inform mitigation measures in line with industry good practice.

1 Environmental Protection Act 1990 Part II;

2 Environment Act 1995;

3 Environment Agency 2008, An ecological risk assessment framework for contaminants in soil. Science Report SC070009/SR1;

4 Derivation and use of soil screening values for assessing ecological risks Report – ShARE id26 (revised);

5 BRE Special Digest (SD) 1: Concrete in Aggressive Ground, 2015;

6 Environmental Permitting (England and Wales) Regulations 2010;

7 Control of Pollution (amendment) Act 1989;

8 Water Framework Directive 2000/60/EC;

9 Groundwater Directive 2006/118/EC;

10 Controlled Waste (Registration of Carriers and Seizure of Vehicles) Regulations

11 1991 (as amended);

12 Controlled Waste (England and Wales) Regulations 2012;

13 Construction (Design and Management) Regulations 2015;

14 Hazardous Waste (England and Wales) Regulations 2005;

15 Waste (England and Wales) Regulations 2011;

16 Waste Framework Directive 2008/98/EC (OJEU, 2008);

17 The Contaminated Land (England) Regulations 2006;

18 The Environment Damage (Prevention and Remediation) Regulations 2015;

19 National Planning Policy Framework, 2019;

20 Environment Agency, Guiding Principles Land Contamination (GPLC2)

21 Environment Agency, Land Contamination Risk Management (2019);

22 Environment Agency, Land contamination groundwater compliance points: quantitative risk assessments, 2017;

23 Environment Agency, Protect groundwater and prevent groundwater pollution, 2017;

24 Environment Agency, Groundwater protection technical guidance, 2017;

25 Environment Agency, The Environment Agency's approach to groundwater protection, 2018;

26 British Standards 10175:2011+A2:2017 'Investigation of Potentially Contaminated Sites - Code of Practice' 2017;

27 British Standards BS3882:2015 'Specification for Topsoil and Requirements for Use' 2015;

28 British Standards BS EN 206:2013+A1:2016 'Concrete - Specification, Performance, Production and Conformity' 2013;

29 BSI Standards Publication "Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings", BS 8485:2015+A1:2019;

30 CIRIA C665 'Assessing risks posed by hazardous ground gases to buildings' 2007;

31 CIRIA C552 Contaminated Land Risk Assessment A Guide to Good Practice. 2001;

32 CIRIA C692 Environmental Good Practice on Site. 4th Edition 2015;

33 National House Building Council, Environment Agency and Chartered Institute of Environmental Health 'R&D Pub 66: Guidance for the Safe Development of Housing on Land Affected by Contamination (Volumes 1 & 2), 2008;

34 National House Building Council, Guidance on Evaluation of Development Proposal on Site Where Methane and Carbon Dioxide are Present Report Edition No.4 March 2007;

35 EA's 'TR P5-065/TR: Technical Aspects of Site Investigation (Volumes 1 & 2)' 2002;

36 DEFRA (2012) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance; and DEFRA Guidance, Pollution Prevention for Businesses, July 2016 (Updated May 2019).

National Planning Policy

H2.2 The National Planning Policy Framework (NPPF) 2019 sets out the Government planning policies for England and how these are to be applied. Chapter 11 (Making effective use of land) and Chapter 15 (Conserving and enhancing the natural environment) of the NPPF - contain the following paragraphs which are relevant to this assessment and are summarised below:

1 Paragraph 117 states that *"Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land"*;

2 Paragraph 118 (c) states that *"planning policies and decisions should give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land"*.

3 Paragraph 170 requires that the planning policies and decisions should *"contribute to and enhance the natural and local environment by: (a) protecting and enhancing valued landscapes, sites of biodiversity or geological value and soils; (b) recognising…the wider benefits from natural capital and ecosystem services…; (d) minimising impacts on and providing net gains for biodiversity…; (e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability…; and (f) by remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate"*.

4 Paragraph 178 requires that *"planning policies and decisions should ensure that: (a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation); (b) after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act*

1990; and (c) adequate site investigation information, prepared by a competent person, is available to inform these assessments".

5 Paragraph 179 states that *"where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner".*

H2.3 Guidance from the Ministry of Housing, Communities & Local Government includes online planning policy guidance on 'Land affected by contamination' (2019) and 'Land stability' (2019).

Local Planning Policy

H2.4 Redcar and Cleveland Borough Council (RCBC) will determine the outline planning application in accordance with Section 38(6) of the Planning and Compulsory Purchase Act 2004, which states that planning applications must be made in accordance with the development plan unless material considerations indicate otherwise.

H2.5 In this case, the relevant statutory development plan comprises:

1 Redcar and Cleveland Local Plan (adopted May 2018);

2 Local Plan Policies Map; and

3 The Tees Valley Joint Minerals and Waste Development Plan Documents, comprising:

(a) Minerals and Waste Core Strategy DPD (adopted September 2011); and

(b) Minerals and Waste Policies and Sites DPD (adopted September 2011).

H2.6 Planning policies relevant to ground conditions and remediation associated with the proposed development are set out below.

H2.7 Local Plan Policy LS 4 (South Tees Spatial Strategy) includes the following aims in relation to the environment:

1 enhance the environmental quality of employment through well planned boundary treatments;

2 secure decontamination and redevelopment of potentially contaminated land;

3 protect European sites, and safeguard and improve sites of biodiversity interest particularly along the River Tees and the estuary and encourage integrated habitat creation and management;

4 enhance the environmental quality of the River Tees and coastline;

5 encourage improvements to access, interpretation and wildlife conservation and biodiversity across the area;

H3.0 Assessment Methodology & Significance Criteria

Assessment Methodology

H3.1 The assessment of impacts to and from the existing ground conditions and from the proposed development is undertaken using importance and significance criteria that have been developed by Arcadis, and successfully applied to other Environmental Impact Assessments. The methodology considers the potential presence of land and groundwater contamination as well as sites of geological/geomorphological significance such as geological conservation features or mineral resources. Geotechnical constraints e.g. differential settlement, subsidence and the potential for explosive ground gas accumulation are also highlighted with the built environment identified as the main sensitive receptor. The built environment includes foundations, below-ground structures, utilities equipment and buildings.

H3.2 The reports listed below and as appendices in paragraph H1.3 above have been used to establish the baseline conditions. The Conceptual Site Model (CSM) presented in the Outline Remedial Strategy (2020) (Appendix H1), is integrated into the baseline conditions. All supporting information is consistent with the risk-based framework adopted by the Environment Agency: Land Contamination Risk Management (2019).

1 Former Steelworks Land, South Tees Outline Remedial Strategy, Prepared for South Tees Development Corporation by Wood, Ref. 41825-wood-XX-XX-RP-OC-0001_S0_P01 dated 25th June 2019 [Wood 2019];

2 The Former SSI Steelworks, Redcar: Former SLEMS Landfill, Intrusive Investigation Report, prepared by Arcadis for South Tees Site Company Ltd., Ref Redcar Steelworks-AUK-XX-XXRP-GE-001-P1-SLEMS_BOS_Oxide_Assessment dated January 2019 [Arcadis 2019];

3 The Former SSI Steelworks, Redcar: Replacement CLE3/8 Landfill Boreholes, CQA Validation Report, prepared by Arcadis for South Tees Site Company Ltd., Ref 37774100007_01, dated January 2019 [Arcadis 2018];

4 TS4 South Bank – Phase 1 Environmental Desk Study, prepared by CH2M Hill for the Homes and Communities Agency, Ref. 678079_TS4_001 dated August 2017 and marked Final [CH2M 2017];

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8 South Tees Industrial Area – Site C – Ground Investigation, prepared by Allied Exploration and Geotechnics Ltd. for English Partnerships, Ref. 1715H dated 12th July 1999 and marked Draft [AEG 1999].

H3.3 Potential and actual sources of contamination associated with the site are identified by considering the:

1 Current and previous land use from a study of existing reports, current and historic maps, photographs, local history sources, environmental database information, and a site inspection; and

2 Available intrusive site investigation data and contamination/ground conditions assessments.

H3.4 Following the identification of potential sources of contamination, the presence and sensitivity of receptors at risk from potential or known contamination are identified by consideration of the following.

1 Surrounding land uses, based on mapping and site visits and existing planning designations;

2 Proposed end-use, based on the nature of the proposed development;

3 Type of construction operations that will be necessary as during the construction phase of development;

4 Nearby Sites of Nature Conservation Interest (SNCIs), Special Protection Areas (SPAs), Sites of Special Scientific interest (SSSI) and other protected areas; and

5 Geology, hydrogeology and hydrology of the Site and surrounding area.

H3.5 Where a significant source has been identified and potential sensitive receptors are present, the potential effects can be determined by considering the pathways through which the source/hazard may affect the receptors. The magnitude of effect and the significance of effect is then determined taking due account of the nature of the pathway between a source and a receptor.

H3.6 For each of the potential effects assessed to be likely, a qualitative assessment is made on the significance of the effect on the receptor.

Significance Criteria

H3.7 The impact is assessed in terms of the sensitivity or importance of a receptor or feature, and the magnitude of change or scale of impact during the construction and operational phases of the proposed development. The importance of potentially affected geological/geomorphological features and the sensitivity of receptors, which may be affected by land contamination impacts, have been assessed according to the four-point scale shown in Table H3.1 below.

Table H3.1 Significance criteria - sensitivity of receptors

Sensitivity / Value of Receptor	Receptors Susceptible to Land Contamination and Ground Hazard Impacts	Soil and Geological Resources
Very High	Residential areas or schools within 50 m of construction works Construction workers involved in below ground works Water features deemed to be of high value Ecological features deemed to be of high value Allotments, arable farmland, livestock or market gardens on or adjacent to the site	Internationally and nationally designated sites Regionally important sites with limited potential for substitution High quality agricultural soils (Grade 1 and 2) or soils of high nature conservation or landscape importance Presence of significant mineral reserves and within a Mineral Consultation Area

		Soil/materials disposal required following earthworks resulting in a significant increase in demand on waste management infrastructure
High	Future site users - B2 (general industry), B8 (storage and distribution) and B1 (office) Residential areas or schools within 50 to 250 m of construction works Commercial areas within 50 m of construction works Construction workers involved in above ground works Water features deemed to be of medium value Ecological features deemed to be of medium value The built environment including buildings	Regionally important sites with potential for substitution Locally designated sites with limited potential for substitution Good quality agricultural soils (Grade 3a) or soils of medium conservation or landscape importance Site within a Mineral Consultation Area Soils/materials disposal required following earthworks resulting in a moderate increase in demand on waste management infrastructure
Medium	Future site users (Masterplan Development - car park, highways and railway related development) Residential areas >250 m from construction works Commercial areas within 50 to 250 m of construction works Water features deemed to be of low value Ecological features deemed to be of low value	Undesignated sites of some local earth heritage interest Moderate or poor quality agricultural soils (Grade 3b or 4) or soils of low nature conservation or landscape importance Limited potential for mineral reserves and site not within a Mineral Consultation Area Soil/materials disposal required following earthworks resulting in a limited or minor increase in demand on waste management infrastructure
Low	Areas where there are no built structures, crops, or livestock Commercial areas within >250 m of construction works Ecological features deemed to be of negligible value	Other sites with little or no local earth heritage interest Very poor-quality agricultural soils (Grade 5) or soils of negligible nature conservation or landscape importance. Negligible potential for mineral reserves to exist

H3.8 Table H3.2 below sets out the magnitude criteria used to assess the magnitude of impacts in this chapter.

Table H3.2 Significance Criteria - Magnitude of Impacts

Magnitude of Impact	**Receptors Susceptible to Land Contamination and Ground Hazard Impacts**	**Soil and Geological Resources**
High	Human Health: Acute risk to human health Surface waters and/or groundwater: Substantial acute pollution or long-term degradation of sensitive water resources (Principal Aquifer, groundwater source protection zone, surface waters of good or very good quality) Ecology: Significant change to the number of one or more species or ecosystems Built Environment: Catastrophic damage to buildings, structures or the environment Landscaping/Agriculture: Loss in value of livestock or crops as a result of death, disease, or physical damage.	Loss of feature or attribute Earthworks resulting in high volume of surplus soil for off-site disposal Classification of surplus soil as Hazardous Waste where the intention is to discard
Medium	Human Health: Chronic risk to human health Surface water and/or groundwater: Pollution of non-sensitive water resources or small-scale pollution of sensitive water resources (Principal or Secondary Aquifers of water courses of fair quality or below1) Ecology: Change to population densities of non-sensitive species Built Environment: Damage to buildings, structures or the environment Landscaping/Agriculture: Non-permanent health effects to vegetation/crops from disease or physical damage, which results in a reduction in value.	Impact on integrity of or partial loss of feature or attribute Earthworks resulting in moderate volume of surplus soil for off-site disposal
Low	Human Health: Slight reversible short-term effects to human health Surface waters and/or groundwater: Slight pollution of non- sensitive water resources Ecology: Some change to population densities of non- sensitive species with no negative effects on the function of the ecosystem Built Environment: Easily reparable effects of damage to buildings or structures Landscaping/Agriculture: Slight or short-term health effects which result in slight reduction in value	Minor impact on feature or attribute Earthworks resulting in low volume of surplus soil for off-site disposal

Negligible	Human Health: No measurable effects on humans Surface waters and/or groundwater: Insubstantial pollution to non-sensitive water resource Ecology: No significant changes to population densities in the environment or in any ecosystem Built Environment: Very slight non-structural damage or cosmetic harm to buildings or structures Landscaping/Agriculture: No significant reduction in landscape value.	Impact of insufficient magnitude to affect use or integrity of feature or attribute No off-site disposal of surplus soil required

H3.9 The significance of the effect of the impact has been determined in accordance with the matrix shown in Table H3.3 below.

Table H3.3 Significance Criteria - Significance of Effect

	Magnitude of Impact			
Sensitivity/value of a Receptor	**High**	**Medium**	**Low**	**Negligible**
Very High	Substantial	Substantial	Moderate	Minor
High	Substantial	Moderate	Minor	Negligible
Medium	Moderate	Minor	Negligible	Negligible
Low	Minor	Negligible	Negligible	Negligible

H3.10 It is considered that any potential impact determined with a significance of moderate adverse or greater is a significant impact for the purposes of this EIA.

Consultation

H3.11 Arcadis (UK) Ltd undertook consultation regarding this chapter with Mick Gent, Contaminated Land Officer, RCBC on 28th May 2020 concerning the basis for the assessment including the available sources of information, the Outline Remediation Strategy (Wood 2019) and suitability of the Significance Criteria described above.

H3.12 Email correspondence from Mick Gent on 9th June 2020, provided at Appendix H2 stated Redcar & Cleveland Borough Council considered the Significance Criteria established in relation to Ground Conditions and Remediation to be acceptable.

Assumptions and Limitations

H3.13 The conclusions reached within this ES chapter are based in part upon information and/or documents that have been prepared by third parties. In view of this, we accept no responsibility or liability of any kind in relation to such third-party information and no representation, warranty or undertaking of any kind, express or implied, is made with respect to the completeness, accuracy or adequacy of such third-party information.

H3.14 There are currently a number of data gaps regarding the geochemical and geotechnical characterisation of ground conditions and contamination at the site which will likely require further site investigation and risk assessment in order to further inform the CSM and confirm the significance of the potential Source Pathway Receptor ('SPR') linkages. The principal data gaps identified following review of previous phases of work relate to:

1 Asbestos in Made Ground – no analysis for asbestos within exploratory locations outside the former SSI SLEMS area. This should be included within any future ground investigations.

2 Ground Gas - Future development proposals located in close proximity to former landfill sites should be supported by further investigation and an associated Gas Risk Assessment and should incorporate any necessary protection measures appropriate to protect buildings from landfill gas migration.

3 Soil and Ground Contamination – limited soil quality data is available for a number of areas across the site, notably the former Metals Recovery Area with limited groundwater data (both spatially and temporally) available across the site. The potential for migration of contamination on to site from nearby offsite sources also remains largely unknown. It is anticipated that supplementary ground investigation within the site boundary may be required to support specific proposed developments and land parcels as they are brought forward for development.

4 Geotechnical properties – Limited data is available from previous site investigations in relation to the geotechnical properties of ground underlying the proposed development area. Further assessment is likely required to inform, for example, foundation and infrastructure design.

H3.15 It is assumed that development will be phased over a number of years and that the engineering design for each phase of development will need to determine the detailed remediation approach based on the intended layout and form of development, to render the site suitable for use. The remediation design statement for each phase will set out how the proposed development conforms with the outline remediation strategy which should be informed by any additional ground investigation and/or risk assessment required.

H3.16 The assessment undertaken within this chapter is supported by the Outline Remediation Strategy (Wood, 2019) which identifies the relevant SPR linkages (based on current data) and the overarching remediation strategy required to address potential risks to identified receptors. Comments on the strategy by the Environment Agency (NA/2019/114630/01-L01, August 2019) state that past industrial activity is considered to pose a medium risk of pollution to controlled waters. The Outline Remediation Strategy also considers that the potential hazard to controlled waters is medium but that given the low likelihood of occurrence and low sensitivity of the controlled water receptors the significance of this risk is moderate / low, and that no active remediation of groundwater is required. Comments received from RCBC (Ref:153731, 06/08/2019) state that they are satisfied that this strategy adequately covers parts (a) (Site characterisation) and (b) (Submission of a Remediation Scheme) of the standard contaminated land conditions. Therefore, it is assumed that the overarching remediation scheme described within the Outline Remediation Strategy is acceptable, and that active remediation of groundwater is not required (subject to any further data that may be obtained as part of addressing identified data gaps).

H3.17 It is assumed that the minimum finished floor level will be 5.79mAOD. The maximum development height is anticipated to be 46m and this allows for a greater FLL dependant on developer requirements. As such, this ES assumes that the site will be cut and fill neutral and that excavated material can be reused onsite to construct the development platform. .

H3.18 It is assumed that existing permits associated with specific areas within the proposed development area, including permitted activities regulated by the Environment Agency ('EA') and by RCBC, will be surrendered in accordance with relevant regulations and guidance to the satisfaction of the relevant authority alongside remediation works prior to site redevelopment.

H4.0 Baseline Conditions

Existing Conditions

H4.1 The site is bound to the north by the River Tees (albeit, the boundary of the site is set back from the river by 20 metres). To the south is the Darlington to Saltburn Railway line, which runs along the periphery of the site on an approximate east-west axis. To the east of the area is Tees Dock, where PD Ports operate, and to the west the boundary is demarcated by internal roads beyond which is the Teesport Commerce Park which contains commercial uses associated with the port. To the south of the area is the Grangetown Prairie area, the South Tees Freight Park and an area used for landfill and waste management activities.

H4.2 The site and surrounding areas have a long and layered industrial history and largely comprise mudflat and marshland reclaimed by deposit of iron and steel slag and by-products. The main land uses were dominated by extensive iron and steel works together with auxiliary industries, infrastructure, power generation and distribution, together with waste management.

H4.3 The site is divided into a number of areas based on current and historical land use which are listed below and referred to throughout this chapter and shown in Appendix H3 – Site Layout and Areas Plan

1 Former SSI SLEMS - Iron and Steel Making waste recycling, Basic Oxygen Steelmaking (BOS) slurry and blast furnace slurry;

2 Former Metals Recovery Area: recycling materials from Iron and Steel making waste; and

3 Modified TS4 Area including former iron and steel making process areas, former benzole plant and Heavy Fuel Oil Storage Area.

H4.4 It is important to note that four specific land parcels are enveloped by, but excluded from, the proposed development area which may be nonetheless potentially significant off-site sources of contamination. These areas are listed below

1 Former SSI High Tip - Iron and steel by-products landfill;

2 Highfield Environmental Facilities – Hazardous and non-hazardous waste landfill;

3 Hanson Concrete and Tarmac Teesside leasehold areas; and

4 South Bank Coke Ovens (SBCO)

H4.5 The Site is largely free of active use and built development, however, it is interspersed by some active industrial uses, notably Hanson Concrete and Tarmac Teesside (part of the Tarmac Group) are currently operational in the central northern part of the Modified TS4 Area, however these commercial sites are excluded from the planning application site area. The Tarmac Teesside area is largely occupied by storage facilities in addition to large stockpiles of material. Land to the east and west of the former South Bank works is currently occupied by PD Ports.

H4.6 Generally, the area is predominantly flat following historic reclamation and development. Much of the area is in a derelict state with several permanent roads and tracks intersecting various parts of the site. Land in the north-west of the area is primarily constituted of unoccupied low-lying scrub and grassland. Large areas of land in the north-east are currently used for material storage and stockpiling in addition to an operational fuel oil depot.

H4.7 The former Metals Recovery Area is located in the east of the area. It is bound to the east by the Main Lackenby outfall, to the south by the Cleveland Channel and to the north and east by internal roads. It has previously been used for heavy industrial uses relating to the recovery of metals and the topography is more variable than the rest of the area, ranging from a platform

approximately 19.0m AOD to existing ground level at approximately 7.0m AOD at its lowest point.

H4.8 The Metals Recovery Area is associated with the permitted area of EPR (Environmental Permit Regulations) permit PP3338MT. The permit issued to Harsco Metals Group Limited is still live and there are some operations relating to slag and metal recovery still being undertaken by Harsco and their subcontractors. These operations are helping to reduce the amount of waste left on site following closure of steel making operations.

H4.9 The former SSI SLEMS landfill is a mounded land raise approximately 22 Ha in area rising to a maximum elevation of approximately 20m above Ordnance datum (AOD) and approximately 15m above the surrounding area. An overhead pipe bridge and a warehouse structure housing excavators are present on the south-eastern Site boundary. The upper surface of the landfill comprises stockpiles of BOS oxide material divided into bays. A series of settling ponds are present in the southern section of the site; formerly an aqueous suspension of BOS oxide was pumped from the BOS Plant into these ponds. Settled material dredged from the ponds was then deposited in adjacent drying bays before being placed at a final deposition point within the landfill. The site is bounded on the south-west, north-west and north-east edges by water channels. During SSI operation these were routinely dredged, and the arisings placed within the SLEMS landfill. Stockpiles of this dredged material are present in the south west and north east of the Site.

H4.10 Prior to commencement of any operation to store or permanently use soil for restoration on any part of the site covered by an EPR permit the Environment Agency will need to be satisfied that the necessary measures referred to in paragraph 14 of Schedule 5 of the Environmental Permitting (England and Wales) Regulations 2016 have been taken. Treatment of contaminated soils on site that are classed as a waste will likely be a permitted activity.

H4.11 Arcadis has not been provided and has not reviewed any correspondence or reports related to previous demolition and reclamation works undertaken at the Site but it is assumed that all relevant legislative requirements regarding the demolition works and possible presence of asbestos were adhered to. Arcadis understands that demolition of the Heavy Fuel Oil (HFO) tanks (within the Fuel Oil storage area) and a number of remaining steel framed above ground structures is currently planned.

On Site Infrastructure

H4.12 Figure B2.3 (Chapter 2) depicts existing on-site infrastructure with full versions of the individual components of this map are also included at Appendix B2. Much of this is associated either with the previous industrial uses on site or the wider industries within the surrounding STDC area.

H4.13 An internal private road network exists across the whole of the STDC area and some of these roads are located within the application site. Northern parts of the internal road network are utilised by PD Ports and they provide it with access between its facilities and to the wider road network.

H4.14 Historically a freight rail network operated across the STDC area, parts of which are still operational. A section of operational track which diverts from the Darlington to Saltburn railway line, runs along the western edge of the Metals Recovery and the SLEMS waste management facility areas, before heading north east to Teesport.

H4.15 National grid electricity infrastructure is present throughout the STDC area, and specifically, the site includes three electricity pylons and associated overhead electricity lines, with a further

pylon located just outside the site. The pylons, and an 11KV electricity sub-station, are located in the South Bank (West) Area as described above.

H4.16 The STDC area contains a large network of critical industrial utility infrastructure. The following industrial pipelines are present on and under the site:

- The now redundant Coke Ovens Gas Main ("COGM") runs from the South Bank Coke Ovens (at the south western part of the site) to the Redcar Coke Ovens in the north eastern part of the STDC area. The pipeline is an over ground feature on the development site and still contains hazardous material and is controlled under a nitrogen blanket to prevent ignition;
- The Heavy Fuel Oil ("HFO") line. This pipeline is an over ground feature on the site and has trace heating to maintain flow; and
- The BOC Gas pipeline is an over ground feature on the site, and follows the route of the Sembcorp utilities corridor, which carries a range of utilities from the Wilton International Complex under the River Tees to Seal Sands and the wider area.

H4.17 The STDC area contains various water infrastructure which comprises:

- An Estuary Water Pumping Mains crosses the site in a north west-south east direction;
- An NWL Water Mains crosses the north western end of the Metals Recovery Area before continuing under the River Tees;
- Industrial Water Mains are present under the south of the South Bank (West) Area connecting to the Estuary Water Pumping Mains and to the South Bank Coke Ovens;
- An Industrial Effluent Pipeline crosses the southern part of the South Bank (West) Area connecting to the South Bank Coke Ovens; and
- An NWL foul sewer also crosses the southern part of the South Bank (West) Area connecting to the South Bank Coke Ovens.

Historical Setting

H4.18 A review of the historical development of the Site (excluding the SLEMS area) was undertaken as part of the Outline Remediation Strategy (Wood 2019) which is provided as Appendix H1 based primarily on a Groundsure Enviro Insight Report (June 2019) and associated historical OS maps. The historical development of the TS4 area was undertaken as part of the Phase 1 Geo-Environmental Desk Study (CH2M 2017) which included information from Sahaviriya Steel Industries (SSI) site records. These reports have been reviewed and summarised below with additional information provided in relation to the SLEMS area.

H4.19 Large scale historic maps are available between 1856 and to 2014. Since 1856 the area has undergone significant development following land reclamation between 1897 and 1913.

Table H4.1 Summary of Historic Site Development and Activities

Date	Description	
	Within Site Boundary	**Outside Site Boundary**
1857	Minimal development – land principally low-lying scrub. Large areas of the northern site constituted mud, sand and marshes.	Middleborough and Redcar railway line adjacent to southern boundary. Land to south east is pasture. A number of becks and streams flow through area to River Tees.
1893 – 1897	By 1893 significant development with emergence of South Bank Iron Works and Antonien Works (Phosphate Works) north of railway line. Development of concrete	Areas south of the railway line outside of the area was subject to extensive industrialisation during this period. Much of the land to the south and south-west of the

	works, and additional slag works in the south-west corner of the area in 1897. Northern area comprises sand and mud from tidal action. Several wharf buildings on the River Tees and rail tracks and infrastructure across the Site. Two reservoirs and a sluice are recorded east of the iron works, and a clay pit 130m northwest of the works. The Former SSI SLEMS area remains underdeveloped during this period with marshland shown in the northern section and a small surface water feature in the north east corner.	site is occupied by iron, brick, salt and gas works. Some residential development around Grangetown characterised by construction of a large market.
1913 – 1938	Significant land reclamation of mud and sand banks in the northern-west area of the area. Emergence of two large reservoirs north of the South Bank Works in 1913, reservoirs no longer present by 1927. Construction of brine wells and tanks north of the South Banks Iron Works. Construction of a number of slag works and concrete works in close proximity to the South Bank Iron Works. South Bank Iron Works undergone further development. Antonien Phosphate Works is now a Basic Slag Works. Additional railway and infrastructure such as tracked travelling cranes constructed during this period. Construction of pumping station on the banks of the Tees. Metal breakers appearing in 1927 on land previously occupied by mud and sand in the centre of the area. By 1915-1929 building in the north west is shown to be a galvanising works. The reservoir south of South Bank Iron Works has been infilled, and the second extended eastwards. The Former SSI SLEMS area remains underdeveloped during this period.	Construction and growth of Smiths Dock to the south-west, west of the area. Further residential development associated with Grangetown south of the area. Emergence of Slag and Tarmacadam works to the west in 1913, becoming principally orientated around Tarmac manufacturing by 1938. Lackenby Iron and Slag Works constructed to the east of the area. Initial Teesport dock construction identified during this period. Closure of Brickworks south west of the site in 1938 making way for a clay pit.
1938 – 1955	Significant development of infrastructure serving the South Bank Iron Works. A number of tanks and pipes are denoted within the area of the South Bank Iron Works alongside a boiler plant and associated chimneys in the eastern part of the works. During this period brine wells and tanks have been removed with the general area now being used for stockpiling of materials. Eston Sheet and Galvanising Facility on the western boundary no longer present by 1955. New tanks and an Electric Sub-Station are recorded north of the Basic Slag Works	Teesport dry dock expansion to the north-east of the area. Further expansion of Cleveland Steel Works. Mud and sandbanks still occupy much of the area north-east of the area near Teesport development. By 1955 Lackenby Iron Works had been demolished. Significant expansion of Cleveland Steel Works, Cargo Fleet and Normanby Iron Works by 1955 and residential expansion of Grangetown to the south of the area.

	and near the pumping station. An Incinerator is located 200m east of the Concrete Works and 260m west of South Bank Iron Works. Clay Lane Iron Works south of the site has been demolished along with the associated railway sidings. The former Slag Wool Works adjacent to the southwest corner of the site has been redeveloped into a Tar Distillation Works encompassing the adjacent former Tar Manufactory site. A silt settlement pond is shown on a 1952 OS map along the western edge of the SLEMS area adjacent to a silt entrainment plant and silt drying beds located immediately to the north.	
1955 – 1993	Between 1955 and 1959 much of the infrastructure associated with the former South Bank Iron Work has been removed. West of the former South bank Iron Works Site a large undefined rectangular building occupies areas where many of the former coke ovens stood. Located West of the former South Bank Iron Works are the original South Bank Coke Ovens and associated Coke Wharf and Quencher. The buildings occupying the former Cement Works include the Blending Bunkers, Klonne Gas Holder, Repair Shop and Coal Stocking Area. Additional infrastructure associated with a by-product plant is also present inclusive of Booster and Exhaust houses, Condensers and De-Tarrers, Gas Washers, Scrubbers, a Rack Cooler, Acid Storage Tanks, Benzole Storage Tanks and Tar Pump House as well as miscellaneous tanks and sub-stations. Coke Stocking Area is situated to the east, with the two large ore stocking areas to the north. Between 1955 and 1992 four substations were constructed in the north east of the area. Construction of an Oil depot north east of the riverside pumping station and installation of a jetty. By 1968 an Ore Crushing Plant and associated conveyor and railway lines has been constructed. Tanks associated with a disused Benzole plant south east of the South Bank Wharf. Within the Former SSI SLEMS area, by 1983 a travelling crane and settling pond are present along the western edge, an open drainage channel along the northern edge with drains and a pipeline route	Further expansion around Teesport and Tees Dock to the north east of the area characterised by construction of storage tanks and additional infrastructure between 1992 and 1993. Demolition of infrastructure and facilities associated with River Tees Docks to the West of the area in close proximity to the Tees. Between 1955 and 1992 large areas of the Cargo Fleet as well as Cleveland Iron Works to the southwest and south of the area respectively were demolished. Between 1955 and 1974 Teesside Works Lackenby was constructed on large areas of former farmland south-east of the area. Further expansion of industrial sites by 1993 in the south-east.

	shown along the eastern SLEMS boundary.	
2002 – present day	Much of the interior of the area is currently undeveloped despite considerable historic land reclamation. Much of the previous infrastructure has been removed with land predominantly used for stockpiling of materials. A number of ponds / lagoons are present within the Former SSI SLEMS area by 2002	Further development of the River Tees dockyard to the west of the area in addition to further development of Seal Sands on the north bank of the Tees. Between 2002 and present-day Tees Dock to the north-east of the area has continued to be developed with the construction of additional warehouses, storage facilities and depots associated with the port.

Summary of Site History

H4.20 Since the earliest maps dated 1857, the area and surrounding areas has undergone considerable development. Between 1857 and 1893 significant industrialisation of the south bank began characterised by the construction of the South Bank Iron Works in addition to numerous other iron, slag, brick and gas works with Cleveland Iron Works being constructed offsite between 1897 and 1913. Cargo Fleet Iron Works to the west of the area underwent considerable development from 1893 and 1913. Much of the north and north east areas of the area situated on land formerly occupied by muds, sands and marsh land. Significant land reclamation of the south bank occurred between 1897 and 1913. It is understood that slag was used to create a high-water embankment. Reclaimed land was subsequently developed characterised by the construction of industrial infrastructure including conveyors, pipelines, travelling cranes, storage tanks and facilities. By 1927 development of Teesport docks began, over time custom houses, wharf buildings and pumping houses were constructed.

H4.21 Based on historic maps, many of the iron works reached their maximum extent by 1955 prior to being demolished/repurposed by 1992 in addition to much of the supporting infrastructure. Much of the area is constituted of land formerly associated with the South Bank Iron Works (SBIW).

Previous Environmental Assessments

H4.22 Available and relevant historic reports and exploratory location records have been identified by Arcadis and these are used to inform the baseline assessment to this EIA.

H4.23 The scope and relevance of previous intrusive environmental site investigations is given in Table H4.2 below

Table H4.2 Summary of Previous Site Investigations

Relevant & Available Reports	Relevant Site Area	Outline Scope
Allied Exploration and Geotechnics Ltd (1999)	Modified TS4 (Partial - North West Corner only)	Advancement of 6 boreholes to depths of between 18.70m BGL (BH-C04) and 22.00m BGL (BH-C03) 33 trial pits were mechanically excavated to depths of between 1.80m BGL (TP-C21) and 8.00m BGL (TP-BHC05) using a 360° tracked excavator. Analysis of 60 samples for Heavy metals, Polycyclic Aromatic Hydrocarbons (PAHs), Phenols and Toluene extractable matter

		Analysis of 4 grab samples of water from trial pits Geotechnical testing in the field including California Bearing ratio and standard penetration testing Geotechnical laboratory testing including Atterberg limits and natural moisture content, particle size distribution, undrained Shear strength, sulphate and pH,
Enviros Ltd (2004)	Modified TS4 Former SSI SLEMS	123 trial pits to up to 3.5m and 11 boreholes to up to 10m. Approximately 232soil samples analysed for metals, pH, sulphate cyanide and PAHs, phenol and Total Petroleum Hydrocarbons (TPH) were taken from within the site boundary One round of groundwater monitoring from 10 groundwater wells for metals, pH, sulphate cyanide and PAHs, phenol and TPH
Corus (UK) Ltd (2008)	Modified TS4 (Partial – Fuel Oil Storage Area)	3 Boreholes in Fuel Oil Storage Area and groundwater monitoring
Arcadis (UK) Ltd (2018)	Modified TS4 (Partial - adjacent to Former SSI High Tip only)	Drilling of 3 no. boreholes using Cable-Percussive drilling techniques; and Installation of 2 no. groundwater monitoring wells, and 1no. combined groundwater / ground gas monitoring well
Arcadis (UK) Ltd (2019)	Former SSI SLEMS	6 no cable percussion boreholes to maximum depth of 17.00m (note 5 of 6 boreholes terminated at shallow depth due to refusal on slag or other obstructions) 8 no machine excavated trial pits Advancement of 11 no. trial pits using a 20-tonne tracked 360 Excavator to a target depth of 4.5m bgl or refusal. Soil sampling and analysis (including metals, TPH and anions) plus asbestos screening undertaken

Geology

H4.24 The British Geological Society (BGS) solid and drift geological map (Sheet 33 -1987) 1:50,000, the BGS GeoIndex Onshore (online resource) and historical exploratory location records have been reviewed in order to assess the geological composition of the Site which is summarised in this section.

Made Ground

H1.1 The BGS 1:50,000 scale Solid and Drift map (Sheet 33 - 1987) identifies the site as being covered entirely by Made Ground. As the site and the wider area are known to comprise reclaimed mudflat and marshland it is likely that this is what is referred to as Made Ground by the BGS mapping.

H4.25 Based on previous ground investigation data, Made Ground is predominantly granular, comprising deposits described as loose black gravelly silty fine to coarse sand or black to grey

sandy gravel and loose to dense dark grey to black sandy gravel to sandy gravelly cobbles and boulders. Sand is typically ash, slag or coal dust, with gravel to cobble-sized fragments of predominantly slag, clinker and brick (furnace, occasionally house); occasionally rubble, timber (including sleepers), coal, coke, metal and concrete and boulder-sized fragments of slag. The looser material typically overlies denser deposits and given their composition and thickness likely represent the stockpiled raw materials associated with the iron and steel making process.

H4.26 Slag is sometimes referred to as pellite or granulated blast furnace slag, with fused slag also recorded within a select number of holes. This is described as green-white-yellow fused slag, fused slag boulders or fused bluish grey slag pellite with patches of loose grey coarse slag granulate. Horizons range from 0.7m (1AT7) to in excess of 3.7m thick (EDT6). Occasionally horizons of concrete and tarmac have also been encountered, consistent with relic infrastructure/foundations, with the large metal plates recorded at <1.5m below ground level ("bgl") (DBT26 and EDT24) possibly indicative of underground services.

H4.27 Historical records indicate that the Made Ground increases in thickness southwards from the River Tees towards the centre of the site, however as the majority of intrusive locations are trial pits which do not prove the base of the Made Ground this is based on a limited number of borehole locations. Deposits typically range between 1m and 7.8m thick, although deposits in excess of 10m thick (to -2.5mOD) have been encountered Including within the northern part of the Site.

H4.28 Made Ground within the former SSI SLEMS area was found to comprise Silty gravelly sand with bands of slag cobbles to 14m Silty sand to 17.0m. BOS Oxide was generally encountered as a black silt containing abundant metallic 'dust' and occasional gravel. Bluish grey weathering was identified in some locations, and locally the BOS Oxide was noted to be red and possibly combusted. Slag identified within the landfill was observed to be generally light grey to white in colour, with vesicles commonly infilled with partially hydrated lime. Slag was generally recovered as a coarse, angular gravel mixed with whole and part refractory bricks, with clasts locally fused by the action of lime. Minor deposits of other waste, including metal machine parts were also encountered within slag layers with minor pockets of brown clay and silt, interpreted as representing channel dredgings, also identified.

Superficial Deposits

H4.29 The BGS 1:50,000 scale map shows the superficial deposits as comprising post-glacial estuarine and marine alluvium, consistent with the BGS GeoIndex which describes Tidal Flat deposits of sand, silt and clay. The BGS Lexicon of Name Rock Units describes the area as intertidal and the lithology "normally a consolidated soft silty clay with layers of sand, gravel and peat". Along the southern site border glacial laminated clay is recorded described by the BGS as a Glaciolacustrine deposit of clay and silt. Given the mapping scale it is possible these deposits extend beneath the site; beneath the tidal flat deposits.

H4.30 The historical logs describe the natural superficial deposits as a mix of granular and cohesive deposits. Granular materials comprise loose to dense sometimes laminated grey to black fine sand to silty fine sand with shell fragments; and occasionally contain lenses/layers of clayey silt, very clayey/silty slightly gravelly to gravelly sand and gravelly sand to sandy gravel. Locally these are underlain by soft to firm fissured red-brown silty clay with fine gravel. Together these deposits most likely represent Tidal Flat deposits and have a thickness of between 2m to 7.5m.

H4.31 Granular superficial deposits are not recorded within holes sunk within the central to southern area of TS4. Here laminated clays are recorded, indicating that the boundary between the Glaciolacustrine and Tidal Flat deposits is located beneath the northern half of TS4, further north than suggested by BGS mapping. Laminated clay is described as very soft to stiff dark

brown/grey brown to orange brown thinly laminated clay to silty slightly sandy laminated clay, mottled slightly sandy clay of high plasticity with silt dustings on laminae and very soft to stiff laminated clays/silts. The deposits are between 3.5m to 11m thick, increasing eastwards and are occasionally described as being slightly weathered.

H4.32 The Tidal Flat and Glaciolacustrine deposits are underlain by deposits of Glacial Till, which is firm to very stiff reddish brown to dark brown silty sandy to sandy gravelly clay of low plasticity with occasional to many cobbles; and stiff to hard fissured red-brown to dark brown sandy silty clay with fine to medium gravel. Gravel is fine to coarse, subangular to subrounded of sandstone, quartzite and mudstone. Occasional reference is made to thin bands of medium dense silty sand or silty clayey sand and gravel which have been inferred as localised glaciofluvial channels. The glacial till ranges between 2.5m and 9m thick, overlying bedrock.

H4.33 Superficial deposits encountered beneath the Former SSI SLEMS area were firm brown sandy gravelly clay, dense black silty sand or laminated black brown silt.

Solid Geology

H4.34 BGS mapping identifies the bedrock to be Mercia Mudstone of the Triassic Mercia Mudstone Group. This is described by the BGS Lexicon as *"dominantly red, less commonly green-grey, mudstone and subordinate siltstones with thick halite-bearing units in some basinal areas. Thin beds of gypsum /anhydrite widespread; sandstones are also present"*. The BGS 1:50,000 scale map also identifies that site is underlain at depth by the Boulby Halite deposit.

H4.35 Where encountered bedrock has been described as being very weak to weak, highly weathered. The rock has been recovered as stiff to hard sometimes laminated, fissured red-brown to grey-green silty clay/clayey silt, grey and brown clay with bands of mudstone and gypsum and silty very sandy clay with gravel-sized fragments of weathered mudstone or limestone and silt partings. Other descriptions describe bedrock as bedded and jointed grey-green and red-brown bands of weathered limestone and mudstone, with veins of gypsum, hard brown clay marl and very weak brown and grey mudstone with bands of gypsum.

H4.36 Rockhead has typically been encountered between 16m (AS04) and 21mbgl (BH-C03); correlating with an elevation of around -11m (AS04) to -15mOD (AS02). Occasionally it appears shallower at around 11m to 12.5mbgl (-5.5m to -7mAOD) and has been proven to an elevation of -19mOD.

Geotechnical and Geological Hazards

H4.37 The site is identified by the BGS as being at very low risk from shrink swell, running sand and landslide hazards. It is also identified as being at very low risk from compressible ground hazards, despite the natural superficial deposits comprising Tidal Flat deposits. This was considered by Wood (2019) to be unlikely, particularly as peat deposits may be present within this material. The southern area of the site is identified as being underlain by evaporate mining.

H4.38 With reference to the Coal Authority Interactive Map, TS4 the site is not within a Coal Mining Reporting Area. This is consistent with BGS mapping and as such coal mining is not discussed further within this report.

H4.39 Limited data is available from previous site investigations in relation to the geotechnical properties of ground underlying the proposed development area. Available data was principally obtained as part of the AEG 1999 Investigation (Modified TS4 Area).

H4.40 The significant thickness of Made Ground present beneath the site (typically between 1m and 7.8m thick but in excess of 10m thick in some locations), and normally consolidated tidal flat deposits, indicates the potential requirement for piled foundations or ground improvement

works in relation to structures sensitive to movement. Any piles would likely require extending to competent bedrock.

H4.41 While there is limited information regarding the presence of expansive slag within Made Ground beneath the site, based on investigations undertaken within other areas of the former Redcar Steelworks, it should be assumed that expansive slag is also likely to be present at the proposed development area.

Hydrology and Hydrogeology

Hydrology

H4.42 The south bank of the River Tees forms the northern boundary of the site and is classified by the Environment Agency ("EA") as a Main River.

H4.43 The Cleveland Channel (an open surface water feature) is located along the western and northern sides of the former SSI SLEMS area (within the development area) and the Lackenby Channel is located immediately east of the MRA (outside of the development area).

H4.44 Mill Stream enters the site (in culvert) via the southern boundary, beneath the footprint of the former South Bank Steel Works. It continues northwards for approximately 560m, appearing at the surface 60m west of the eastern boundary and 750m southeast of the River Tees. It continues northwest for approximately 660m, before turning northwards and continuing in culvert as it passes beneath the access road parallel to the south bank of the Tees, outfalling into the river towards the eastern end of South Bank Wharf. The stream is classified by the EA as a secondary river.

H4.45 A culverted, unnamed drainage cut is located 340m east of the site. It flows towards the northwest, outfalling into the River Tees. Given the history of the TS4, the possible presence of other culverts on site should be considered.

Hydrogeology

H4.46 The EA interactive mapping (MAGIC map) indicates that bedrock beneath the site is classified as a Secondary B Aquifer with the overlying superficial deposits classified as a Secondary Undifferentiated Aquifer. The EA describe a Secondary B Aquifer as "predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering". A Secondary Undifferentiated aquifer is defined as "assigned in cases where it has not been possible to attribute either category A or B". This generally means that the horizon has variable characteristics allowing it to function as both a minor and non-aquifer in different locations.

H4.47 The site is not located within a Groundwater Source Protection Zone, nor within a surface water, groundwater or eutrophic Nitrate Vulnerable Area. The site has a Groundwater Vulnerability Classification of "minor aquifer high".

H4.48 Groundwater monitoring undertaken by Enviros (2004) found that the water table ranges from 0.84m to 7.6m bgl (-0.8mAOD to 5.2mAOD), rising eastward away from the sea. These investigations found perched groundwater within this range between permeable Made Ground, sands and gravels, and less permeable Boulder Clay. The general direction of groundwater flow is north north-west toward the River Tees and the North Sea and possibly toward the South Gare and Coatham Sands SSSI at the northern part of the Redcar Works. Groundwater monitoring over a twelve-hour period showed that the tidal influences on groundwater were not significant.

Land Contamination

Potential Sources of On-Site Contamination

H4.49 Notable historic and contemporary features within the area which may have implications for land contamination include but are not limited to:

1 Antonien Phosphate Works (North) later a Basic Slag Works.

2 Land and infrastructure associated with the South Bank Iron Works (SBIW) inclusive of reservoirs, settlement tanks and ponds chemical and fuel storage tanks, gas holdings, coal and materials stockpiling facilities, waste disposal facilities/refuse heap, material conveyor belts and pipelines (features situated across the site, principally in centre of the area running on a north-south axis).

3 Brine works and tanks (South West).

4 Sheet metal and Galvanising works (North West).

5 Slag works (South and South West).

6 Concrete works (South West).

7 Benzole plant (North).

8 Ore crushing and handling plant (North).

9 Electricity Substations (North West).

10 Fuel Oil Storage Area and associated Pipeline (North).

11 Pumping station (North).

12 Former Metals Recovery Area (North East).

13 Former SSI SLEMS steel making waste landfill (East).

Potential Source of Off-Site Contamination

H4.50 Notable historic and contemporary features outside of the Site boundary which may have implications for land contamination include but are not limited to

1 Former SSI High Tip - Iron and steel byproducts landfill (Central);

2 Highfield Environmental Facilities – Hazardous and non-hazardous waste landfill (Central); and

3 Manufacturing infrastructure associated with the South Bank Coke Ovens (SBCO) (South) in addition to land and supporting Infrastructure.

4 Slag works (South-West).

5 Concrete works (South-West).

6 Land and infrastructure associated with the Cleveland Iron and Steel Works (South, South West).

7 Normanby, Cargo Fleet Iron Works and associated infrastructure (West).

8 Lackenby Iron and Brick Works (East).

9 Slag Works (South-West).

10 Slag Reduction Works (East).

11 Brick Works and associated infrastructure (South West).

12 Gas Works and associated infrastructure (South).

13 Salt Works and associated infrastructure (West).

14 Tarmac Works (to the East & West).

15 Mineral Wool Works (South West).

16 Imperial Works (South West).

17 Seal Sands (North).

18 Teesside Works Lackenby (East, South East).

19 River Tees Dockyard and associated infrastructure inclusive of docks, wharfs, warehouses (West).

20 Teesport inclusive of docks, wharfs, warehouses (North East).

21 Tees Dock inclusive of docks, wharfs, warehouses (North East).

AEG 1999 Investigation (Modified TS4 Area)

H4.51 Lead in soil exceeded the Generic Assessment Criteria (GAC) (Category 4 Screening Levels (C4SUL)) for commercial end use of 2,300mg/kg selected within the Outline Remediation strategy (Wood (2019)). This was in two of the 60 samples with maximum of 2,945.2mg/kg. Concentration of the remaining metals were all below the GAC for commercial end use.

H4.52 The Toluene Extractable Matter (TEM) analysis undertaken reflects a wide range of organic contamination (and potentially natural organics) such as PAHs and TPH but is no longer considered best practice in contaminated land investigations and cannot be directly compared with GAC. However, it is noted that elevated (>1,000mg/kg) concentrations of TEM were identified in 24 of 60 samples with a maximum of 3560mg/kg detected in soil sampled from the area of the former benzol storage tanks (North site).

Enviros 2004 (Modified TS4 and Former SSI SLEMS Area)

H4.53 Oily and tarry deposits and strong organic odours were noted at exploration locations located to the northwest of the By Products Plant (particularly near the former benzol storage tanks). Fill materials across the site are typically characterised by alkaline pH and elevated concentrations of sulphide and sulphate. This is due to the widespread occurrence of slag within Made Ground.

H4.54 Made Ground deposits underlying the site. Lead was elevated above thresholds for commercial end use in 4 of the 238 locations and naphthalene was above the thresholds for commercial end use (Wood (2019)) near the off-site coke ovens. TPH (by Gas Chromatography) above 1000mg/kg was identified at 14 of the 232 locations and three exceeded a screen for C10-C40 near the coke ovens. These were mostly near the SLEMS and off-site coke ovens.

H4.55 Benzene was detected near the off-site coke ovens. While zinc was below the GAC elevated zinc concentrations were detected which could lead to soil being classified as hazardous in about 5-10% of samples.

H4.56 Groundwater quality data collected from 10 monitoring wells were compared with UK Drinking Water Standards (UKDWS) and Dutch Invention Values (DIV) which were appropriate generic initial screening levels at the time of undertaking but are considered conservative in relation to determining the requirement or targets for remediation. Despite elevated pH is soils due to alkaline slag deposits, groundwater pH was only locally elevated. Widespread elevated sulphate concentrations were encountered. Toxic metals, cyanide and organic contaminants (PAH, Benzene, Toluene, Ethylbenzene and Xylenes (BTEX), TPH and Gasoline Range Organics (GRO) were above screening criteria in the SLEMS and SBCO areas. Evidence of free product was

identified within water samples taken from the west of the SBCO (by-products plant) near the benzol tanks.

Corus UK Ltd 2008 (Modified TS4 Area – Fuel Oil Storage Area)

H4.57 TPH and PAHs in all nine samples were low with TPH at a maximum of 100mg/kg and benzo(a)pyrene at a maximum of 1.4mg/kg.

Arcadis (UK) Ltd 2018 (Modified TS4 Area –Former SSI SLEMS)

H4.58 The results of chemical analysis for metals and PAHs benzo(a)pyrene and naphthalene in 11 soil samples collected were compared to the GAC selected within the Outline Remediation Strategy (Wood (2019)). In total, 6 samples were measured above the GAC for Lead (2,300mg/kg) with a maximum value of 7,900mg/kg. 1 sample was measured above the GAC for benzo(a)pyrene (77mg/kg) at a concentration of 150mg/kg and 1 sample (from the same location) measured above the GAC for naphthalene (1,900mg/kg) at a concentration of 3,600mg/kg.

H4.59 Asbestos screening was undertaken on soil sampled from 10 locations with no asbestos fibres or asbestos containing material identified.

Ground Gas

H4.60 No ground gas monitoring has been undertaken within the proposed development area to date which represents a significant data gap and therefore future development proposals, particularly those located in close proximity to former landfill sites, should be supported by further investigation and an associated Gas Risk Assessment and should incorporate any necessary protection measures appropriate to protect buildings and future site users from landfill gas migration. This will be considered at the reserved matters stage of development.

Future Baseline

H4.61 As described in Section H4 (Existing Conditions), there are a number of potential on site sources of contamination (Former SSI SLEMS, Former Metals Recovery Area) as well as potential off-site sources (Former SSI High Tip, Highfield Environmental Facilities, Hanson Concrete and Tarmac Teesside Leasehold areas and the SBCO)). The identified contamination beneath the Site to date predominantly relates to historic land use and it is considered that no significant deterioration in ground conditions will occur in the absence of development. It is assumed that any on-going operations / procedures of current works / industry will be controlled in line with modern industry regulations and best practice.

H4.62 Therefore, existing baseline conditions with respect to geology, hydrogeology and land quality would be unlikely to change significantly between now and the completion of the works in the absence of the Development.

Relevant Sensitive Receptors

H4.63 The following receptors have been identified for the Site:

Table H4.3 Identified Receptors

Receptor	Phase		Sensitivity (as defined in Table H3.1)
	Construction	Operation	
Human Health Receptors			
Construction Workers	Applicable	n/a	High to Very High
Offsite Human Health Receptors	Applicable	n/a	Low to High

Future Site Users (commercial / industrial end use B1, B2 and B8)	n/a	Applicable	High
Environmental Receptors			
Surface Waters	Applicable	Applicable	Medium
Groundwater	Applicable	Applicable	Medium
Built Environment			
Built Environment and Landscape	n/a	Applicable	High
Waste Management Facilities	Applicable	n/a	Medium

Sources

H4.64 The following key sources have been defined within the Outline Remediation Strategy (Wood 2019) with regard development of the site:

1 **Iron and Steel Works** – The site and the wider Teesside area has an extensive industrial legacy including almost 170 years of iron and steel making, together with auxiliary works including fuel oil storage. Previous investigation of the land has confirmed the presence of contaminants including heavy metals, hydrocarbons and abnormal pH.

2 **Made Ground** –The site is known to extensively comprise reclaimed land, made up of slag, together with supplementary Made Ground deposits comprising ash and demolition rubble giving rise to a range of contaminants including heavy metals, abnormal pH and sulphate/sulphides. The ubiquitous nature of such materials across the site and its prevalence at the surface is one of the key sources of contamination regarding development of the site.

3 **Hazardous Ground Gases** – Previous investigation of adjacent land has identified the presence of ground gases (methane (flammable gas) and carbon dioxide) which are likely to be derived from the historical legacy of landfilling, infilling and reclamation both on and off the site. Based on ground gas concentrations and a range of exposure pathways, the presence of ground gases may present a risk to current and future onsite and offsite human health (e.g. asphyxiation) as well as onsite and offsite properties (e.g. explosion). Given the nature of contaminants, there is also the potential for risks to human health from exposure to volatile organic compounds (VOCs).

4 **Asbestos** – Investigation data has identified the presence of asbestos in Made Ground which is likely to be derived from the historical legacy of landfilling, infilling and reclamation activities as well as operational aspects associated with the site.

Source Pathway Receptor Linkages

H4.65 Key contaminant linkages (CL) identified as requiring some form of mitigation are summarised in the table below.

Table H4.4 Key Contaminant Linkages Requiring Mitigation

Contaminant Linkage No.	Contaminant Linkage Description
CL1	Construction workers, future site users and offsite human health receptors via inhalation of asbestos fibres associated with Made Ground.
CL2	Construction workers, future site users and offsite human health receptors via dermal contact, accidental ingestion and dust

	inhalation of organic and inorganic contamination within Made Ground.
CL3	Future site users via gas migration into buildings from landfills.
Cl4	Construction workers and future site users via inhalation of volatile contamination within Made Ground.

Contaminant Linkages Not Considered to Require Mitigation

H4.66 A range of metals, phenols, aliphatic hydrocarbons, PAH's, VOCs, Semi Volatile Organic Compounds (SVOC) and aromatic hydrocarbon contaminants were identified within the soil with the potential to impact groundwater quality. Based on the low sensitivity, productivity aquifer and saline intrusion into groundwater beneath the site and surrounding area from the River Tees estuary, the site presents a 'Low to Moderate' risk to groundwater. Groundwater within the area is recognised by the Environment Agency as being non-viable.

H4.67 A range of metals, phenols, aliphatic hydrocarbons, PAH's VOCs, SVOCs and aromatic hydrocarbon contaminants were identified within the soil with the potential to impact surface water quality. Based on the former and current industrial land uses, and the influences of saline intrusions of the River Tees, the sensitivity of the surface water bodies is considered to be low, therefore the site would present a 'Low to Moderate' risk to surface water bodies. Moreover, contaminants potentially entering the surface water bodies would likely be subject to dilution and dispersion during migration. If contaminants did manage to enter the surface water bodies, further dilution and dispersion would likely occur especially when entering the River Tees. Given the industrial land use surrounding the site and the likelihood that the surface water bodies are acting as drainage for a wider industrial area, establishing a true causal relationship between site derived contaminants and the surrounding surface water bodies would prove challenging.

H5.0 Potential Effects

Embedded Mitigation

H5.1 The proposed embedded mitigation measures relevant to ground conditions include:

1 Earthworks: for the purpose of this EIA it is assumed that the construction stage of the development will be cut and fill neutral; and

2 Site Levels: the proposed minimum finished floor level will be 5.79m AOD.

During Construction

Impacts on Human Health Receptors

H5.2 The use of heavy equipment and activities such as excavation, backfilling, and compaction may disturb the soil and result in dust generation as well as provide opportunities for direct contact and inhalation of contaminants. Made Ground is present across the site and typically extends to 6.5 to 8m below ground although it is locally deeper (deposits in excess of 10m thick (to -2.5mOD) have been encountered). The site is known to extensively comprise reclaimed land, made up of slag, together with supplementary Made Ground deposits comprising ash and demolition rubble giving rise to a range of contaminants including heavy metals, hydrocarbons, abnormal pH and sulphate/sulphides.

H5.3 Asbestos screening was undertaken on soil sampled from 10 locations within the former SSI SLEMS area with no asbestos fibres or asbestos containing material identified but it is noted that elsewhere in the wider STDC area asbestos has been detected in made ground. Asbestos screening has only been undertaken within the former SSI SLEMS area to date. further assessment will be required and a conservative approach to defining protective measures (see the following section of the chapter).

H5.4 Analysis of the made ground have indicated that the potential contaminant concentrations are generally below commercial end use criteria. Lead in soil exceeded the GAC C4SUL for commercial end use (2,300mg/kg) in a total of 12 samples out of >300 soil samples analysed over multiple site investigations.

H5.5 There was evidence of localised hydrocarbon contamination in soil and groundwater within the area near the off-site south bank coke ovens and benzol tanks and near the SLEMS facility and in lower concentrations at South Bank Oil Tank Farm in the north of the site.

H5.6 TPH (by Gas Chromatography) above 1000mg/kg was identified at 14 locations and 3 samples exceeded a screen for C10-C40 near the coke ovens. Elevated (>1,000mg/kg) concentrations of Toluene Extractable Matter (TEM) (reflective of hydrocarbon contamination) were identified in 24 of 60 samples with a maximum of 3560mg/kg detected in soil sampled from the area of the former benzol storage tanks where oily and tarry deposits and strong organic odours were also noted. 1 sample was measured above the GAC for benzo(a)pyrene and 1 sample (from the same location) measured above the GAC for naphthalene from the former SSI SLEMS area.

H5.7 Based on existing survey data available, the sensitivity of the human receptors which includes construction workers and residents/visitors of surrounding properties is high and the magnitude of impact prior to mitigation is medium. This could lead to impacts of **moderate** adverse significance (considered 'significant' in EIA terms) if mitigation actions are not carried out.

Environmental Receptors (Surface Waters and Groundwater)

H5.8 Despite elevated pH is soils due to alkaline slag deposits, ground pH was only locally elevated. Widespread elevated sulphate concentrations were encountered. Toxic metals, cyanide and organic contaminants (PAH, Benzene, Toluene, Ethylbenzene and Xylenes (BTEX), TPH and Gasoline Range Organics (GRO) were above screening criteria in the SLEMS and SBCO areas. Evidence of free product was identified within water samples taken from the west of the SBCO (by-products plant) near the benzol tanks. Groundwater quality data collected by Enviros 2004 was compared with UK Drinking Water Standards (UKDWS) and Dutch Invention Values (DIV) which are considered conservative in relation to determining the requirement or targets for remediation.

H5.9 Comments on the Outline Remedial Strategy (Wood 2019) by the EA (NA/2019/114630/01-L01, August 2019) state that past industrial activity is considered to pose a medium risk of pollution to controlled waters. The Outline Remedial Strategy also considers that the potential hazard to controlled waters is medium but that given the low likelihood of occurrence and low sensitivity of the controlled water receptors the significance of this risk is moderate / low, and that no active remediation of groundwater is required. Comments received by RCBC (Ref:153731, 06/08/2019) state that they are satisfied that this strategy adequately covers parts a (Site characterisation) and b (Submission of a Remediation Scheme) of the standard contaminated land conditions. Therefore, it is assumed that overarching remediation scheme described within the Outline Remedial Strategy is acceptable and that active remediation of groundwater is not required.

H5.10 The assessment of significance undertaken within this EIA supports the remedial strategy with the sensitivity of the controlled water receptors considered medium (reflecting a water receptor deemed to be of low value) and that given the low magnitude of likely impact the overall significance is considered **negligible** and therefore not significant**.**

H5.11 There remains a data gap with respect to groundwater quality and soil leaching potential across the Site and further investigation and/or groundwater monitoring may be required to inform the CSM and confirm the overall significance of likely impact to groundwater and surface water determined within this assessment.

Impacts on the Built Environment (Waste Management Facilities)

H5.12 A summary of the remedial works envisaged within the Outline Remedial Strategy (Wood 2019) is given in Section H5.1 which includes removal of relic subsurface obstructions, selective excavation of contaminant 'hotspots' and the provision of clean service run areas. Site won and imported clean cover soils will be placed to form a 0.3m capping layer to physically break Made Ground contaminant linkages.

H5.13 The outline remediation strategy does not require the existing site levels to be raised beyond remediation cover system requirements and to enable a level platform for ease of the development. It is assumed that the minimum finished floor level will be 5.79mAOD and the maximum development height will be 46m. This allows for a larger finished floor level where required for soil deposits. Furthermore, it is assumed that the overall cut and fill balance for the redevelopment will be neutral (balanced) inclusive of the capping layer.

H5.14 Subject to viability and if piling is used in the final design it may be possible to re-use pile and foundation arising's within the confines of the site, beneath the capping layer. This will be subject to chemical analysis of the arising's to ensure they are in keeping with the soil chemistry in the shallow Made Ground and do not lead to leachable contaminants.

H5.15 Where excavated Made Ground is not suitable for use within the capping layer (e.g. contaminant 'hotspots') then disposal within existing adjacent landfills, within the wider STDC area, will be utilised wherever appropriate. The option to use existing adjacent landfills as a repository for residual, unsuitable materials from ground remediation and site preparation activities provides promotes a more cost-effective and environmentally sustainable alternative to off-site disposal.

H5.16 The sensitivity of the landfills (waste management facilities) is medium and the magnitude of impact prior to mitigation is medium. Thus, the impact on landfills (waste management facilities) is considered to be of **minor** adverse significance which is not considered 'significant' in terms of this EIA assessment.

During Operation

Impacts on Human Health Receptors

H5.17 The South Industrial Zone and South Bank Site will have undergone remedial works which are assumed to meet the following objective as detailed within the Outline Remedial Strategy (Wood 2019):

"to mitigate the level of ground remediation required across the STDC area, minimise conflicts with the many safety restrictions (including various prevailing safety hazard zones) and avoid introducing future end users that would otherwise conflict with the existing industrial and commercial activities within the area", and

"breaking the identified significant pollutant linkages…to manage the associated risks"

H5.18 The exposure of the future end-users will be limited as the developed site will be covered with a variety of finishes including commercial and industrial buildings and hard-standing associated with car parking and roads. The remediation works will ensure that capping materials placed within the top 0.3m of the development surface will not contain contaminants above the generic 'Chemical Suitability Assessment Criteria (Industrial/ Commercial) for Soils' provided within the Outline Remedial Strategy (Wood 2019) which also states that an additional layer of engineering fill, of approximately 0.5m, may be required to enable the protection of the remediation capping layer during both the construction and full site operational phase.

H5.19 A clean or lined service run will be installed to protect both future land users (maintenance) and utility assets.

H5.20 The sensitivity of the human receptors is high and the magnitude of impact prior to mitigation is considered to be low. Thus, the impact on human receptors prior to mitigation is considered to be of **minor** adverse significance which is not considered 'significant' in terms of this EIA assessment.

Environmental Receptors (Surface Waters and Groundwater)

H5.21 The proposed development is based on a future commercial and industrial end use - B2 (general industry), B8 (storage and distribution) and B1 (office). B1 does not include activities that during the operational phase that are likely to generate contaminants that could pose substantial risk to the soil surface water and/or groundwater.

H5.22 In relation to B2 and B8, a wide range of potentially hazardous materials may be used and/or stored during the operational phase. This might include chemicals, oils, fuels, and wastes in various forms. In the event of uncontrolled releases of such materials, either from storage areas on the site, or during transportation / handling, contamination of local soils, drainage system, surface watercourses and groundwater may result. The magnitude of any impacts will depend on the type of material released, as well as the quantity and timing of the release.

H5.23 The majority of the site will be covered by commercial and industrial buildings and hard-standing associated with car parking and roads with rainfall infiltration rates through Made Ground being significantly reduced and therefore limiting the potential for leaching of contaminants from soils. Hardstanding will also reduce the potential for any spills or leaks resulting from activities related to B2 and B8 Site use to adversely affect surface water and groundwater

H5.24 The sensitivity of the underlying ground water and the River Tees is considered low.

H5.25 Any retained landfill areas will be appropriately licensed and engineered such that leachate and ground gas is with managed in accordance with applicable discharge consent and emissions criteria.

H5.26 The Mill Stream is culverted beneath the site with other unknown culverted water features also potentially present. The Cleveland Channel is present within the Former SSI SLEMS area and the Lackenby Channel is present immediately east (outside the development area) of the MRA.

H5.27 The sensitivity of the surface waters and/or groundwater is medium and the magnitude of impact prior to mitigation is medium. Thus, the impact on surface waters and/or groundwater is considered to be of **minor** adverse significance which is not considered 'significant' in terms of this EIA assessment.

Built Environment and Landscape

H5.28 Materials such as concrete, metals and plastics will be employed in the construction of the development platform and site buildings and infrastructure. These materials could be used underground or above ground level. The built environment can be impacted where materials have been incorrectly specified at the design / construction stage. Buried concrete could be exposed to chemical attack especially from ground-borne acids and sulphates and this could compromise the structural integrity of the underground structures.

H5.29 The presence of metals, acids, hydrocarbons and phenol contamination in the Made Ground could result in the corrosion and permeation of plastics used in pipework for water supplies. Therefore, there is the potential for ongoing material degradation throughout the operational life of the development.

H5.30 The sensitivity of the built environment and landscape associated with the development is high and the magnitude of impact prior to mitigation is medium. Thus, the impact on development infrastructure and landscape during the operation stage prior to mitigation is considered to be of **moderate** significance which is considered 'significant' in terms of this EIA assessment.

H6.0 Mitigation and Monitoring

Outline Remediation Strategy

H6.1 The Outline Remediation Strategy (Wood 2019) will form the basis for an remediation strategy for the development site. It includes several elements which will mitigate potential environmental risks associated with the proposed development as part of the proposed remedial works, including:

1 Demolition of legacy structures and ground preparation operations including removal of relic subsurface obstructions (to ~2.5mbgl), vegetation clearance and infilling of voids. It should be noted that the demolition of existing structures within the development site has been considered within this EIA, albeit it is anticipated that these will be removed subject to existing prior approval applications (see chapter B of this ES);

2 The option for selective excavation and disposal at the adjacent hazardous waste facility of limited 'hotspots' of contamination; and

3 Site won and imported clean cover soils will be placed under a controlled methodology, mainly driven by geotechnical requirements, to form a 0.3m capping layer to physically break Made Ground contaminant linkages. It is assumed cut and fill balance will be neutral.

H6.2 A clean or lined service run area will be installed to protect both future land users (maintenance) and utility assets. A no dig layer may be installed as required. This overarching approach is compatible with a phased remediation of the site and this gives flexibility regarding the phased development of the site and the future layout design, allowing development hard surfacing (e.g. associated with access roads and site building footprints) to also contribute to remediation solutions (i.e. as part of the capping layer to break direct contact and dust generation pathways).

H6.3 An Outline Remediation Strategy is currently being progressed for the wider STDC area and this is high level at the point of submitting this outline planning application. The detailed design for each of the development plots will determine the detailed remediation approach based on the intended layout and form of development. As set out in Section 6.0 of this Chapter a Remediation Design Statement for each development plot will set out how the proposed development conforms, where possible, with the outline remediation strategy. This should be informed by additional ground investigation and/or risk assessment, where required. Because of the current nature of the outline remediation strategy it is being classified as secondary mitigation (see below) and is therefore not embedded into the design of the scheme.

During Construction

H6.4 A Construction Environmental Management Plan (CEMP) will be prepared for the development. This document will be developed to avoid, minimise or mitigate any construction effects on the environment and the surrounding community. Those measures that should be included to reduce the impact of ground conditions include:

Measures to Protect Human Health Receptors

1 measures to minimise dust generation;

2 provision of personal protective equipment (PPE), such as gloves, barrier cream, overalls etc. to minimise direct contact with soils;

3 provision of adequate hygiene facilities and clean welfare facilities for all construction site workers;

4 monitoring of confined spaces for potential ground gas accumulations, restricting access to confined spaces, i.e. by suitably trained personnel, and use of specialist PPE, where necessary; and

5 preparation and adoption of a site and task specific health and safety plan.

6 damping of ground with water to minimise dust;

7 adoption of and adherence to measures to ensure no materials are trafficked onto the public highway;

8 processing of excavated materials and using in the works at the site where appropriate;

9 sheeting of lorries transporting any spoil off site and the use of dust suppression equipment on plant;

10 adequate fuel/chemical storage facilities e.g. bunded tanks, hard standing and associated emergency response/spillage control procedures;

11 routine testing of soils and materials in accordance with the Outline Remedial Strategy (Wood 2019) and any detailed remediation statements prepared for specific developments;

12 well maintained plant and associated emergency response/spillage control procedures; and

13 any temporary onsite storage of contaminated material will be stored on sheeting and covered to minimise the potential for leachate and run off from the stockpile being generated;

14 a significant programme of monitoring will be in place before, during and post remediation works. The monitoring programme will include as appropriate the following:

a ground gas monitoring;

b groundwater monitoring;

c surface water monitoring;

d noise and vibration monitoring;

e odour monitoring; and

f air quality monitoring.

Measures to Protect Environmental Receptors (Surface Waters and Groundwater)

15 All encountered perched water within the Made Ground shall be collected in a collection tank or lined lagoon prior to any treatment and discharge. The incidental water shall either be:

a discharged to foul sewer under a trade effluent consent agreed with the local sewerage undertaker and/or;

b discharged to surface water under a water discharge activity environmental permit ("WDA-EP") from the EA.

16 It is envisaged that an on-site treatment plant may be required to ensure that the concentrations of key determinands in the effluent discharge are within consented discharge limits.

17 In order to manage the discharge of runoff water on the site and / or any perched water encountered during the works, a construction stage surface water management plan shall be developed. The following principal items shall be included:

a a series of temporary land drains around the development discharging to discharge point(s);

b a monitoring and sampling point constructed at the point(s) of discharge;

c settlement lagoons, if required, constructed upstream of the discharge point(s);

d cut-off ditches around the perimeter of the site to prevent water discharging at any location other than the aforementioned discharge point(s).

H6.5 During the construction works, it will be necessary to fuel and maintain a fleet of mobile plant.

Impacts on Human Health Receptors

H6.6 Based on the results of the previous ground investigations as well as any further investigation undertaken, areas that pose a risk to human health as a result of identified contamination would be delineated and remediated prior to construction works. Further investigations are recommended to include, but are not limited to, the following tasks which will identify the need for further mitigation.

- Survey of asbestos in Made Ground across the entire Site including detection and, where detected, quantification of asbestos;
- Monitoring and assessment of ground gas regime across the Site, especially in the vicinity of areas of adjacent landfilling / waste disposal to inform requirements for remediation and/or gas protection measures;
- Assessment of soil quality with regard to potential Contaminants of Concern in specific areas where current data is limited e.g. Metals Recovery Area;
- Assessment of groundwater quality across the entire site within the Made Ground, superficial deposits and, if considered required, the bedrock aquifer with temporal assessment of trends should significant contaminant be identified;
- Assess of geotechnical properties of the underlying ground to inform e.g. foundation and infrastructure design.

H6.7 As asbestos contaminated Made Ground is likely to be encountered during construction works, an appropriate Health and Safety Plan would be prepared to manage delineated materials in a safe manner in accordance with the Construction (Design and Management) Regulations 2015 and the requirements of the Control of Asbestos Regulations 2012. The remediation objectives which include breaking the identified significant pollutant linkages to manage the associated risks and the provision of a capping layer and development hardstanding across the Site (as well as an additional protective layer of engineering fill as required) will break SPR linkages pathways associated with inhalation of respirable asbestos in soils and materials. Where visible Asbestos Containing Material (ACM) is identified in excavated material this is to be removed and sentenced for off-site disposal. Otherwise, soil materials with detected quantities of asbestos fibres in soil are to be placed within the development platform below the capping layer to break dust/fibre inhalation pathways. Maintain a watching brief for the presence of ACM in all excavated soils with identified ACM handpicked or segregated from the soil, wherever possible, and sentenced for off-site disposal. Any areas of the site where soils containing asbestos have been permanently placed should have this clearly indicated on the soil audit and also be included on a marked-up Site plan indicating location, depth and extent of any asbestos containing soils.

H6.8 Potential impacts specific to construction workers during site preparation, remediation and reclamation earthworks will be mitigated by the following measures and through working in accordance with CIRIA C692 Environmental Good Practice on Site. 4th Edition (2015) as outlined in Section H5.34

H6.9 The potential impacts on surrounding land use, surrounding sensitive land uses and surface water and groundwater will be addressed and mitigated through the adoption of the measures outlined in Section H5.34.

Environmental Receptors (Surface Waters and Groundwater)

H6.10 The mitigation measures would aim at ensuring the surface water run-off from the site during clearance, remediation, reclamation earthworks and construction does not have a detrimental effect on the receiving watercourse (River Tees) and the underlying groundwater. The surface water run-off would be controlled using appropriate drainage measures and infiltration into the ground would be minimised. This will be controlled through an appropriate drainage strategy.

H6.11 During the remediation and reclamation works perched water in the Made Ground materials could contain elevated concentrations, in comparison to applicable discharge consent criteria or Environmental Quality Standards (EQS) of various metals (e.g. chromium, cadmium, manganese, nickel, zinc), inorganic (e.g. ammonia, ammonium, sulphate) and organic (various PAHs) determinands and there is therefore a requirement for its collection and treatment prior to discharge.

H6.12 Where perched water encountered during the progress of the earthworks contains concentrations of determinands that would breach any consent/permit for discharge then the water shall be subject to pre-treatment. This treatment will be influenced by the nature of the exceedances and may include the use of the following treatment processes: settlement, flocculation, air stripping, aeration, chemical oxidation, granulated carbon adsorption. It is envisaged that an on-site treatment plant may be required to ensure that the concentrations of key determinands in the effluent discharge are within consented discharge limits.

H6.13 A construction stage surface water management plan shall be prepared in conjunction with the programme of works and reviewed regularly during the works to ensure that it meets the objectives above.

H6.14 During the construction works, it will be necessary to fuel and maintain a fleet of mobile plant.

H6.15 In addition, the prevention of pollution of groundwater will comply with the requirements of the following EA and DEFRA Guidance documents:

1 EA, Protect groundwater and prevent groundwater pollution, 2017 (ref 9.44);

2 EA, Groundwater protection technical guidance, 2017 (ref 9.45);

3 EA, The Environment Agency's approach to groundwater protection, 2018 (ref 9.46);

4 DEFRA Guidance, Pollution Prevention for Businesses, July 2016 (Updated May 2019) (ref 9.58).

H6.16 Consideration will also be needed to providing temporary drainage throughout the reclamation and remediation of the site, to minimise the risk of impacts on both the water quality and discharge rate on adjacent properties. A Surface Water Management Plan should be prepared to minimise risk of impacts on water quality.

Impacts on Waste Management Facilities

H6.17 The disposal of solid waste, contaminated or otherwise to landfill sites will be best mitigated by prevention or minimisation of the overall quantities of waste generated during construction and by ensuring that excavated material consigned to landfill is deposited within the existing adjacent Highfield Landfill. The Outline Remedial strategy (Wood 2019) sets compliance targets

for materials to be used within the capping layer of the development. The Strategy has been developed with the intention to minimise off-site disposal of materials.

H6.18 A Materials Management Plan will be prepared which will detail the procedures and measures that will be taken to classify, track, remediate, store, use and if necessary, dispose of materials that will be encountered during the remediation works.

H6.19 As part of the plan the records of all materials movements on-site and off-site will be kept by the Reclamation / Earthworks Contractor in paper and electronic format for a minimum period of 2 years following completion of the works and production of the Validation / Verification Report. To allow auditing of the Materials Management Plan; data will be stored electronically in a specifically designed database on site. Daily data uploads would be undertaken. All data would be geo-referenced, and all stockpile sample nomenclature would ensure individual identification.

During Operation

Impacts on Human Health Receptors

H6.20 No ground gas monitoring has been undertaken within the proposed development area to date which represents a significant data gap and therefore future development proposals, particularly those located in close proximity to former landfill sites, should be supported by further investigation and an associated Gas Risk Assessment and should incorporate any necessary protection measures appropriate to protect buildings and future site users from landfill gas migration. This will be considered at the reserved matters stage of development.

H6.21 Site buildings will be designed with adequate ground gas mitigation measures to prevent the accumulation of ground gas in confined spaces. The ground gas protection measures would be implemented in accordance with CIRIA C665 (Assessing Risks Posed by Hazardous Ground Gases to Buildings) and the NHBC Guidance on Evaluation of Development Proposals on Sites Where Methane and Carbon Dioxide are Present Report Edition No 4 (2007).

H6.22 Maintenance workers that are required to undertake ground excavations during the operational life of development will be provided with sufficient information on the nature of each sub-area, upon which to base site and task specific risk assessments.

H6.23 A clean service run area will be installed, as required, to protect future land users (maintenance).

Environmental Receptors (Surface Waters and Groundwater)

H6.24 Areas of hardstanding would be designed to avoid uncontrolled discharges to the drains.

H6.25 The NPPF, Local Plan and water management guidance detailed in Chapter G: Water Management and Flooding highlights the need for suitable management of water and drainage, where appropriate through use of natural flood management. There is an aspiration for blue green networks to provide treatment and management of surface water run-off (and these may be provided where achievable and possible). This will not include infiltration SuDS such as soakaways in order to limit mobilisation of contamination. In addition, surface drainage and networks will be lined with a geomembrane (impervious to water) so there is no interaction with contaminated land. Direct discharges to the Tees are not required to be attenuated but all drainage on site that is not directly discharge to the Tees watercourse is proposed to be attenuated.

Built Environment

H6.26 Materials used in infrastructure will be designed and specified accordingly taking due account of the potential for aggressive ground conditions such as those related to the possible presence of elevated sulphate or the presence of ground gas. The assessment methodology set out in BRE Special Digest 1 (2015) will be adopted to determine the appropriate concrete classification in relation to the protection of buried concrete against sulphate attack.

H6.27 A clean or lined service run area will be installed to protect utility assets.

H7.0 Residual Effects

During Construction

Impacts on Human Health Receptors

H7.1 The sensitivity of human receptors (construction workers and offsite human health receptors) is high and the magnitude of impact following mitigation is negligible. There are likely to be impacts of **negligible** significance after the implementation of mitigation measures. This is not considered significant in EIA terms.

Environmental Receptors (Surface Waters and Groundwater)

H7.2 The sensitivity of the surface water and/or groundwater is medium, and the magnitude of impact following mitigation is negligible. Therefore, the impacts after the implementation of mitigation measures are considered to be of **negligible** significance. This is not considered significant in EIA terms.

Impacts on Waste Management Facilities

H7.3 The sensitivity of the waste management facilities is medium, and the magnitude of impact following mitigation is Low and thus the impact on management facilities during the construction phase is considered to be of **negligible** significance. This is not considered significant in EIA terms.

During Operation

Impacts on Human Health Receptors

H7.4 The sensitivity of human receptors (future residents, visitors and maintenance workers of the proposed development, residents and visitors of surrounding properties) is high and the magnitude of impact following mitigation is negligible. Therefore, following the implementation of mitigation measures impacts are of **negligible** significance. This is not considered significant in EIA term.

Environmental Receptors (Surface Waters and Groundwater)

H7.5 The sensitivity of the surface water and/or groundwater is medium, and the magnitude of impact following mitigation is negligible. Therefore, the impacts following mitigation are of **negligible** significance. This is not considered significant in EIA terms.

Built Environment and Landscape

H7.6 The sensitivity of the built environment and landscape is medium, and the magnitude of impact following mitigation is negligible. Therefore, the impacts are considered to be of **negligible** significance. This is not considered significant in EIA terms.

H8.0 Summary & Conclusions

H8.1 A number of potential impacts of varying significance to receptors, associated with land quality, ground conditions and contamination have been identified. These potential impacts have been considered and assessed within the context of the proposed construction (including the proposed remediation works detailed in the *Outline Remedial Strategy (Wood 2019))* and operation of the Development. The sensitivity of the human receptors (construction workers and residents/visitors of surrounding properties) is high while the groundwater and principal surface water feature (River Tees) are considered of low value and hence considered a medium sensitivity.

H8.2 Mitigation that is designed to protect the identified receptors susceptible to impacts from contamination in Made Ground soils have been set out. The residual significance of the impacts identified is considered to be negligible following the implementation of the mitigation measures.

H8.3 There are currently a number of data gaps regarding the geochemical and geotechnical characterisation of ground conditions and contamination at the site which will likely require further site investigation and risk assessment in order to inform detailed design statements (in line with the overall remedial strategy) produced to support the development of specific areas during subsequent phases of development.

H8.4 Table 7.1 summarises the impacts relating to Land Quality, Ground Conditions and Contamination.

Table H7.1 Summary of Impacts relating to Ground Conditions and Contamination

Relevant Receptors	Significance of Potential Effects	Effects					Description of Mitigation / Enhancement Measures	Description of Residual Effects	Significance of Residual Effects	Residual Effects				
		B/A	P/T	D/I	ST /M/LT	L /R/N				B/A	P/T	D/I	ST /M/LT	L /R/N
Construction Phase														
Construction workers and off-site human health receptors	Moderate	A	P	D	LT	L	Remediation works will be undertaken to break source pathway receptor linkages and manage risks including via a capping layer. Such works will be undertaken taking into consideration CIRIA C692 Environmental Good Practice on site. Chemical testing of soil and dust, odour and noise monitoring.	Residual risks managed via appropriate risk assessment, PPE and other controls during construction works. Additional layer of fill can be installed to protect capping layer.	Negligible	A	T	D	ST	L
Surface water and Groundwater	Negligible	A	T	D	ST	L	Construction stage surface water management plan to be implemented and reviewed on a regular basis. Follow appropriate EA guidance documents. Surface water and groundwater considered of low value. Remediation works will reduce potential for contaminant leaching.	-	Negligible	A	T	D	ST	L
Waste Management Facilities	Minor	A	T	I	M	R	Materials Management Plan to be implemented to minimise waste generation also in accordance mitigation measures outlined within the Waste and Materials Management chapter. Overall cut and fill balance to be neutral (balanced).	Existing adjacent landfill used for unsuitable material with minimal quantities requiring off-site disposal.	Negligible	A	T	I	ST	L
Operational Phase														
Future site users (commercial / industrial end use B1, B2 & B8)	Minor	A	T	D	M	L	Remediation works will be undertaken to break source pathway receptor linkages and manage risks including via a capping layer. Clean service runs installed. Site use with buildings and hardstanding also break pathways. Ground gas will be further assessed, and appropriate gas protection measures will be installed.	-	Negligible	A	T	D	ST	L
Surface water and Groundwater	Minor	A	T	D	ST	L	Majority of Site will be covered in hardstanding and buildings reducing	Future site uses & adjacent landfills will	Negligible	A	T	D	ST	L

Relevant Receptors	Significance of Potential Effects	Effects					Description of Mitigation / Enhancement Measures	Description of Residual Effects	Significance of Residual Effects	Residual Effects				
		B/A	P/T	D/I	ST /M/LT	L /R/N				B/A	P/T	D/I	ST /M/LT	L /R/N
							infiltration and potential for contaminant leaching. Surface water features will remain culverted or otherwise hydraulically contained. Surface water and groundwater considered of low value.	be appropriately licensed and managed.						
Built Environment and Landscape	Moderate	A	P	D	LT	L	Materials used will be specified taking due account of the potential for aggressive ground conditions and ground gas. Ground materials used for landscaping / planting will not contain elevated concentrations of phytotoxic substances. A clean or lined service run area will be installed to protect utility assets.	-	Negligible	A	T	D	ST	L

Notes:

(Beneficial or Adverse) (B/A), (Permanent or Temporary) (P/T), (Direct or Indirect) (D/I), (Short Term, Medium, Long Term) (ST, M, LT), (Local, Regional, National) (L, R, N)

H9.0 Abbreviations & Definitions

1	AOD	Above Ordnance Datum
2	BOS	Basic Oxygen Steelmaking
3	BGS	British Geological Society
4	C4SL	Category 4 Screening Levels
5	CSM	Conceptual Site Model
6	CEMP	Construction Environmental Management Plan
7	DEFRA	Department Environment Food and Rural Affairs
8	DPD	Development Plan Document
9	EA	Environment Agency
10	EPR	Environmental Permit Regulations
11	ES	Environmental Statement
12	GAC	Generic Assessment Criteria
13	HFO	Heavy Fuel Oil
14	MMP	Materials Management Plan
15	NPPF	National Planning Policy Framework
16	PPE	Personal Protective Equipment
17	PAH	Polycyclic Aromatic Hydrocarbons
18	RCBC	Redcar and Cleveland Borough Council
19	SVOC	Semi Volatile Organic Compounds
20	SNCI	Sites of Nature Conservation Interest
21	SLEMS	Solid Liquid Effluent Management Site or South Lackenby Environmental South Lackenby Environmental Management Site
22	SPR	Source Pathway Receptor
23	STDC	South Tees Development Corporation
24	TEM	Toluene Extractable Matter
25	TPH	Total Petroleum Hydrocarbons
26	VOC	Volatile Organic Compounds

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