Net Zero Teesside – Environmental Statement

Planning Inspectorate Reference: EN010103

Volume III – Appendices

Appendix 10A: Preliminary Sources Study Report

The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended)

Prepared by: AECOM

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10A. Preliminary Sources Study Report

10.1 Introduction

10.1.1 The Proposed Development comprises the construction, operation and decommissioning of a Carbon Capture Utilisation and Storage (CCUS) project comprising a gas-fired Combined Cycle Gas Turbine together with equipment required for the capture and compression of carbon dioxide (CO_2) emissions from the generating station. In addition, there is a need for supporting infrastructure and connections to facilitate the Proposed Development and to integrate it with a wider industrial carbon capture network in Teesside, the construction of which also forms part of this project. The design of the Proposed Development at this stage of the project incorporates a degree of flexibility in the dimensions and configurations of buildings and structures to allow for the future selection of the preferred technology and construction contractors.

10.1.2 Geotechnical assessment follows the guidance as set out in BS5930:2015+A1:2020 Code of practice for ground investigations, Section 2, Part 11, Desk study and is produced in accordance with guidance reports and should therefore meet the requirements of BS EN 1997-1 and BS EN 1997-2. Geotechnical reporting follows the general format set out in DMRB Highways England Design CD622, 'Managing Geotechnical Risk', Revision 0, August 2019.

10.1.3 This Preliminary Sources Study Report (PSSR has been updated to reflect changes to the Site boundary since the preparation of the Preliminary Environmental Information (PEI) Report.

10.2 Project Details

10.2.1 The Proposed Development is shown on ES Figure 3-1: Site Boundary Plan (Environmental Statement (ES) ES Volume II, Document Ref. 6.3). The Proposed Development is separated into a number of different elements and areas as shown on Figures 3-2A to 3-2E (ES Volume II, Document Ref. 6.3) and as described below.

10.2.2 These different elements and areas will be used as the basis of the descriptions provided in this PSSR.

PCC Site

10.2.3 The location of the Power Capture and Compression (PCC) Site is shown (see grey area) on Figure 3-2A (ES Volume II, Document Ref. 6.3). This is located on part of the former Redcar Steelworks (now known as the Teesworks site). It will include the generating station with carbon capture and compression equipment.

CO_2 Export Pipeline

10.2.4 The conditioned and compressed CO_2 captured from the generating station and industrial emitters will be transported offshore via a pipeline that will direct the dense phase liquid to the storage site. The underground storage site will be in the Southern North Sea approximately 145 km east south-east of the Site. This PSSR is intended to only describe the onshore section of the CO_2 Export Pipeline (i.e. above Mean Low Water Springs and hatched green on Figure 3-2A (ES Volume II, Document Ref. 6.3).

Water Supply and Discharge Corridors

10.2.5 Water will be needed to provide cooling for the generating station and the CO_2 capture and processing plant. Process water will also be required in order to provide make-up to the steam/water cycle of the generating station and associated CO_2 equipment. There will also be a requirement for water for domestic/sanitary use. Wastewater (including treated process water and surface water run-off) will be discharged to the Tees Bay. Proposed areas for water supply and discharge are shown (hatched blue) on Figure 3-2D (ES Volume II, Document Ref. 6.3).

CO_2 Gathering Network and Natural Gas Connection Corridors

10.2.6 The CO_2 Gathering Network Corridors are shown (solid yellow area) on Figure 3-2E (ES Volume II, Document Ref. 6.3).It is intended that the Proposed Development facilitates future third-party industrial carbon capture connections to the offshore storage site.

10.2.7 The CO_2 Gathering Network will be constructed from a new pipeline running along existing pipe racking and using existing culverts and pipe overbridges together with new buried in-ground sections. The gathering network, together with the in addition to the CO_2 captured from the generating station will pass to the compression booster station.

10.2.8 The proposed Natural Gas Connection Corridor are shown (hatched blue area) are shown on Figure 3-2B (ES Volume II, Document Ref. 6.3). There is considerable overlap between the proposed Natural Gas and CO_2 Gathering Network Corridors and therefore for the purposes of this report these will be considered as a single combined area.

Electrical Connection Corridor

10.2.9 The Electrical Connection Corridor is shown (hatched purple area) on Figure 3-2C (ES Volume II, Document Ref. 6.3).

10.2.10 The proposed Electrical Connection will be between the Electricity Generating Station and National Grid's Tod Point sub-station and will comprise a 275 kV single circuit cable route and control system cables.

10.3 Objectives of the Report

10.3.1 The purpose of this report is to collate geotechnical and geo-environmental information for the Proposed Development, present a summary of that information and identify possible geotechnical and geo-environmental development constraints as supporting information for Chapter 10: Geology, Hydrogeology and Contaminated Land (ES Volume I, Document Ref. 6.2).

10.3.2 The objectives of the PSSR are to identify and review geotechnical and geo-environmental risks and constraints associated with the Proposed

Development for further consideration within Chapter 10 of the ES Volume I, Document Ref. 6.2. As part of this assessment the following tasks have been undertaken:

- review of the site geology, hydrogeology, topography;
- review of the site historical setting;
- identify and review previous intrusive investigations and factual reports;
- identify and review previous interpretative reports;
- review relevant geo-environmental records and data;
- provide an overview of ground and groundwater conditions;
- identify potential geotechnical risks; and
- identify potential geo-environmental risks (contaminated land).

10.3.3 The review activities detailed above have been undertaken in order to:

- aid specification of ground investigation for further stages of assessment;
- help determine potential constraints for design and construction; and
- identify areas of information deficiency and any on-going or anticipated future geotechnical and geo-environmental problems which may affect the Proposed Development.

10.3.4 A ground investigation will be undertaken in Q2/Q3 2022.

10.4 Limitations and Exceptions to the Report

10.4.1 Where any conclusions and recommendations contained in this Report are based upon information provided by others, it has been assumed that all relevant information has been provided by those parties and that such information is accurate. Any such information obtained by AECOM has not been independently verified by AECOM, unless otherwise stated in the Report. AECOM accepts no liability for any inaccurate conclusions, assumptions or actions taken resulting from any inaccurate information supplied to AECOM from others.

10.4.2 The methodology adopted and the sources of information used by AECOM in providing its services are outlined in this Report. The work described in this Report was undertaken between November 2019 and January 2021 (including updates since the PEI Report) and is based on the information available during that time. The scope of this Report and the services are accordingly factually limited by these circumstances. AECOM disclaim any undertaking or obligation to advise any person of any change in any matter affecting the Report, which may come or be brought to AECOM's attention after the date of the Report.

10.4.3 Any risks identified in this Report are perceived risks, based on the information reviewed during the Preliminary Sources Study and therefore partially based on conjecture from available information. The study is limited by the non-intrusive nature of the work and actual risks can only be assessed following a physical investigation of the site.

10.4.4 The opinions expressed in this report and the comments and recommendations given are based on a desk assessment of readily available information. At this stage an initial site reconnaissance (walkover) by an AECOM Engineer and intrusive investigations have yet to be undertaken at site to establish actual ground and groundwater conditions and to provide data for an assessment of the geotechnical and geo-environmental status of the site.

10.4.5 Reference to historical Ordnance Survey (OS) maps and/or data provides invaluable information regarding the land use history of a site. However, it should be noted that historical evidence will be incomplete for the period pre-dating the first edition and between the release of successive maps and / or data. Selected features from historical maps and data supplied by Landmark have been presented by AECOM on constraints maps, however as these do not capture every feature, reference should be made to the original historical mapping supplied in the Envirocheck Report for detailed design.

10.4.6 Where assessments of works or costs identified in this Report are made, such assessments are based upon the information available at the time and where appropriate are subject to further investigations or information which may become available.

10.5 Sources of Information and Desk Study

10.5.1 Sources of information have been obtained as part of this study are summarised in Table 10A-1 below.

Table 10A-1: Sources of Information

Category	Source	Type of Information
Geotechnical	British Geological Survey (BGS)	1:50,000 scale BGS online Digital Geological of Great Britain (undated) http://mapapps2.bgs.ac.uk/geoindex/home.html
	BGS	1:50,000 scale BGS Geological Map Sheet 33, Solid and Drift Edition – Stockton (1987). 1:50,000 scale BGS Geological Map Sheet 34, Solid and Drift Edition – Guisborough (1998).
	BGS	1:10,000 BGS Geological Map Sheet NZ42SE (1984) 1:10,000 scale BGS Geological Map Sheet NZ52SW (1984) 1;10,560 scale, County Series Geological Map, Yorkshire, Sheet 7 FS (1881).
	BGS	1: Triassic Sandstones of the Vale of York, Baseline Series Report, Report CR/02/102N, 2002
	BGS	Technical Reports Geological Memoir:

Category	Source	Type of Information
		Frost, DV (1998). Geology of the country around Northallerton. Memoir of the British Geological Survey, Sheet 42 (England and Wales) Mineral Resources: Highley, DE, Lawrence, DJD, Young, B, Harrison, DJ, Cameron, DG, Holloway, S, Lott, GK and Bloodworth, AJ (2000). Mineral Resource Information for Development Plans: Phase One County Durham and the Tees Valley: Resources and Constraints (Co Durham, Darlington, Hartlepool, Middlesbrough, Redcar & Cleveland, and Stockton-on-Tees): Resources and Constraints. British Geological Survey Technical Report WF/00/6 ISBN 0 85272 368 7
	BGS	BGS Boreholes (http://mapapps2.bgs.ac.uk/geoindex/home.html) BGS 1:50,000 Digital Mapping Web Mapping Service Streamed into ArcGIS from https://www.bgs.ac.uk/data/services/digmap50wms.html
	Regional Geological Guide	Robson's Geology of North East England, Editor: G.A.L. Johnson. Transactions of The Natural History Society of Northumbria, Volume 56, Part 5, August 1995
	Technical papers	Bell, FG (2001). The geotechnical properties of some till deposits along the coastal areas of Eastern England, Engineering geology, 63, 2002, pp49-68.
Mining	Cleveland County Council	Report on Abandoned Mineral Workings and Possible Surface Instability Problems by C.H. Morris, 1982.
	BGS / Office of the Deputy Prime Minister	*Mineral Planning Factsheet – Salt*, January 2006 *Mineral Planning Factsheet – Underground Storage*, January 2006
Historical	Landmark	Envirocheck Report Reference 218629364_1_1 and 218629437_1_1, dated 9 September 2019 (updated digitally only where required in 2021 for change to the Site boundary). Note the red line boundary implemented in the printed Envirocheck Report does not reflect the site extents considered in this PSSR as the site alignment has been altered since the purchase of this document. However, areas discussed in this PSSR are included within the Envirocheck Report 1:10,000 mapping and within digital data supplied separately by Landmark
	Cleveland County Council	Teesside's Economic Heritage by G.A. North (1975)
Environmental	Environment Agency	Environment Agency Historical Landfills released under the Open Government Licence for Public Sector Information https://data.gov.uk/dataset/17edf94f-6de3-4034-b66b-004ebd0dd010/historic-landfill-sites

Category	Source	Type of Information
Previous Factual Reports	Allied Exploration & Geotechnics Ltd	PCC Site Former Steelworks, Redcar – Advance Boreholes in SSI1 Areas C & D, Contract No. 4145, South Tees Site Company Ltd, February 2018 The Former SSI Steelworks, Redcar – Ground Investigation Contract – Priority Areas Within SSI Landholdings Contract 1 and Contract 2 (Area A), Final Factual Report, Contract No. 4153 & 4154 (Area A), South Tees Site Company, June 2018
	CH2M Hill	PCC Site and Water Connections SSI Redcar – SSI 1, Factual Report – Initial Trial Pitting, South Tees Site Company Ltd, November 2017.
	CH2M Hill	PCC Site, CO_2 Gathering Network and Natural Gas Connection Corridors and Electrical Connection Corridor SSI Redcar – SSI 2, Factual Report – Initial Trial Pitting, South Tees Site Company Ltd, November 2017.
Previous Interpretive Reports	ARCADIS	PCC Site The Former SSI Steelworks Redcar: Priority Areas within SSI Landholdings Contract 1 and 2A: Contract 1 and 2A Site: Condition Report, dated August 2018 The Former SSI Steelworks Redcar: Priority Areas within SSI Landholdings Contract 1 and 2A: Contract 1 and 2A Site: Geotechnical Risk Assessment Report, dated November 2018 The Former SSI Steelworks Redcar: Priority Areas within SSI Landholdings Contract 1 and 2A: Contract 1 and 2A Site: Ground Remediation Options Appraisal Report, dated December 2018

10.6 Field Studies

Site Walkover

10.6.1 A site reconnaissance (walkover) was undertaken at the Teesworks Site (Redcar Steelworks) on the 18th and 19th March 2020 by representatives of BP and AECOM who were accompanied by a representative of the South Tees Development Corporation (STDC). A detailed description of the features observed during the site walkover, and accompanying photographs, are included as Annex F.

Geomorphological / Geological Mapping

10.6.2 No scheme specific mapping undertaken.

Probing, Pitting and Testing

10.6.3 None reviewed or undertaken.

Drainage / Hydrogeological Mapping

10.6.4 None reviewed or undertaken.

Geophysical Surveys

10.6.5 None reviewed or undertaken.

Previous Assessment / Ground Investigation

Introduction

10.6.6 This section provides a summary of factual ground investigation data and interpretive reports received from OGCI Climate Investments LLP as part of the desk study data collection process. A list of the reports provided which have been reviewed as part of this study are listed in Table 10A-1. Most of the data relates to parts of the SSI Redcar Steelworks (which form the PCC Site in this study) together with the northern end of the CO_2 Gathering Network and Natural Gas Connection Corridors.

10.6.7 Details of the ground investigations undertaken at both sites and the interpretation drawn from the data are discussed in below.

Factual Reports

CH2M Hill 2017 Trial Pit investigations – SDSC Land Holdings SSI1 and SSI2A

10.6.8 Allied Exploration & Geotechnics Ltd (AEG) carried out two ground investigations across the PCC Site and adjacent areas both of which were reported in November 2017. Both investigations were specified by CH2M Hill (now part of Jacobs plc). The first investigation was carried out between November 2016 and April 2017, across a landholding named SSI 1 by South Tees Site Company (STSC). The purpose of the investigation was to determine ground conditions present across this part of the former SSI Redcar Works.

10.6.9 The SSI 1 ground investigation was carried out between November 2016 and April 2017 across individual areas designated as Areas A, B, C, H, and I. These areas lie within land designated as PCC Site and a small area of site works falls within the northern portion of the CO_2 Gathering Network and Natural Gas Connection Corridors and Electrical Connections Corridor in this study. The site works comprised excavation 292 machine dug trial pits, all of which were undertaken within the Site areas or within 500 m of the Site boundary. The trial pits were excavated to depths of 0.1 to 6.0m bgl.

10.6.10 A programme of geotechnical laboratory testing was undertaken on recovered soil samples and included dry density / moisture content tests, determination of resistance to fragmentation (Los Angeles test), consolidated drained large shear box tests and consolidated drained shear box tests.

10.6.11 A programme of geo-environmental testing was also undertaken using an external testing house, Derwentside Environmental Testing Services Limited. Dissolved concentrations of metals, inorganic compounds (pH, total, complex and free cyanide, monohydric phenol, thiocyanate, chloride, sulphate and pH), aliphatic and aromatic hydrocarbons, total petroleum hydrocarbons (TPH), benzene, toluene, ethylbenzene and xylene (BTEX), PCBs, US 16 EPA polycyclic aromatic hydrocarbons (PAH), Volatile Organic

Compounds (VOCs), Semi-volatile Organic Compounds (SVOCs), asbestos identification and quantification were measured. A limited number of leachate tests were undertaken using the NRA leachate preparation method and the 10:1 liquid / solid methodology. Concentrations of dissolved metals, inorganics, petroleum hydrocarbons including TPH and PAHs were also determined.

10.6.12 The other investigation (identified as SSI 2) was undertaken between May and July 2017, across an area of the site designated as Area A. The works were also undertaken across land which formed part of the former SSI Redcar Works. The majority of the ground investigation was carried out across the PCC Site but the western part of the site works was undertaken on land that is outside of the Site boundary. The works comprised 68 machine dug trial pits, which were excavated to depths of 1.05 to 5.8m bgl. Fifty-four of these trial pits are located within the Site boundary.

10.6.13 No geotechnical laboratory testing was undertaken during this phase of ground investigation. A programme of geo-environmental laboratory testing was however undertaken using external testing house Derwentside Environmental Testing Services Limited. Dissolved concentrations of metals, inorganic compounds (pH, total, complex and free cyanide, monohydric phenol, thiocyanate, chloride, sulphate and pH), aliphatic and aromatic hydrocarbons, TPH, BTEX, PCBs, US 16 EPA PAH, VOCs, SVOCs, asbestos identification and quantification were measured. A limited number of leachate tests were undertaken using the NRA leachate preparation method and the 10:1 liquid / solid methodology. Concentrations of dissolved metals, inorganics, petroleum hydrocarbons including TPH and PAHs were also determined.

10.6.14 Allied Exploration & Geotechnics Ltd have carried out two ground investigations across the former Steelworks site (including the PCC Site) and adjacent areas which reported in February and June 2018. The first investigation was specified by CH2M Hill (now part of Jacobs plc) with the second by Arcadis. The most relevant investigation was carried out in June 2018 which investigated ground conditions across land holdings Contract 1 (SSI1) and Contract 2 (Area A) (SSI2A).

10.6.15 The June 2018 investigation comprised:

- 31 cable percussion boreholes, 7 of which were continued by rotary drilling using open hole or coring techniques;
- 15 machine dug trial pits;
- In-situ testing comprising Standard Penetration Tests (SPTs), Hand Shear Vale Tests, Photo-Ionisation Detector and Variable (Falling) Head Permeability tests;
- Unexploded ordnance (UXO) survey;
- Installation of gas / groundwater monitoring instrumentation;
- Site works and post site works gas / groundwater monitoring; and
- Post site works continuous water monitoring from installations (to detect possible changes in groundwater level due to tidal variations).

10.6.16 The site works were carried out in October and November 2017 across an area designated as the PCC Site in this study. 31 cable percussion boreholes were sunk to depths of 0.50 to 27.40 m bgl. Seven of the boreholes to depths between 39.80 and 41.00 m bgl. The trial pits were excavated to depths of 1.8 to 4.5 m bgl. A specialist subcontractor was present during the site works to conduct unexploded ordnance (UXO) survey during the GI site works. One anomaly was encountered in a borehole at 11.0m depth, which was subsequently terminated.

10.6.17 Monitoring instrumentation was installed in 26 of the 31 boreholes. The instruments were monitored for gas and / or groundwater during and after the site works. All installations were commissioned after site works by removing up to 10 x well volumes to prove correct functionality. Six of the 26 borehole installations included Mini-Diver instruments to provide continuous groundwater monitoring to determine if water levels were tidally influenced. The readings indicate that the water levels recorded in these instruments did not fluctuate with tidal changes although 2 of the 6 instruments remained dry during monitoring.

10.6.18 A programme of geotechnical laboratory testing was undertaken on soil and included classification tests, particle size distributions, shear strength by direct shear, unconsolidated undrained triaxial compression tests without pore water pressure measurement, dry density / moisture content tests and resistivity, redox potential, organic content, total sulphur, sulphate and pH determinations. Point load index and unconfined compressive testing was carried out selected rock core specimens.

10.6.19 A programme of geo-environmental testing was also undertaken using an external testing house. Dissolved concentrations of metals, inorganic compounds (pH, total, complex and free cyanide, monohydric phenol, thiocyanate, chloride, sulphate and pH), aliphatic and aromatic hydrocarbons, TPH, BTEX, PCBs, US 16 EPA PAH, VOCs and SVOCs were measured on recovered groundwater samples. Soil contamination testing comprised total metals, inorganic compounds, petroleum hydrocarbons including TPH, PAHs, PCBs, asbestos identification and quantification. A limited number of leachate tests were undertaken using the NRA leachate preparation method and the 10:1 liquid/solid methodology. Concentrations of dissolved metals, inorganics, petroleum hydrocarbons including TPH and PAHs were measured. X-ray fluorescence (XRF) analysis was undertaken on selected samples of slag-dominant material to determine the presence and percentage of various metals and other compounds including molybdenum, arsenic, antimony, copper, sulphur, chromium, vanadium, magnesium, manganese, aluminium and iron. In addition, petrographic analysis of slag was also undertaken by an external testing house.

10.6.20 The other investigation (February 2018) undertaken by AEG across an area of the site designated as Areas C & D. The works were undertaken across an area of open grassland, the eastern edge of which just encroaches across part of an area designated as the CO_2 Gathering Network and Gas Connection Corridors / Electrical Connection Corridor in this study. The works comprised:

- seven cable percussion boreholes, one of which was extended by rotary coring techniques;
- in-situ testing Standard Penetration Tests (SPTs) and Variable Head Permeability testing;
- associated sampling;
- installation of combined gas / groundwater monitoring instrumentation; and
- Post site works gas / groundwater monitoring.

10.6.21 Seven cable percussion boreholes were sunk to depths of 15.5 to 23.5m bgl. One of the seven boreholes was further advanced by rotary coring to a depth of 40.3m bgl. Six of the seven boreholes were drilled previously excavated and backfilled trial pits. A specialist subcontractor was present during drilling to conduct unexploded ordnance (UXO) survey close to the boreholes.

10.6.22 Combined gas / groundwater monitoring instrumentation (slotted standpipes) were installed in all seven boreholes. Instruments were monitored for gas and groundwater on four visits after completion of the GI site works. Groundwater samples were retrieved from six of the seven boreholes on three occasions after purging. The recovered samples were sent to an external testing house for geo-environmental laboratory analysis.

Interpretive Reports

Arcadis 2018 Site Condition Report, Geotechnical Risk Assessment Report & Ground Remediation Options Appraisal Report – SDSC Land Holdings SSI1 & SSI2A

10.6.23 Three reports prepared by ARCADIS in 2018 for South Tees Site Company Limited (STSC) which focus on geotechnical and geo-environmental conditions, issues and risks present across parts of the PCC Site. The reports comprise of Site Condition Report (SCR), Geotechnical Risk Assessment Report (GRAR) and Ground Remediation Appraisal Report (GRAR). The works were focussed on two areas identified as SSI1 (Contract 1) and SSI2 Area A (Contract 2A). SSI1 is a 116 hectares (ha) rectangular area in the north west of the former SSI Redcar Steelworks. SSI2A is located to the north of SSI1, is also rectangular in shape and comprises 84ha.

10.6.24 The SSI1 area is divided by roads, steelwork structures including the Teesside Management Office, Sinter Plant, D Jones Construction and Haulage Limited and Redcar Bulk Terminal (RBT). Railway lines cross the site, aligned broadly east to west and then connect the offsite RBT to the regional rail network. It was also reported that tunnels associated with the former Pellet Plant may be present. Former coal, ore and sinter stocks were apparently located in the south, centre and west of the SSI1 site. Disused conveyor belts were still present in 2018 together with old material stockpiles which formed an east to west aligned mound present across the central stockpiling area. SSI2A comprises of two areas of land. One area of land is across the former Redcar Coke Ovens (RCO) which covers approximately 12.3ha and includes the old coke stocking area and a liquid nitrogen and fuel oil storage plant. The second area of land formerly known as RDL Stores is approximately 29.1ha in area and includes the ponding / disposal area and Redcar stores.

10.6.25 These areas straddle the PCC Site and northern end of the CO_2 Gathering Network and Natural Gas Connection Corridors. A brief overview of the purpose and findings from each report is given below.

Arcadis (August 2008) - Contract 1 and 2A: The former SSI Redcar Steelworks: Priority Areas within SSI Landholdings Contract 1 and 2A Site Condition Report

10.6.26 The SCR provides a review of historic documentation and a review of advanced ground investigation (GI) undertaken in two areas of the former SSI Steelworks site and uses this to develop a Conceptual Site Model (CSM) for this part of the Redcar Steelworks site. The advanced GI were designed by CH2M Hill (now part of Jacobs Ltd) and were undertaken by AEG. The works comprised:

- site service and utilities clearance at exploratory hole locations;
- 15 trial pits excavated to target depth of 4.5m or refusal;
- 26 boreholes to target depth of 15 to 20m or refusal on bedrock;
- unexploded Ordnance (UXO) clearance using down-hole magnetometer at each borehole in the natural deposits;
- soil sampling;
- a programme of geotechnical and geo-environmental laboratory testing;
- installation of 26 groundwater monitoring wells with subsequent purge development;
- ground gas monitoring in installed monitoring wells;
- groundwater sampling of installed monitoring wells;
- review of data obtained from CH2M Hill advanced works for SSI1 and SSI2A;
- geospatial elevation survey at exploratory hole locations; and
- groundwater elevation survey of all installed monitored wells.

Summary results of the SCR included:

– Made Ground was encountered across both the SSI1 and SSI2A sites which included sand and gravel with variable quantities of slag, concrete, brick and other materials. The recovered slag varied between gravel and boulder size and was locally fused. The base depth of the Made Ground was proven in most of the exploratory holes;
– Most of the Made Ground comprised slag dominant or granular Made Ground although cohesive Made Ground, potential hydraulic fill and waste rich deposits were also proven;

- Buried foundations and underground structures were found which were reported likely to impact future site redevelopment;
- Asbestos fibres were encountered in approximately 10% of Made Ground in both SSI1 and SSI2. Asbestos was most frequently encountered around the former Pellet Plant in SSI1;
- Geo-environmental testing confirmed the Made Ground to be highly alkaline with pH in the range 10 to 12.5. The pH of leachate from the Made Ground was reported strongly alkaline to neutral as was the groundwater;
- Elevated sulphate levels were present in the Made Ground, bedrock and groundwater;
- Leaching of sulphate from gypsum in the Mercia Mudstone was considered to present a potential dissolution hazard to piled foundations;
- Statistical analysis of the geo-environmental laboratory testing indicated that the highest concentrations of metal were recorded in slag dominant Made Ground, and the highest concentrations of PAH in granular Made Ground. Concentrations in natural deposits were reported to be generally an order of magnitude lower;
- The investigation identified point sources of petroleum hydrocarbon associated with the Made Ground;
- Leachability testing identified that metals readily leached from the (crushed samples of) Made Ground. TPH and PAH were also detected in the groundwater; and
- Laboratory testing to investigate the petrology, chemical composition and potential volumetric instability of the slag indicated the majority of the Slag deposits to comprise mixed blast furnace (and refractory slag) and basic steel slag, with the latter mostly comprising the minor fraction. The tests indicated that approximately half the slag samples tested showed signs of past expansion with the potential for further expansion in the future. The basic steel slags (and refractory slag) were reported to have the highest expansion potential.

Arcadis (November 2008) - Contract 1 and 2A: The former SSI Redcar Steelworks: Priority Areas within SSI Landholdings Contract 1 and 2A Geotechnical Risk Assessment Report

Introduction

10.6.27 This report is a Geotechnical Risk Assessment Report (GRAR) which identifies risks by a review of the advanced ground investigation (GI) works undertaken on parts of development area SSI1 and the entire area of SSI2. Arcadis described the scope for risk assessment as comprising a review of the ground conditions and development constraints identified in the SCR and a discussion of potential mitigation measures.

Ground conditions

10.6.28 The report outlined a Preliminary Conceptual Site Model (PCSM) for the areas investigated. Made Ground had been proven to considerable depth across both development areas up to 6 m depth below SSI1 increasing to depths greater than 9 m below parts of SSI2A. In both areas the Made Ground was predominantly found to comprise slag of gravel to boulder size. Other Made Ground present included refractory bricks, demolition wastes and Cohesive Made Ground. The state of compaction of the Made Ground was reported to be variables and petrographic analysis of selected samples identified a mix of both basic iron and steel slag within the Made Ground.

10.6.29 Locally the Made Ground comprised loose reworked natural sand which Arcadis suggested had been placed by hydraulic means. The report indicated that the findings of the advanced GI were consistent with earlier desk studies prepared for SSI1 and SSI2 by CH2M Hill in August 2017 that the site was established on a former salt marsh reclaimed by a combination of end tipping and placement of hydraulic fill.

10.6.30 The principal types of Made Ground found were:

- Slag-dominant material; and
- Granular Made Ground.

10.6.31 Other types of Made Ground included:

- Cohesive Made Ground;
- Hydraulic Fill Material;
- Sinter;
- Lime; and
- Waste.

10.6.32 Obstructions were encountered in the Made Ground including a disused tunnel within the Redcar Stores area (part of the SSI2A site). The tunnel was of masonry construction with the crown present at approximately 0.5 m bgl. The tunnel was observed to have partially collapsed and due to health and safety concerns about its integrity, no further investigation was undertaken near the structure. Other obstructions included relict floor slabs and walls, boulders comprised of floor slab and layers of fused slag. Around half of the trial pits terminated in Made Ground due to groundwater inflows, side wall collapses or the presence of obstructions.

10.6.33 Superficial soils, primarily identified from boreholes, comprised:

- Blown Sand;
- Tidal Flat Deposits;
- Glacial Till; and
- Glaciolacustrine Deposits.

10.6.34 Blown sand was present in one borehole located in the Redcar Stores area of SSI2A (within the PCC Site) and extended to 10 m bgl.

10.6.35 The extent of the Tidal Flat Deposits was not described but they are shown to underlie the entire site. These soils were predominantly found to be medium dense silty sands with occasional gravel horizons and beds of soft clay or silt. Arcadis stated that the thickness of these deposits appeared to be closely linked to the depth of bedrock, proven up to 18 m bgl.

10.6.36 Glacial Till comprised firm becoming stiff and very stiff slightly sandy slightly gravelly clay. The gravel subfraction was comprised of mixed lithologies including limestone, sandstone and rare coal. Till was proved to a maximum depth of 27 m.

10.6.37 Glaciolacustrine deposits were also proved locally below the site. These soils comprised brown laminated clay interlaminated with silt partings were locally noted to be organic. Arcadis reported that the occurrence of the lacustrine soils was consistent with historic investigations which encountered generally thin laminated clays at depth. The laminated clays were proved to a maximum depth of 27 m.

10.6.38 A magnetic anomaly was encountered whilst progressing one borehole through the Tidal Flat Deposits at 11m bgl; the cause of the anomaly in the slightly silty sandy soils was unclear.

10.6.39 Bedrock was encountered at elevations of -19.47 to -2.48 m OD. The bedrock was found to comprise:

- Redcar Mudstone Formation;
- Penarth Group; and
- Mercia Mudstone Group.

10.6.40 Arcadis reported that the extent of the Redcar Mudstone below the site was similar to that indicated on published geological mapping. The mudstone was proven below the SSI2A (Redcar Stores area) and most of SSI1 and is therefore expected to underlie most of the PCC Site and the northern end of the CO_2 Gathering Network and Gas Connection Corridors. The material was recovered as an extremely weak to weak mudstone which was locally noted to be fossiliferous. Some horizons were found to be heavily fractured, or, recovered as non-intact rock.

10.6.41 Rocks of the Penarth Group were found in one borehole only, recovered as interbedded weak mudstones and siltstones.

10.6.42 Mercia Mudstone was present below the west of the site in the vicinity of the Water Connection Corridors and northern part of the Onshore CO_2 Export Pipeline. The mudstone comprised distinctly weathered extremely weak or weak red brown mudstone. Locally, significant gypsum veins were present, but no evidence of solution features was found.

10.6.43 From interpretation of historic and advanced GI data, Arcadis concluded that several rockhead valleys cross the site which were subsequently infilled with Glacial Till and subsequently Tidal Flat Deposits. Glacial Till was reportedly absent in areas of locally elevated bedrock (i.e. pre-glacial hills or ridges). The bedrock was reported to dip to the south east (i.e. following the regional dip).

10.6.44 Analysis of groundwater levels indicated that groundwater generally flows to the north east. Groundwater was recorded at elevations of 1.8 to 5.4 m OD. Arcadis reported that groundwater entered approximately half of the trial pits excavated across these parts of the SSI1 and the full SSI2A sites.

Geotechnical constraints

10.6.45 Arcadis identified the following geotechnical constraints from their geo-environmental Conceptual Site Model (CSM) presented in the SCR:

- Bearing capacity of Made Ground is predicted to be inadequate to support structures;
- Total and differential settlement / heave is expected to exceed tolerable limits;
- There is a risk of potential collapse compression occurring due to surface water infiltration and groundwater flow;
- Sulphate attack of concrete;
- Potential for UXO to be present within the Tidal Flat deposits; and
- Obstructions and buried underground structures are likely to be present in the Made Ground associated with the Slag-dominant material and past unexcavated structures that were present.

10.6.46 These and other potential geotechnical constraints identified from review of the advanced GI were then discussed in relation to the extensive cover of Made Ground present below the SSI1 and SSI2A site (the PCC Site and Water Connections Corridor).

10.6.47 The investigations proved that the Made Ground may be at risk of future ground movements caused by:

- Self-weight of the Made Ground;
- Future loading from new structural loading or raising of ground by placement of earthworks fill material;
- Changes in groundwater level or moisture content;
- Decomposition of biodegradable Made Ground; and
- Future chemical reactions.

10.6.48 Arcadis considered that the risk of further settlement due to fill self-weight is negligible because the material was largely granular in nature and has been in place for a number of decades (over 40 years at the time of writing).

10.6.49 Arcadis did not determine the definitive risk of settlement from future loading but noted that the need to form level development platforms across the site and the construction of new structures was expected to lead to additional load being imposed on the Made Ground. Therefore, settlement was expected to result from the increased loadings.

10.6.50 Arcadis stated that most of the Made Ground comprised slag dominant-material that was often difficult to excavate and penetrate. These observations from the advanced GI are consistent with the presence of well-compacted material but desk studies prepared by others (CH2M Hill) suggest that parts of the SSI Redcar Steelworks site were formed by a combination of end tipping material and the placement of hydraulic fill. In SSI1, Arcadis reported evidence that hydraulic fill material was present below the slag dominant Made Ground which was very loose to loose. In SSI2A (Coke Ovens area) there was evidence of settlement which had occurred from inundation where fine fill (i.e. dredged sand) was suspected to have moved laterally into adjacent coarser material (e.g. slag).

10.6.51 Arcadis noted the GI data did not indicate the Made Ground was highly biodegradable and as such the risk of ground movement occurring from decomposition was considered to be low. However, it is known that types of slag are prone to chemical reactions that led to volume change (generally heave). Ferrous slag is known to have the potential to lead to:

- Differential expansion of different types of slag, which can cause damage to structures and roads many years after being placed;
- Presence of other chemically active materials (i.e. those which include sulphates) resulting in expansive reactions when mixed with blast furnace or steel slag; and
- Presence of sulphates and sulphides within blast furnace and steel slag that could potentially attack buried concrete.

10.6.52 Arcadis reported that settlement can be reduced in material that was excavated, then blended and replaced in compacted layers. However, the BRE BR481 reported cases where differential movement of ~60mm in four years (with a maximum heave of ~100 mm) at a reclaimed steel works site.

10.6.53 Arcadis reported that the CH2M Hill desk studies for the two sites indicated that a large quantity of ferrous slag (including blast furnace slag, steel slag as well as basic refractory material) had been produced at the site and was used to raise ground levels and reclaim land from the sea. Historical photographs show slag was placed next to railway lines into areas that were located beyond the foreshore. The material is likely to have been placed in an uncontrolled manner and although mostly comprised refractory slag may also contain minor fractions of Basic Oxygen Steel (BOS) slag and refractory material.

10.6.54 During their site walkover, Arcadis observed damage to buildings and structures in the vicinity of the Sinter Plant was noted, comprising:

- Cracking of brickwork
- Movement of brickwork within walls; and
- Uneven pavements.

10.6.55 It was suspected that damage was caused by ground heave, most likely from the expansion of slag although damage from ettringite or thaumasite formation within concrete footings and ground bearing floor slabs due to capillary action of sulphate rich groundwater originating from slag wastes was also identified as a possible cause of the structural damage observed.

10.6.56 Arcadis reported that the petrological testing undertaken as part of the advanced GI works, indicate that most of the slag deposits at the site are dominated by blast furnace slags but with a minor fraction of steel slag which undergo expansion in the future. Arcadis recommended that further testing is required to understand the likely magnitude of the expansion. It was also observed that it will not be possible to identify discrete zones of different types of slag material due to the depth of the material and the way it was placed.

Possible Mitigation Measures

10.6.57 Arcadis suggested that the main mitigation methods that could be used to mitigate the risks presented by expansive ferrous slags include:

- Adjustment of Proposed Development layout and levels to ensure that vulnerable buildings, structures and infrastructure are located on areas not underlain by expansive slag;
- Removal of potentially expansive slag below footprints of proposed buildings, structures and infrastructure and replaced with stable fill if required, or
- Undertake geotechnical processes to improve the engineering properties of the material.

10.6.58 Arcadis considered because the anticipated random pockets of expansive BOS and refractory slags present below the SSI Steelworks site (the PCC Site and northern end of the CO_2 Gathering Network and Natural Gas Connection Corridors) the only economically viable approach would be to improve the ground.

10.6.59 The feasibility of undertaking an on-site programme of excavation and treatment was discussed by Arcadis who also suggested it would solve other geotechnical issues such as removal of obstructions within the Made Ground, removal of areas of poorly compacted material that could be prone to future settlement and it would confirm the presence / absence of UXO at future pile positions.

10.6.60 Arcadis emphasised the need for a robust screening methodology to ensure that potentially expansive materials are effectively identified and segregated for treatment.

10.6.61 Appropriate methods which could be used to support building foundations was discussed. The advantages and disadvantages of the installation of driven and continuous flight auger (CFA) piles were discussed. Arcadis suggested that given the vertical and lateral variability of the superficial deposits it would be prudent to transfer pile loads into bedrock below the site but was recognised for the most lightly loaded structures that this may not be necessary. It was recognised that pile construction would be complicated by the presence of obstructions including boulders of slag within the Made Ground and the potential for UXO following discovery of an anomaly in one borehole drilled as part of the advanced GI works. It was also noted that piles will need to be identified to accommodate axial and transverse expansion forces caused by potential future volume change in the slag, this could be accommodated by sleeving the piles through the Made Ground.

10.6.62 An overview of possible ground improvement techniques which could be used on site was also given, although Arcadis considered that vibrocompaction or vibro-replacement techniques are unlikely to be suitable due to the nature of the Made Ground and presence of boulders. Other techniques, such as dynamic compaction and high energy impact compaction, were considered suitable to solve some of the settlement issues but would not address problems from boulders and the presence of expansive slag.

10.6.63 Arcadis concluded that a programme of bulk earthworks would be best placed to solve the identified geotechnical problems but recognised that the effectiveness of such works will be impeded by the presence of slag below the water table. It was suggested that further assessment will be required to determine whether the slag below the water table has reached its full expansive potential. In the GRAR Arcadis recognised that a number of different earthworks solutions are likely to be undertaken on site. Potential solutions include:

- Local excavation of slag below the water table to remove obstructions; this may be required below proposed buildings;
- Probing at future pile locations to clear positions of obstructions and potential UXO prior to subsequent piling. Arcadis suggested that this approach could potentially disturb the potential of the Made Ground and therefore some ground improvement may be required prior to backfilling; and
- Preloading to reduce settlement in slag below the groundwater table in areas where poor ground conditions are present and future loading could result in unacceptable settlement.

10.6.64 The GRAR also discussed summarised environmental risks that might arise from site redevelopment focussing on the environmental state of the slag, the presence of asbestos fibres which could become sterilised by the placement of clean capping. Arcadis also provided an outline of waste regulatory options which could be adopted to ensure that materials moved around the site are not classified as waste on completion of the works. Available regulatory options include:

- Waste exemption;
- Standard Rules Environmental Permit;
- Bespoke Environmental Permit;
- WRAP Aggregates Quality Protocol; and
- Application in accordance with CL:AIRE guidance ‘Definition of Waste: Development Industry Code of Practice’.

10.6.65 Arcadis also outlined that to demonstrate the four factors that have been fulfilled will require preparation of various reports including:

- Site Condition Report;
- Quantitative Risk Assessment;
- Remediation Strategy or Design Statement;
- Materials Management Plan; and

- Verification Report (on completion of works).

10.6.66 Discussion was also provided how the risk of UXO could be addressed during future site reclamation. Options included:

- Record anomaly in health and safety file – only viable if structures are to be constructed above the depth at which the anomaly was encountered (~11 m bgl); and
- If interaction is possible, then undertake a series of closely spaced magnetometer cone penetration tests (CPT) probe holes around the anomaly in an attempt to define the feature. A pile offset distance could then be defined.

10.6.67 Given the depth of Made Ground present below the site and the potential for expansion of the slag to occur, Arcadis recommended that fully suspended floor slabs be adopted within sufficient clearance provided to allow for future heave in the underlying slag-dominant material.

10.6.68 Summary results of gas monitoring were provided. Low levels of methane (typically <0.1% v/v, max. 0.6% v/v) and carbon dioxide (typically <0.1%, max. 0.2%) were measured and gas flow rates were negligible. Arcadis classified the site as CIRIA Characteristic Situation 1 and depending on building size, gas protection measures may not be required. However, Arcadis indicate that once development proposals are finalised, confirmatory additional monitoring should be carried out across individual development plots.

10.6.69 Groundwater was recorded in monitoring wells at depths typically between 2 and 5 m bgl. A limited programme of monitoring was carried to determine if water levels are influenced by tidal fluctuations, but this was not by Arcadis in this report. However, inspection of the continuous readings presented in AEG GI Factual Report for SSI1 and SSI2A (Contract 4153 and 4154) indicated little change with time although it was noted that 2 of the 6 instruments were dry during the tidal monitoring.

10.6.70 Arcadis noted that services are likely to be affected by differential movement. It was recommended that the design of services such as drains should accommodate potential heave or settlement and allowance should be made to install flexible connections for water and gas lines to accommodate ground movement.

10.6.71 A review of ground aggressivity testing carried out in the advanced GI works was undertaken by Arcadis. Elevated concentrations of sulphates and sulphides present within the Made Ground were sufficient to place the site into Design Sulphate Class DS-5 and the corresponding ACEC Class taking into account the alkaline pH conditions and groundwater mobility. As a result, precautionary measures will be needed to protect buried concrete against sulphate attack. Arcadis indicated that as well as sulphate resistant cement, Additional Protective Measures (APMs) such as the provision of surface protection, sacrificial layers and / or enhanced concrete quality. However, Arcadis also reported that the resistance provided will also depend upon other design factors such as the intended working life.

10.6.72 Arcadis did not provide details of chloride conditions measured across the site. Elevated chloride concentrations measured in samples recovered from groundwater monitoring installations could be indicative of brackish or saline groundwater present below the site. Inspection of data presented in the AEG Factual Report indicated chloride concentrations ranged from 520 to 8800 mg/l. For comparison, internet searches suggest brackish groundwater typically contains chloride concentrations of between 500 and 5000 mg/l, suggesting the presence of brackish groundwater across parts of the areas investigated.

Arcadis (December 2008) - Contract 1 and 2A: The former SSI Redcar Steelworks: Priority Areas within SSI Landholdings Contract 1 and 2A Ground Remediation Options Appraisal Report

Introduction

10.6.73 This report is remediation options appraisal to address environmental and geotechnical development constraints relating to ground conditions identified by the advanced ground investigation (GI) works undertaken on parts of development area SSI1 and the entire area of SSI2.

10.6.74 The purpose of this report was to review two other reports, the environmental risk assessment report (not seen by AECOM) and geotechnical risk assessment report (GRAR) and identify applicable remediation options for the site (which covers the PCC Site and northern end of the CO_2 Gathering Network and Natural Gas Connection Corridors).

10.6.75 The remediation options appraisal undertaken using available information to assess feasible remediation strategies which could be adopted to address active source-pathway-receptor linkages identified by the Site Condition Report and development constraints identified by the GRAR within the conceptual site model (CSM) for the contract areas in order to develop a preferred remediation technology selection and design.

10.6.76 As no detailed development proposals were available, Arcadis assumed that any redevelopment of the site will be for a generic commercial / industrial end use. Remediation technologies have been based on Arcadis' professional judgement and experience of large-scale redevelopment of brownfield sites.

Development Constraints

10.6.77 In their other three reports, SCR, the Environmental risk assessment report and Geotechnical risk assessment report, Arcadis identified development constraints which were summarised in the remediation options appraisal and divided into Environmental, Ground Gas and Geotechnical categories.

10.6.78 Environmental development constraints were identified in the SCR via potentially active source-pathway-receptor (SPR) linkages:

- Human Health – risk to commercial workers via inhalation of asbestos fibres, originating from the shallow Made Ground across the site;
- Risk to groundwater resource receptors – through the leaching of contaminants of concern including metals, and PAHs to groundwater were identified in the Environmental risk assessment report. A potential

pollutant linkage into the solid bedrock aquifers was considered to be potentially active; and

- Risk to surface water resource receptors – these may be potentially impacted by contamination in shallow groundwater.

10.6.79 Arcadis stated that the environmental risk assessment report recommended that a wider Controlled Waters Assessment be conducted for the wider former Redcar Steelworks site (including the PCC Site) due to the possibility of upgradient sources causing regional impacts to groundwaters and surface waters and that a remediation options appraisal addressing risks to groundwater would be completed as part of this process. As this had not been completed at the time of writing, consideration of Controlled Waters was excluded from the remediation options appraisal as the precise requirement for remediation cannot be defined.

10.6.80 It is not known if the Controlled Waters assessment has been carried out.

10.6.81 The Arcadis Environmental risk assessment report (not seen) did not identify an unacceptable risk to human health or built receptors from the accumulation of ground gas. However, the SCR investigation was not designed for a particular redevelopment scenario and may therefore not be representative of site wide conditions for a particular redevelopment. Additional ground gas monitoring at greater density was recommended prior to redevelopment to determine the risk from ground gases on the site.

10.6.82 Geotechnical development constraints at the site identified by Arcadis included:

- Expansive slag deposits which could lead to damage to structures and hardstanding;
- The Made Ground and underlying Tidal Flat Deposits are of insufficient strength to support proposed structures using shallow foundations;
- Variable ground conditions;
- Anticipated total and differential settlement / heave may exceed tolerable limits due to changes in loading or groundwater caused by site redevelopment;
- Potential collapse or inundation settlement as a result of surface water infiltration and groundwater flow;
- Sulphate attack on buried concrete;
- Presence of shallow groundwater below parts of the site;
- Mitigation of any identified ground gas risk (subject to confirmation due to additional monitoring);
- Obstructions within the Made Ground including slag boulders, buried underground structures and tunnels; and
- Potential for unexploded ordnance (UXO) within the Tidal Flat Deposits.

<u>Remediation Selection Criteria</u>

10.6.83 Arcadis reported that their selection procedure broadly follows the design making process outlined by Construction Industry Research and Industry Associates (CIRIA) and incorporates issues raised by the Environment Agency (EA) for the selection of remediation strategies. The objectives were split into:

- Contamination related objectives; and
- Engineering objectives.

10.6.84 Site specific constraints on the remediation strategy were also considered.

10.6.85 Arcadis prioritised objectives in order to reconcile any potential conflicts and the ranking objective was then used to identify and evaluate potential options. The remediation design strategy involved the following stages:

- Stage 1: Review of available technologies and a preliminary assessment of their suitability;
- Stage 2: Identification of appropriate technologies; and
- Stage 3: Evaluation of appropriate technologies.

10.6.86 Following the identification and evaluation of the appropriate technologies, Arcadis applied professional judgement to the final design of the remediation strategy. This involved incorporation of design decisions as well as overarching principles such as practicability, effectiveness, durability and efficiency in order to determine the most appropriate strategy for tackling the pollution linkage / geotechnical constraints identified.

Remediation Ranking Discussion

10.6.87 Based on the results of the ranking, each technology was given a final technological, operational and commercial score by Arcadis and, therefore, an overall ranking. The results of the ranking process were used to develop likely remediation strategies for the site.

10.6.88 The top selected technologies for soil and groundwater were:

- Asbestos:
  - Excavation and disposal; and
  - Capping, in-situ
- Expansive Slag and Aggressive Ground:
  - Engineering controls;
  - Excavation and disposal; and
  - Excavation, separation, treatment and reuse.

Excavation and Disposal

10.6.89 Arcadis reported that excavation and disposal would involve removal of contaminant material from site and disposal at an appropriately licenced waste management / treatment facility. Imported material will then brought to site to backfill the excavation. A number of issues were raised including that this option would not prevent potential from expansive slag and aggressive ground causing damage to existing structures that are to be retained and excavation in saturated Made Ground would require temporary dewatering control. Arcadis therefore concluded that although technically feasible, this option was not considered practical from an operational and commercial standpoint.

10.6.90 Excavation was considered suitable for the remediation of isolated areas of unexpected contamination identified during the redevelopment.

Excavation, Separation, Treatment and Reuse

10.6.91 Arcadis envisaged that this option would be similar to excavation and treatment except that rather than disposal off-site, material will be crushed, screened and treated before re-use. It was envisaged that screening would involve separation of the slag-dominant material from other Made Ground. It was then proposed that laboratory and on-site testing would then be used to separate the higher risk steel slag from the blast furnace slag. It was suggested that high risk steel slag should be placed in low risk areas of the development away from proposed structures. Arcadis also recognised that the scope of excavations to address expansive slag would be determined by the proposed redevelopment layout. Like the Excavation and Treatment option, this option would also require temporary groundwater dewatering especially across SSI1. As a result, it was concluded this option that although technically feasible, would not be practical from an operational and commercial standpoint. As above, it may be possible to use this option in the remediation of isolated areas of unexpected contamination identified during the redevelopment.

Capping In-situ (Asbestos only)

10.6.92 Arcadis described capping in situ as a process to provide a barrier between contaminated material and the receptor to break the pathway. The cap design would be dependent on the redevelopment scenario but was envisaged to include a geotextile liner overlain by clean imported material. Encapsulating material below new infrastructure constructed as part of the redevelopment could also be considered an appropriate capping method. Advantages and disadvantages associated with this approach were identified as follows:

- Advantages:
  - Capping will encapsulate all asbestos in unsaturated materials;
  - Minimise exposure to construction workers during remediation as the material is left in-situ; and
  - It will be a sustainable remediation approach.
- Disadvantages:
  - Contaminated material remains on site and therefore liability is retained;
  - The cap may need to be replaced in future;
  - Future ground works will need to be planned to avoid breaching the cap; and

– A cap would be based on specific redevelopment proposal; additional works may be required if additional redevelopment occurs following the initial redevelopment.

10.7 Photographic Surveys

10.7.1 A site reconnaissance (walkover) was undertaken at the Teesworks Site (Redcar Steelworks) on the 18th and 19th March 2020 by representatives of BP and AECOM who were accompanied by a representative of the STDC. Photographs taken as part of this site walkover are included in Annex F.

10.8 Site Description

10.8.1 The location of the Site is shown as Figure 3-1 (ES Volume II, Document Ref. 6.3). The Proposed Development is separated into a number of different elements and areas as described above and shown on Figures 3-2B to 3-2E (ES Volume II, Document Ref. 6.3). For the purposes of this report these are identified as Areas 1 to 5 as summarised below:

1. The Power, Capture and Compressor site (PCC Site);
2. CO_2 Export Pipeline;
3. Water Connection Corridors;
4. CO_2 Gathering Network and Natural Gas Connection Corridors - Due to overlap between these corridors these are considered as a single area for the purpose of this PSSR; and
5. Electrical Connection Corridor.

Topography

10.8.2 Topographical levels obtained from current OS mapping and OS Terrain 50 data (for areas where no OS map contour lines are present) for each area described above is summarised in Table 10A-2 below. A topographical survey has not been carried out in conjunction with the PSSR.

Table 10A-2: Topographical Levels

No	Site	Description	Level	
			Min. (m OD)	Max. (m OD)
1	PCC Site	Ground levels at the PCC Site generally slope from the south of the area to the north, towards the North Sea coastline. The centre of the PCC Site is slightly undulated with minor changes in ground levels.	4	8.2
2	Onshore CO_2 Export Pipeline	Ground levels fall towards the North Sea coastline. OS maps show dunes varying in ground level from 5 to 10m OD. Coatham Sands is anticipated to be close to sea level.	0	10
3	Water Supply and	The Supply Connection is within and adjacent to the PCC Site, while the	0	7.5

No	Site	Description	Level	
			Min. (m OD)	Max. (m OD)
	Discharge Corridors	Discharge Connection slopes towards the North Sea.		
4	CO_2 Gathering Network and Natural Gas Connection Corridors	Ground levels of the western corridor slope to the east from Billingham to the Seal Sands Industrial Estate.	5	9
		The Seal Sands Industrial Estate is shown as generally level across the estate, however, lower ground levels of 3m OD are shown at the eastern end of the Seal Sands Industrial Estate adjacent to the River Tees. The Pipe Tunnel will be below sea level.	3	5
		The ground levels on the eastern side of the River Tees fall towards the Teesmouth. Contour levels of 20m OD are shown on OS maps to the south of the corridors which gradually reduce to 5m OD in the northern portion of the site (south of the PCC Site). Teesport Estate is shown as relatively level with ground levels of 5m OD.	5	20
5	Electrical Connection Corridor	Ground levels fall to the north / north west towards Teesmouth. Contour levels of 25m OD are present immediately north of Lazenby, which gradually reduce to 5m OD in the northern portion of the site (south of the PCC Site).	5	25

Geology

Introduction

10.8.3 The geology beneath the site is shown on BGS 1:50,000 Sheet 33 Stockton (1987) and Sheet 34 Guisborough (1998) and extracts of the British Geological Survey (BGS) 1:50,000 Digital Geological Map of Great Britain obtained as part of the Envirocheck Report included as Annex B.

10.8.4 The Envirocheck Report included as Annex B has not been updated to reflect the most recent revision of the red line boundary alignment of the site. However, as this revision has resulted in the site area being generally reduced, and any new regions are covered in the buffer zones of the original alignment in the Envirocheck Report, this is not considered a constraint to the report. Consequently, the content of the existing Envirocheck Report has been used to inform this site assessment and any no-longer relevant aspects of the report have been omitted.

10.8.5 British Geological Survey (BGS) 1:50,000 scale mapping reproduced from the Envirocheck Report is shown on Figures 10-1 to 10-3 and included in Annex B.

10.8.6 Artificial ground (Made Ground), superficial geology (recent and drift soils) and bedrock geology mapped across individual areas of the site described above is summarised in Table 10A-3.

10.8.7 Table 10A-3 is based on GIS data layers of 1:50,000 Digital Geological Map of Great Britain reproduced from the Envirocheck Report. The table uses the summary geological descriptions provided in the BGS GIS data layers; and the superficial geology refers to that present at the top of the natural soil succession. The table identifies surface soils and rocks at rock head; soil and rock layers not exposed are not listed. Glacial soils may underlie Blown Sand or Tidal Flat Deposits and not be recorded in the table.

Table 10A-3: Geology

No	Site	Artificial Ground	Superficial Geology	Bedrock Geology
1	PCC Site	Present below the site	Blown Sand - Sand Tidal Flat Deposits – Sand and Silt Glacio-Lacustrine Deposits Glacial Till	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone Sherwood Sandstone Group - Sandstone may be present at shallow depths below rockhead beneath the Mercia Mudstone Group)
2	CO_2 Export Pipeline	None Present	Beach and Tidal Flat Deposits (Undifferentiated) - Sand Blown Sand - Sand Tidal Flat Deposits – Sand and Silt	Redcar Mudstone Formation - Mudstone
3	Water Connections Corridor	Present below the south of the Site	Beach and Tidal Flat Deposits (Undifferentiated) - Sand Blown Sand – Sand Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone (Sherwood Sandstone Group - Sandstone may be present at shallow depths below rockhead beneath the Mercia Mudstone Group)
4	CO_2 Gathering Network and Natural Gas Connection Corridors	Present either side of the River Tees (including reclaimed areas of Seal Sands, Bran Sands and Saltholme Marsh)	Glaciolacustrine Deposits – Clay and Silt Blown Sand - Sand Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay Peat	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone Sherwood Sandstone Group - Sandstone
5	Electrical Connection Corridor	Present below the north west of the Site	Glaciolacustrine Deposits, Devensian – Clay and Silt Blown Sand - Sand Tidal Flat Deposits – Sand and Silt Tidal Flat Deposits – Sand, Silt and Clay	Redcar Mudstone Formation - Mudstone Penarth Group - Mudstone Mercia Mudstone Group - Mudstone (Sherwood Sandstone Group - Sandstone may be present at shallow depths below rockhead beneath the Mercia Mudstone Group)

Artificial Ground

10.8.8 Figure 10-1: Artificial Geology (ES Volume II, Document Ref. 6.3) indicates that artificial ground is widespread across the site. The Artificial Ground is associated with long historical industrial use of the site. Further detail is provided on the 1:10,000 geological map sheet NZ52SW which provides detail for Saltholme and Seal Sands extending south across the estuary to Teesport. West of the Tees, the Artificial Ground is reported to be "Reclaimed (Made) Ground" whilst to the south "Thick Slag" is indicated to be presence within a spoil heap west of Tees Dock. Summary details from boreholes provide little additional detail on the depth and composition of the Artificial Ground as the depth of Made Ground and Drift is often reported. Significant thicknesses (greater than 1m) of artificial of variable composition are anticipated below the site area.

10.8.9 Historical mapping and anecdotal evidence suggest that the Tees Estuary was confined within training walls built of slag mostly constructed between 1859 and 1871, and adjacent areas were infilled in sections divided by slag walls with estuary dredgings and industry wastes e.g., slag. The South Gare Breakwater was constructed between 1863 and 1888 of slag and topped with a concrete wall. The land areas to the north underlying the PCC Site, CO_2 Export Pipeline and Water Connections Corridor were completed using mainly blast furnace slag and smaller quantities of basic steel slag in the late nineteenth and twentieth century. Between 1900 and 1930 areas east and south of the Brinefields were reclaimed by infilling between porous slag walls, the Reclamation Pond remaining tidal until further land was reclaimed to the north. The area of "The Marshes" to the south of the PCC Site appears to have been drained in the 1950s and thereafter it is assumed raised with industrial wastes and/or dredgings. Between 1964 and 1969 the main Tees Estuary channels were deepened with dredgings pumped into the eastern margin of Seal Sands creating a raised bank of sand and clay known as "The Peninsular" (underlying the eastern pipeline corridor). This merged into the enclosure of the "Monsanto Option" between the central and southern pipeline corridors (west of the Tees). The latter was progressively filled by dredging of the Tees deep water channel which continued irregularly until 1974 using the Dutch hydraulic fill method, which became the exclusive fill technique for the remainder of Seal Sands and potentially also Bran Sands. An area of the PCC Site has been identified as containing former settling ponds for fine wastes.

Superficial Geology

Introduction

10.8.10 The published British Geological Survey (BGS) 1:50,000 scale maps show the wider site area underlain by variable superficial deposits. Details of superficial geology mapped across the site and surrounding parts of Teesside are shown on Figure 10-2: Superficial Geology (ES Volume II, Document Ref. 6.3) The distribution of individual deposits in relation to individual development areas which form the overall Site is summarised from youngest to oldest below. Summary lithological descriptions on the BGS Lexicon are provided where available together with additional detail from specialist geological and mineral publications.

10.8.11 As the BGS have published geological memoirs, sheet descriptions and sheet explanations for the areas shown on geological map Sheets 33 (Stockton) and 34 (Guisborough), reference has been made to the BGS memoir for the country around Northallerton (1998) which covers the area of North Yorkshire south west of the Teesside plain and Robson's (1995) Guide to the Geology of North East England and Bell FG (1981) paper on the geotechnical properties of Till along coastal Eastern England for additional detail.

10.8.12 The glacial deposits present across North East England are often subdivided into Lower and Upper Boulder Clays separated by Middle Sands and Gravels. The Lower Boulder Clay is typically dark grey, stiff, stony and contains many erratics of different origins whereas the Upper Boulder Clay is reddish brown with only a small gravel fraction. Researchers have noted that the Middle Sands and Gravels to be locally absent or interbedded with Till throughout the glacial succession. The Northallerton memoir suggests that "north of the Cleveland Hills, however, there is evidence of two or more phases of ice movements" implying a complicated, long lasting glacial period. Bell, FG (2001) reported that the Lower and Upper Boulder Clays of the Teesside area were regarded by Smith, DB (1981) as products of successive Late Devensian ice sheets. The first deposited lodgement Till (now classified as Diamicton by the BGS) and outwash as it retreated, and these deposits were then overlain by a second ice sheet which deposited its own lodgement Till and outwash. The Tills were reported thickest in the north and west of Teesside where they were 30 m thick but thinned markedly to the south and east reducing to less than 5 m thick.

10.8.13 Robson's Geology of North East England (1995) provided a review of the differing interpretations of the origin of the till sequences found across North East England including Teesside. The presence of two or more superimposed tills and interbedded water laid sediments could be a result of:

- Separate glacial advances or re-advances (tills emplaced by lodgement, intervening outwash);
- Composite, stacked ice sheets (tills emplaced by lodgement and other mechanisms);
- Distinct emplacement mechanisms (lodgement, deformation, melt-out or flow);
- Post-glacial weathering (of lodgement tills): and
- Unconformable facies superimposition (tills emplaced by lodgement); on a larger scale lithological variation caused by major shifts in ice flow direction and source areas during a glacial cycle.

10.8.14 Bell also suggested that a proglacial lake formed across Teesside during the ice retreat and the Tees Laminated Clay was deposited in this water body resting on the Upper Boulder Clay. The geological memoir reports that *"The Teesside – Middlesbrough area is underlain by a nearly flat sheet of laminated clay, dissected by later erosion and partly concealed by alluvium (now reclassified as Tidal Flat deposits by the BGS). The laminated clay* *rarely exceeds 10m in thickness but extends south-westwards up the valley sides of the Tees".*

10.8.15 The sharp variation in the depth of superficial (recent and glacial drift) deposits across Teesside has been confirmed by reference to a BGS Report (Buried Valleys (onshore) version 1 Ref. OR/19/003) and accompanying GIS data published under the Open Government Licence titled ModelledThicknessofBuriedValleysGB_V1. Data is presented on Figure 10-25: BGS Buried Valleys (ES Volume II, Document Ref. 6.3) together with the overall Site boundary. It should be noted that the BGS are only able to present and interpret data they hold and a there is no legal requirement in the UK for this information to be passed to them. The model should therefore be considered to provide a regional overview of superficial deposits depths across Teesside rather than a refined prediction. The thickest superficial deposits are generally present to the north of the River Tees. Superficial deposits depths are typically 20 to 30 m below the western and central parts of the CO_2 Gathering Network but locally thickening to between 30 and 40 m at Saltholme and Seal Sands. The distribution of superficial deposits suggests a channel trending north east across this area. Closer to the north bank of the Tees and south of the river, a superficial deposits thickness of 10 to 20 m is more typical.

10.8.16 The northern extent of the site area, located near (and in some parts along) the coastline, is shown to be underlain by two deposits, associated with coastal processes, Blown sand and Beach and Tidal Flat deposits (Undifferentiated).

Peat-Peat

10.8.17 A small area of Peat Deposits encroaches across the western CO_2 Gathering Network and Natural Gas Connection Corridors. The BGS Lexicon describes the deposits as *"Peat is a partially decomposed mass of semi-carbonized vegetation which has grown under waterlogged, anaerobic conditions, usually in bogs or swamps".* The origin of the peat at this location is unknown.

Beach and Tidal Flat Deposits (Undifferentiated)

10.8.18 The drift soils on the present beach are mapped as Beach and Tidal Flat Deposits (Undifferentiated) the mapped area coincides with the centre of the northern leg of the Water Connections Corridor and the northern portion of the CO_2 Export Pipeline. The extent of the deposits is shown on Figure 10-2: Superficial Geology (ES Volume II, Document Ref. 6.3) and they are indicated to trend north west – south east across this area. The BGS Lexicon does not provide a lithological description for this material but a similar composite undifferentiated material is described as "Composite of 'Beach Deposits': Shingle, sand, silt and clay; may be bedded or chaotic; beach deposits may be in the form of dunes, sheets or banks, and 'Tidal Flat Deposits': commonly silt and clay with sand and gravel layers: possible peat layers; from the tidal zone.

Blown Sand – Sand

10.8.19 Further in land behind the beach deposits Blown Sand deposits are mapped these coincide with the centre of the northern leg of the Water Connections Corridor, the majority of the CO_2 Export Pipeline, the central eastern portion of the PCC Site and locally the northern part of the Electrical Connection Corridor. The BGS Lexicon describes the deposits as "Blown Sand is sand that has been transported by wind, or sand consisting predominantly of wind-borne particles". The deposits are of Quaternary age.

Tidal Flat Deposits

10.8.20 The majority of the Tees Estuary is mapped as Tidal Flat Deposits. These deposits were previously identified by the BGS as Estuarine Alluvium. The BGS has provided two different layer types for these deposits; Sand and Silt and Sand, Sand, Silt and Clay, respectively, depending on which 1;50 000 geological map Sheet covers the area of interest. Across land covered by the Stockton sheet (Sheet 33), the deposits are indicated to comprise Sand, Silt and Clay whilst further east on the Guisborough sheet (Sheet 34) they are reported to comprise of Sand and Silt. From borehole logs it is found that these deposits commonly contain shell fragments, which may be diagnostic.

10.8.21 Figure 10-2: Superficial Geology (ES Volume II, Document Ref. 6.3) shows that most of the CO_2 Gathering Corridor north of the Darlington to Saltburn Branch line is underlain by Tidal Flat Deposits apart from the western end around Haverton Hill to the south Billingham. These deposits also underlie the PCC Site, the southern leg of the Water Connections Corridor and the northern part of the Electrical Connection Corridor. According to the BGS Lexicon, *"Tidal Flat Deposits, including mud flat and sand flat deposits, are deposited on extensive nearly horizontal marshy land in the intertidal zone that is alternatively covered and uncovered by the rise and fall of the tide. They consist of unconsolidated sediment, mainly mud and / or sand. They may form the top surface of a deltaic deposit. Normally a consolidated soft silty clay, with layers of sand, gravel and peat. Characteristically low relief".*

10.8.22 These deposits are most likely associated with the River Tees and North Sea.

Glaciolacustrine Deposits

10.8.23 Around the edges of the Tees Estuary Glaciolacustrine Deposits comprising of Clay and Silt are mapped. Figure 10-2: Superficial Geology (ES Volume II, Document Ref. 6.3) shows the southern and western portions of the site underlain by Glaciolacustrine deposits comprising of clay and silt. The fine-grained soils are considered to form part of the Tees Laminated Clay. These deposits represent part of a large glacial lake that formed against the North Sea ice sheet and consequently probably underlie the estuarine alluvial deposits (now reclassified by the BGS as Tidal Flat Deposits). Further south west in rural North Yorkshire across the Vale of Mowbray, similar sands define the edges of glacial lakes, interpreted to have been deposited in deltas during short lived mobile fluvial depositional episodes. The BGS Lexicon does not provide a lithological description for the material but the parent unit is described as *"composed of coarse-grained bedload and* *suspended fine-grained material transported by meltwater flowing into lakes bordering the glacier. Deposits include sands, silts and clays of deltaic origin, shoreface sand and gravel and lake bottom varved, fine-grained (fine sand, silt and clay) sediments".*

Bedrock Geology

Introduction

10.8.24 Figure 10-3: Bedrock Geology (ES Volume II, Document Ref. 6.3) presents the BGS 1:50,000 bedrock geology present below the site. The oldest strata are shown to subcrop (be present at soil rock interface) on the western part of the site with progressively younger layers subcropping to the east indicating a shallow regional dip towards the east. In sequence oldest to youngest four rock formations subcrop across the study area: the Sherwood Sandstone Group in the north and west, to Mercia Mudstone Group in the centre and Redcar Mudstone Formation in the south and east. A fourth unit, the Penarth Group occurs as a thin band between the Mercia Mudstone Group (centre) and Redcar Mudstone Formation (south and east). The outcrop of the Penarth Group generally trends south west – north east but swings to the north west below Bran Sands before turning to the north east south of the former Redcar Steelworks. The oldest rocks occur to the north west and the youngest to the south east. The Sherwood Sandstone Group is underlain by Permian marls and mudstones which include beds of halite and anhydrite which have been exploited in the past by mining and in Brine Well Fields to the south west of Wilton and near Billingham.

Permian

10.8.25 Permian strata underlie the whole site at depth and comprise interbedded limestones, mudstones and evaporate deposits. These deposits are part of the thick evaporites laid down in Zechstein Sea during Middle to Late Permian times 250 million years ago. Exploitation of the evaporite deposits comprising mining of anhydrite at Billingham and brine pumping from locations scattered across the whole site area but concentrated north of the River Tees, within this sequence led to the development of the chemical industry in Teesside. The 1:50,000 Stockton Sheet 33 geological map Sheet shows the halite deposit to extend below the eastern half of the study area. The BGS Lexicon which describes the formations as *"Dolostone, grey to buff grey, commonly oolitic or granular, with subordinate mudstone, dolomitic siltstone and sandstone"* and *"Mudstone, red-brown, with subordinate siltstone and sandstone, Dolostone and gypsum / anhydrite locally common".*

Sherwood Sandstone Group

10.8.26 Rocks of the Sherwood Sandstone Group underlie the whole site subcropping along the western edge of corridor of the CO_2 Gathering Network and Natural Gas Connection Corridors in the vicinity of Billingham and Saltholme. The BGS Lexicon describes the Sherwood Sandstone as *"Sandstone, red, yellow and brown, part pebbly; conglomeratic in lower part; pebbles generally extraformational quartz and quartzite, with some intraformational clasts; subordinate red mudstone and siltstone".* The BGS Baseline Series Report indicates that the sandstone comprises a thick sequence of fine to medium grained sandstones with common argillaceous beds varying in thickness from 250 to 450 m gently dipping ~1 - 2° to the east, in the Yorkshire and Cleveland area. The sandstones are of Triassic age.

Mercia Mudstone Group

10.8.27 The rocks subcropping in the centre of the site and underlying the site to the east of this are early Triassic rocks of the Mercia Mudstone Group, described on the Sheet 34 legend as *"Red and green mudstone with gypsum and sandstone: halite in lower part".* The BGS Lexicon also gives a more thorough description of the Group which is defined as *"Dominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite-bearing units in some basinal areas. Thin beds of gypsum/anhydrite widespread; sandstones are also present".* The BGS memoir of the country around Northallerton, an area underlain by a similar solid succession located to the south west of Teesside, reports. Based on the geological map sheet sections, the thickness of the formation ranges from 200 m (Sheet 33) and 200 to 215 m (Sheet 34). A bed of Halite is indicated to be present at the base of the succession on the Guisborough sheet; the evaporite is unnamed and occurs just above the unconformity between the Triassic and Permian strata. The Stockton sheet identifies the Seaton Carew Formation to form the base of the Mercia Mudstone Group; the BGS Lexicon describes these rocks as *"mudstone, red brown and grey green mottled, and sandstone, coarse-grained, sporadically pebbly, brown or grey-green. Sandstone occurs within convoluted soft injection structures and sandstone dykes".*

Penarth Group

10.8.28 The subcrop of the Penarth Group occurs in a narrow band extending from South Bank towards the Container Terminal at Teesport before swinging towards the PCC Site (the former SSI Redcar Steelworks) site. The generalised vertical section presented on geological map sheet 34 describes the Penarth Group as *"Grey and green mudstone and sandstone"*, however, the BGS Lexicon provides a slightly different, more detailed description as *"grey to black mudstones with subordinate limestones and sandstones; predominantly marine in origin".* The BGS Lexicon identifies the thickness of the group to vary between 0 and >12 m compared to 10 m and 11 to 19 m approximately on geological map sheets 33 and 34, respectively. The rocks are of Triassic age forming the top of the succession.

Redcar Mudstone Formation

10.8.29 Jurassic rocks of the Redcar Mudstone Formation subcrop below the east portion of the CO_2 Gathering Network and Electrical Connection Corridor. These materials are indicated to extend north and east across large areas of land to the south of the River Tees including Bran Sands, parts of Teesport and below the PCC Site (former SSI Redcar Steelworks) site. The generalised vertical section on geological map sheet 34, the Redcar Mudstone is described as *"Mudstone with thin sandstone and limestone beds in lower part".* A more detailed description is given on the BGS Lexicon which describes the formation as *"grey, fossiliferous, fissile mudstones and siltstones with subordinate thin beds of shelly limestone in lower part, and fine-grained carbonate-cemented sandstone in upper part; argillaceous limestone concretions occur throughout".* Based on the geological map sheet sections, the thickness of the formation ranges from 230 to 275 m (Sheet 33) to around 275 m (Sheet 34).

10.8.30 The BGS memoir of the country around Northallerton reports that the formation has been divided into four units based on composition from logging of coastal exposures on the North Yorkshire coast, south of Saltburn by the Sea. The Calcareous Shale Member forms the base of the formation and comprises mudstone with numerous thin beds of shelly, argillaceous limestone, which tend to become sandier up-sequence. The overlying Siliceous Shale member, around 30 m thick on the coast, comprises silty mudstones with intercalations of strong calcareous siltstone and sandstone. The top of the formation has been divided into the Pyritous Shale Member consisting of mudstones with pyritic burrows and fossils, and the Ironstone Shale Member with hard sideritic ironstone nodules.

Structure

10.8.31 The 1:50 000 BGS geological mapping (Stockton 1:50,000 geological map Sheet 33) shows the strata to have a regional dip to the east as discussed above cut by one fault below the site although other faults are located in close proximity. The fault which encroaches below the site is named the Saltholme Fault on 1:10,000 geological map Sheet NZ52SW, passing below the western CO_2 Gathering Network and Natural Gas Connection Corridor trending east - west approximately. The fault extends east towards the River Tees south of Seal Sands Industrial Estate. It is assumed that the fault has been traced in underground anhydrite workings and associated preliminary prospecting bores located north of the Tees and may extend further east across Teesport on the south of the estuary. The fault downthrows strata to the north but the throw is not recorded. Additional detail is provided on 1:10 000 geological map sheet NZ42SE which reports a throw of ~30 m to the north in the Billingham Anhydrite, confirming how the presence of the fracture was discovered.

10.8.32 The presence of bedrock at depth overlain by a considerable cover of Artificial Ground and recent and drift superficial deposits masks the faulting pattern in the soil succession below the site.

Agricultural Land Classification

10.8.33 Information provided on magic.defra.gov.uk/MagicMap.aspx for Agricultural Land Classification (ALC) as supplied by Defra, presented in two data sets, Provisional ALC and Post 1988 ALC maps. The Provisional ALC data covers the entire study area, whereas the Post 1988 ALC data shows a localised area in greater detail. The Agricultural Land Classification has been summarised into individual site areas and in Table 10A-4 below. Sheet 1 of Figure: 10-24 Agricultural Land Classification (Sheets 1 & 2) (ES Volume II, Document Ref. 6.3) presents the site wide Provisional ALC data (Sheet 1), and Sheet 2 illustrates the Post 1988 ALC data.

10.8.34 The Provisional ALC map shows the PCC Site to be underlain by urban and non-agricultural soils giving the soils a negligible impact value.

10.8.35 The CO_2 Export Pipeline is shown classified as non-agricultural soils. These soils are deemed to have a negligible impact value.

10.8.36 The Provisional ALC map shows the Water Connection Corridors to be underlain by urban and non-agricultural soils giving the soils a negligible impact value.

10.8.37 The CO_2 Gathering Network and Natural Gas Connection Corridors are classified primarily of urban soils with recorded areas of non-agricultural, Grade 5 and Grade 4 soils. The urban and non-agricultural soils are categorised with a negligible impact valve. The Grade 4 and 5 soils fall within a Low impact value.

10.8.38 The Provisional ALC map indicates the majority of the Electrical Connection Corridor is classified as urban soils with an area of non-agricultural soils, located south of the PCC Site. The urban and non-agricultural soils are deemed to have a negligible impact value.

Table 10A-4: Agricultural Land Classification

Site Area	Soil Grading	Impact Value
PCC Site	Urban and non-agricultural	Negligible
CO_2 Export Pipeline	Non-agricultural	Negligible
Water Connection Corridors	Urban and non-agricultural	Negligible
CO_2 Gathering Network and Natural Gas Connection Corridors	Grades 4 and 5, Urban and non-agricultural	Negligible to Low
Electrical Connection Corridor	Urban and non-agricultural	Negligible

BGS Boreholes

10.8.39 The positions of boreholes held by the BGS Onshore Geoindex national borehole database within the Site are shown in Figure: 10-4 BGS Boreholes (ES Volume II, Document Ref. 6.3). The boreholes are differentiated on the figure by colour. Positions coloured blue represent boreholes of 0 to 10 m depth, with those coloured green indicating boreholes of 10 to 30 m depth and those coloured red greater than 30 m depth. Fourteen of these borehole records have been chosen to provide an insight into the ground conditions present within individual parts of the site and provide an overview of the variability which may occur across a large and geographically extensive area.

10.8.40 The location of the selected boreholes in relation to individual proposed development areas which form the NZT study site are summarised in Table 10A-5.

Table 10A-5: Selected BGS Boreholes

No.	Site Area	Borehole number	BGS Borehole reference
1	PCC Site	2 [1]	NZ52NE56 & NZ52SE51
2	CO_2 Export Pipeline	0 [2]	N/A
3	Water Connection Corridors	3	NZ52NE56, NZ52NE151 & NZ52NE5/F
4	CO_2 Gathering Network and Natural Gas Connection Corridors	7 [3]	NZ42SE13651/1486, NZ52SW151/R, NZ52SW105/B, NZ52SW238/C, NZ52SE1, NZ52SE51 & NZ52SE13742/7a
5	Electrical Connection Corridor	2	NZ52SE51, NZ52SE1

Notes

1. *No boreholes available for PCC Site, so, interpretation is based on the records of 2 nearby boreholes (NZ52NE56 & NZ52SE51).*
2. *[2]: There are no BGS boreholes located within the CO_2 Export Pipeline site area. Due to the position of the proposed development the closest boreholes to this region are not considered representative of the underlying strata.*
3. *[3]: Borehole log summarised in PCC Site subsection of Table 6 (see below).*

10.8.41 The strata proved in the selected BGS boreholes are summarised in Table 10A-6.

Table 10A-6: BGS Boreholes

Depth from (m)	Depth to (m)	Level to (m OD)	Thickness (m)	Strata Description	Interpreted Geological Unit
PCC Site – no BGS boreholes are located within the proposed site area					
NZ52SE51 – Location: 456023, 525506. Approximately 310m south of the PCC Site (refer to this borehole positioned within the CO_2 Gathering Network and Natural Gas Connection Corridors) **Borehole Name: Redcar Stage 2 3001** **Ground Level: 5.16m OD**					
0.00	4.50	0.66	4.50	Gravel to boulder sized slag with a trace of dark grey brown silty clay. (FILL).	Made Ground
4.50	5.00	0.16	0.50	Dark brown grey fine and medium SAND with occasional shell fragments.	Tidal Flat Deposits – Sand and Silt
5.00	5.80	-0.64	0.80	Dark grey clayey coarse SILT and fine SAND with occasional shell fragments.	Tidal Flat Deposits – Sand and Silt
5.80	7.80	-2.64	2.00	Dark grey brown clayey silty fine with a little medium SAND with occasional shell fragments.	Tidal Flat Deposits – Sand and Silt
7.80	9.70	-4.54	1.90	Soft to firm dark grey brown structureless silty CLAY flecked with black carbonaceous matter and occasional pockets of green grey sand. (ESTUARINE DEPOSITS).	Tidal Flat Deposits – Sand, Silt and Clay
9.70	12.20	-7.04	2.50	Firm to stiff dark brown and grey mottled sandy silty CLAY with a little subangular siltstone and coal gravel.	Glacial Till
12.20	18.10	-12.94	5.90	Poorly thinly laminated moderately jointed dark grey calcareous weak MUDSTONE with 50 - 150m bands of silty moderately weak mudstone. (LOWER LIAS)	Redcar Mudstone Formation – Mudstone
18.10	28.20	-23.04	10.10	Dark grey calcareous moderately weak MUDSTONE with occasional bands of impure shelly moderately strong limestone. (LOWER LIAS).	Redcar Mudstone Formation – Mudstone

Depth from (m)	Depth to (m)	Level to (m OD)	Thickness (m)	Strata Description	Interpreted Geological Unit
Water Supply and Discharge Connection Corridors					
NZ52NE56 – Location: 456657, 525710. Within the Water Connections Corridor site area. Approximately 180m west of the PCC Site (refer to this borehole for the PCC Site). Borehole Name: Redcar Stage 2 3903A Ground Level: 7.22m OD					
0.00	4.30	2.92	4.30	Sand to cobble sized slag. (FILL).	Made Ground
4.30	12.20	-4.98	7.90	Light brown fine and medium SAND with a trace of rounded fine gravel and occasional shell fragments.	Tidal Flat Deposits – Sand and Silt
12.20	15.10	-7.88	2.90	Stiff brown with a little pale grey mottled silty CLAY with a trace of subangular fine and medium gravel.	Glacial Till
15.10	42.60	-35.38	27.50	Highly and moderately weathered closely and moderately fractured red brown very weak MUDSTONE with occasional bands of red brown and green grey weak silty mudstone. (KEUPER MARL).	Mercia Mudstone Group – Mudstone
42.60	45.10	-37.88	2.50	Slightly weathered moderately fractured brown slightly gypsiferous weak MUDSTONE. (KEUPER MARL).	Mercia Mudstone Group – Mudstone
NZ52NE151 – Location: 455200, 526100. Within the proposed Water Connections Corridor site area. Borehole Name: Redcar Steel Works, Tees T4 Ground Level: 3.57m OD					
0.00	3.00	0.57	3.00	No log available	N/A
3.00	3.74	-0.17	0.74	Interbedded dark grey brown black fine to medium sand and dark grey clay.	Tidal Flat Deposits – Sand, Silt and Clay
3.74	4.15	-0.58	0.41	Dark grey brown fine to medium SAND	Tidal Flat Deposits – Sand and Silt
4.15	5.15	-1.58	1.00	No recovery.	N/A

Depth from (m)	Depth to (m)	Level to (m OD)	Thickness (m)	Strata Description	Interpreted Geological Unit
5.15	8.77	-5.20	3.62	Dark grey brown fine to coarse shelly SAND.	Tidal Flat Deposits – Sand and Silt
8.77	13.30	-9.73	4.53	Light olive brown fine to medium sand with gravel horizons / layers.	Tidal Flat Deposits – Sand and Silt
13.30	14.00	-10.43	0.70	Grey brown fine to coarse pebbly SAND.	Tidal Flat Deposits – Sand and Silt
14.00	22.50	-13.43	8.50	Grey brown fine to coarse SAND	Tidal Flat Deposits – Sand and Silt
22.50	32.41	-23.34	9.91	Dark grey silty CLAY with organic and black peaty partings	Tidal Flat Deposits – Sand, Silt and Clay
32.41	33.00	-23.93	0.59	Black and dark grey sandy SILT.	Tidal Flat Deposits – Sand, Silt and Clay
NZ52NE5/F – Location: 455139, 525917. Within the proposed Water Connections Corridor site area. Borehole Name: Redcar Works Ground Level: -0.76m OD					
0.00	3.66	-4.42	3.66	Sand and silty SAND.	Tidal Flat Deposits – Sand and Silt
3.66	7.62	-8.38	3.96	SAND and GRAVEL.	Tidal Flat Deposits – Sand and Silt
7.62	9.75	-10.51	2.13	Very coarse SAND.	Tidal Flat Deposits – Sand and Silt
9.75	14.94	-15.70	5.19	Very coarse SAND and large GRAVEL.	Tidal Flat Deposits – Sand and Silt
14.94	20.73	-21.49	5.79	Silty SAND.	Tidal Flat Deposits – Sand and Silt

Depth from (m)	Depth to (m)	Level to (m OD)	Thickness (m)	Strata Description	Interpreted Geological Unit
20.73	29.95	-30.71	9.22	Silty SAND with bands of clay containing organic matter.	Tidal Flat Deposits – Sand, Silt and Clay
29.95	30.48	-31.24	0.53	CONGLOMERATE.	Tidal Flat Deposits – Sand and Silt
30.48	32.00	-32.76	1.52	Red, green and grey MARL.	Mercia Mudstone Group – Mudstone
CO_2 Gathering Network and Natural Gas Connection Corridors					
NZ42SE13651/1486 – Location: 447800, 522350. Located at furthest most western portion of the CO_2 Gathering Network Corridor. **Borehole Name: Billingham Cooling Towers** **Ground Level: N/A**					
0.00	4.00	N/A	4.00	Fill – Ashes slag and bricks.	Made Ground
4.00	4.70	N/A	0.70	Firm silty brown / grey clay with gravel.	Glaciolacustrine Deposits – Clay and Silt
4.70	5.10	N/A	0.40	Firm silty brown laminated clay.	Glaciolacustrine Deposits – Clay and Silt
5.10	7.80	N/A	2.70	Stiff brown boulder clay.	Glacial Till
7.80	8.30	N/A	0.50	Sand.	Glaciolacustrine Deposits - Sand
8.30	13.80	N/A	5.50	Stiff brown boulder clay	Glacial Till
13.80	15.50	N/A	1.70	Sand.	Glaciolacustrine Deposits - Sand

Depth from (m)	Depth to (m)	Level to (m OD)	Thickness (m)	Strata Description	Interpreted Geological Unit
15.50	16.70	N/A	1.20	Stiff silty brown laminated clay.	Glaciolacustrine Deposits – Clay and Silt
16.70	17.30	N/A	0.60	Gravel.	Glacial Till
17.30	20.00	N/A	2.70	Stiff brown boulder clay.	Glacial Till
NZ52SW151/R – Location: 451464, 523664. Within the CO_2 Gathering Network Corridor, approximately 800m east of Billingham Community Fire Station, west of Seal Sands. **Borehole Name: Seal Sands Industrial Development R** **Ground Level: N/A**					
0.00	12.19	N/A	12.19	Loamy silt.	Tidal Flat Deposits – Sand and Silt
12.19	16.46	N/A	4.27	Grey silt.	Tidal Flat Deposits – Sand and Silt
16.46	18.90	N/A	2.44	Dark brown clay.	Glaciolacustrine Deposits – Clay and Silt
18.90	22.25	N/A	3.35	Gravel.	Glaciofluvial Deposits – Sand and Gravel
22.25	23.47	N/A	1.22	Brown clay and gravel.	Glaciolacustrine Deposits – Clay and Silt
23.47	24.54	N/A	1.07	Soft brown clay.	Glaciolacustrine Deposits – Clay and Silt
24.54	26.52	N/A	1.98	Boulder clay.	Glacial Till

Depth from (m)	Depth to (m)	Level to (m OD)	Thickness (m)	Strata Description	Interpreted Geological Unit
26.52	26.82	N/A	0.30	Small gravel.	Glaciofluvial Deposits – Sand and Gravel
26.82	30.48	N/A	3.66	Hard red marl.	Mercia Mudstone Group – Mudstone
NZ52SW105/B – Location 453517, 523384. Within the CO_2 Gathering Network and Natural Gas Connection Corridors, approximately 120m west of the River Tees, south of Seal Sands. Well 105 referred to. Borehole Name: ICI River Tees Tunnel Borings Ground Level: N/A					
0.00	3.35	N/A	3.35	Sandy silt.	Tidal Flat Deposits – Sand and Silt
3.35	9.75	N/A	6.40	Grey silty clay with small stones.	Tidal Flat Deposits – Sand, Silt and Clay
9.75	29.26	N/A	19.51	Brown clay.	Glaciolacustrine Deposits – Clay and Silt
29.26	-	N/A	-	B.S. (Bunter Sandstone).	Sherwood Sandstone Group – Sandstone
NZ52SW238/C – Location: 454315, 524722. Within the CO_2 Gathering Network and Natural Gas Connection Corridors, approximately 100m west of the River Tees, at Seal Sands. Borehole: Wilton Tip Extension T271 Ground Level: 2.00m OD					
0.00	0.46	1.54	0.46	Silt and sand.	Tidal Flat Deposits – Sand and Silt
0.46	9.14	-7.14	8.68	Sand.	Tidal Flat Deposits – Sand and Silt

Depth from (m)	Depth to (m)	Level to (m OD)	Thickness (m)	Strata Description	Interpreted Geological Unit
9.14	9.75	-7.75	0.61	Sand and gravel.	Tidal Flat Deposits – Sand and Silt
9.75	11.28	-9.28	1.53	Sand and a little gravel.	Tidal Flat Deposits – Sand and Silt
11.28	11.43	-9.48	0.15	Laminated clay.	Glaciolacustrine Deposits – Clay and Silt
11.43	14.33	-12.33	2.90	Red boulder clay.	Glacial Till
14.33	15.85	13.85	1.52	Red and grey marl.	Mercia Mudstone Group – Mudstone
NZ52SE1 – Location: 455296, 522395. Within the CO_2 Gathering Network and Natural Gas Connection Corridors, adjacent to Tees Dock Road Roundabout, (refer to this borehole for the Electrical Corridors). Borehole Name: Foreshore Bire at Lackenby Ground Level: N/A					
0.00	3.96	N/A	3.96	Clay and gravel.	Glaciolacustrine Deposits – Clay and Silt
3.96	7.52	N/A	3.56	Hard red clay and gypsum.	Mercia Mudstone Group – Mudstone
7.52	181.97	N/A	174.45	Hard red and blue marl.	Mercia Mudstone Group – Mudstone
181.97	364.24	N/A	182.27	Red sandstone.	Sherwood Sandstone Group – Sandstone
364.24	500.79	N/A	136.55	Red marl with sandstone beds.	Permian Eskdale Group / Staintondale Group – Permian

Depth from (m)	Depth to (m)	Level to (m OD)	Thickness (m)	Strata Description	Interpreted Geological Unit
					Upper Marls (Roxby Siltstone Formation)
500.79	506.88	N/A	6.09	Hard white rock.	Permian Staintondale Group – Sherburn Anhydrite Formation
506.88	509.63	N/A	2.75	Honeycomb marl.	Permian Staintondale Group – Permian Upper Marls – Rotten Marl
509.63	513.89	N/A	4.26	SALT and marl, mixed.	Permian Teesside Group – Boulby Halite
513.89	549.86	N/A	35.97	Rock SALT, clean	Permian Teesside Group – Boulby Halite
549.86	550.47	N/A	0.61	White rock.	Permian Teesside Group –- Billingham Anhydrite
NZ52SE13742/7A – Location: 456250, 521590. Within the proposed CO_2 Gathering Network and Natural Gas Connection Corridors. Borehole Name: Wilton ICI 7a Ground Level: 11.80m OD					
0.00	0.25	11.55	0.25	Topsoil	Topsoil

Depth from (m)	Depth to (m)	Level to (m OD)	Thickness (m)	Strata Description	Interpreted Geological Unit
0.25	0.35	11.45	0.10	Stiff brown slightly sandy CLAY.	Glaciolacustrine Deposits – Clay and Silt
0.35	2.10	9.70	1.75	Stiff light brown to brown with some grey mottled slightly silty CLAY with fine to coarse gravel.	Glacial Till
2.10	3.20	8.60	1.10	Firm to stiff reddish brown silty CLAY with gravel.	Glacial Till
3.20	3.50	8.30	0.30	Firm to stiff reddish brown silty sandy CLAY with fine to coarse gravel.	Glacial Till
3.50	4.00	7.80	0.50	Firm to stiff brown silty CLAY with gravel.	Glacial Till
4.00	12.50	-0.70	8.50	Firm becoming stiff reddish brown silty CLAY with fine medium gravel. Occasional cobble.	Glacial Till
12.50	13.00	-1.20	0.50	Stiff brown silty CLAY with fine medium coarse gravel.	Glacial Till
13.00	13.50	-1.70	0.50	Highly weathered grey MUDSTONE.	Redcar Mudstone Formation – Mudstone
Electrical Connection Corridor					
NZ52SE51 – Location: 456023, 525506. Approximately 310m south of the PCC Site. **Borehole Name: Redcar Stage 2 3001** **Ground Level: 5.16m OD**					
0.00	4.50	0.66	4.50	Gravel to boulder sized slag with a trace of dark grey brown silty clay. (FILL).	Made Ground
4.50	5.00	0.16	0.50	Dark brown grey fine and medium SAND with occasional shell fragments.	Tidal Flat Deposits – Sand and Silt
5.00	5.80	-0.64	0.80	Dark grey clayey coarse SILT and fine SAND with occasional shell fragments.	Tidal Flat Deposits – Sand and Silt
5.80	7.80	-2.64	2.00	Dark grey brown clayey silty fine with a little medium SAND with occasional shell fragments.	Tidal Flat Deposits – Sand and Silt

Depth from (m)	Depth to (m)	Level to (m OD)	Thickness (m)	Strata Description	Interpreted Geological Unit
7.80	9.70	-4.54	1.90	Soft to firm dark grey brown structureless silty CLAY flecked with black carbonaceous matter and occasional pockets of green grey sand. (ESTUARINE DEPOSITS).	Tidal Flat Deposits – Sand, Silt and Clay
9.70	12.20	-7.04	2.50	Firm to stiff dark brown and grey mottled sandy silty CLAY with a little subangular siltstone and coal gravel.	Glacial Till
12.20	18.10	-12.94	5.90	Poorly thinly laminated moderately jointed dark grey calcareous weak MUDSTONE with 50 - 150m bands of silty moderately weak mudstone. (LOWER LIAS)	Redcar Mudstone Formation – Mudstone
18.10	28.20	-23.04	10.10	Dark grey calcareous moderately weak MUDSTONE with occasional bands of impure shelly moderately strong limestone. (LOWER LIAS).	Redcar Mudstone Formation – Mudstone
NZ52SE1 – Location: 455296, 522395. Adjacent to Tees Dock Road Roundabout. **Borehole Name: Foreshore Bire at Lackenby** **Ground Level: N/A**					
0.00	3.96	N/A	3.96	Clay and gravel.	Glaciolacustrine Deposits – Clay and Silt
3.96	7.52	N/A	3.56	Hard red clay and gypsum.	Mercia Mudstone Group – Mudstone
7.52	181.97	N/A	174.45	Hard red and blue marl.	Mercia Mudstone Group – Mudstone
181.97	364.24	N/A	182.27	Red sandstone.	Sherwood Sandstone Group – Sandstone
364.24	500.79	N/A	136.55	Red marl with sandstone beds.	Permian Eskdale Group / Staintondale Group – Permian Upper Marls

Depth from (m)	Depth to (m)	Level to (m OD)	Thickness (m)	Strata Description	Interpreted Geological Unit
					(Roxby Siltstone Formation)
500.79	506.88	N/A	6.09	Hard white rock.	Permian Staintondale Group – Sherburn Anhydrite Formation
506.88	509.63	N/A	2.75	Honeycomb marl.	Permian Staintondale Group – Permian Upper Marls – Rotten Marl
509.63	513.89	N/A	4.26	SALT and marl, mixed.	Permian Teesside Group – Boulby Halite
513.89	549.86	N/A	35.97	Rock SALT, clean	Permian Teesside Group – Boulby Halite
549.86	550.47	N/A	0.61	White rock.	Permian Teesside Group –– Billingham Anhydrite

Mining

Introduction

10.8.42 Economic extraction of evaporite minerals including halite, gypsum and anhydrite and potash, have been of economic significance across Teesside since 1927. These minerals were precipitated during the evaporation of sea water which existed during the Permian age in North East England. As noted above, these rocks occur at depth below the Triassic Sandstone and Mudstone which underlie most of Teesside. The drying cycles occurred on multiple occasions and resulted in the deposition of two mineral beds (the Billingham Anhydrite Formation and the Boulby Halite Formation) which have been extensively exploited across Teesside. CIRIA C758D report that *"salt deposits beneath Middlesbrough were discovered in the 1860s and were extracted by uncontrolled solution mining between 1874 and 1918 and during the latter part of the 20th Century".* CIRIA also report that *"anhydrite was also mined in the Billingham and Hartlepool area from the 1920s to 1971".*

10.8.43 The BGS Durham and the Tees Valley Mineral Resources and Constraints Report indicated that "the Billingham Anhydrite was extensively mined on Teesside between 1927 and 1971 as a source of sulphur for the manufacture of the fertiliser ammonium sulphate and sulphuric acid. It was reported that *"the Boulby Halite formed the basis of the Teesside chemical industry and was still being worked by brine pumping in 2000".* Report on Abandoned Mineral Workings and Possible Surface Instability Problems (Morris et al, 1982) indicates that the mine at Billingham (NZ478227) located within the site was operational between 1926 and 1971. Mining ceased due to the decline in use of ammonia sulphate fertiliser and because the Anhydrite Process of sulphuric acid production became uncompetitive with methods using elemental sulphur.

10.8.44 It is noted that the site falls outside of a Coal Authority Mining Reporting Area and CIRIA C758D indicates that it lies to the north of areas underlain by historic ironstone workings, these being located across the elevated topography of the North Yorkshire Moors.

Evaporite Minerals

Salt

10.8.45 Halite (sodium chloride, NaCl) or 'rock salt' occurs below large areas of Teesside and the chemical industry which developed in this area was initially based on exploitation of these extensive mineral deposits. The Boulby Halite Formation is up to 90 m thick close to the coast but thins west before thinning out sharply due to dissolution near its outcrop. The BGS Minerals Resources report states that *"salt was discovered in Permian strata in 1859-62 and commercial brine pumping began between 1876 and 1882, with the first recorded salt production in 1888".* Early extraction was undertaken by allowing water from the overlying Sherwood Sandstone to flow down wells into the salt. The brine fluid which formed was then pumped up to the surface. According to the BGS, *"extraction resulted in subsidence around Haverton Hill and south of Saltholme. Brine was also pumped south of the Tees near Grangemouth".* The settlement was caused by uncontrolled lateral cavity extension caused by the lower density of freshwater in comparison to the brine.

10.8.46 In 2000, the BGS reported that brine was still extracted north of Saltholme Farm below 300m bgl. Initially controlled brine pumping took place on Saltholme and Cowpen Marshes, to the west of Seal Sands. Initially, extraction took place in the south but has progressively moved to the north. Salt extraction was also undertaken at the ICI Wilton complex (latterly by SABIC). According to BGS / Office of the Deputy Prime Minister Mineral Planning Factsheet, all Teesside brine extraction ceased in 2002.

Potash

10.8.47 Potash is a generic term for potassium-bearing minerals and refined manufactured products. Potash is extracted from Boulby Mine near Loftus below the North Yorkshire coast and North Sea to the south. The minerals are not exploited across Teesside in the vicinity of the Site and is therefore not discussed further.

Gypsum / Anhydrite

10.8.48 Gypsum and anhydrite are naturally occurring forms of calcium sulphate which are deposited beds or in nodular bodies. Their thickness is variable, but beds can typically be a few metres thick. Gypsum develops due to the hydration of anhydrite but tends to pass into anhydrite at depths below 100 m approximately. The BGS Minerals Resources Report notes that "gypsum is highly soluble and dissolves rapidly at or near surface and may give risk to subsidence problems". According to the BGS, gypsum has not been "produced on any significant scale in the area" but anhydrite was mined extensively from 1923 to 1955. The Permian strata dip gently to the east and the mineral beds slowly thicken in this direction. Anhydrite occurs at a number of horizons; from bottom to top, these are Hartlepool Anhydrite, the Permian Edlington Formation (formerly the Middle Marls), the Billingham Anhydrite and the Sherburn Anhydrite. According to the generalised vertical section on BGS Sheet 33, the Hartlepool Anhydrite is thickest, ~100 m thick, although the BGS Minerals Resources Report indicated it is up to 150 m thick. The Billingham Anhydrite and Sherburn Anhydrite are thinner but generally more consistent in extent and thickness. The former is indicated to be 80 m thick on the section, but the latter is not identified. The anhydrite in the Middle Marls is the thinnest mineral bed and although not shown on the generalised vertical section can reportedly be up over 20 m thick.

10.8.49 The BGS report that the Billingham Anhydrite Mine was sunk to 260 m bgl to extract the Billingham Anhydrite Formation at around 220 m depth. Report on Abandoned Mineral Workings and Possible Surface Instability Problems (Morris et al, 1982) reports that ICI mined the 7m thick seam of the Main Anhydrite. The mine closed in 1971. The BGS also state that the workings are flooded.

Tees Valley Joint Minerals and Waste Development Documents

10.8.50 Tees Valley Joint Minerals and Waste Development Documents, Policies & Sites DPD was adopted in September 2011The Tees Valley consists of five

Boroughs: Darlington, Hartlepool, Middlesbrough, Redcar & Cleveland and Stockton-on-Tees. In the case of minerals and waste planning, the five authorities have joined together to prepare planning policies on minerals and waste. The local authorities decided to combine minerals and waste planning policies in one set of Development Plan Documents (DPDs) because minerals and waste operations have many planning issues in common. In addition, the Tees Valley has relatively few remaining minerals operations and the preparation of minerals-only DPDs would not be justifiable. Joint Minerals and Waste DPDs cover the period from 2011 to 2026.

10.8.51 Historically there has been mineral extraction of salt and gypsum around Billingham and the Tees Estuary.

10.8.52 The Tees Valley has a rich history of mineral extraction, the specialist nature of which supported the development of the chemical and steel making industries on the Tees. Historically there has been mineral extraction of salt and gypsum around Billingham and the Tees Estuary. However, the range of current primary mineral extraction is limited to crushed rock and sand and gravel with some brine extraction at Seal Sands and small-scale clay extraction at Cowpen Bewley. The Tees Valley has relatively few remaining minerals operations.

10.8.53 Conversely there are significant secondary and recycled materials (blast furnace slag; construction and demolition waste) and marine-dredged aggregates landed at wharves along the Tees which help provide the minerals resources needed and move minerals provision up the minerals hierarchy. The challenge is to ensure that the use of secondary and recycled materials is facilitated whilst making sufficient land available to provide an appropriate level of primary mineral resources to contribute to the identified local, regional and national need for minerals; safeguarding resources and ensuring the prudent use of these resources in line with sustainable development objectives.

10.8.54 There is one brinefield currently active near Seal Sands (Stockton-on-Tees). Two further brinefields in the Seal Sands area have extant planning permissions. Information from the British Geological Survey (BGS) indicates brine extraction has limited viability itself, but it is acknowledged that there may be future interest to create storage caverns for gas and certain fluids. Permission was granted in 2009 for the extraction of gas at Kirkleatham (Redcar and Cleveland). Permission also exists for the extraction of anhydrite from a deep mine at Billingham (Stockton-on-Tees) although the mine has not been worked since 1971.

10.8.55 Ten dormant sites were identified in the Tees Valley, one of which has had new conditions approved for minerals extraction (the anhydrite mines at Billingham). Of the remaining nine it is now considered that seven of these sites are highly unlikely to ever resume extraction due to recent development, designations or proposed allocations for other uses. Land at the remaining sites at Low Middlesfield Farm and Eaglescliffe Brickworks (Stockton-on- Tees) would require new conditions to be approved before they could be reopened.

10.8.56 The Envirocheck Report indicates that six mine cavities are recorded on the site, all of which are located near the Belasis Hall Technology Park (western end of site), Commodity: Anhydrite. There are two mine cavities within 200m of the Site boundary located north of Bolckow Industrial Estate: Commodity: salt and gypsum.

10.8.57 The Envirocheck Report indicates that the western portion of the Site falls within a non-coal mining area; Commodities: Anhydrite, salt and brine; Hazards: Rare, Sporadic underground mining of restricted extent may have occurred; Highly Unlikely, localised small scale underground mining may have occurred; and likely, Underground mining is known or considered likely to have occurred within or close to the area.

10.8.58 Landmark uses available mining risk databases to report potential risk from coal mining, non-coal mining as well as the risk from natural and man-made cavities on and within 200 m of the Site. Table 10A-7 provides a summary of the mining data included in the Envirocheck datasheets for each report slice. It should be noted however that the slice areas often cover areas extending well outside the Site boundary and as a result, the reported features may not impact the site.

10.8.59 The summaries report that the site divisions are not within coal mining affected areas. Most of the site is indicated to be at risk from mining instability associated with the extraction of evaporites, areas have been assigned classes; conclusive evaporites mining or inconclusive evaporites mining.

Table 10A-7: Mining Risk

No.	Site	Coal Mining Affected Areas		Mining Instability		Man-made mining Cavities		Natural Cavities		Non-Coal Mining Areas of Great Britain	
		On site	0 to 250m	On site	0 to 250m	On site	0 to 250m	On site	0 to 250m	On site	0 to 250m
1	PCC Site	No	n/a	Yes	n/a	None	None	None	None	Yes	No
2	CO_2 Export Pipeline	No	n/a	Yes	n/a	None	None	None	None	No	No
3	Water Connections Corridor	No	n/a	Yes	n/a	None	None	None	None	No	No
4	CO_2 Gathering Network and Natural Gas Connection Corridors	No	n/a	Yes	n/a	6	4	None	None	Yes	Yes
5	Electrical Connection Corridor	No	n/a	Yes	n/a	None	2	None	None	Yes	No

Source:

Envirocheck datasheet summary sheets.

n/a: not defined, presumed not applicable.

PCC Site

10.8.60 Table 10A-7 shows that the PCC Site is in an area that might not be affected by coal mining based on property searches to The Coal Authority included in Envirocheck report (60559231_EC2_G). Ove Arup & Partners (Arup) 'A Review of Mining Instability Study in Great Britain' reported this area to have inconclusive evidence of evaporites mining. There is no hazard from non-coal mining at the site according to data provided by the BGS. The Department of the County Surveyor and Engineer of the former County of Cleveland (CC) in July 1982 prepared a Report on Abandoned Mineral Workings and Possible Surface Instability Problems. According to the report, none of the three abandoned brine wells identified in the Borough of Langbaurgh (now renamed as Redcar and Cleveland Borough Council) were located on or near the PCC Site. The report did however state that the identified brine wells do not include those occupied by Imperial Chemical Industries Limited at the time of writing in 1982 concentrated at Saltholme north of the River Tees.

CO_2 Export Pipeline

10.8.61 Table 10A-7 shows that the mining risks reported by Envirocheck (60559231_EC2_G & I) are the same as those recorded for the PCC Site to the south south-west.

Water Supply and Discharge Corridors

10.8.62 Table 10A-7 shows that the mining risks reported by Envirocheck (60559231_EC2_F, G, H & I) are the same as those identified for the PCC Site and CO_2 Export Pipeline areas located to the south east.

Electrical Connection Corridor

10.8.63 Table 10A-7 shows that the high level mining risks identified by Envirocheck (60559231_EC2_A, B, C, D, F & G) are similar to those identified above for the CO_2 Export Pipeline and Water Supply and Discharge Corridors.

CO_2 Gathering Network and Natural Gas connection Corridors

10.8.64 Table 10A-7 shows that the CO_2 Gathering Network and Natural Gas Connection Corridors have similar mining risks to that encountered elsewhere across the site. Based on property searches, The Coal Authority have identified this part of the site to be in an area that might not be affected by coal mining. The BGS record the risk posed by non-coal mining areas to vary between rare and likely. Arup recorded conclusive evidence of Evaporites mining in a localised area south of Haverton Hill straddled by the B1275 believed to be associated with a former deep Anhydrite Mine at Billingham. The former CC reported that anhydrite was extracted from the mine between 1928 and 1971 and provides a plan showing the extent of the workings which extend below the southern dog leg at the western end of the CO_2 Gathering Network Corridor between Billingham and Haverton Hill.

10.8.65 Six man-made cavities are present in the Envirocheck site area. These all relate to a former Anhydrite Mine located on the south side of Billingham. The cavity type is described as Pillar & Stall Anhydrite Mine-Known Mined

Ground and the commodity Anhydrite. Summary details of the solid and superficial geology area also given. The report prepared by the former CC recorded 19 abandoned brine wells in the Borough of Stockton on Tees; these were in a triangular area of land on the north bank of the River Tees bounded by the Furness Estate near Haverton Hill in the west extending to Saltholme and the Transporter Bridge in the east. Where recorded the average depth to the base of the salt varied from 247 to 395 m. The average of the seam was between 12 and 33 m thick. The date of well sinking varied from 1874 to post 1892. The wells are located to the south of the CO_2 Gathering Network Corridor and not expected to affect the site.

Quarrying and Landfill

Introduction

10.8.66 Quarries and landfills present on and within 200 m of the Site have been identified from the Envirocheck Report and Site Sensitivity maps (showing Envirocheck Map ID numbers) are included in Annex B. In addition, data has been obtained from the Environment Agency's Historical Landfills digital data released under the Open Government Licence for Public Sector Information. The Envirocheck report also includes areas of Potentially Infilled Land (non-water) and Potentially Infilled Land (water). The Envirocheck Report does not include further details as to the nature of infill and these have been interpreted from a review of historical maps and other datasets described above.

10.8.67 GIS data of the Envirocheck Report was provided by Landmark in order to produce figures for significant features and hazards across the site. Pertinent features identified in the Envirocheck data have been presented in Figure:10-5: Quarrying and Landfill (ES Volume II, Document Ref. 6.3) Figure 10-6: Waste (ES Volume II, Document Ref. 6.3), Figure 10-7: Infilled Land - Non Water (ES Volume II, Document Ref. 6.3) and Figure 10-8: Infilled Land – Water (ES Volume II, Document Ref. 6.3) displaying the quarrying and landfill hazards, waste management, potentially infilled land (non-water) and (water) on adjacent to the comprehensive site area.

PCC Site

10.8.68 There is one historic landfill site located onsite (within 25m of the Site boundary) (see Figure: 10-5 Quarrying and Landfill (ES Volume II, Document Ref. 6.3). Details of this entry are summarised in Table 10A-8, below.

Table 10A-8: Quarries and Landfills - PCC Site

Relevant Feature	On site (within 25m)	Off-site (within 200 m)	Envirocheck Map ID
Historical Landfill Sites	Name: Warrenby, Location: Land Adjacent to Redcar Blast Furnace, Redcar, Cleveland Reference: EAHLD05576 Waste: Inert and Industrial Waste	-	2G101
		-	

10.8.69 The historical landfill is named as the Warrenby Historical Landfill site and the waste deposited is recorded as inert and industrial waste. The Envirocheck data identifies that British Steel Plc are the license holders for the landfill. The first and last input dates are not supplied. Given the location of the landfill, it is unlikely to have an adverse impact to the PCC Site.

10.8.70 The Envirocheck data identifies numerous areas of potentially infilled land (water) on and near the site area from their review of the historical mapping. These areas are shown in Figure 10-8: Infilled Land – Water (ES Volume II, Document Ref. 6.3), which shows the PCC Site within green hatched zones. In review of Figure: 10-8 Infilled Land – Water (ES Volume II, Document Ref. 6.3) and the historical OS maps it is suggested that the areas of potential infilled land are associated with historical land reclamation of marshland and coastline between 1856 and 1953, and appear to have been infilled as part of, or, just before construction of the former Redcar Iron and Steel Works and redevelopment as Teesside Works (Redcar Blast Furnace and Coking Works). These features may have a significant impact on development of the Steelworks site and will need further assessment through ground investigation.

10.8.71 Review of historical mapping and aerial photography on Google Earth Pro indicates settling ponds were in use on the PCC Site. According to Department of Environment (DoE) Industry profiles, fume cleaning may generate between 10 to 15 kg of dust or slurry for each tonne of manufactured steel. Generally, these are contaminated with lead, zinc and other metals making them unsuitable for recycling and since the 1970s most steel industry slurry was lagooned on site or landfilled. Residues may be present at the location of the former settling ponds.

CO_2 Export Pipeline

10.8.72 There is one quarrying or landfill entry (a historical landfill) within 25m of the CO_2 Export Pipeline corridor, shown on Figure 10-5: Quarrying and Landfill (ES Volume II, Document Ref. 6.3). Details of this landfill (Warrenby Historical Landfill) are summarised in Table 10A-9, below.

Table 10A-9: Quarrying and Landfill Entries - CO_2 Export Pipeline

Relevant Feature	On site (within 25m)	Off-site (within 250m)	Envirocheck Map ID
Historical Landfill Sites	Name: Warrenby, Location: Land Adjacent To Redcar Blast Furnace, Redcar, Cleveland Reference: EAHLD05576, CLE 87 Waste: Inert and Industrial Waste		2G101

10.8.73 The Envirocheck data identifies that British Steel Plc are the license holders for the landfill. The first and last input dates are not supplied.

10.8.74 The Envirocheck data identifies several areas of potentially infilled land (water) on and near the site area from their review of the historical mapping. These areas are shown in Figure 10-8: Infilled Land – Water (ES Volume II, Document Ref. 6.3). Figure 10-8: Infilled Land – Water (ES Volume II, Document Ref. 6.3) shows the CO_2 Export Pipeline within green hatched zones. In review of Figure 10-8: Infilled Land – Water (ES Volume II, Document Ref. 6.3) and the historical OS maps it is suggested that the areas of potential infilled land are associated with historical land reclamation of marshland and coastline between 1856 and 1953, and appear to have been infilled as part of, or, just before construction of the former Redcar Iron and Steel Works and redevelopment as Teesside Works (Redcar Blast Furnace and Coking Works). These features may have a significant impact on development of the CO_2 Export Pipeline site and will need further assessment through ground investigation.

Water Connections Corridor

10.8.75 The Envirocheck data, presented in Figure: 10-5 Quarrying and Landfill (ES Volume II, Document Ref. 6.3), identifies multiple entries under Historical Landfill Sites, Registered Landfill Sites and Licensed Waste Management Facilities (boundaries) depending on the date of entry as well as to reflect the change in land use, i.e. from Historical Landfill Site to Registered Landfill Site. These quarrying and landfill entries are summarised in Table: 10A-10.

Table 10A-10: Quarrying and Landfill Entries - Water Connections Corridor

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Envirocheck Map ID
Historical Landfill Sites	Name: Warrenby, Location: Land Adjacent To Redcar Blast Furnace, Redcar, Cleveland Reference: EAHLD05576, CLE 87 Waste: Inert and Industrial Waste		2F41, G101
Historical Landfill Sites		Name: B S Redcar Works, Location: Steel House, Redcar, Cleveland Reference: EAHLD36066 Waste: Industrial Waste	2F42
Historical Landfill Sites	Name: Blast Furnace Plant, Location: Redcar Complex, Cleveland Reference: EAHLD05682, CLE 68/2 Waste: Industrial Waste		2G100
Registered Landfill Sites	Name: Coke Ovens, Redcar Works Location: Redcar, Cleveland Reference: CLE 97 Waste: Eff. from Coke Fines Recovery Plant Max Input Rate: Very Large (Equal to or greater than 250,000 tonnes per year)		2F62

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Envirocheck Map ID
	Status: Licence known to be Surrendered Dated: 1st October 1980		
Licensed Waste Management Facilities (Landfill Boundaries)		Name: B S Redcar Works, Location: Teesside Division, Steel House, Redcar, Cleveland, TS10 5QW Licence Number: 60141 Waste: Industrial Waste	2F44
Licensed Waste Management Facilities (Landfill Boundaries)	Name: Blast Furnace Plant, BSC Redcar Works Complex, Location: Redcar, Cleveland, TS10 5NT Licence Number: 68638 Waste: Industrial Waste		2G102

N.O.S: Not Otherwise Specified

10.8.76 The identified landfills below this part of the site may represent an onerous development constraint. Due to less rigorous controls on landfilling prior to EU Landfill Directive 1993/33/EC, historical landfills may represent a potential harmful landfill gas risk due to inclusion of biodegradable content that will require further assessment during ground investigation for foundations or underground structures.

10.8.77 There is a potential that Registered Landfill sites could pose a risk to the site due to the nature of some of the waste material deposited in the landfill sites, i.e. purge water (contaminated) and prohibited waste, it is considered that Registered Landfill sites CLE 124/3 and CLE 68/2 may pose a risk to the Water Connection site area.

10.8.78 The Envirocheck Report identifies three waste management sites, presented in Figure: 10-6 Waste Management (ES Volume II, Document Ref. 6.3). The waste management entries are summarised in Table 10A-11.

Table 10A-11: Waste Management - Water Connections Corridor

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Envirocheck Map ID
Licensed Waste Management Facilities (Locations)		Redcar, Cleveland, TS10 5NT Licence Number: 68638 Category: Industrial Waste Landfills Licence Status: Expired Issued: 19th July 1993 Expires: 1st April 1996	2F47
Licensed Waste Management Facilities (Locations)		Teesside Division, Steel House, Redcar, Cleveland, TS10 5QW Licence Number: 60141 Category: Industrial Waste Landfills Licence Status: Surrendered Issued: 12th January 1983 Surrendered: 29th November 2018	2F48

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Envirocheck Map ID
Licensed Waste Management Facilities (Locations)		Location: Land Adjacent to Redcar Blast Furnace, Redcar, Cleveland, TS10 5RD Licence Number: 60250 Category: Landfills Taking Non-biodegradable Wastes (Not Construction) Licence Status: Surrendered Issued: 11th December 1979 Surrendered: 13th April 1997	2G106
Licensed Waste Management Facilities (Landfill Boundaries)		Name: Warrenby Landfill Location: Teesside Works Redcar Licence Number: 60138 Category: Household, Commercial and Industrial Waste Landfills Licence Status: Modified Issued: 14th June 1977	

10.8.79 The Licensed Waste Management Facility (Locations), Licence Number: 60250, appears to be related to EA historic landfill site, Licence Number: EAHLD05576. There is a potential that the Licenced Waste Management Facilities sites could pose a risk to the site due to the nature of some of the industrial waste material deposited into landfill, i.e. potentially harmful landfill; gas, purge water (contaminated) and prohibited wastes.

10.8.80 The Envirocheck data identifies numerous areas of potentially infilled land (water) on and near the site area from their review of the historical mapping. These areas are shown in Figure 10-8: Infilled Land – Water (ES Volume II, Document Ref. 6.3), which shows the Water Connections Corridor falling within green hatched zones. In review of the figure and the historical OS maps it is suggested that the areas of potential infilled land are associated with historical land reclamation of marshland and coastline between 1856 and 1953, and appear to have been infilled as part of, or, just before construction of the former Redcar Iron and Steel Works and redevelopment as Teesside Works (Redcar Blast Furnace and Coking Works). These features may have a significant impact on development of the Water Connections Corridor site and will need further assessment through Ground Investigation.

CO_2 Gathering Network and Natural Gas Connection Corridors

10.8.81 Due to the great length and low impact of development of the proposed CO_2 Gathering Network and Natural Gas Connection Corridors only on-site pertinent features will be described in each respective table.

10.8.82 As the CO_2 Gathering Network and Natural Gas Connection Corridors are proposed to be situated above ground using existing conduits/ pipelines, the risk of quarrying and landfill hazards affecting the proposed layout is low.

10.8.83 The Envirocheck data, presented in Figure: 10-5 Quarrying and Landfill (ES Volume II, Document Ref. 6.3), identifies multiple entries under Historical Landfill Sites, Registered Landfill Sites and Licensed Waste Management

Facilities (boundaries) depending on the date of entry as well as to reflect the change in land use, i.e. from Historical Landfill Site to Registered Landfill Site. These quarrying and landfill entries are summarised in Table 10A-12.

Table 10A-12: Quarrying and Landfill Entries - CO_2 Gathering Network and Natural Gas Connection Corridors

Relevant Feature	On site (within 25m)	Envirocheck Map ID
BGS Recorded Mineral Sites (Underground)	Name: Billingham Anhydrite Mine, Location: Billingham, Cleveland Reference: **4968** Commodity: Anhydrite Geology: Billingham Main Anhydrite (Permian) Status: Ceased	1A129
BGS Recorded Mineral Sites (Opencast)	Name: Haverton Hill Brick Works, Location: Billingham, Co Durham Reference: **123958** Commodity: Common Clay and Shale Geology: Glaciolacustrine Deposits, Devensian (Quaternary) Status: Ceased	1A132
BGS Recorded Mineral Sites (Opencast)	Name: Kinkerdale Brick Yard, Location: Grangetown, Middlesbrough, Cleveland Reference: **110278** Commodity: Common Clay and Shale Geology: Glaciolacustrine Deposits, Devensian (Quaternary) Ceased	2C187
Historical Landfill Sites	Name: South of the Seal Sands Road, Location: Adjacent to the Monsanto site Reference: **EAHLD05490, CLE/R 4/1** Waste: Inert, Industrial and Commercial Waste First Input Date: 31st December 1973 Last Input Date: 31st December 1978	1F299 1G102
Historical Landfill Sites	Name: Redcar Trunk Road Landscaping, Location: Redcar, Cleveland Reference: **EAHLD05591, CLE 255** Waste: Inert and Industrial Waste First Input Date: 14th September 1977 Last Input Date: 10th August 1979	2D153 2G98 2C112
Historical Landfill Sites	Name: Teesport Eston Tip, Location: Redcar, Cleveland Reference: **EAHLD05578, CLE 29/3** Waste: Inert, Industrial, Commercial and Household Waste First Input Date: 31st December 1977 Last Input Date: 17th September 1993	2F37
Historical Landfill Sites	Name: West Coatham Lane, Location: Dormanstown, Redcar, Cleveland Reference: **EAHLD05592** Waste: Inert Waste First Input Date: 25th January 1993 Last Input Date: 1st February 1993	2G97

Relevant Feature	On site (within 25m)	Envirocheck Map ID
Historical Landfill Sites	Name: Redcar Complex, Location: Redcar Landscaping, Redcar, Cleveland Reference: **EAHLD05585, CLE 31/6, BRI003** First Input Date: Not Supplied Last Input Date: Not Supplied	2G99
Registered Landfill Sites	Name: Bran Sands Waste Disposal Site Location: Wilton Works, Middlesbrough, Cleveland Reference: **CLE 24/9, CLE 24/2** Waste: Alkalis All Inorganic Compounds Asbestos Canteen Waste Commercial Waste Construction Ind. Wastes Contaminated Materials Fuels, Oils, Greases Ind. Non-Haz. Inert, Non-Flammable Ind. Non-Haz. Potentially Combustible Interceptor Waste, Tar, Paint Etc Maximum Waste Specified In Lic. Metal Oxides Metals As Trace Contam.Of Group J Miscellaneous Chemical Waste Miscellaneous Wastes Non-Toxic Metal Compounds Organic Acids + Related Cmpds Organic Compounds Other Inorganic Materials Polymeric Materials And Precursors Toxic Metal Compounds Prohibited Waste Arsenates & Arsenites Fellmongers Waste Ferro And Ferri Cyanides Fluorides Etc Hypochlorites And Chlorites Inorganic Peroxides Liable To Cause Environmental Hazards Organic Peroxides Other Halogenated Organics Pcb'S And Analogues Sodium/Potassium Cyanides Soluble Complex Cyanides Sulphides, Selen'S, Tell'S, Arsen'S $ Tannery Waste Tetra Ethyl Lead Tetra Methyl Lead Waste N.O.S. Waste React.W/Water -Airborne Hazard Wastes Likely To Cause Odour Emission Max Input Rate: Small (Equal to or greater than 10,000 and less than 25,000 tonnes per year) Status: Operational as far as is known Dated: 1st July 1988	1H25
Registered Landfill Sites	Name: Bran Sands Waste Disposal Site Location: Wilton Works, Middlesbrough, Cleveland Reference: **CLE 24/9, CLE 24/2** Waste: Alkalis All Inorganic Compounds Asbestos Canteen Waste Commercial Waste Construction Ind. Wastes Contaminated Materials Fuels, Oils, Greases Ind. Non-Haz. Inert, Non-Flammable Ind. Non-Haz. Potentially Combustible Interceptor Waste, Tar, Paint Etc Maximum Waste Specified In Lic. Metal Oxides Metals As Trace Contam.Of Group J Miscellaneous Chemical Waste Miscellaneous Wastes Non-Toxic Metal Compounds Organic Acids + Related Cmpds Organic Compounds Other Inorganic Materials Polymeric Materials And Precursors Toxic Metal Compounds Prohibited Waste Arsenates & Arsenites Fellmongers Waste Ferro And Ferri Cyanides Fluorides Etc $ Hypochlorites And Chlorites Inorganic Peroxides Liable To Cause Environmental Hazards Organic Peroxides Other Halogenated Organics Pcb'S And Analogues Sodium/Potassium Cyanides Soluble Complex Cyanides Sulphides, Selen'S, Tell'S, Arsen'S $ Tannery Waste Tetra Ethyl Lead Tetra Methyl Lead Waste N.O.S. Waste React.W/Water -Airborne Hazard Wastes Likely To Cause Odour Emission Max Input Rate: Small (Equal to or greater than 10,000 and less than 25,000 tonnes per year) Status: Operational as far as is known Dated: 1st July 1988	2C169 2D205 2G145

Relevant Feature	On site (within 25m)	Envirocheck Map ID
Licensed Waste Management Facilities (Landfill Boundaries)	Name: Bran Sands Landfill Location: Land/ Premises At, Bran Sands, Redcar, Cleveland, TS6 6UE Licence Number: **60092** Category: Other Landfill Sites Taking Special Waste	1H20
Licensed Waste Management Facilities (Landfill Boundaries)	Name: Bran Sands Landfill, Location: Land/ Premises At, Bran Sands, Redcar, Cleveland, TS6 6UE Licence Number: **60092** Category: Other Landfill Sites Taking Special Waste	2C116 2D157 2G103
Historical Landfill Sites	Name: W. of Wolviston to Seal Sands link Road Location: Saltholme Mounting, Billingham, Cleveland Reference: EAHLD05492, CLE/R20 Waste: Inert and Industrial Waste	

10.8.84 The potential landfill and quarrying hazards on site are not considered a risk to the Proposed Development as the CO_2 Gathering Network and Natural Gas Connection Corridors are anticipated to utilise the existing pipelines and / or conduits.

10.8.85 The Envirocheck Report identifies five waste management sites, presented in Figure 10-6: Waste Management (ES Volume II, Document Ref. 6.3). The waste management entries are summarised in Table 10A-13, below.

Table 10A-13: Waste Management - CO_2 Gathering Network and Gas Connection Corridors

Relevant Feature	On site (within 25m)	Envirocheck Map ID
Licensed Waste Management Facilities (Locations)	Name: Bran Sands Landfill Location: Land/ Premises At, Bran Sands, Redcar, Cleveland, TS6 6UE Licence Number: **60092** Category: Other Landfill Sites Taking Special Waste Licence Status: Modified Issued: 24th May 1977	2G107

10.8.86 The waste management features on site are not considered a risk to the proposed development as the CO_2 Connectivity and Natural Gas Corridors are anticipated to utilise the existing pipelines and / or conduits.

10.8.87 The Envirocheck data identifies one area of potentially infilled land (non-water) on site, shown on Figure 10-7: Infilled Land - Non Water (ES Volume II, Document Ref. 6.3) and the entry has been summarised in Table 10A-14.

Table 10A-14: Potentially Infilled Land (non-water) - CO_2 Gathering Network and Gas Connection Corridors

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Envirocheck Map ID
Potentially Infilled Land (Non-Water)	Unknown Filled Ground (Pit, quarry etc), dated 1992. Former Annealed Concrete Works located adjacent to the Darlington - Saltburn Railway Branch line and north of Grangetown.		2C124

10.8.88 The area of potential infilled land (non-water) hazard on site is not considered a risk to the Proposed Development as the CO_2 Gathering Network and Natural Gas Connection Corridors are anticipated to utilise the existing pipelines and / or conduits.

10.8.89 The Envirocheck data identifies numerous areas of potentially infilled land (water) on and near the site area from their review of the historical mapping. These areas are shown in Figure 10-8: Infilled Land – Water (ES Volume II, Document Ref. 6.3), which shows the CO_2 Gathering Network and Natural Gas Connection Corridors falling within green hatched zones. In review of Figure 10-8: Infilled Land – Water (ES Volume II, Document Ref. 6.3) and the historical OS maps it is suggested that the areas of potential infilled land are predominantly associated with historical land reclamation of marshland and coastline and several historical reservoirs. The figure also presents lines and points which are generally associated with historical ponds, streams, drains and culverts. These features are historical recorded between 1857 and 1955 and appear to have been subsequently infilled as part of, or, just before reclamation of this area and subsequent construction of the Seal Sands Industrial Estate and the former Redcar Works. These features appear to have historically been infilled. These features could need further assessment through ground investigation if there are significant construction works such as but not restricted to: piled foundations, heavily loaded structures or deep excavations.

10.8.90 The areas of potential infilled land (water) hazards on site are not considered risks to the Proposed Development as the CO_2 Gathering Network and Natural Gas Connection Corridors are anticipated to utilise the existing pipelines and / or conduits.

Electrical Connection Corridor

10.8.91 Due to the great length and low impact of development of the proposed Electrical Connection Corridor only on-site pertinent features will be described in each respective table.

10.8.92 As the Electrical Connection Corridor are proposed to be situated above ground using existing electrical systems, the risk of quarrying and landfill hazards affecting the proposed layout is low.

10.8.93 The Envirocheck data, presented in Figure 10-5: Quarrying and Landfill (ES Volume II, Document Ref. 6.3)), identifies multiple entries under Historical Landfill Sites, Registered Landfill Sites and Licensed Waste Management

Facilities (boundaries) depending on the date of entry as well as to reflect the change in land use, i.e. from Historical Landfill Site to Registered Landfill Site. These quarrying and landfill entries are summarised in Table 10A-15.

Table 10A-15: Quarrying and Landfill Entries - Electrical Connection Corridor

Relevant Feature	On site (within 25m)	Envirocheck Map ID
BGS Recorded Mineral Sites (Opencast)	Name: Kinkerdale Brick Yard, Location: Grangetown, Middlesbrough, Cleveland Reference: **110278** Commodity: Common Clay and Shale Geology: Glaciolacustrine Deposits, Devensian (Quaternary) Status: Ceased	2C187
Historical Landfill Sites	Location: West Coatham Lane, Dormanstown, Redcar, Cleveland Reference: **EAHLD05592** Waste: Inert Waste First Input Date: 25th January 1993 Last Input Date: 1st February 1993	2G97
Historical Landfill Sites	Location: Redcar Complex, Redcar Landscaping, Redcar, Cleveland Reference: **EAHLD05585**	2G99
Registered Landfill Sites	Location: Bran Sands Waste Disposal Site, Wilton Works, Middlesbrough, Cleveland Reference: **CLE 24/9** Waste: Alkalis All Inorganic Compounds Asbestos Canteen Waste Commercial Waste Construction Ind. Wastes Contaminated Materials $ Fuels, Oils, Greases Ind. Non-Haz. Inert, Non-Flammable Ind. Non-Haz. Potentially Combustible Interceptor Waste, Tar, Paint Etc $ Maximum Waste Specified In Lic. Metal Oxides Metals As Trace Contam.Of Group J Miscellaneous Chemical Waste Miscellaneous Wastes Non-Toxic Metal Compounds Organic Acids + Related Cmpds Organic Compounds Other Inorganic Materials Polymeric Materials And Precursors Toxic Metal Compounds Prohibited Waste Arsenates & Arsenites Fellmongers Waste Ferro And Ferri Cyanides Fluorides Etc $ Hypochlorites And Chlorites Inorganic Peroxides Liable To Cause Environmental Hazards Organic Peroxides Other Halogenated Organics, PCBs and Analogues Sodium/Potassium Cyanides Soluble Complex Cyanides Sulphides, Selen's, Tell's, Arsen's $ Tannery Waste Tetra Ethyl Lead Tetra Methyl Lead Waste N.O.S. Waste React.W/Water -Airborne Hazard Wastes Likely To Cause Odour Emission Max Input Rate: Small (Equal to or greater than 10,000 and less than 25,000 tonnes per year) Status: Operational as far as is known Dated: 1st July 1988	2C169, 2D205, 2G145

10.8.94 The potential landfill and quarrying hazards on site are not considered a significant risk to the proposed development as the Electrical Connection Corridor are anticipated to primarily utilise the existing electrical systems. Where new connections are proposed, these sites may pose a risk, for example from potentially harmful landfill gas or excavation of potentially contaminated soils in order to construct foundations for overhead pylons.

10.8.95 There are no waste management sites present within the Electrical Connection Corridor, as presented in Figure 10-6: Waste Management (ES Volume II, Document Ref. 6.3).

10.8.96 As previously mentioned, the waste management entries in the vicinity of the site are not considered risks to the proposed development as the Electrical Connection Corridor are anticipated to utilise the existing electrical connections.

10.8.97 The areas of potential infilled land (non-water) hazards on site is not considered risks to the proposed development as the Electrical Connection Corridor are anticipated to utilise the existing electrical systems.

10.8.98 The Envirocheck data identifies numerous areas of potentially infilled land (water) on and near the site area from their review of the historical mapping. These areas are shown in Figure 10-8: Infilled Land – Water (ES Volume II, Document Ref. 6.3), which shows the north and north western portions of the Electrical Connection Corridor falling within green hatched zones. In review of Figure 10-8: Infilled Land – Water (ES Volume II, Document Ref. 6.3) and the historical OS maps it is suggested that these areas of potential infilled land are associated with historical land reclamation of marshland and coastline and several historical reservoirs. The figure also includes lines and points which are generally associated with historical ponds, streams, drains and culverts. These features are historical recorded between 1857 and 1953 and appear to have been subsequently infilled as part of, or, just before reclamation of this area and subsequent construction of the Redcar Works and various other industrial works. These features could need further assessment through ground investigation if there are significant construction works such as but not restricted to: piled foundations, heavily loaded structures or deep excavations.

10.8.99 The areas of potential infilled land (water) hazards on site are not considered risks to the Proposed Development as the Electrical Connection Corridor are anticipated to utilise the existing electrical systems.

BGS Hazards

10.8.100 The Envirocheck Report and Site Sensitivity maps are included in Annex B. Details of BGS hazards within the individual site areas are summarised in Table 10A-16.

Table 10A-16: BGS Hazards

BGS Hazard	Hazard Potential
PCC SITE	
Potential for Collapsible Ground Stability Hazards	No Hazard
Potential for Compressible Ground Stability Hazards	Very Low to Moderate
Potential for Ground Dissolution Stability Hazards	No Hazard
Potential for Landslide Ground Stability Hazards	Very Low
Potential for Running Sand Ground Stability Hazards	Very Low to High
Potential for Shrinking or Swelling Clay Ground Stability Hazards	No Hazard to Very Low
Radon Potential - Radon Affected Areas	The property is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level).
Radon Potential - Radon Affected Areas	The property is in an Intermediate probability radon area (1 to 3% of homes are estimated to be at or above the Action Level).
Radon Potential - Radon Protection Measures	No radon protective measures are necessary in the construction of new dwellings or extensions
CO_2 EXPORT PIPELINE	
Potential for Collapsible Ground Stability Hazards	No Hazard
Potential for Compressible Ground Stability Hazards	Very Low to Moderate
Potential for Ground Dissolution Stability Hazards	No Hazard
Potential for Landslide Ground Stability Hazards	Very Low
Potential for Running Sand Ground Stability Hazards	Low to High
Potential for Shrinking or Swelling Clay Ground Stability Hazards	No Hazard to Low

BGS Hazard	Hazard Potential
Radon Potential - Radon Affected Areas	The property is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level).
Radon Potential - Radon Affected Areas	The property is in an Intermediate probability radon area (1 to 3% of homes are estimated to be at or above the Action Level).
Radon Potential - Radon Protection Measures	No radon protective measures are necessary in the construction of new dwellings or extensions.
WATER SUPPLY AND DISCHARGE CORRIDORS	
Potential for Collapsible Ground Stability Hazards	No Hazard
Potential for Compressible Ground Stability Hazards	No Hazard to Moderate
Potential for Ground Dissolution Stability Hazards	No Hazard
Potential for Landslide Ground Stability Hazards	Very Low
Potential for Running Sand Ground Stability Hazards	Very Low to High
Potential for Shrinking or Swelling Clay Ground Stability Hazards	No Hazard to Very Low
Radon Potential - Radon Affected Areas	The property is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level).
Radon Potential - Radon Affected Areas	The property is in an Intermediate probability radon area (1 to 3% of homes are estimated to be at or above the Action Level).
Radon Potential - Radon Protection Measures	No radon protective measures are necessary in the construction of new dwellings or extensions.
CO_2 GATHERING NETWORK AND NATURAL GAS CONNECTION CORRIDORS	
Potential for Collapsible Ground Stability Hazards	No Hazard to Very Low
Potential for Compressible Ground Stability Hazards	No Hazard to High
Potential for Ground Dissolution Stability Hazards	No Hazard
Potential for Landslide Ground Stability Hazards	Very Low to Low

BGS Hazard	Hazard Potential
Potential for Running Sand Ground Stability Hazards	No Hazard to High
Potential for Shrinking or Swelling Clay Ground Stability Hazards	No Hazard to Low
Radon Potential - Radon Affected Areas	The property is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level).
Radon Potential - Radon Affected Areas	The property is in an Intermediate probability radon area (1 to 3% of homes are estimated to be at or above the Action Level).
Radon Potential - Radon Affected Areas	The property is an Intermediate probability radon area (3 to 5% of homes are estimated to be at or above the Action Level).
Radon Potential - Radon Protection Measures	No radon protective measures are necessary in the construction of new dwellings or extensions.
Radon Potential - Radon Protection Measures	Basic radon protective measures are necessary in the construction of new dwellings or extensions.
ELECTRICAL CONNECTION CORRIDOR	
Potential for Collapsible Ground Stability Hazards	No Hazard to Very Low
Potential for Compressible Ground Stability Hazards	No Hazard to Moderate
Potential for Ground Dissolution Stability Hazards	No Hazard
Potential for Landslide Ground Stability Hazards	Very Low to Low
Potential for Running Sand Ground Stability Hazards	No Hazard to High
Potential for Shrinking or Swelling Clay Ground Stability Hazards	No Hazard to Low
Radon Potential - Radon Affected Areas	The property is in a Lower probability radon area (less than 1% of homes are estimated to be at or above the Action Level).
Radon Potential - Radon Affected Areas	The property is in an Intermediate probability radon area (1 to 3% of homes are estimated to be at or above the Action Level).
Radon Potential - Radon Affected Areas	The property is an Intermediate probability radon area (3 to 5% of homes are estimated to be at or above the Action Level).

BGS Hazard	Hazard Potential
Radon Potential - Radon Protection Measures	No radon protective measures are necessary in the construction of new dwellings or extensions.
Radon Potential - Radon Protection Measures	Basic radon protective measures are necessary in the construction of new dwellings or extensions.

10.8.101 Areas recorded with a high potential for running sand are likely to be associated with watercourses, River Tees and/ or coastline.

10.8.102 A small area along the western CO_2 Gathering Network and Natural Gas Connection Corridors is recorded with a high compressible ground hazard, this is likely to be associated with the adjacent reservoirs and the underlying peat deposits.

10.8.103 The Envirocheck Report indicates that there is an area underlying the existing railway lines adjacent to Tees Dock Road within both the CO_2 Gathering Network and Natural Gas Connection Corridors, and the Electrical Connections Corridors. That is identified as an Intermediate probability radon area. In this region, 3 to 5% of homes are estimated to be at or above the Action Level, basic radon protection measures are required.

10.8.104 BGS hazards across the entire site do not constitute unusual or onerous development constraints.

Hydrology

10.8.105 Figure 10-16: Flood Risk (ES Volume II, Document Ref. 6.3) and Figure 10-20: Risk of Flooding from Rivers and Seas (ES Volume II, Document Ref. 6.3) present areas at risk from flooding across the site area.

10.8.106 The Envirocheck Report and Site Sensitivity maps are included in Annex B. Details of hydrological features at each of the respective site areas are summarised in Table 10A-17.

Table 10A-17: Hydrology

Relevant Feature	On site	Off-site (within 250m)
PCC SITE		
Extreme Flooding from Rivers or Sea without Defences	None	None
Flooding from Rivers or Sea without Defences	None	None
Risk of Flooding from Rivers and Seas	None	None
Areas Benefiting from Flood Defences	None	None
Flood Defences	None	None
CO_2 EXPORT PIPELINE		
Extreme Flooding from Rivers or Sea without Defences	None	None
Flooding from Rivers or Sea without Defences	Yes – Zone 3	Yes – Zone 3
Risk of Flooding from Rivers and Seas	High	High
Areas Benefiting from Flood Defences	None	None
Flood Defences	None	None
WATER SUPPLY AND DISCHARGE CORRIDORS		
Extreme Flooding from Rivers or Sea without Defences	Yes – Zone 2	None
Flooding from Rivers or Sea without Defences	Yes – Zone 3	Yes – Zone 3
Risk of Flooding from Rivers and Seas	Low to High	High
Areas Benefiting from Flood Defences	None	None
Flood Defences	None	None
CO_2 GATHERING NETWORK AND NATURAL GAS CONNECTION CORRIDORS		
Extreme Flooding from Rivers or Sea without Defences	Yes – Zone 2	Yes – Zone 2

Relevant Feature	On site	Off-site (within 250m)
Flooding from Rivers or Sea without Defences	Yes – Zone 3	Yes – Zone 3
Risk of Flooding from Rivers and Seas	Low to High	Low to High
Areas Benefiting from Flood Defences	Yes	Yes
Flood Defences	None	None
ELECTRICAL CONNECTION CORRIDOR		
Extreme Flooding from Rivers or Sea without Defences	Yes – Zone 2	Yes – Zone 2
Flooding from Rivers or Sea without Defences	Yes – Zone 3	Yes – Zone 3
Risk of Flooding from Rivers and Seas	Low to High	Low to High
Areas Benefiting from Flood Defences	None	None
Flood Defences	None	None

10.8.107 The areas identified at risk from flooding from rivers or seas are likely to be associated with the River Tees and tidal activity along the coastline. A vast area north of Port Clarence which extends up to the site, is shown at risk of flooding, the area appears to fall within a floodplain comprising numerous watercourses and reservoirs which may be attributable to causes of flooding. Figure 10-16: Flood Risk (ES Volume II, Document Ref. 6.3) and Figure 10-20: Risk of Flooding from Rivers and Seas (ES Volume II, Document Ref. 6.3) show an area from the north of Teesport Docks to west of Dormanstown, Trunk Road Roundabout, at low to high risk of flooding, this is associated with several unnamed watercourses.

10.8.108 Hydrological features across the entire site do not constitute unusual or onerous development constraints.

Hydrogeology

10.8.109 Figure 10-17: Bedrock Aquifer (ES Volume II, Document Ref. 6.3) and Figure 10-18: Superficial Aquifer (ES Volume II, Document Ref. 6.3) present the designated superficial and bedrock aquifers below the site, respectively. The designated aquifers have been defined by the Environment Agency (EA) below.

10.8.110 Principal Aquifer: *"layers of rock or drift deposits that have high intergranular and / or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and / or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer".*

10.8.111 Secondary Aquifer – A: *"permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers".*

10.8.112 Secondary Aquifer – B: *"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. These are generally the water-bearing parts of the former non-aquifers".*

10.8.113 Secondary Aquifer – Undifferentiated: *"has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type".*

10.8.114 Unproductive Strata: *"These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow".*

10.8.115 The Envirocheck Report and Site Sensitivity maps are included in Annex B. Details of hydrogeological features within the respective site areas are summarised in Table 10A-18.

Table 10A-18: Hydrogeology

Relevant Feature	Aquifer Designation	Strata
PCC Site		
Superficial Aquifer Designation	Secondary Aquifer – A Unproductive Strata Unproductive Strata	Blown Sand and Tidal Flat Deposits (sand and silt) Glacio-lacustrine deposits Glacial Till
Bedrock Aquifer Designation	Principal Aquifer Secondary Aquifer – B Secondary Aquifer – Undifferentiated	Sherwood Sandstone Group- Sandstone Mercia Mudstone Group – Mudstone and Penarth Group - Mudstone Redcar Mudstone Formation
Groundwater Vulnerability	High Vulnerability	
Productivity	Productive	
Source Protection Zones	None (Magic Defra)	
CO_2 Export Pipeline		
Superficial Aquifer Designation	Secondary Aquifer – A Unproductive Strata Unproductive Strata	Blown Sand and Tidal Flat Deposits (sand and silt) Glacio-lacustrine deposits Glacial Till
Bedrock Aquifer Designation	Principal Aquifer Secondary Aquifer – Undifferentiated Secondary Aquifer – B	Sherwood Sandstone Group- Sandstone Redcar Mudstone Formation Mercia Mudstone Group and Penarth Group
Groundwater Vulnerability	High Vulnerability	
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	
Water Connection Corridors		
Superficial Aquifer Designation	Secondary Aquifer – A	Blown Sand and Tidal Flat Deposits (sand and silt)

Relevant Feature	Aquifer Designation	Strata
	Secondary Aquifer – Undifferentiated Unproductive Strata Unproductive Strata	Tidal Flat Deposits (sand, silt and clay) Glacio-lacustrine deposits Glacial Till
Bedrock Aquifer Designation	Principal Aquifer Secondary Aquifer – Undifferentiated Secondary Aquifer - B	Sherwood Sandstone Group- Sandstone Redcar Mudstone Formation Mercia Mudstone Group and Penarth Group
Groundwater Vulnerability	High Vulnerability	
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	
CO_2 Gathering Network and Natural Gas Connection Corridors		
Superficial Aquifer Designation	Secondary Aquifer – A Secondary Aquifer – Undifferentiated Unproductive Strata	Blown Sand and Tidal Flat Deposits (sand and silt) Till (Diamicton) and Tidal Flat Deposits (sand, silt and clay) Glaciolacustrine Deposits (clay and silt) and peat
Bedrock Aquifer Designation	Principal Aquifer Secondary Aquifer – Undifferentiated Secondary Aquifer - B	Sherwood Sandstone Group Penarth Group and Redcar Mudstone Formation Mercia Mudstone Group and Penarth Group
Groundwater Vulnerability	High Vulnerability	
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	
Electrical Connection Corridor		
Superficial Aquifer Designation	Secondary Aquifer – A Secondary Aquifer – Undifferentiated Unproductive Strata	Glaciofluvial Deposits (sand and gravel), Blown Sand, Tidal Flat Deposits (sand and silt) and Glaciolacustrine Deposits (sand) Tidal Flat Deposits (sand, silt and clay) Till (Diamicton)

Relevant Feature	Aquifer Designation	Strata
		Glaciolacustrine Deposits (clay and silt)
Bedrock Aquifer Designation	Principal Aquifer Secondary Aquifer – Undifferentiated Secondary Aquifer - B	Sherwood Sandstone Group- Sandstone Redcar Mudstone Formation and Penarth Group Penarth Group and Mercia Mudstone Group
Groundwater Vulnerability	High Vulnerability	
Productive Strata	Productive	
Source Protection Zones	None (Magic Defra)	

10.8.116 The aquifer designations and inferred groundwater vulnerability risk may constitute an unusual or onerous constraint for development, particularly in relation to the historical slag / iron and steel works, infilled land and registered and historical landfills on the site. Ground investigation and installation of groundwater quality monitoring standpipes is proposed. Further groundwater risk assessment may be required.

10.8.117 BGS Groundwater Flood Susceptibility (GFS) data is also provided in the Envirocheck Report. Details of the potential for groundwater flooding within 200 m of the site are shown in Table 10A-20. Figure: 10-19 BGS Flood Susceptibility (ES Volume II, Document Ref. 6.3) shows the extent of the potential for groundwater flooding to occur across the site area.

Table 10A- 19: BGS Groundwater Flooding Potential

Site Area	Relevant Feature (On site)
PCC Site	
Flood Susceptibility	Potential for Groundwater Flooding of Property Situated Below Ground Level.
Flood Susceptibility	Potential for Groundwater Flooding to Occur at Surface.
CO_2 Export Pipeline	
Flood Susceptibility	Potential for Groundwater Flooding of Property Situated Below Ground Level.
Flood Susceptibility	Potential for Groundwater Flooding to Occur at Surface.
Water Supply and Discharge Connection Corridors	
Flood Susceptibility	Potential for Groundwater Flooding of Property Situated Below Ground Level.
Flood Susceptibility	Potential for Groundwater Flooding to Occur at Surface.
CO_2 Gathering Network and Natural Gas Connection Corridors	
Flood Susceptibility	No Potential for Groundwater Flooding to Occur.
Flood Susceptibility	Limited Potential for Groundwater Flooding to Occur.
Flood Susceptibility	Potential for Groundwater Flooding of Property Situated Below Ground Level.
Flood Susceptibility	Potential for Groundwater Flooding to Occur at Surface.
Electrical Connection Corridor	
Flood Susceptibility	No Potential for Groundwater Flooding to Occur.
Flood Susceptibility	Limited Potential for Groundwater Flooding to Occur.
Flood Susceptibility	Potential for Groundwater Flooding of Property Situated Below Ground Level.
Flood Susceptibility	Potential for Groundwater Flooding to Occur at Surface.

10.8.118 The groundwater flooding potential may constitute an unusual or onerous constraint for development. Ground investigation and installation of groundwater monitoring standpipe piezometers is proposed.

Historical Development

10.8.119 Envirocheck Reports (Reference: 218629364_1_1 (EC1) and 218629437_1_1 (EC2)) dated 19/09/2019 were procured for the scheme. The report includes Ordnance Survey (OS) Maps dated between 1856 and 2019, provided in Annex B. An overview of the historical development on and within the vicinity of the site are provided as digital features supplied by Landmark in Figure: 10-10 Contaminated Land – Point (ES Volume II, Document Ref. 6.3), Figure: 10-11 Contaminated Land – Line (ES Volume II, Document Ref. 6.3) Figure: 10-12 Contaminated Land – Polygon (ES Volume II, Document Ref. 6.3), and Figure: 10-13 Historic Tanks (ES Volume II, Document Ref. 6.3). Pertinent historical features from the small-scale mapping 1:2,500 Ordnance Survey mapping are incorporated within the 1:10,000 and 1:10,560 map dates described below in Table 10A-20.

10.8.120 As a separate exercise, significant features where these were readily apparent from historical mapping have been plotted in Figure 10-23: Historical Features (Sheets 1 to 3) (ES Volume II, Document Ref. 6.3) according to the following themes to be used as an adjunct to the Landmark information:

- Sitewide Industry;
- Transport Infrastructure; and
- Waste sites, quarries, localised areas of infilled land, historical watercourses, ponds, non-industrial land uses.

10.8.121 Due to congestion of the mapping over multiple map editions it is not practical to identify and overlay all map features, therefore for detailed design it will be necessary to review the maps presented in Annex B for full disclosure of all relevant features from historical mapping.

10.8.122 In the 1850s the areas surrounding Stockton and Redcar were predominantly recorded as agricultural land, marshland towards the coast and sand & mud adjacent to the River Tees. The towns of Redcar and Billingham were already established by this time.

10.8.123 Historical development on the PCC Site is dominated by two phases of development; first as Redcar Iron and Steel Works, and more recently the Redcar Blast Furnace and Coking Works (Teesside Works) acquired by SSI in 2012, and finally closed in 2015. The initial works comprised a steel works and a rolling mill, with the iron works assumed to be located east of the site. Most of the old structures relating to the Teesside Works still exist on site. Historical imagery shows that auxiliary buildings were present on the PCC Site; these have since been demolished, this may include a number of large chimneys. The extent to which relict foundations have been removed is unknown; however, investigations by AEG found buried foundations including tunnels below the site therefore it can be assumed that these may be quite extensive. It should also be noted that much of the site was reclaimed from the estuary in the 1800s to facilitate the construction of the

South Gare peninsular including the former breakwater below the site. A large proportion of the fill material appears to be end-tipped slag, likely to have been derived from iron works located to the east of the site. It is also known that dredgings were used to reclaim land either side of the main estuary channel, and these too may have been used on the site. Additional land was reclaimed to the south of the Redcar Iron and Steel Works by draining “The Marshes”, which facilitated later expansion of the works. Reclamation of areas of Bran Sands in the 1970s is likely to have utilised a similar methodology to that employed at Seal Sands, with construction of slag walls and placement of hydraulic fill dredged from the River Tees.

Table 10A-20: Historical Development

OS Map Edition(s)	Significant features on site	Significant features off site
PCC Site		
EC2_F_10000_ Yorkshire - 1856 - 1857 EC2_G_10000_ Yorkshire - 1856 - 1857 EC2_H_10000_ Yorkshire - 1856 - 1857 EC2_I_10000_ Yorkshire - 1856+A2:C8	Site is predominantly estuarine denoted to the west as "Bran Sands" with Todd Point breakwater situated on the east of the site at ~NGR E:457150 N:525120. The north boundary of the Site is the approximate line of the "Ordinary Spring Tide Mark".	The Stockton & Darlington Railway is situated along the coastline separating the estuary, breakwater and rock outcrops east site adjacent to Coatham Marsh, to the south east, at a minimum distance of 110 m from the Site boundary. The marsh is crossed by numerous drainage ditches and cuts, the largest of which is named "The Fleet". A short section of this drainage system is located at the nearest section of the railway to the site running parallel to the east of the line. Approximately 325 m to the south of this, one of the larger drains terminates at the railway indicating a possible culvert below the line at ~NGR E:457170 N:524520. A strip of land north of the marsh extends east from the site changing from rocky headland south of the coast to farmland. The nearest habitation is Marsh House at ~NGR E:457930 N:525060, approximately 600m east of the site. The area north of the Bran Sands is shown as Tees Bay (marine).
EC2_F_10000_Yorkshire - 1895, EC2_G_10000_Yorkshire - 1895 EC2_G5_2500_Yorkshire - 1894 EC2_G6_2500_Yorkshire - 1894 EC2_G9_2500_Yorkshire - 1894 EC2_G10_2500_Yorkshire - 1894 EC2_G13_2500_Yorkshire - 1894 EC2_G14_2500_Yorkshire - 1894	The central north east – south west strip of the Site has been reclaimed along the line of the South Gare stretching north west of the site. Three residential type structures are located at Todd Point centred around ~NGR E:457126 N:525082, ~NGR E:457154 N:525028 and ~NGR E:457167 N:524965, measuring ~30 m, ~50 m and ~20 m in length, respectively. The two smaller buildings resemble semi-detached houses, the larger building is a row of 10 terraces. The southern end of the terrace at ~NGR E:457160 N:525000 has a benchmark of 19.4. There is a water tank ("W.T.") at ~NGR E:457136 N:525065 north of the terrace. The buildings are in close proximity to a "Tramway", which enters the site at ~NGR E:457166 N:524861 in the south east corner of the Site, turning from north northeast to north east adjacent to the northern most of the three buildings at ~NGR E:457115 N:525070, and exiting the site at ~NGR E:456786 N:525507. A	The Darlington & Stockton Railway has been labelled as the Darlington - Saltburn Branch. Seven railway sidings lead from the branch line to Redcar Iron Works centred on ~NGR E:457490 N:524560 to the south east of the Site. Ten tramway sidings north of Redcar Iron Works join together before crossing the railway branch line and entering the Site. The edge of the Redcar Works is not clearly defined in the mapping; however the operations appear to extend to the Darlington & Stockton Railway branch line to the west. A pond approximately 20 m in diameter is situated 60m from the southeast corner of the Site. Coatham Iron Works is situated on the west of the Darlington - Saltburn Branch line centred at ~NGR E:457420 N:525030. The works includes five tramways which join prior to entering the Site, and there are also three rail sidings joining the

OS Map Edition(s)	Significant features on site	Significant features off site
	benchmark 10 m north of the tramway halfway across the Site at ~NGR E:457026 N:525221 is given as 15.2. The South Gare Breakwater runs approximately 30 m to the south east of the tramway. A strip of heathland south east of the breakwater varies in width from between ~70 m and ~160 m. On the west boundary of the Site south of the tramway, there is a causeway which approaches from a south-southwest direction. A footpath is shown running along the causeway on 1:2,500 mapping. A narrow strip of heathland runs along the east of the causeway which widens to a maximum width of ~30 m at the southern boundary of the Site. The area between the two strips of heathland between the breakwater and causeway are separated by sands, which are about 240 m wide aligned east - west at the intersection with the southern Site boundary. A pond approximately 55 m long and 15 m wide centred at ~NGR E:456778 N:525244 is shown on the east edge of the causeway, 130 m from the South Gare Breakwater. The area to the west of the causeway is labelled "Bran Sand". Additional tramways are situated across the centre of the Site in the reclaimed South Gare, which has been widened along the northern bank in the north west of the Site to a maximum extent of ~100 m. These link two off-site works "Coatham Iron Works" and "Redcar Iron Works" to the east and south east of the Site respectively, with South Gare. A line from the smaller Coatham Iron works, west of the Darlington & Stockton Railway, enters the site at ~NGR E:457321 N:525138 and runs northwest to ~NGR E:457225 N:525298, where it turns north northeast to meet a second tramway at ~NGR E:457265 N:525610. This second tramway is associated with the larger Redcar Iron Works, east of the Darlington & Stockton railway. This tramway enters the site in a south east – north west direction at ~NGR E:457374 N:525297, sub-parallel to the step in the eastern boundary of the Site, and splits into two shortly after the aforementioned tramway intersection. The bifurcated lines diverge only slightly and exit the Site at ~NGR E:456879 N:525750 and ~NGR E:456895	Darlington - Saltburn Branch line on the south side of the works. The area to the north of the works adjacent to the east boundary of the Site includes several small buildings and enclosures 25 m from the Site boundary and a reservoir 80m from the Site boundary at ~NGR E:457422 N:525189. A benchmark of 31.1 is marked on the tramway at ~NGR E:457447 N:525238 north east of the reservoir. Coatham Marsh dominates the area to the east of the Darlington - Saltburn Branch line beyond the Works. The new development of Warrenby is evident east of Marsh House along the coastal land strip including housing, a School, Mission Church, Chapel and Hotel. The central South Gare Tramway runs north westwards out of the site before turning west and slightly south along Redcar Jetty at ~NGR E:454850 N:525630 to Redcar Wharf and a dolphin on the navigable Tees Estuary.

OS Map Edition(s)	Significant features on site	Significant features off site
	N:525791, at a separation distance of about 40 m measured along the western Site boundary. The most northerly tramway splits into three lines approximately 50 m short of the Site boundary in the direction of travel. The strip of land to the north east of the most northern tramway is approximately 35 m wide. The north area of the site from ~32 m south of the north west corner and 100m south-southwest of the north east corner of the Site is mainly denoted as Coatham Sands. Two new fingers or spits of land (denoted in later mapping as "Slag Heaps") stretch from south to north off the South Gare across a portion of Coatham Sands adjacent to the eastern boundary of the site, assumed to be part of ongoing land reclamation activity. There are heaps of materials positioned in an area on the east of the site, south of the central tramway. An elongate north to south orientated heap measuring approximately 70 m by 20 m is situated south of a circular heap of approximately 40 m diameter at ~NGR E:457280 N:525305. These lie north west of a partially on-site composite triangular structure of heaps fanning from an area off-site adjacent to Coatham Iron Works.	
EC2_G5_2500_Yorkshire - 1915 EC2_G6_2500_Yorkshire - 1914 - 1915 EC2_G9_2500_Yorkshire - 1915 EC2_G10_2500_Yorkshire - 1914 - 1915 EC2_G13_2500_Yorkshire - 1915 EC2_G14_2500_Yorkshire - 1915 EC2_F_10000_Durham - 1923 EC2_G_10000_Yorkshire - 1920	A "Tar Macadam Works" is shown at ~NGR E:457327 N:525163 on the eastern Site boundary on the composite triangular area of heaps. An associated structure at ~NGR E:457312 N:525175 within the Site is attached to a complex network of rail / tramway sidings on the Site. These are more developed than previous mapping with although the general linkage between the South Gare, Coatham Iron Works and the Darlington - Saltburn Branch line remains intact. The two northerly tramways split into seven sub-lines approximately 100 m short of the Site boundary, with additional splitting and fanning out of the lines outside the Site. Two additional rail sidings from South Gare lead up to the spits of reclaimed land in the north east of the Site. The area of sand between the two land spits is labelled as a “Rifle Range” on the north of the Site.	Part of the Coatham Iron Works (no longer named) ~100m from the east Site boundary at ~NGR E:457383 N:525009 is a “”. A “Tank” is shown at ~NGR E:457441 N:525066 on the Coatham Iron Works site. A collection of eight structures centred at ~NGR E:457350 N:525080 is labelled "Brick Works", the closest large building is located 45 m from the east Site boundary between tramway / rail sidings north west of Coatham Iron Works. A smaller building that may be associated with the Brick Works at ~NGR E:457317 N:525122 is located on the eastern boundary of the Site. Mapping at 1:2,500 scale shows butts (rifle targets) on a spit of land north of the Site. Two "Slag Wool Works" are located within the Redcar Iron Works slightly ambiguously from the labelling at ~NGR E:457416 N:524578, and ~NGR E:457586 N:524620. A "Slag

OS Map Edition(s)	Significant features on site	Significant features off site
	There is possible small-scale residential development at ~NGR E:457183 N:525098 and enclosures with small structures at ~NGR E:457180 N:525100, ~NGR E:457180 N:525100 and ~NGR E:457060 N:525190, potentially relating to smallholdings within the south east portion of the Site.	Brick Works" is situated on the west side of the Redcar Iron Works at ~NGR E:457524 N:524721. The small pond 20 m wide is no longer present 60 m off the south east corner of the site. There is a small building denoted "W.M." at ~NGR E:457246 N:524894, possible referring to a weighing machine although the Ordnance Survey code is also used for water main. There appears to be a pond, 50 m by 20 m, with drainage from the Macadam Works located at ~NGR E:457431 N:525104.
EC2_F_10000_Yorkshire - 1930 EC2_G_10000_Yorkshire - 1930 EC2_G5_2500_Yorkshire - 1929 EC2_G6_2500_Yorkshire - 1929 EC2_G9_2500_Yorkshire - 1929 EC2_G10_2500_Yorkshire - 1929 EC2_G13_2500_Yorkshire - 1929 EC2_G14_2500_Yorkshire - 1929 EC2_F_10000_Yorkshire - 1938 EC2_G_10000_Yorkshire - 1938	The reclaimed area at South Gare is substantially unchanged within the Site, with no development south of the South Gare Breakwater. There has been a slight northward extension of land ~35 m on the northern boundary adjacent to the north west corner of the Site, and also into the adjacent triangular area of land towards the western most spit extending from the north boundary of the Site. The triangular area has a tramway around the perimeter indicating probable land raising activity. The south west corner of the Site is shown predominantly as heathland although sands are still evident extending across ~115 m of the southern Site boundary, and the pond at ~NGR E:456778 N:525244 remains. Large scale industrial development as "Redcar Iron & Steel Works" is shown on the reclaimed South Gare south-central region of the Site, south of the central spine tramway. The works are dominated by two large buildings aligned in a row along a south east to north west axis in-line with South Gare. The main southern building measures ~310 m by ~90 m with corners at ~NGR E:457177 N:525097, ~NGR E:456990 N:525343, ~NGR E:457061 N:525397, ~NGR E:457247 N:525150. The main northerly building measures ~440 m by ~90 m and straddles the west boundary of the Site with corners at ~NGR E:456940 N:525427, ~NGR E:456685 N:525786, ~NGR E:456757 N:525841 and ~NGR E:456940 N:525427.	Off-site parts of the Redcar Iron & Steel Works northern main building are labelled as follows: • "Reservoir" at ~NGR E:456741 N:525589 • "Pumping Station" at ~NGR E:456763 N:525561 • "Tank" at ~NGR E:456774 N:525548 The tramways from both the new Slag & Macadam Works lead to a railhead situated ~200 m from the north western corner of the Site linking to Redcar Jetty. The Rifle Range is no longer labelled on the north east of the Site, however, the associated spits of reclaimed land have not been developed. The structures forming the former Coatham Iron Works are still present, although the Slag Works is no longer labelled as such. The Brick Kilns are replaced by new rail sidings and a travelling crane, and structures west of these centred at ~NGR E:457377 N:525072 have been remodelled indicating continued industrial use of the Site. A "Meter House" belonging to Redcar Corporation Water Works is labelled at the intersection of the central tramway and the Darlington - Saltburn Branch line at ~NGR E:457621 N:525066. The old Tar Macadam Works is replaced with a new ~20 m by ~14 m rectangular building at ~NGR E:457350 N:525134

OS Map Edition(s)	Significant features on site	Significant features off site
	Most of the surrounding smaller structures are unlabelled however details are provided for a few: Meter Houses (two) at ~NGR E:457147 N:525063, ~NGR E:456904 N:525398 Reservoirs at ~NGR E:457211 N:525240 Water Tower at ~NGR E:457204 N:525304 Water Coolers (four) centred at ~NGR E:457027 N:525453 Chimneys (four) at ~NGR E:456957 N:525436, ~NGR E:456978 N:525451, ~NGR E:457009 N:525475, ~NGR E:457029 N:525491 Two tanks are evident approximately 20 m north west of the reservoir at ~NGR E:457174 N:525263 and ~NGR E:457177 N:525259 as confirmed in notation of later maps. The small areas of housing along the tramway in the south east corner of the Site are replaced by multiple railway sidings along the Breakwater that extend from the Darlington – Saltburn Branch line and a collection of five buildings at Todd Point centred around ~NGR E:457225 N:525010. The largest of these located at ~NGR E:457262 N:524979 is ~45 m long and ~17 m wide and has a rail track leading from the south end towards the Branch Line. To the south of these, another structure 35 m in length, straddles the eastern boundary of the Site, just north of the location of the former off-site weighing machine. The old Tar Macadam Works is no longer labelled as such, although there is a nearby crane (Cr) at ~NGR E:457335 N:525155. There are two new “Tar Macadam & Slag Works” north of the central tramway within the Site at ~NGR E:456993 N:525770 about 100 m from the north west corner of the Site, and at ~NGR E:457166 N:525539 adjacent to the southern main Redcar Iron & Steel Works building.	approximately 15m east of the Site boundary and a nearby crane “(Cr)” at ~NGR E:457350 N:525134. The weighing machine at ~NGR E:457245 N:524895 is no longer labelled, however, the structure is still present and two more small structures have been added, the closest being ~3m from the eastern Site boundary. The surrounding area has been developed with numerous additional rail tracks between the Darlington - Saltburn Branch line and the Redcar Iron & Steel Works. Land on the South Gare has been reclaimed north of the site with development of Warrenby Slag Works 415 m to the north west. The reclaimed land west of the site linking South Gare to Redcar Jetty has been widened progressively southward towards the eastern side by up to ~200 m. A large residential development is evident at Dormanstown east of West Cotham Marsh since the previous 1:10,560 mapping of 1895. Improvements have been made to road infrastructure with construction of the A1085 Trunk Road which runs around the north west side of Dormanstown adjacent to Wiley Bridge Plantation, where it bends from a north east to east northeast orientation at ~NGR E:457840 N:524100. The density of housing has also increased at Warrenby with infilling of the settlement but no significant outward expansion of its area.
EC2_F_10000_Ordnance Survey Plan - 1953 - 1955	The sands in the north of the Site are now shown as heathland on 1:10,000 mapping but sands on 1:2,500 mapping, the triangular area of assumed infilling is no longer surrounded by a tramway. The outline of the spits of land extending north across the north	A new straight course has been constructed for the meandering Dabholm Gut with a diversion of the join with

OS Map Edition(s)	Significant features on site	Significant features off site
EC2_F_10000_Ordnance Survey Plan - 1970 - 1976 EC2_G_10000_Ordnance Survey Plan - 1953 EC2_G_10000_Ordnance Survey Plan - 1970 - 1976 EC2_G5_2500_Ordnance Survey Plan - 1953 - 1954 EC2_G5_2500_Ordnance Survey Plan - 1954 EC2_G9_2500_Ordnance Survey Plan - 1953 - 1954 EC2_G9_2500_Additional SIMs - 1953 - 1981 EC2_G9_2500_Ordnance Survey Plan - 1954 EC2_G9_2500_Ordnance Survey Plan - 1953 - 1954 EC2_G9_2500_Additional SIMs - 1953 - 1981 EC2_G9_2500_Ordnance Survey Plan - 1954 EC2_G6_2500_Ordnance Survey Plan - 1954 EC2_G10_2500_Ordnance Survey Plan - 1953 - 1954 EC2_G10_2500_Additional SIMs - 1953 - 1983 EC2_G10_2500_Ordnance Survey Plan - 1954 EC2_G14_2500_Ordnance Survey Plan - 1953	east boundary are still evident and are marked as Slag Heaps on 1:10,000 mapping. A bifurcating tramway extends halfway down the section of the eastern spit within the Site. The south west corner of the Site is shown with a rectangular network of drains running north-northeast and east-southeast at a variable spacing of between 100 m and 200 m. The pond at ~NGR E:456778 N:525244 is now shown as marsh. A well and surrounding pond are shown close to the west Site boundary at ~NGR E:456794 N:525427. An irregular pond measuring ~670 m by ~30 m centred on ~NGR E:456737 N:525013 encroaches onto the Site over the southern boundary, linked apparently to a low area of the drain network. The main north and south buildings of the Redcar Iron & Steel Works have been joined by an extension or canopy across the southern portion of the gap south of the water coolers. Rail platforms and a travelling crane and sidings indicate continued internal rail linkages between the two buildings. Minor external changes have been made to the Redcar Iron & Steel Works infrastructure, such as a 30 m long elongate building centred at ~NGR E:457250 N:525064, a travelling crane at ~NGR E:456620 N:525250. A building at ~NGR E:457229 N:525371 has been replaced by a tank farm comprising three large circular tanks at ~NGR E:457227 N:525390, ~NGR E:457238 N:525379 and ~NGR E:457241 N:525366, and two smaller tanks at ~NGR E:457229 N:525370 and ~NGR E:457231 N:525361, of diameter ~12 m and ~8 m for each site respectively, and an ~8 m by ~5 m rectangular structure at ~NGR E:457232 N:525354. A tank is shown at ~NGR E:456998 N:525469 adjacent to the chimneys and water coolers to the south of the Redcar Iron & Steel Works main north building. A pipeline is labelled at ~NGR E:457060 N:525519. A small (sub-2 m) rectangular tank is shown at ~NGR E:456900 N:525704 on the north east side of the Redcar Iron & Steel Works main north building, with a nearby electrical substation presumed to be the separate structure at ~NGR E:456900 N:525702, although equally this could be one of the	Dabholm Brook. Land has been extensively drained for a distance of 1 km south of the Site to Dabholm Gut. To the south of the Redcar Iron and Steel Works main north building, a cooling tower is shown at ~NGR E:456756 N:525611 just north of the former reservoir which is now denoted as a tank. A building at ~NGR E:456755 N:525614 is labelled as a pumping station. There is a tank labelled close to the north west corner of the main north building of the Redcar Iron & Steel Works approximately 150 m from the north west corner of the Site, and a nearby travelling crane. Coatham Iron Works has been demolished and the reservoir at ~NGR E:457422 N:525189 has been removed. Many of the rail / tramway sidings are still present and the travelling crane has been slightly relocated to a position slightly overlapping the east boundary of the Site. Warrenby Rail Station has been constructed 115 m south east of the site at Warrenby Halt, north of the former Redcar Iron Works. The remains of an industrial site (unnamed) are shown on 1:2,500 mapping centred around ~NGR E:457626 N:525374 on the western side of Coatham Common. The largest building measures ~40 m by ~15 m and there are more than a dozen ancillary buildings, mostly located on platforms of raised land. There is a heap ~60 m long and ~30 m wide at most opposite the north west of the largest building. The 1:10,000 mapping shows only three small buildings, although later 10,000 mapping shows the full extent of the works. The area of Coatham Common to the east, north of Warrenby is noted to be a Cleveland Golf Links. Some of the structures associated with the old Redcar Iron Works site have been removed. One of the structures is still denoted as a Slag Wool Works. Towards the end of this period in 1973 the Redcar Iron Works have been renamed South Teesside Works, with only a few of the larger buildings remaining. The adjacent land to the east has been reclaimed from marshland with surrounding embankments and removal

OS Map Edition(s)	Significant features on site	Significant features off site
EC2_G14_2500_Additional SIMs - 1953 EC2_G14_2500_Ordnance Survey Plan - 1954 - 1968 EC2_G_10000_Middlesbrough - 1975 (Russian) EC2_G_10000_Ordnance Survey Plan - 1970 - 1976 (north)	other nearby structures attached to the main building. Tanks are also noted on the north east side of the main southern Redcar Iron & Steel Works building at ~NGR E:457223 N:525229 (multiple) and ~NGR E:457228 N:525219, with a nearby electrical substation at ~NGR E:457228 N:525202, and also a tank at ~NGR E:457258 N:525136 at the south east end of the main south building. The two Slag & Tarmacadam Works in the north of the site have been removed from the 1:10,000 mapping but the southernmost works is still shown on 1:2,500 mapping. Tanks associated with the latter are shown on the map boundary at ~NGR E:457141 N:525554. The circular and elongate slag heaps and the adjoining composite triangular heaps structure (partially on-site) have been removed or levelled and replaced by two buildings measuring ~35 m by ~17 m centred at ~NGR E:457264 N:525260 and ~88 m by ~37 m centred at ~NGR E:457337 N:525251, the north east corner of the latter extending slightly outside the Site. A benchmark of ‘30.89’ is shown at the north west corner of the larger building at ~NGR E:457347 N:525295. In later 1:2,500 mapping of 1973 the larger of the two buildings is shown to have been extended by ~45 m to the north west and now meets beyond the centre of the north east wall of the second building.	of a large irregular ~50 m diameter pond and a ~180 m long narrow water body indicating land raising. Wiley Bridge Plantation has been removed, and the marshland to the north is replaced by rail sidings. There is a benchmark on the north end of the Redcar Iron & Steel Works main building of ‘27.64’ at ~NGR E:456847 N:525778.
EC2_F_10000_Ordnance Survey Plan - 1970 - 1976 EC2_F_10000_Middlesbrough - 1975 (Russian) EC2_G_10000_Ordnance Survey Plan - 1970 - 1976 (south) EC2_G_10000_Ordnance Survey Plan - 1982 - 1985 EC2_G5_2500_Additional SIMs - 1980 - 1989	Redcar Iron & Steel Works has been completely redeveloped as Teesside Steel Works, Redcar. The rail and road infrastructure have been replaced and the orientation of the new works has changed form a north west orientation to a west-northwest orientation. The area formerly occupied by the Redcar Iron & Steel Works main south building has largely been abandoned with the exception of a new conveyor and retention of the extended composite building situated on the east Site boundary, south of the central tramway / railway at ~NGR E:457330 N:525270.	Bran Sands has been mostly reclaimed with the exception of Bran Sands Lagoon to the north of Dabholm Gut. Workings are shown in 1985 mapping north of Dabholm Gut, and subdivision of the area with flooding of some compartments is shown in 1991 (Russian) and 1992 mapping with a landing stage in Bran Sands Lagoon at ~NGR E:455560 N:524620. The area corresponds with the I.C.I Bran Sands Tip, Wilton Works. Teesside Works extends south and west of the Site using a system of south-north west orientated conveyors, which connect to the Ore Terminal on the Tees located at ~NGR

OS Map Edition(s)	Significant features on site	Significant features off site
EC2_G5_2500_Ordnance Survey Plan - 1984 - 1988 EC2_G6_2500_Additional SIMs - 1980 EC2_G6_2500_Ordnance Survey Plan - 1986 EC2_G9_2500_Ordnance Survey Plan - 1973 - 1983 (north) EC2_G9_2500_Supply of Unpublished Survey Information - 1974 - 1976 EC2_G9_2500_Supply of Unpublished Survey Information - 1976 EC2_G9_2500_Additional SIMs - 1981 EC2_G9_2500_Ordnance Survey Plan - 1984 - 1988 EC2_G10_2500_Additional SIMs - 1981 EC2_G10_2500_Ordnance Survey Plan - 1986 EC2_G13_2500_Ordnance Survey Plan - 1981 - 1983 EC2_G13_2500_Additional SIMs - 1981 EC2_G5_2500_Large-Scale National Grid Data - 1993 EC2_G6_2500_Large-Scale National Grid Data - 1993 EC2_G9_2500_Large-Scale National Grid Data - 1993	The building approximately 15m from the east boundary of the Site at ~NGR E:457330 N:525270 has been retained. It appears to be serviced from the north by a new access road subsequent to removal of many of the rail sidings. The Redcar Iron & Steel Works main north building has also been removed and new plant erected partially over the south east corner of the former building footprint within the Site and extending over the site boundary to the west. The main building is approximately rectangular in shape centred at ~NGR E:456900 N:525439, with one rectangular cut-out of the south east side, and building corners at ~NGR E:456840 N:525493, ~NGR E:456817 N:525432, ~NGR E:456885 N:525406, ~NGR E:456891 N:525422, ~NGR E:456958 N:525396 and ~NGR E:456976 N:525441. There are two large conveyor structures to the south of the main structure running in parallel. From mapping it might be assumed these are ground structures; however, shadows on later aerial photography and Google Pro imagery show these are largely or wholly mounted on columns, nevertheless needing foundations. There are two associated chimneys of diameter ~2 m at ~NGR E:456786 N:525349 and ~NGR E:456790 N:525389. There are two approximately rectangular structures attached to the main building in succession to the north west measuring ~62 m by ~24 m and ~50 m by 17 m, the latter being positioned over the west boundary of the Site. New industrial development forming an extension of the Teesside Works extends onto the south east of the Site, extending midway along the southern boundary. There are four smaller buildings at ~NGR E:456963 N:525018 (~60 m by ~12 m), ~NGR E:457024 N:524995 (~40 m by ~18 m), ~NGR E:457010 N:524967 (~60 m by ~18 m) and ~NGR E:457063 N:524961 (~22 m by ~9 m). A ~7 m diameter chimney is situated on the eastern side of these structures at ~NGR E:457063 N:524961 associated with a sub-circular ~20m diameter structure centred at ~NGR E:457056 N:524932. This structure is attached to a larger building, which is the shape of a long rectangle aligned with the Site boundary	E:454850 N:525530. The tramway linking to Redcar Jetty is no longer shown, and the adjacent land to the south has been developed as part of the Steel Works on its eastern extent. The Teesside Works comprise a main building measuring 90 m by 90 m centred at NGR E:456605 N:525800, with a 20 m (external) by 32 m (internal) rectangular inset for a 15 m diameter hopper. Rails are shown entering and leaving the building at the south east and north west sides, in addition to a large aerial conveyor connecting the south of the building to the south southeast, and smaller conveyors attached to the north of the building and the hopper. There are numerous conveyors, travelling cranes, and other structures associated with the works. These include two gas holders measuring ~50 m diameter and ~40 m diameter at ~NGR E:456375 N:525687 and ~NGR E:456272 N:525776, respectively, the closest being ~420 m from the western Site boundary. There are numerous cylindrical structures including tanks on the Teesside Works site to the west including some stoves within 250 m of the Site at; ~NGR E:456748 N:525770, ~NGR E:456741 N:525749, ~NGR E:456716 N:525803, ~NGR E:456640 N:525722, ~NGR E:456636 N:525735 and ~NGR E:456628 N:525761. There are other circular structures which appear from later aerial photography to be mainly hoppers or bins. There are two chimneys noted to be within 250 m west of the site at ~NGR E:456614 N:525736 and ~NGR E:456627 N:525775. The area west of the Site is understood to have included a coking works. The development of Teesside Steel Works south of the Site includes numerous buildings, conveyors and other structures. There is a presumed ~7 m diameter tank at ~NGR E:457121 N:524869 approximately 4 m from the Site boundary, a ~9 m diameter tank approximately 26 m from the Site boundary at ~NGR E:456916 N:524924, a ~3 m diameter tank approximately 20 m from the Site boundary at ~NGR E:456910 N:524935. There are two chimneys south of the

OS Map Edition(s)	Significant features on site	Significant features off site
EC2_G10_2500_Large-Scale National Grid Data - 1993 EC2_G13_2500_Large-Scale National Grid Data - 1993	measuring ~68 m by ~17 m joined on the eastern short side of a ~60 m by ~75 m rectangle. To the east of these structures there is another chimney at ~NGR E:457170 N:524885 approximately 58 m from the south east corner of the Site. There are conveyors present to the west of the middle of the southern Site boundary. These extend onto Site in a north northeast direction linking to the northernmost conveyor by the main building, and the mainly off-site works positioned south of the south west corner of the Site, with the exception of two relatively small rectangular on-site structures at ~NGR E:456676 N:525055 and ~NGR E:456746 N:525031 arranged long side parallel to the Site boundary, measuring ~48 m by ~12 m and ~40 m by ~18 m, respectively. The north of the Site is mainly devoid of structures apart from tracks which post-date the former central Slag & Tar Macadam Works and appear from later aerial photography to relate to settlement and disposal of waste in drainage pens off the north-northwest trending tracks. A road also cuts across the north of the Site linking the road on the east boundary with the new works west of the northwest corner. There are two relatively small buildings in the north west of the Site, the smaller being located within the former footprint of the Redcar Iron & Steel Works main north building at ~NGR E:456975 N:525572, measuring ~14 m by ~9 m, and the second building being a probable remnant of the previous infrastructure at ~NGR E:456913 N:525684, measuring ~20 m by ~42 m.	Site boundary at ~NGR E:456948 N:524930 (~1m diameter) and ~NGR E:456986 N:524844 (~3 m diameter). Areas shown as spoil heaps north of the Site are now shown as heathland indicating either natural vegetation or possible reclamation works taking place. The unnamed works to the west of Coatham Common show signs of further dereliction with only three structures shown on 1:2,500 mapping by 1993 (shown as a single building on 1:10,000 mapping). The Darlington - Saltburn Branch line is shown to be dismantled, and a new line bypassing Warrenby through Coatham Marsh / Marsh Hills, with a station at ~NGR E:457410 N:524210 some ~650 m from the site, adjacent to Steel House. The former Redcar Iron Works is no longer in evidence and the area appears to have been cleared of the older structures on the west side of the South Teesside Works.
EC2_F_10000_10K Raster Mapping - 2000 EC2_F_10000_10K Raster Mapping - 2006 EC2_G_10000_10K Raster Mapping - 2000 EC2_G_10000_10K Raster Mapping - 2006	Aerial photography dated 1999 shows a relict foundation in the north west corner of the Site comprising a white rectangular outline measuring ~100 m by ~35 m centred around ~NGR E:456967 N:525770, with the long axis parallel to the northern Site boundary but approximately 30 m to the north, containing four hexagonal outlines measuring ~20 m diameter. From the alignment and the white colour, which is more evident on Google Pro, the structure is probably associated with a partially exposed foundation located 10m outside the western Site boundary. The foundations on the Site are partially obscured by numerous	The remaining east side of the South Teesside Works has been dismantled. Evidence of foundations are visible on aerial photography dating from 2012 in the west (formerly Redcar Iron Works) and the newly demolished east of the site. A development of two structures approximately 60 m from the mid-centre of the eastern boundary has occurred centred at ~NGR E:457461 N:525294. The main rectangular development area measures only ~41 m by ~37 m, however, there is an extensive enclosed area attached to the north of the development stretching north northeast just 20 m short of

OS Map Edition(s)	Significant features on site	Significant features off site
EC2_G5_2500_Historical Aerial Photography G5 (1999) EC2_G6_2500_Historical Aerial Photography G6 (1999) EC2_G9_2500_Historical Aerial Photography G9 (1999) EC2_G10_2500_Historical Aerial Photography G10 (2012) EC2_G13_2500_Historical Aerial Photography G13 (1999) EC2_G14_2500_Historical Aerial Photography G14 (2012)	containers or heaps of materials, mainly limited to the foundation area but extending over an area of ~30 m by ~30 m on the south east side. Google Pro imagery from 2008 shows the area to contain sorted heaps of industrial-sized scrap metal pipes and other materials. The relict building from the Redcar Iron & Steel Works at ~NGR E:456913 N:525684 is no longer evident. The newer structure at ~NGR E:456975 N:525572 is also absent on the 1999 aerial photography although the foundations are still evident; however, there is a slightly smaller building in the vicinity at ~NGR E:456981 N:525555 with a number of scattered objects (e.g. sheds, vehicles, heaps) to the west and south within a 45 m radius. The north east corner of the Site has little development except for the rail tracks and settlement ponds noted previously. The Teesside Works infrastructure in the west and southwest of the Site remains standing. Aerial photography from 1999 shows a few vehicles parked north of the largest building however there is no evidence of activity on recent Google Pro aerial photographs. In the south east of the Site, three of the four buildings are left standing in aerial photography of 1999; recent Google Pro images show signage for a vehicle rental company. The industrial plant to the east including the chimney and composite (L-shaped) building have been removed. Recent Google Pro images show the empty south east corner and adjoining land to the south to be planted around with shrubs. The building on the centre of the east Site boundary just south of the former central tramway at ~NGR E:457330 N:525270 appears dilapidated on the 1999 aerial photography with one of the attached buildings on the south east side being demolished. Recent aerial photography on Google Pro shows the roof of the main building to be in disrepair and the building looks to be abandoned. The rectangular building to the south of this at ~NGR E:457262 N:524979 retained from the Redcar Iron & Steel Works still appears to be in operation in 1999, with the associated parking to the west being in use. Recent Google Pro imagery	the mean high water mark, a distance of nearly 700 m. The enclosure is irregular in shape with a width perpendicular to the coast of between ~20 and ~150 m, the latter being measured across the long section and an ancillary rectangular promontory pointing back towards the north east corner of the site to within ~100 m of the site itself. On aerial photography the enclosed area appears to be more level than adjacent land, and the vegetation is more uniform. The perimeter of the enclosure is visible in recent Google Pro images and mapping from 2000, 2006 and 2019 apart from a section on the east side to the north of middle of the site boundary which is missing on Google Pro imagery of 2017 and 1:10,000 mapping of 2019. It is assumed that this outline may relate to the Central Area Transmission System Pipeline, a 91cn diameter gas pipeline running from the North Sea which makes landfall northeast of the site. The pipeline, which started operating in 1993, runs parallel to and within 50m of the east Site boundary. Further development comprising a larger and smaller rectangular building centred at ~NGR E:457520 N:525260 is shown in 2019 mapping, approximately 150m east of the centre of the eastern Site boundary. The perimeter of the development is approximately ~40 m by ~30 m. There is no evidence on 1:10,000 mapping of the unnamed works centred around ~NGR E:457626 N:525374, although aerial photography from 2012 still shows outlines of earthworks. The land to the east of this is still denoted as Cleveland Golf Links. The section of the dismantled Darlington - Saltburn Branch line north of the former Redcar Iron Works shown on the 2006 mapping is no longer present in the 2019 edition. Two factory sites without building outlines are shown ~500 m east of the site at ~NGR E:457750 N:524820 and ~NGR E:457850 N:524720 on 2019 mapping.

OS Map Edition(s)	Significant features on site	Significant features off site
	shows a variety of industrial plant including excavators and bulldozers, low loaders and empty waggons. The 1:10,000 map of 2006 shows minor changes in infrastructure with removal of a rail track across the centre of the site. Google Pro imagery dating to June 2017 shows the Site to be pockmarked with spoil from a rectangular grid of exploration holes at a spacing of ~50 m between locations.	A Sewage Works is shown ~580m south southwest of the southern Site boundary on 1:10,000 mapping dating from 2000 on reclaimed land north of Dabholm Beck corresponding to Northumbrian Water Limited's Bran Sands effluent treatment works. Mapping of 2000 indicates continued use of Wilton Tip, with development of a site premises at ~NGR E:456260 N:524320. Google Pro imagery of 2005 shows works on the east of the tip including removal of a large storage yard measuring ~140 m by ~100 m adjacent to the Bran Sands effluent treatment works to the east. Linear haulage roads and evidence of compartments are absent in 2006 mapping, and a more rounded ambulatory track around the landfill is shown, although imagery from 2008 on Google Pro indicates that restoration of vegetation is partially complete, with removal of the site premises by July 2006. The Envirocheck report indicates that the site was managed between 2005 and 2008 by Impetus Waste Management Ltd. No development is evident on the site in Google Pro imagery dated January 2018. In mapping of 2019 the area appears to have been set aside for "Factories".
CO_2 Export Pipeline		
EC2_G_10000_Yorkshire - 1856 - 1857	The earliest Ordnance Survey mapping dated 1856 shows most of the Site to lie below the Mean High Water Mark of Ordinary Spring Tide, which lies close to the northern boundary with the PCC Site. The Mean Low Water Mark of Ordinary Spring Tide, which runs across the site in a west northwest direction indicates that most of the site was usually underwater.	
EC2_G10_2500_Yorkshire - 1894 EC2_G_10000_Yorkshire - 1895 EC2_G_10000_Yorkshire - 1895_2 EC2_G14_2500_Yorkshire - 1915	With construction of the Tees breakwater and associated reclamation of land towards South Gare to the north west, the Site is now above Low Mean Mark of Ordinary Spring Tide. The Mean High Mark of Ordinary Spring Tide which runs through the centre of the site in a west-north-westerly direction indicates the	

OS Map Edition(s)	Significant features on site	Significant features off site
EC2_G_10000_Yorkshire - 1920	southern half of the Site was usually above water. The ground and foreshore are indicated to be Sand and are named Coatham Sands. The southern boundary of the south east corner of the Site is delineated by a tramway developed prior to 1894, which leads north northwest from Redcar Iron Works located to the south east towards South Gare or diverting south east to Redcar Jetty. Coatham Iron Works located south of the Site is also connected by rail to the tramway, and both ironworks may be a source of imported waste, e.g. slag. Two slightly elevated spits of land protrude from the PCC Site to the Mean High Mark of Ordinary Tide on the eastern side of the Site. No rail lines are shown crossing into the east of the Site. However, the pattern of groundworks suggest material has been brought from the land-side to partially reclaim this area and build sea defences to protect the coast east of the Site.	
EC2_G14_2500_Yorkshire - 1929 EC2_G_10000_Yorkshire - 1930 EC2_G_10000_Yorkshire - 1938 EC2_G13_2500_Ordnance Survey Plan - 1953 EC2_G_10000_Ordnance Survey Plan - 1953 EC2_G_10000_Ordnance Survey Plan - 1970 - 1976 EC2_G_10000_Middlesbrough - 1975 (Russian)	Large scale development of Redcar Iron and Steel Works has taken place by 1929 to the south of the site. Except for a slight overlap of the south west corner of the Site by a Slag and Tar Macadam Works north of the tramway there is little evidence of impact across this area site from the associated industry. The north east extent of the waste heap associated with the Slag and Tar Macadam Works was defined by a steep embankment below a railway which persisted up until at least 1970. Presence of a triangular area of tramway to the south of the Site indicates further possible land-raising, which may also have occurred on the Site during this period. In 1938 mapping, a second or possibly relocated / extended Slag and Tar Macadam Works is shown adjacent to the south east corner of the Site. Neither Slag and Tar Macadam Works site is shown as being active in 1953, however, the "spoil heaps" continue to develop with evidence of working of the heaps from the west side by road.	
EC2_G_10000_Ordnance Survey Plan - 1982 - 1985	Extensive redevelopment of the Redcar Iron & Steel Works has occurred with the new plant constructed in a different orientation	

OS Map Edition(s)	Significant features on site	Significant features off site
EC2_G_10000_Middlesbrough - 1991 (Russian) EC2_G_10000_10K Raster Mapping - 2000	and renamed South Teesside Works. A new road is present. Later mapping dated 1991 shows ponded water within and north of the area of former slag (spoil) heaps, and a smaller area spanning across the east of this area. Mapping from 2000 indicates retreat of the ponded area in the south west towards the northern shore, but the ponds appear to have recovered or enlarged in 2006 and 2019 mapping. Mapping from 2000 onwards shows works associated with a North Sea gas pipeline, which is part of the Central Area Transmission System (known as CATS). The small area of incursion occurs at an angle to the main alignment outside the eastern boundary of the Site leading to a Beach Valve Station, and possibly relates to construction activities rather than the pipeline itself.	
Water Supply and Discharge Connection Corridors		
EC2_I_10000_Yorkshire - 1856 EC2_H_10000_Durham - 1861	The earliest Ordnance Survey mapping dated 1856 shows the site to be part of Tees Bay and estuary. The northern extension is mainly below the Mean Low Mark of Ordinary Spring Tide, the remaining area comprises sand banks and pools assumed to be regularly transgressed by floods and high tides. The sands are labelled "Inner Sandbanks" to the north and "Bran Sands" to the south. South Gare and North Gare are shown within the Tees Estuary within 1.5km of the Site. There is no evidence of land reclamation activities in the vicinity of the Site.	
EC2_F_10000_Yorkshire - 1895 EC2_G_10000_Yorkshire - 1895 EC2_G_10000_Yorkshire - 1895_2 EC2_H_10000_Yorkshire - 1895 EC2_I_10000_Yorkshire - 1895 EC2_F_10000_Durham - 1898 - 1899	Mapping dated 1895 shows extensive land reclamation works having occurred at the intersection of the northern and western Site extensions by construction of the South Gare Breakwater from Todd Point. The breakwater and associated tramway cross the Site. A second tramway heads off in a west-southwest direction from NGR E:456420 N:525960 across Bran Sands towards the Redcar Jetty. A wall has been constructed at either side of the Tees Estuary main channel, which is now shown as being below Mean Low	

OS Map Edition(s)	Significant features on site	Significant features off site
EC2_H_10000_Durham - 1898 EC2_F_10000_Yorkshire - 1920 EC2_F_10000_Durham - 1923 EC2_G_10000_Yorkshire - 1920 EC2_H_10000_Yorkshire - 1920 EC2_H_10000_Durham - 1923 EC2_I_10000_Yorkshire - 1920 EC2_I_10000_Durham - 1923	Mark of Ordinary Tides. The Mean High Water Mark of Ordinary Tide shows that the eastern half of the tramway to Redcar Jetty is slightly raised above the usual tides (shown as embankment in Yorkshire 1:2,500 mapping of 1894), however, the western half becomes submerged between tides. The Redcar Jetty is marked as having a Dolphins and a wharf for tying up and loading and unloading ships, which presumably brought in raw materials and / or exported iron and steel products from the Iron and Steel Works east of the site or further afield through the connected rail system. Bran Sands are dissected or partially dissected by channels below the low water mark, one of which extends south below the Redcar Jetty tramway. This suggests that the Redcar Jetty extended across to the tramway embankment as shown in later maps. The northern length of the northern Site extension remains below the Mean Low Water Mark of Ordinary Tides. The intertidal zone is approximately 500 m wide and named as part of western extent of Coatham Sands. Short railways (or tramways) branching out on the north side of the South Gare tramway and associated raising of land suggests recent or ongoing land reclamation adjacent to the South Gare breakwater. A wall extends south from the South Gare Breakwater dividing the area known as "The Marshes" (mostly sand in the northern portion) from Bran Sands to the west. No significant development is evident on the site between 1895 and 1923.	
EC2_F_10000_Yorkshire - 1930 EC2_F_10000_Yorkshire - 1938 EC2_F_10000_Durham - 1938 - 1951 EC2_F_10000_Durham - 1952 EC2_F_10000_Ordnance Survey Plan - 1953 - 1955	A strip of land south of the Redcar Jetty and tramway is shown to have been progressively reclaimed, initially to the south, to a width of ~100 m by 1930 and ~300 m by 1952. This reclaimed area widens with rail lines extending from the Redcar Iron & Steel Works onto the reclaimed land south of the South Gare Breakwater. A smaller area measuring ~250 m by ~150 m north of the tramline has also been reclaimed by 1952. 1970s mapping shows additional roadways and railways on the reclaimed strip with widening of the northern reclaimed area with "spoil" to a	

OS Map Edition(s)	Significant features on site	Significant features off site
EC2_F_10000_Ordnance Survey Plan - 1970 - 1976 EC2_G_10000_Yorkshire - 1930 EC2_G_10000_Yorkshire - 1938 EC2_G_10000_Ordnance Survey Plan - 1953 EC2_G_10000_Ordnance Survey Plan - 1970 - 1976 EC2_G_10000_Middlesbrough - 1975 (Russian) EC2_H_10000_Yorkshire - 1930 EC2_H_10000_Durham - 1938 - 1951 EC2_H_10000_Durham - 1951 - 1952 EC2_H_10000_Ordnance Survey Plan - 1953 - 1954 EC2_H_10000_Ordnance Survey Plan - 1970 EC2_H_10000_Middlesbrough - 1975 (Russian) EC2_I_10000_Yorkshire - 1930 EC2_I_10000_Durham - 1938 EC2_I_10000_Durham - 1951 EC2_I_10000_Ordnance Survey Plan - 1953 EC2_I_10000_Ordnance Survey Plan - 1970 EC2_I_10000_Middlesbrough - 1975 (Russian)	width of ~280m, and extension of the strip westward towards the Redcar Jetty (not within the mapped area for 1970). Bran Sands is shown to be intersected by a 150 m channel near the edge of the mapped area at E:455000. Between 1923 and 1930 the Redcar Iron & Steel Works were developed north of the South Gare Breakwater. The westernmost of the two main buildings making up the works (believed to be the Plate Mill, with the eastern building being the Steelworks), are aligned west northwest in the direction of South Gare. The multiple associated railway lines entering or leaving the west end of the works join the improved rail link to the Redcar Jetty. A pumping station and associated reservoir and tank are located south of the Iron & Steel Works at ~NGR E:456740 N:525580. Mapping from 1930 also shows development of the Warrenby Slag Works at ~NGR E:456640 N:526160 with rail tracks linking to the Redcar Iron & Steel Works, and links also to rail headings at ~NGR E:456740 :525960 which are attached to a Slag and Tarmacadam Works located at ~NGR E:456990 N:525760. The Warrenby Slag Works is shown in 1953 when the Slag & Tarmacadam Works is no longer evident. Mapping from 1970 shows roads and presumed slag heaps but Warrenby Slag Works is no longer shown. Except for the small proportion of land taken up by the Redcar Iron & Steel Works and Warrenby Slag Works, the northern Site extension comprising part of Coatham Sands and Tees Bay has not significantly changed. The Marshes to the south east of the Site are shown to be undergoing reclamation with a network of drains.	
EC2_F_10000_Middlesbrough - 1975 (Russian)	Russian mapping of 1975 shows significant reclamation of land south of the Site with railways extending onto the former Marshes	

OS Map Edition(s)	Significant features on site	Significant features off site
EC2_F_10000_Ordnance Survey Plan - 1981 - 1985 EC2_F_10000_Ordnance Survey Plan - 1990 - 1995 EC2_F_10000_Middlesbrough - 1991 (Russian) EC2_F_10000_Ordnance Survey Plan - 1993 EC2_F_10000_10K Raster Mapping - 2006 EC2_G_10000_Middlesbrough - 1975 EC2_G_10000_Ordnance Survey Plan - 1982 - 1985 EC2_G_10000_Middlesbrough - 1991 (Russian) EC2_G_10000_Ordnance Survey Plan - 1992 EC2_G_10000_10K Raster Mapping - 2000 EC2_G_10000_10K Raster Mapping - 2006 EC2_G_10000_VectorMap Local - 2019 EC2_H_10000_Hartlepool - 1978 EC2_H_10000_Ordnance Survey Plan - 1981 - 1982 EC2_H_10000_Middlesbrough - 1991 EC2_H_10000_Ordnance Survey Plan - 1995 EC2_H_10000_10K Raster Mapping - 2000 EC2_H_10000_10K Raster Mapping - 2006 EC2_H_10000_VectorMap Local	with areas of spoil suggesting the land has been raised. In this map the Redcar Iron & Steel Works is still shown as standing, however all later maps from 1981 onwards show complete redevelopment of the Site with construction of the new Teesside Works. This is understood to have been based around a single open-hearth blast furnace used for making iron and the associated coking works, with steel making being located offsite at Lackenby. The transport corridor meets a handling area 170 m from Tees Bank. Russian mapping from 1991 shows expansion of the Teesside Works infrastructure westward. However, there are few additional buildings in evidence, and with one exception at ~NGR E:455480 N:525870 measuring 100 m long by 20 m wide, these are within about 135 m of the former western extent of the Teesside Works. On the basis of 1999 aerial photography provided by Landmark this area was used as materials storage yard. Mapping at 1:2,500 and aerial photography, which has been reviewed for areas of particular interest, shows plant to include a large blast furnace connected to numerous hoppers, tanks and conveyors on the east side of the works, and coking ovens, gas holders, numerous tanks, flare stacks and cooling towers forming the coke works plant which is integral to steel making on the west side of the works. Internet sources report that the coke ovens were shut down in 2015 with little prospect of them reopening (https://www.gov.uk/government/news/redcar-coke-ovens-to-be-closed).	

OS Map Edition(s)	Significant features on site	Significant features off site
- 2019 EC2_I_10000_Ordnance Survey Plan - 1982 EC2_I_10000_Middlesbrough - 1991 (Russian) EC2_I_10000_10K Raster Mapping - 2000 EC2_I_10000_10K Raster Mapping - 2006 EC2_I_10000_VectorMap Local - 2019		
CO_2 Gathering Network and Natural Gas Connection Corridors / Electrical Connection Corridor		
Area EC1_A		
EC1_A_10000_Yorkshire - 1857 EC1_A_10000_Durham - 1859 EC1_A_10000_Yorkshire - 1895 EC1_A_10000_Durham - 1899 EC1_A_10000_Durham - 1923 EC1_A_10000_Durham - 1923_2	In First Edition Ordnance Survey 1:10,000 mapping of 1859 the area is shown as being predominantly flat agricultural land at a level of c.25ft O.D. crossed by hedged field boundaries. The Port Clarence branch of the Hartlepool Railway crosses the area between ~NGR E:447720 N:522860 and ~NGR E:447950 N:522820. Belasis Hall is located at ~NGR E:447913 N:523134 with a large ~50 m wide moat to the south, which is fed by a watercourse which meets the moat at ~NGR E:447860 N:523000. This is understood to be a medieval manor house (possibly a strong house) https://www.pastscape.org.uk/hob.aspx?hob_id=27029. Associated buildings are located nearby at ~NGR E:447941 N:523115 and ~NGR E:447843 N:523142 (Middle Belasis). By 1899 the only significant change is the presence of Haverton Hill Brick Works and by 1923 this includes a clay pit at ~NGR E:447723 N:522481 measuring approximately 80 m east - west and 125 m north - south. In 1:2,500 Durham mapping of 1915 this is already shown as "Old Clay Pit", with a cutting leading to the Haverton Hill Brickworks (off-site at ~NGR E:447801	

OS Map Edition(s)	Significant features on site	Significant features off site
	N:522271). From 1899 the railway is shown as part of N.E.R. (North Eastern Railway).	
EC1_A_10000_Durham - 1938	South of the railway, which is now owned by L.N.E.R. (London and North Eastern Railway) there is no significant change within the area and the clay pit is still evident but not expanded. North of the railway Belasis Hall is still present but the ground including the moat are partially occupied by Council Offices at ~NGR E:448120 N:523040, and the adjacent areas are residential. The developed area is crossed by Belasis Avenue which runs parallel to the railway at a distance of 90 m, and Collingwood Road which heads north and then east from Belasis Road to the south of the Council Offices. West of the Council Offices there is a residential development of Rosedale Grove, skirting the north of the area is Hood Drive, which joins to Nelson Avenue, which runs south southeast on the east side of the Council Offices. Associated development includes St Hilda's Church at ~NGR E:448176 N:523055 opposite the Council Offices on Nelson Avenue, which is bordered to the north and east by a recreational area and to the south by a Presbyterian Church, with an ancillary building rectangular building at ~NGR E:448200 N:523028, shown on Durham 1939 1:2,500 mapping.	
EC1_A15_2500_Durham - 1939 EC1_A15_2500_Ordnance Survey Plan - 1951 - 1952 EC1_A_10000_Ordnance Survey Plan - 1954	Significant industrial development associated with the I.C.I. Chemical Works at Billingham is shown to have occurred in Durham 1939 1:2,500 mapping south of the railway line. The east of the area south of the railway is mainly taken up by railway sidings, with the end of a plant building centred at a works, connected by a conveyor to a small part of the works centred within the west of the area. From external sources of information, the buildings to the east area associate with the Anhydrite Process Plant to manufacture sulphuric acid and cement clinker, and the western structures are the anhydrite mine pithead and associated buildings. Most of the associated chemical works belong to the ICI Synthetic Ammonia Works. Tanks are shown in the east of the area in 1:2,500 mapping at ~NGR E:447877	

OS Map Edition(s)	Significant features on site	Significant features off site
	N:522598 and at locations on and off-site east of this location. There is a cooling pond labelled in the south of the area at ~NGR E:447707 N:522363. Between 1939 and 1952 the 1:2,500 shows continuing development of the chemical works including new tanks labelled at ~NGR E:447807 N:522667, ~NGR E:447729 N:522631, ~NGR E:447708 N:522531 and a chimney at ~NGR E:447774 N:522596. The north area remains little changed except for Belasis Hall which has fewer buildings and is shown to be in partial ruin in 1:2,500 mapping of 1951, and the addition of a pipeline which enters the chemical works by passing under Nelson Avenue, Belasis Avenue and the railway. The housing is still present despite the pipeline and is named Furness Estate. The watercourse once feeding the moat is shown to widen adjacent Belasis Hall to the west where it passes between Middle Belasis and Belasis Hall and leaves the north of the area, and to the east, where it re-enters the Belasis Hall grounds prior to crossing below the pipeline and Nelson Avenue, where it is named Belasis Beck. Issues are shown on the south side of the pipeline in the former grounds of Belasis Hall entering the beck. The land around the Council Offices is fenced leaving a gap to the pipeline. The Council Offices are shown as having an Electrical Substation on 1:2,500 mapping of 1951 at ~NGR E:448069 N:523010.	
EC1_A15_2500_Ordnance Survey Plan - 1962 - 1972 EC1_A15_2500_Supply of Unpublished Survey Information - 1973 EC1_A15_2500_Ordnance Survey Plan - 1973 - 1978 EC1_A_10000_Ordnance Survey Plan - 1975 EC1_A_10000_Middlesbrough - 1975 (Russian)	The area south of the railway line remains industrialised with minor changes to the disposition of smaller structures, however, the area north of the railway line is substantially changed with removal of Belasis Hall, housing, Council Offices and church buildings. The Electrical Substation is still showing on 1:2,500 mapping dating from 1972.	

OS Map Edition(s)	Significant features on site	Significant features off site
EC1_A15_2500_Additional SIMs - 1984 - 1986 EC1_A_10000_Ordnance Survey Plan - 1987 EC1_A_10000_Middlesbrough - 1991 (Russian) EC1_A_10000_Ordnance Survey Plan - 1993	The industry south of the railway continues to develop with addition of three ~60m diameter cooling towers. The chemical plant has been removed between 1973 and 1978 based on 1:2,500 mapping, and the plant on the west of the area adjacent to the railway also appears to be redundant and partially removed by 1984. The pipeline north of the railway is shown by 1984 as "pipelines", which are located on both sides of Belasis Beck where it passes below Nelson Avenue.	
EC1_A_10000_10K Raster Mapping - 2000 EC1_A_10000_VectorMap Local - 2019	The area north of the railway is not significantly changed. However, the chemical plant is mostly removed between 1993 and 2000, although the cooling tower in the south of the area and other cooling towers and chemical plant to the southwest are still standing. A new Waste Destructor has been built on the former industrial land east of the area. A railway skirting from the mainline around the Waste Destructor is shown as disused, however, there is nothing to suggest that some of the rail lines are no longer operated. By 2019 a second building has been constructed north of the Waste Destructor with access roads linking this to the Waste Destructor building.	
Area EC1_E		
EC1_E_10000_Durham - 1859 - 1861 EC1_E4_2500_Durham - 1898 EC1_E_10000_Durham - 1898 - 1899 EC1_E3_2500_Durham - 1915 - 1916 EC1_E_10000_Durham - 1923 EC1_E_10000_Durham - 1923_2 EC1_E_10000_Durham - 1938 EC1_E3_2500_Durham - 1939 EC1_E4_2500_Durham - 1939	First Edition 1:10,000 mapping shows the area to be agricultural fields with a beck crossed by a track over a post bridge at ~NGR E:448485 N:523297, and a small oval pond measuring approximately 12 m by 18 m located 10m to the east. There is a house or farm located at Low Belasis. There is a substantial drain starting at ~NGR E:448878 N:523416 approaching the beck in a north easterly direction before turning east northeast just short of the map boundary and meeting the beck at ~NGR E:449086 N:523530. The drain cuts across the edge of North Marsh which transgresses onto the east end of the area by about 150 m on the southern boundary and 270 m on the northern boundary. Little change occurred to the site by 1999 with the exception of a	

OS Map Edition(s)	Significant features on site	Significant features off site
	realignment of the track on a more direct route named in later mapping as Cowpen Bewley Road. The first evidence of the development to the south appears in 1938 mapping with the appearance of residential development of Hood Crescent at the southern end of the area. The field east of Low Belasis is denoted as a playing field, and there appears to be improvement to the local drainage with a drain east of the playing field shown to link with the wide drain.	
EC1_E3_2500_Ordnance Survey Plan - 1951 EC1_E4_2500_Ordnance Survey Plan - 1951 EC1_E_10000_Ordnance Survey Plan - 1954 EC1_E3_2500_Ordnance Survey Plan - 1968 - 1969 EC1_E3_2500_Ordnance Survey Plan - 1968 - 1972 EC1_E_10000_Ordnance Survey Plan - 1975 EC1_E_10000_Middlesbrough - 1975 (Russian) EC1_E_10000_Hartlepool - 1978	1951 mapping at 1:2,500 scale and the 1:10,000 1954 edition show development of a pipeline crossing below Cowpen Bewley road at ~NGR E:448441 N:523339 and Belasis Beck at ~NGR E:448556 N:523427. The pipeline east of the intersection with Belasis Beck is shown as being wider than the section to the west although even where this is evident on the 1:2,500 1975 mapping, the feature is still described as a single pipeline. The housing along Hood Avenue is removed between the 1968 and 1971 1:2,500 map editions.	
EC1_E4_2500_Additional SIMs - 1951 - 1985 EC1_E_10000_Ordnance Survey Plan - 1981 - 1987 EC1_E_10000_Ordnance Survey Plan - 1989 EC1_E_10000_Middlesbrough - 1991 EC1_E_10000_Ordnance Survey Plan - 1993 EC1_E3_2500_Large-Scale	By 1984 the pipeline is shown as multiple pipelines crossing Cowpen Bewley Road at ~NGR E:448443 N:523335 and ~NGR E:448464 N:523311. The 1:2,500 mapping of 1984 and 1:10,000 mapping of 1987 show a Works on the former Hood Avenue estate in the south of the area. The Works includes two electrical substations at ~NGR E:448174 N:523236 and ~NGR E:448298 N:523303 and two tanks at ~NGR E:448189 N:523247 and ~NGR E:448228 N:523269. The other structures which are predominantly north of the site include many small tanks, chimneys, flare stacks, two larger electrical substations and at least one smaller one, and a large circular cooling tower off-site at	

OS Map Edition(s)	Significant features on site	Significant features off site
National Grid Data - 1994 EC1_E_10000_10K Raster Mapping - 2000 EC1_E_10000_10K Raster Mapping - 2006	~NGR E:448303 N:523378 measuring approximately 57 m in diameter. The Site currently operates mycoprotein fermenters for food production on Nelson Avenue. From anecdotal evidence, the Site may previously have been the I.C.I. Pruteen Factory (animal protein from natural gas) built in 1978. Additional structures are evident at the Nelson Avenue works including two circular structures at ~NGR E:448232 N:523237 and ~NGR E:448267 N:523245 and a third structure in the shape of a cross at ~NGR E:448245 N:523229. These are accompanied by a larger rectangular building measuring ~20 m wide and ~35 m long at ~NGR E:448196 N:523220 in aerial photography dated 2000 which does not appear on the 2006 map. No significant development has taken place between 1987 and 2006 in the north of the area. However, the 1:10,000 mapping shows significant areas of flooding in the east of the area adjacent to Belasis Beck to the north of the pipelines, and in a larger area on the eastern extent of the map area.	
EC1_E_10000_VectorMap Local - 2019	Redevelopment of the works on Nelson Avenue has been undertaken since 2006 with some new structures evident in 2019 mapping and the removal of the large cooling tower. Additional structures have been constructed including circular features at ~NGR E:448300 N:523280 and ~NGR E:448320 N:523300.	
Area EC1_F		
EC1_F_10000_Yorkshire - 1857 EC1_F_10000_Durham - 1859 - 1861 EC1_F1_2500_Durham - 1939	The west and centre of the area is shown as open land with a network of meandering watercourses and straight drains in Ordnance First Edition 1:10,000 mapping of 1859. There is a straight single track or road between ~NGR E:449516 N:523654 (13ft O.D.) and ~NGR E:449656 N:523441 (15ft O.D.) which is linked to a settlement called Salt Holme. A flood defence labelled "The Batts" is shown in a mainly north to south alignment with a short 70 m east to west dog-leg at ~NGR E:450980 N:523620. The eastern side of The Batts for a width of ~130 m is marked as liable to flood, and to the south as *salt grass* or *Samphire*. Beyond this the Tees Estuary is shown as sand with	

OS Map Edition(s)	Significant features on site	Significant features off site
	occasional channels in the north of the area, which were mapped in 1961. The Salt Holme track is shown as level at 14ft O.D., although the benchmark to the south at 16.74ft O.D. suggests that the ground continues to rise slightly to the south.	
EC1_F_10000_Durham - 1898 - 1899 EC1_F1_2500_Durham - 1939	By 1898 a wall has been constructed approximately 570 m east of The Batts marking the new High Water Mark of Ordinary Tides. The reclaimed land is marked as a range with targets on the northern end, and the strip of land north of this joins Cowpen Marshes. The two areas are divided by an east to west section of wall between estuary wall and The Batts. Cowpen Salt Works and associated brine mills is located to the west of The Batts. A wagonway terminates at the Cowpen Salt Works. There is a thin strip of marsh and area of mud marked on the west side of the estuary wall, and an oval pond or reservoir measuring ~120 m long by 80 m wide sandwiched between the range and estuary wall. A convoluted channel is shown running southward before meandering eastward level with the reservoir.	
EC1_F_10000_Durham - 1923 EC1_F_10000_Durham - 1938 - 1951	By 1923 the Cowpen Salt Works is shown as disused, and the wagonway is no longer shown west of The Batts. The new Greatham Creek branch of the North Eastern Railway has been constructed on the east of The Batts. New Road has been constructed on a north to south alignment. The rifle range is somewhat diminished in width by about 300 m on the eastern edge however the land is shown as being open. The reservoir is shown as two compartments either side of the east to west wall. The estuary wall is shown to deviate ~90 m further into the estuary opposite the reservoir indicating further land reclamation. New Road becomes A178 Seaton Carew Road by 1938.	
EC1_F1_2500_Ordnance Survey Plan - 1968 EC1_F2_2500_Ordnance Survey Plan - 1968 - 1969 EC1_F3_2500_Ordnance Survey	On 1:2,500 mapping, pipelines have been constructed by 1968 running east to west. Between ~NGR E:449750 and E:450450, three large "Saltholme salt brine reservoirs" have been constructed in series from west to east measuring 164 m, 240 m and 164 to 80 m in width, respectively, with shared north to south	

OS Map Edition(s)	Significant features on site	Significant features off site
Plan - 1969 EC1_F4_2500_Ordnance Survey Plan - 1969 EC1_F8_2500_Ordnance Survey Plan - 1969 EC1_F12_2500_Ordnance Survey Plan - 1968 - 1969	aligned walls, 380 m in length. The adjacent section of pipelines is accompanied by a southern drain which links to drains to the west and east of the brine reservoirs. An electrical transmission line (ETL) is shown to run approximately parallel and north of pipelines in an easterly direction to ~NGR E:451038 N:523637, from where it is diverted to ~NGR E:451206 N:523544 to continue eastward on the south side of the pipelines. The ETL crosses the estuary. A second ETL travels eastwards until terminating at ~NGR E:453301 N:523594. A tank (or potentially two tanks) are shown at ~NGR E:450241 N:523666 adjacent to the brine reservoirs which appear to be connected to the pipelines. To the south there is a brine pumping station at ~NGR E:450776 N:523337, which connects to a service road. The service road leads to a facility which includes a tank at ~NGR E:450971 N:523538 on the south side of the pipelines, located at the former dog-leg of The Batts. The linear feature running north from this facility east of Swiss Cottage is shown in later mapping to be a pipeline. A pipeline is also shown to run alongside the former railway in a southern direction on the edge of the Landmark mapping area at ~NGR E:451071 N:523600. The pipelines running parallel to the Site are crossed by a north to south aligned pipeline and track. The former southern section of The Batts is shown as a drain. The area between the dismantled railway and the estuary wall (west of Seal Sands) is shown as comprising mainly brine fields. A partial wall is shown extending east from the estuary wall at ~NGR E:451555 N:523729 into Seal Sands. Saltholme Clay Field is shown south of the Site, southwest of the brine reservoirs.	
EC1_F_10000_Ordnance Survey Plan - 1975 EC1_F_10000_Middlesbrough - 1975 (Russian) EC1_F1_2500_Additional SIMs - 1978	By 1975 a new road runs parallel with the southern boundary of the Saltholme brine reservoirs. The road meets a new roundabout on the A178 Seaton Carew Road at ~NGR E:450650 N:523700. The area becomes more congested with development by 1978 of an electrical substation at ~NGR E:449300 N:523646, a fire	

OS Map Edition(s)	Significant features on site	Significant features off site
EC1_F_10000_Ordnance Survey Plan - 1981 - 1987 EC1_F_10000_Ordnance Survey Plan - 1990 - 1995 EC1_F_10000_Middlesbrough - 1991 EC1_F_10000_Ordnance Survey Plan - 1993	station on Seaton Carew Road at ~NGR E:450629 N:523456, electrical substations at ~NGR E:450939 N:523518 and ~NGR E:451620 N:523850, construction of a railway adjacent to the brine fields, and construction of additional east to west pipelines between 1978 and 1991. By 1979 the reclamation of much of Seal Sands has occurred. There is one large 5ha pond present, accompanied on the other side of a wall to the north by a 0.343ha pond, and a third similarly sized pond. Mapping from 1990 at 1:10,000 scale shows continued ponding of the same scale and the northern area to remain undeveloped. Russian mapping dating from 1975 shows flooding between ~NGR E:451250 N:523490 and ~NGR E:451470 N:523480. Ordnance Survey mapping from 1990 and 1993 shows much smaller scale flooding occurring adjacent to this flood. The off-site waterbody apparently responsible for this flooding is named Dorman's Pond in off-site mapping.	
EC1_F_10000_10K Raster Mapping - 2000 EC1_F_10000_10K Raster Mapping - 2006 EC1_F_10000_VectorMap Local - 2019	Seal Sands is shown to be partially developed by 2000. There is sparse evidence of works in the southern half including at chimney at ~NGR E:451730 N:524320. The northern half appears to be laid out for development with access tracks but ponded areas remain and no buildings are shown. Possibly the tracks are part of the "PL" (pipeline) running east to west which is shown across the middle of the area of Seal Sands, however, it is not evident how or whether this connects to the pipelines within the brine fields to the west. Later mapping of 2006 appears to confirm that the tracks are pipelines. The northern half of the Seal Sands area resembles the brine fields to the west in regards to the layout of pipelines and pools of water. By 2019 the southern half of the Seal Sands is shown as a factory with numerous unnamed buildings including circular structures at ~NGR E:451643 N:524279, ~NGR E:451643 N:524292, ~NGR E:451638 N:524306, ~NGR E:451649 N:524305, ~NGR E:451733 N:524321 and ~NGR E:451731 N:524295. This appears to be the Teesside Gas Processing Plant (TGPP) which	

OS Map Edition(s)	Significant features on site	Significant features off site
	processes gas from the UK Central North Sea and from the northern part of the Southern Gas Basin http://www.nsmp-limited.com/index.php/tgpp-home.	
Area EC1_G		
EC1_G_10000_Yorkshire - 1857 EC1_G_10000_Durham - 1859 - 1861	First Edition 1:10,000 mapping shows the area to be part of the Tees Estuary or "Tees Mouth". The northern area from south of ~NGR N:525500 is named Seal Sands. The south east corner (current North Tees Works jetties) straddles the estuary North and Middle Channels. The boundary of the north west of the area crosses onto a small area of shallows named Ninth Buoy Scarp. In Durham mapping of 1859 this is labelled as "Muscle Bed" (mussel bed). The sands in the south west area are cut by two channels which converge at ~NGR E:451820 N:524000.	
EC1_G_10000_Yorkshire - 1895 EC1_G_10000_Durham - 1898 - 1899 EC1_G_10000_Yorkshire - 1920	Walls have been constructed along the east and west banks of the Tees Estuary channel south east of the area. The two channels in the south east corner are shown in mapping of 1898-1899 as one main "West Channel". The sands in the south east corner and the north east corner west of the estuary walls are also cut by estuary channels.	
EC1_G_10000_Durham - 1923 EC1_G_10000_Durham - 1923_2 EC1_G_10000_Durham - 1938 - 1951	Reclamation has been initiated for land in the south west area by construction of a wall and a narrow strip of land on its western flank. The mapping shows the wall to terminate at ~NGR E:452140 N:523640. It is inferred that the land is being raised with estuarine dredgings (mud) within the cell wall with gravity drainage via the Western Channel. The west side of the western estuary wall is shown as flooded along a 30 m (typical) wide strip between channels. Preliminary attempts at reclamation of Seal Sands may have been made by construction of a (partial wall) from the estuary wall at ~NGR E:454560 N:524460 onto land in the east in a west-northwest alignment to ~NGR E:454180 N:524630 and continuing to termination at ~NGR E:453990 N:524760 on a north west alignment. This feature appears to affect the course of a	

OS Map Edition(s)	Significant features on site	Significant features off site
	neighbouring channel which drains from Seal Sands in a south east direction to the estuary wall.	
EC1_G_10000_Durham - 1952 EC1_G_10000_Ordnance Survey Plan - 1954 - 1955	A substantial wall / embankment has been constructed across the south of the area overlapping the north section of the previous wall and extending east to ~NGR E:453270 N:523630, prior to turning south east to ~NGR E:453520 N:523390 at a jetty constructed on the west bank of the Tees Estuary (future Tees Works). The mapping of 1952 to 1955 shows the area to the south of the wall within the reclamation cell to be in transition from marshland to dry land by land raising adjacent to the walls leaving a large area of water within the centre. This water body known as The Reclamation Pond approaches the northern wall adjacent to the Western Channel, leaving a portion of the area underwater between ~NGR E:451850 N:523490 and ~NGR E:452200 N:523480. The area surrounding The Reclamation Pond is shown as marshland up to the wall. The area to the east of this is featureless south of the wall and appears to have been reclaimed. The area north of the wall (excluding the jetties) is shown as mud and sand (or sand and mud in the northern section mapped in 1954).	
EC1_G_10000_Middlesbrough - 1975 EC1_G_10000_Ordnance Survey Plan - 1981	Russian mapping of 1975 shows the fully reclaimed area east of Dorman's Pond to be heavily developed with fuel storage or natural gas tanks set out on a rectangular grid aligned in a north west to south east direction adjacent to the jetties (North Tees Works). The works are understood to have been part of I.C.I.'s North Tees Works Oil Refinery, which were constructed alongside the existing ICI North Tees Works. On the western side of the tank areas are two off-site locations at ~NGR E:452680 N:523340 and ~NGR E:452470 N:523450 which are marked with multiple factory (chimney) symbols. No pipelines are shown in the southern pipeline(s) corridor, although these may have been confused with a road, which is shown. There are two services within the southern pipeline corridor, the more southern being	

OS Map Edition(s)	Significant features on site	Significant features off site
	denoted to be a high tension cable on pylons (line with solid rectangles between outward facing arrowheads), whereas the northern line although shown with solid circular symbols appears to correspond with the pipelines (expected to be open circles for an above ground pipeline). There are several small structures located within and adjacent to the triangular area of Site adjacent to the Tees Works jetties, however, there are no tanks situated on the adjacent estuary bank. The western corridor north of the jetties is shown to contain railway sidings north of ~NGR N:523800, which converge to a point at ~NGR E:453430 N:524100 alongside a road which connects to the north. Tanks and a factory are shown to the west of the railway sidings, believed to be the former Monsanto Textiles plant for making intermediates for manufacture of acrylics, and there is a tank farm, or collection of tanks farms shown to the east of the sidings which appears to be a depot to the north. The area south of the depot appears to be a works (possibly associated with the Monsanto "Seal Sands Works" to the west or part of the former Phillips Imperial Petroleum Refinery). The combined railway and the road make their way westward along the central east to west pipeline corridor route to ~NGR E:452120 N:524130. At this point the railway and road turn gradually south west around a body of water north of the Reclamation Pond. After running south west for ~400 m the railway turns westward to join the track running south of the Brine Fields on the adjacent mapping. The road splits into two at this point with both routes meeting at the same roundabout on the A178 Cowpen Bewley Road. The road passing through the central pipeline corridor passes north of the railway sidings and turns north northeast along the centre of the eastern pipeline corridor. The area of Seal Sands off-site to the west of this section has been developed with numerous tanks and large buildings. These are labelled on later Ordnance Survey mapping as Works although the Russian mapping only provides the Site with the distinction of one factory symbol. This site has been under numerous ownerships however	

OS Map Edition(s)	Significant features on site	Significant features off site
	from internet information obtained from the current owners Lianhetech the known products are organic fine chemicals used for crop protection, pharmaceutical and performance chemicals markets. A wall is shown on the northern boundary of the fine chemicals site running along Northing 524600 between ~NGR E:453050 within the area and ~NGR E:453780 on the north-eastern corner of the works. On the west side this wall turns south southwest to ~NGR E:452750 N:524140 where it follows the road westward within the central east to west site corridor. On the east side the wall diverts slightly south before making its way east to meet the estuary wall at ~NGR E:454360 N:524540. A pipeline linking the fine chemicals works to the northern depot is present. A second pipeline diverges from the first south eastwards before turning east southeast to a jetty at ~NGR E:454300 N:524380. Another pipeline is shown, intersecting the wall at ~NGR E:453940 N:524540 and taking a easterly route along the wall to a jetty at ~NGR E:454360 N:524540. On the northern boundary of the fine chemicals works a further wall has been constructed from ~NGR E:453660 N:524600 leading off in a north west direction to ~NGR E:453260 N:524930, where it makes a north northeast turn. The triangular piece of land between the north west trending wall and the east to west wall along the northern boundary of the fine chemicals works is shown to be mostly underwater. The area between the south west trending wall on the west side of the fine chemicals works and the Western Channel is shown to be cut with east to west trending channels which join to the Western Channel. An oil refinery is shown to the north in 1981 believed to be the Teesside Oil Terminal operated by ConocoPhilips. Mapping for this date only shows the area north of ~NGR N:525000 (off-site) however it is evident that substantial reclamation of Seal Sands affecting the Site must have been undertaken to facilitate this development.	
EC1_G_10000_Middlesbrough - 1991	The ConocoPhillips Teesside Oil Terminal refinery is shown to have been developed north of the Site boundary. The	

OS Map Edition(s)	Significant features on site	Significant features off site
EC1_G_10000_Ordnance Survey Plan - 1990 - 1995	ConocoPhillips oil refinery and terminus contains numerous tanks, chimneys, industrial buildings and offices. The rail track running along the central pipeline route is shown with an additional branch line starting north west of the sidings at ~NGR E:453280 N:524120, which runs north along the eastern pipeline corridor, to the west of the pipelines. The rail track cuts across the northern pipeline corridor. The northern pipeline corridor adjacent to the estuary has indications of only one pipeline route shown, which enters a tunnel crossing below the estuary to land at Dabholm Gut. A large compartmentalised enclosure measuring 760 m long east to west and 250 m wide (maximum) with two rectangular buildings centred at ~NGR E:452680 N:524750 is shown. The buildings have only a partial network of internal roads, and the Site is labelled "Seal Sands". The only detail mapped within the eastern pipeline corridor is the line of pipelines, rail tracks and a road, together with an electrical substation located at ~NGR E:453530 N:524090. South of substation there has been further development of the Monsanto works, which extends to the area of Site south of the railway sidings. A line on the west side of the sidings extends through one of four buildings associated with this development. A triangular area extends from the chemical works south of the sidings to a point at ~NGR E:453480 N:523470. Two small circular structures are evident inside the northern boundary of the triangular area, from aerial photography dating 2000 it is probable that the adjacent rectangular structures are also tanks relating to chemical works. The jetties opposite the central east to west pipeline corridor are shown to be developed with three large tanks. Pipelines are shown crossing in a south east direction to the south of these in the direction of a pipeline tunnel below the estuary starting at ~NGR E:453520 N:523400. The central east to west pipeline corridor contains pipelines to the north and two electrical transmission lines running in the direction of the corridor. There is a tank shown within the central pipeline corridor at ~NGR	

OS Map Edition(s)	Significant features on site	Significant features off site
	E:452520 N:523590 north of the Tees North Works refinery. The western pipeline route is shown as rough land with tracks-roadway to the north of the wall, and as undeveloped land to the south east on the southern pipeline corridor.	
EC1_G_10000_Ordnance Survey Plan - 1993 EC1_G_10000_10K Raster Mapping - 2000	The only notable additions to previous mapping in 1993 are development of a laboratory within the eastern end of the northern pipeline corridor at ~NGR E:454040 N:524730, and extension of the Seal Sands Chemicals (Vertellus) operations on the opposite side of the pipelines. Mapping from 2000 shows significant development on the east of the area. The western boundary of the area overlaps the Teesside Gas Processing Plant (TGPP), which has been constructed in the southern part of the western pipeline corridor. A second works has been developed to the east of this, bordering onto the north boundary of the southern pipeline route. This is understood to be the Antin (formerly British Petroleum) Central Area Transmission System (CATS) Terminal which takes natural gas from the North Sea via pipeline from Coatham Sands. The CATS site extends northwards onto part of the northern pipeline corridor, although apart from tracks and a pond there is no significant infrastructure.	
EC1_G_10000_10K Raster Mapping - 2006 EC1_G_10000_VectorMap Local - 2019	The ConocoPhillips property crossing into the northern pipeline corridor contains five rectangular panels in 2006 mapping believed to be related to reclamation of waste oils from Teesside Oil Terminal by land farming (current aerial photography shows the eastern enclosure used for waste material management, and the west to contain five green rectangular panels separated by bunds). A mast is shown north of the sidings on the eastern pipeline corridor at ~NGR E:453550 N:524114. A pipeline is shown crossing the east end of the northern pipeline corridor from the tank depot to the south. The pipeline extends northwards alongside a track east of the laboratory before joining the line of an east to west linear feature, which appears to	

OS Map Edition(s)	Significant features on site	Significant features off site
	terminate in the vicinity of the pipeline tunnel. The 2019 mapping replaces the label "pipeline" with "track", which potentially indicates the 2006 mapping was incorrect. The railway sidings in the eastern pipeline corridor are no longer shown in 2019 mapping.	
EC2_F		
EC2_F_10000_Yorkshire - 1856 - 1857 EC2_F_10000_Durham - 1859 - 1861	The map area is featureless in Ordnance First Edition 1:10,000 Mapping for the area beyond that previously described west of NGR E:454450 (east of the "Muscle Bed" / Sixth Buoy Scarp).	
EC2_C16_2500_Yorkshire - 1894 EC2_F_10000_Yorkshire - 1895 EC2_F_10000_Yorkshire - 1895_2 EC2_F_10000_Durham - 1898 - 1899 EC2_F_10000_Yorkshire - 1920 EC2_F_10000_Durham - 1923 EC2_F_10000_Durham - 1923_2 EC2_F_10000_Yorkshire - 1930 EC2_F_10000_Yorkshire - 1938 EC2_F_10000_Durham - 1952 EC2_F_10000_Ordnance Survey Plan - 1953 - 1955	Two walls have been constructed to maintain a navigable channel for the Tees Estuary. The wall is shown as the Low Water Mark of Ordinary Tide, confirming the flow in the estuary channel is maintained by the walls. The walls are marked with regular navigational beacons. The Central Channel of Low Water is approximately central between the walls. The eastern side of the estuary channel is shown as mainly foreshore sand water with two areas of mud in the north and southern edges which are above the Low Water Mark of Ordinary Tide. The second sheet also dated 1895 shows a second Low Water Mark of Ordinary Tide to the east of the estuary walls. The area east of this low water mark is shown as mud and sand, with an area of mud cut into by a winding channel of Dabholm Gut which extends to a north-northeast trending wall. This wall is marked as the High Water Mark of Ordinary Tide separating the land to the east from the estuary and foreshore to the west. The area to the east of the high water mark is labelled "The Marshes". Dabholm Beck extends eastward from the high water mark at the wall where it becomes Dabholm Gut. There is a small pond landward of the wall at ~NGR E:456090 N:523864 and several small water bodies within The Marshes. Dabholm Beck and another tributary at ~NGR E:455812 N:523572 collecting water from east of the wall (slightly south of the map) appear to be culverted across the wall.	

OS Map Edition(s)	Significant features on site	Significant features off site
	In 1923 mapping the bifurcated east estuary channel wall is shown as a single thickened wall, otherwise there is no significant change noted between 1894 and 1938.	
EC2_C16_2500_Ordnance Survey Plan - 1954 - 1955 EC2_F3_2500_Ordnance Survey Plan - 1954 - 1955 EC2_F4_2500_Ordnance Survey Plan - 1954 - 1955 EC2_F7_2500_Ordnance Survey Plan - 1954 EC2_F8_2500_Ordnance Survey Plan - 1954	Mapping at 1:2,500 scale shows reclamation of The Marshes through construction of a rectangular grid of drains of typical spacings of between 110 and 150 m aligned with the estuary, and spacing being shorter perpendicular to the estuary.	
EC2_F4_2500_Ordnance Survey Plan - 1963 - 1976 EC2_F_10000_Ordnance Survey Plan - 1970 - 1976 EC2_F_10000_Middlesbrough - 1975 EC2_F_10000_Hartlepool - 1978	Only partial mapping is available for 1963, however, this shows significant development occurring with construction of the new channel for Dabholm Gut whilst Dabholm Beck is still present towards the wall at the high water mark which is still evident in the 1963 map. The north of the 1:2,500 map area shows the Site in 1976 (survey actually performed at 1:1,250 scale), showing the newly aligned Dabholm Gut entering an engineered channel across land reclaimed from Bran Sands between the wall at high water mark and the estuary wall. The 1:10,000 mapping is dated 1970 in the north of the map and shows Bran Sands unreclaimed, whereas the section to the south shows the new engineered alignment of Dabholm Gut crossing the former Bran Sands. To the south of Dabholm Gut there are railway lines and an electrical substation at ~NGR E:455888 N:524064. Two railway branches are shown leaving the east side of the Dabholm Gut sidings, one turning around towards the south west, and the other bending more slightly to the south southeast. The Mean High Water line follows the edge of the engineered(widened) section of Dabholm Gut indicating the water is tidal. The south of the area has been developed as Teesport Refinery. One of the associated roadways from the refinery	

OS Map Edition(s)	Significant features on site	Significant features off site
	terminates at ~NGR E:455322 N:524128. Russian mapping from 1975 shows tracks within the area south of Dabholm Gut with no evidence of any other structures. Bran Sands lagoon is situated north of Dabholm Gut within the bund structures shown on previous mapping. The north east corner of the lagoon is fed by a watercourse off the reclaimed land to the north. There are two other bunded or partially bunded water bodies to the south east of the lagoon. A track is shown on the north side of Dabholm Gut, with a branch diverting northeast from ~NGR E:455879 N:524295 linking to other off-site lagoons stretching NNE from ~NGR E:456397 N:524544. A road leads up to the end of Dabholm Gut from an east-southeast direction aligned with the watercourse and bends 90° north northeast to form a junction with the track running alongside Dabholm Gut. The triangular area between the road leading up to the Dabholm Gut and the railway heading south east from the south of the Gut is shown to be largely underwater within the map area except on its eastern side. Russian mapping shows several jetties on the estuary.	
EC2_F_10000_Ordnance Survey Plan - 1981 - 1985	The south of the map area, which is reported to have been mapped in 1985, is similar to the 1975 Russian mapping apart from a portion of the Teesside Works and the area of Bran Sands Lagoon, which is shown only as "workings". The north of the area mapped in 1982 shows a portion of the Teesside (Redcar) Works. The works showncomprises mostly conveyors and railways leading to Redcar Jetty. These are aligned mainly in an east-northeasterly direction except for the area adjacent to the coking works, where additional conveyors are orientated at ninety degrees in a north-northeast direction towards the coking works. Aerial photography from Google Earth Pro shows the areas between conveyors to be used for bulk material storage assumed to be for the Redcar blast furnace. The most southern jetty is linked to an area labelled Container Terminal with a travelling crane ("Trav C.").	

OS Map Edition(s)	Significant features on site	Significant features off site
EC2_F_10000_Middlesbrough - 1991 EC2_F_10000_Ordnance Survey Plan - 1993 EC2_F_10000_Ordnance Survey Plan - 1990 - 1995	The south west corner of the mapping dated 1990 and 1993 and Russian mapping dating 1991 shows tanks at the Teesport Refinery whereas the mapping dating from 1995 of the south east corner indicates these have been removed. The area to the north of Dabholm Gut adjacent to Bran Sands Lagoon is shown to be subdivided by bunds into multiple cells, many of which are lagooned.	
EC2_F_10000_10K Raster Mapping - 2000	The railway on the south of Dabholm Gut is no longer shown, and the area between the former railway and road to the east of Dabholm Gut is shown as dry. A new facility has been constructed on the land south of this reclaimed area that has been identified from recent Google mapping to relate to a chemical manufacturing company making corrosion inhibitors and drilling emulsifiers for the North Sea Oil and Gas Industry. The area adjacent to the east bank of the estuary contains a large sub-rectangular compound measuring ~210 m by 270 m, with a service road linked to a roundabout at ~NGR E:456116 N:525076. The estuary wall has been realigned to form a bay at this point, believed to be the Teesside Ro-Ro Terminal. A jetty has been constructed between Dabholm Gut and Bran Sands Lagoon which is believed to be for import of sewage sludge to the NWL sewage treatment facility. The east shore of Bran Sands Lagoon has a landing stage. Lagoons are no longer evident to the east of Bran Sands Lagoon, however there are new tracks and a facility constructed at ~NGR E:456414 N:525129 which are presumed to be part of a waste management facility. Circular structures belonging to the NWL Sewage Treatment Works are shown in part to the east of this facility on the edge of the mapped area. A potash terminal has been constructed at the old Teesport Refinery and the Conveyor Terminal has been expanded.	
EC2_F_10000_10K Raster Mapping - 2006	The Teesside Ro-Ro Terminal jetty has been constructed at ~NGR E:454995 N:524447.	

OS Map Edition(s)	Significant features on site	Significant features off site
	The former lagoon area east of Bran Sands Lagoon has new ambulatory tracks and appears to have been remodelled.	
EC2_F_10000_VectorMap Local - 2019	The area south of Dabholm Gut has been developed with a large supermarket distribution centre measuring ~580 m by ~130 (minimum) to 185 m (maximum) to the east of the Teesside Ro-Ro Terminal and a warehouse measuring ~300 m by ~125 m between the distribution centre and the chemicals plant. The former area of lagoons to the east of Bran Sands Lagoon is empty but marked for factory development. Teesside Works is labelled simply as “factory”.	
Area EC2_G		
EC2_G_10000_Yorkshire - 1856 - 1857	The First Edition Ordnance Survey 1:10,000 scale mapping shows the Site to be on the edge of the Tees Estuary. The north of the Site is west of the rocky headland at Todd Point. A railway is shown along the east bank of the estuary running north northeast alongside "The Fleet Electric Telegraph". The railway bends from Coatham Junction to the east and straightens up along the coast at about the Darlington 21 Mile Post at ~NGR E:457282 N:524765. The area to the east of the bend is labelled Coatham Marsh, the area in the south is labelled West Coatham Marsh. Drainage of the area is complex with a combination of straight drains and natural watercourses including The Fleet and at this time the Mill Race. Marsh Hills (ancient salt hills) are evident at West Coatham Marsh and to the north east into Coatham Marsh. These are understood to be remains of overburden from medieval salt works.	
EC2_G_10000_Yorkshire - 1895 EC2_G_10000_Yorkshire - 1895_2	South Gare Breakwater has been constructed to the north east to meet with the straight section of railway labelled Darlington and Saltburn Branch Line of N.E.R. (North Eastern Railways) alongside the estuary bank. Multiple rail tracks divert from the branch line to meet at (Redcar or Warrenby) iron works centred at ~NGR E:457465 N:524551, south east of the bend in the railway. A smaller number of rail lines divert off the west side of	

OS Map Edition(s)	Significant features on site	Significant features off site
	the railway to (Coatham) iron works centred around ~NGR E:457419 N:525022 north east of the railway bend adjacent to Todd Point. The area immediately west of the railway has been separated from the estuary by a north - south wall leading from the South Gare Breakwater. The divided land to the east of this wall labelled "The marshes". A tramway is shown leaving the south east iron works before re-entering into the reclaimed South Gare. The area between the tramway and the railway is shown as marshland with two water bodies and a drain. The West Coatham Marsh to the south of Redcar Iron Works is not significantly changed.	
EC2_G_10000_Yorkshire - 1920 EC2_G_10000_Yorkshire - 1930 EC2_G_10000_Yorkshire - 1938	The marshland between the tramway and railway is no longer present and the railways have been substantially expanded on the reclaimed land, and the land around the Redcar and Coatham Ironworks. A new steelworks has been constructed on the South Gare and new railway infrastructure has been constructed to join this with the existing branch line and the two iron works as part of Redcar Iron & Steelworks. A new railway station "Warrenby Halt" has been constructed on the railway bend at ~NGR E:457264 N:524755. Both ironworks have additional structures, and the Redcar Ironworks site has a Slag Wool Works centred around ~NGR E:457590 N:524611. Significant residential development has taken place at Dormanstown with development of extensive new road infrastructure. A road "Sandy Lane" has been constructed across West Coatham Marshes. Little further development has occurred to the area of West Coatham Marshes although a slight incursion of allotments is shown between the two roads. The Marshes west of the railway are shown as marshland with some grassland and pools.	
EC2_G_10000_Ordnance Survey Plan - 1953	The former Coatham Iron Works are no longer in use and the buildings and structures have been removed leaving railway	

OS Map Edition(s)	Significant features on site	Significant features off site
	tracks and a small structure at ~NGR E:457326 N:525100. A new railway line has been constructed on the north side of West Coatham Marsh leading to railway siding east of the former Redcar Ironworks. Land to the south of the Redcar Ironworks site appear to have been raised and a previous watercourse is no longer shown in the raised area. A small amount of development is evident on the south side of West Coatham Road.	
EC2_G_10000_Ordnance Survey Plan - 1970 - 1976	The old Redcar Ironworks site has been demolished in the 1976 mapping within the south of the area including the Slag Wool Works. Sandy Lane has been replaced by the A1085 with a large roundabout at a new intersection with the diverted West Coatham Lane at ~NGR E:457556 N:523816 being shown under construction. The area of former marshland at West Coatham Marshes is relatively featureless and no longer shown with drains, tributaries or salt hills. There is a large electricity substation at ~NGR E:455965 N:525010 (~100m mean diameter). An electrical transmission line leaves the substation in a west southwest direction before turning south southwest at ~NGR E:456886 N:523797. The south of the area between the railway line and the A1085 is developed as an east to west transport corridor with pipelines, a track and one or more rail lines. The area of "The Marshes" to the west of the rail branch line is shown as having active workings. Rail lines diverting from the branch line to the south divert eastwards before crossing over the branch line at ~NGR E:457123 N:524482 and entering the Marshes, with additional lines making the linkage in reverse by swinging around from The Marshes to meet the west of the branch line at ~NGR E:456976 N:524185. The steelworks site at Redcar is also linked to the railway bridging over the branch line by a new track exiting at ~NGR E:457375 N:525291 along the former South Gare Breakwater. The mapping in the north of the area dating from slightly earlier in 1970 shows The Marshes being	

OS Map Edition(s)	Significant features on site	Significant features off site
	reclaimed with a panel of drains. The east of the allotment gardens has been repurposed as an industrial estate at ~NGR E:457886 N:523864 (Dormanstown Industrial Estate) with a depot to the north. The recent development of several buildings south of West Coatham Road has been removed from mapping and a single building is shown at ~NGR E:457769 N:523671.	
EC2_G_10000_Middlesbrough - 1975 EC2_G_10000_Ordnance Survey Plan - 1982 - 1985 EC2_G_10000_Middlesbrough - 1991 EC2_G_10000_Ordnance Survey Plan - 1992 EC2_G_10000_10K Raster Mapping - 2006 EC2_G_10000_VectorMap Local - 2019	Russian mapping from 1975 shows a transitional phase for the development of Teesside Works replacing Redcar Iron & Steelworks. This is more easily explained by reference to the Ordnance Survey mapping which shows a more complete state of development. The iron and steel works at Redcar were replaced by 1978 by the Redcar Blast Furnace forming part of the Teesside Works, preceding the mapping of 1982 (north) and 1985 (south) in the published Ordnance Survey. The works have been heavily modified and extended. Major infrastructure changes have been made to the wider area. The railway branch line has been diverted on a more easterly track from ~NGR E:456802 N:523828 in the south via new (unnamed) station at ~NGR E:457410 N:524213, crossing Coatham Marsh to re-join the old track at ~NGR E:456448 N:525268. The old branch line has been dismantled and new lines provided to divert off the western side of the railway (initially along the branch route) into the Teesside Works. Railway lines and combined road and rail overbridges have also been provided to take traffic from the Teesside Works over to the eastern side of the railway or the complex new road network. The new roads also service new offices at Steel House and also link to the existing A1085 roundabout. The old Redcar Ironworks site is shown as devoid of features however Russian mapping of 1991 shows the area to have several structures and a network of tracks, which are absent from Ordnance Survey mapping of 1992. The site structures could relate to temporary construction works or a high security (unmapped) site.	

OS Map Edition(s)	Significant features on site	Significant features off site
	A warehouse at ~NGR E:457771 N:523667 replaces a smaller building shown previously.	
EC2_C		
EC2_C_10000_Yorkshire - 1857	First Edition Ordnance Survey mapping at 1:10,000 from 1857 show the Site to be part of the Tees Estuary to the north west and agricultural land for the most part in the central and south east. A railway and an electric telegraph run along the east bank of the estuary. There is a brick field at ~NGR E:455172 N:521998, Lackenby (Railway) Station at ~NGR E:455359 N:522185, brick yard at ~NGR E:455430 N:522237 adjacent to Lackenby Station and Lazenby (Railway) Station at ~NGR E:456238 N:523117. The area is dissected by a rectangular grid of field boundaries and drains, with occasional watercourses; the main being Kinkerdale Beck. The Eston Ironworks (Bolckow & Vaughan) has been developed at ~NGR E:454313 N:521336.	
EC2_C_10000_Yorkshire - 1895 EC2_C_10000_Yorkshire - 1895_2 EC2_C_10000_Durham - 1899	The Eston Ironworks has been massively expanded as Cleveland Steelworks at ~NGR E:454424 N:521456 with development of Grangetown to the south, and South Bank Iron Works (Bolckow and Vaughan) centred at ~NGR E:453941 N:521503 to the north. (Cleveland Steelworks pioneered the Gilchrist-Thomas adaptation of the Bessemer Converter to make steel from local phosphate rich iron ore, with production of basic slag which was often used as fertiliser). A reclamation wall has been constructed approximately 620m north west of the railway from Lackenby Station. The land between the railway and the reclamation wall appears to be undergoing filling with earthworks and railway / tramway lines much in evidence. The probable source of fill material is South Bank Iron Works and Cleveland Steelworks which are connected by railway lines to the areas of filling. There is a much smaller iron works at Lackenby at ~NGR E:455709 N:522283. The features of the iron works include a chimney at ~NGR E:455485 N:522253, several buildings, railway tracks, a pond at ~NGR E:455518 N:522197 and tips / storage piles. This	

OS Map Edition(s)	Significant features on site	Significant features off site
	is linked by railway to filling between the reclamation wall and the estuary training wall, whereas the adjacent area is marked with footpaths and may have been filled before the published mapping from one of the works or another fill source, e.g. dredged material. A small unnamed works (W) is shown west of Lackenby Iron Works at ~NGR E:455248 N:522073. There is an associated excavation measuring ~130 m by ~130 m on the south west side of the plot with a central pond suggestive of this being a brick works. The Site north west of the reclamation wall between ~NGR E:454881 N:522607 and ~NGR E:455027 N:522730 is shown as sand and drainage channels. This area between the Low Water Mark of Ordinary Tide and High Water Mark of Ordinary Tide has been created behind the estuary training walls that confine the main channel. Eston Grange (Railway) Station has been constructed at ~NGR E:454935 N:521836. There are excavations at ~NGR E:455155 N:521705 south east of Eston Grange Station. A short row of terrace housing "Eston Grange" is shown at ~NGR E:455119 N:521497. Two ponds are shown at ~NGR E:454960 N:521279. In 1899 mapping labelling of one of the buildings adjacent to South Bank Iron Works at ~NGR E:453955 N:521814 indicates this is "Antonien Works (Phosphate Manure)".	
EC2_C_10000_Yorkshire - 1919 - 1931 EC2_C_10000_Durham - 1923	The east of the mapping area dating from 1919 shows Grange Town Power Station has been developed at ~NGR E:455218 N:521829. The excavations noted previously at ~NGR E:455155 N:521705 just west of the new power station are labelled "old clay pits". There is a reservoir (presumed) at ~NGR E:455201 N:521776. Mapping in the west of the area dating from 1931 shows Eston Grange Station has been renamed Grangetown Station. There is an engineering works at ~NGR E:454945 N:521696, and at ~NGR E:454986 N:521328 there is a cooling pond with a pumping station, presumed to be part of the adjacent Cleveland	

OS Map Edition(s)	Significant features on site	Significant features off site
	Steelworks. Allotment gardens are shown to the east of the cooling pond. There is a Tar Macadam Works to the east at ~NGR E:454839 N:521838 developed post-1924 with sidings. There are small subdivisions of land in a ~110 m wide strip south of the allotments, indicating these may be smallholdings. The Antonien Works (phosphate manure) is labelled as a Basic Slag Works, known to be a source of phosphate fertiliser. A zig-zag reclamation wall has been constructed on an average north to south alignment between the estuary training wall and the existing south east aligned reclamation wall north west of the railway. This is marked as the High Water Mark of Ordinary Tides and railway lines to the west of the wall indicate the probable means of infilling on that side. The adjacent land is marked as mud and sand and cut by water channels.	
EC2_C_10000_Yorkshire - 1938 EC2_C_10000_Durham - 1938	Tees Slag Works is shown at ~NGR E:455692 N:522501 north of Lackenby Iron Works. Lackenby Slag Breaking Plant is shown at ~NGR E:455530 N:522823, with associated tips and railways lines present. Station Road has been constructed adjacent to Cleveland Steel Works. Two large new works buildings have been constructed however these do not appear to be fully integrated to the railway system. The northern building is understood to be a steel mill, and the southern building is the South Steel Works. There is a reservoir on the north side of the railway at ~NGR E:455480 N:522414 opposite Lackenby Iron Works. Meter houses associated with Tees Valley Water Board are located adjacent to the junction between the railway line and Lazenby Sidings at ~NGR E:456249 N:523107.	
EC2_C_10000_Durham - 1952 EC2_C_10000_Ordnance Survey Plan - 1953 - 1955	A new reclamation wall (Tees Dock Road) has been constructed on a north west alignment between the estuary training wall and the old north east trending reclamation wall. This is shown as the High Water Mark of Median Tides. The area between the old reclamation wall and the estuary training wall, and the new	

OS Map Edition(s)	Significant features on site	Significant features off site
	reclamation wall and the zig-zag reclamation wall (no longer shown) and beyond has been largely reclaimed, excepting a drainage cut adjacent to Tees Dock Road and Teesport Depot, which is shown on reclaimed land at ~NGR E:454049 N:523043. The depot appears to be in an early stage of construction, with two tanks shown but limited infrastructure is evident. The area to the north east of the reclaimed land is shown as mud & sand and is cut by a channel flowing towards the estuary. Grangemouth Power Station is no longer labelled although a large building and two reservoirs remain at ~NGR E:455205 N:521770 and ~NGR E:455236 N:521716, together with another water body at ~NGR E:455230 N:521918. Part of the land in the south of the power station is marked as allotments and a football field. Lackenby Iron Works is no longer shown, although the Tees Slag Works and Lackenby Slag Breaking Plant are still labelled. A new railway siding has been constructed between Grangetown Station and Lackenby Sidings diverting from the existing line by between ~120 m at ~NGR E:455395 N:522049, where it meets a siding from the former power station, at a typical distance of ~90 m north of the Tees Slag Wool Works. The new Tees Dock Road is in the process of being constructed along the new reclamation wall in a south east direction to the old north east trending reclamation wall where it turn east-southeast to a new roundabout at ~NGR E:455521 N:522489, before crossing southwards over the railway at ~NGR E:455528 N:522396. The Tees Dock road then runs south westwards along the south side of the railway to approximately ~NGR E:455189 N:521969, where it turns south southwest to cross the new railway siding at ~NGR E:455180 N:521934, before travelling down to ~NGR E:455112 N:521334. From this point Tees Dock Road bends to the south east and terminates at ~NGR E:455688 N:520912 at a junction with a new roundabout on the upgraded Trunk Road (A1085) at ~NGR E:455700 N:520925. A large electricity substation is shown at ~NGR E:455099	

OS Map Edition(s)	Significant features on site	Significant features off site
	N:521056 measuring ~200 m by ~100 m adjacent to the south west section of the Tees Dock Road. The south of the area to the south of the Bolckow Road is shown to have a network of roads, however, no buildings are evident. The Teesport Depot has two large tanks ~30 m in diameter within bunds.	
EC2_C_10000_Middlesbrough - 1975 EC2_C_10000_Ordnance Survey Plan - 1976 EC2_C11_2500_Additional SIMs - 1977 - 1984	Russian mapping dating 1975 shows significant industrial development having occurred across much the area in the previous twenty plus years. The Cleveland Steelworks has been substantially redeveloped. The area adjacent to the steel works is no longer residential with allotments and most of the area is shown as rail siding running either side of Tees Dock Road. The Lackenby Steel Works comprise four large elongate building arranged with long axes on a north to south alignment of lengths of between ~440 and ~930 m and a typical width of ~90 m or more (maximum ~220 m) and many smaller buildings. The area to the south of the southern end of Tees Dock Road (south of the old Bolckow Road) has been developed for housing. The area alongside the railway is now congested with rail sidings associated with the adjacent Lackenby Steelworks, as well as two roads. The Teesport Depot has been extended adjacent to the estuary and comprises c.32 tanks. Tees Dock Road and a parallel engineered channel exists to the west of the road, which is crossed by a road linking the Tees Dock Road to the Teesport Depot. On its southern reach the channel is joined to a lagoon measuring c.415 m by 300 m. On the estuary side of the large lagoon there are eight smaller square lagoons of ~50m side length arranged in two banks of four. These are assumed to be settling ponds used by Teesside Works. Lackenby Tank Farm is located adjacent to the large lagoon on a triangular site. Tanks are arranged within four areas of 12 mostly smaller tanks to the south, 3 large tanks on the west and 13 large tanks to the east, and two small tanks to the north. Tank diameters range very approximately between 9 and 33 m.	

OS Map Edition(s)	Significant features on site	Significant features off site
	Teesport with associated roads, rail track and buildings are present with road links to Tees Dock Road via a roundabout at ~NGR E:455172 N:522658. The Teesport Refinery has been developed to the north of Lackenby Steelworks adjacent to Teesport Dock. The refinery has numerous tanks to the north and buildings to the south (shown as a works). The buildings on Ordnance Survey mapping dating from 1976 show a different configuration, several chimneys and an electricity substation. Ordnance Survey mapping from 1976 shows a works sandwiched between the main railway line and parallel sidings associated with Teesport. The works include an electrical substation at ~NGR E:455739 N:522788. The works which correspond with the address of a current industrial gas supplier has overall dimensions of ~600 m by ~100 m aligned with the long axis in a north east direction. Land between the works and the Teesport sidings appears to be susceptible to flooding. An electrical transmission line is shown adjacent to the lagoons, with one or more lines then turning north east to follow the railway adjacent to the Lackenby Steelworks, and others following the Tees Dock Road to the southern end of the map. A pipeline is shown entering the edge of mapping at ~NGR E:454997 N:521881 towards the north east within the railway tracks through a tunnel below the Tees Dock Road at ~NGR E:455530 N:522409 and exits the map at ~NGR E:456466 N:523371. A second pipeline enters the mapped area at ~NGR E:455001 N:52128 and runs south of the Lackenby Steelworks along the Tees Dock Road to ~NGR E:455463 N:521008 and then heads in a north east direction. The destination of the pipeline is unclear thereafter as it is not possible to distinguish between pipelines and rail tracks, however, the pipeline may continue in a north east direction as indicated in Russian mapping, as well as a branch entering the Lackenby Works steel plant along a north route from ~NGR E:455851 N:521290. The large electricity substation on the Tees Dock Road is labelled a "Grid Site".	

OS Map Edition(s)	Significant features on site	Significant features off site
	Development of a chemical works is evident in the south east corner to the map.	
EC2_C_10000_Ordnance Survey Plan - 1985	Ordnance Survey mapping of 1985 shows a fire station adjacent to Teesport Refinery at ~NGR E:455756 N:523319. Further development of the Lackenby Steelworks has been undertaken to the south of the existing building comprising two large circular structures attached to a building at ~NGR E:455202 N:521334 and a second smaller building to the south at ~NGR E:455197 N:521276. A small works is shown on the Tees Dock Road at ~NGR E:455336 N:520985 near the southern border of the map.	
EC2_C_10000_Ordnance Survey Plan - 1990 - 1992 EC2_C_10000_Middlesbrough - 1991	Ordnance Survey mapping of 1992 no longer shows the any circular tanks in the Lackenby Tank Farm. One of the remaining structures at ~NGR E:455151 N:522571 is now labelled an electrical substation. There are two small rectangular tanks labelled at ~NGR E:455117 N:5225665 and ~NGR E:455035 N:522604. The adjacent lagoon is labelled a settling pond. The eight smaller ponds are no longer in evidence. The area of spoil to the west of the lagoons shows signs of development with a grid or tracks in the north west and lagoon bund in the south east. The Teesport Refinery is shown as a depot and the only remaining structures are labelled electrical substation in a ~100 m by ~200 m area. The fire station and adjacent area adjacent to the Teesport Refinery are also labelled as a depot. The rail track along the Trunk Road is extended to ~NGR E:455770 N:520919, beside a Freightliner Terminal located at ~NGR E:456054 N:521310 and travelling crane. The continued expansion of the Wilton complex includes a building at ~NGR E:456135 N:521453 adjacent to the former location of Kinkerdale Beck, which is no longer labelled. Two small unnamed buildings have been constructed between Lackenby Steelworks and the Tees Dock Road at ~NGR E:455346 N:521088 including a ~50 m by 50 m compound, and ~NGR E:455288 N:521107 without a compound. These structures are no longer shown in the 2000 mapping.	

OS Map Edition(s)	Significant features on site	Significant features off site
	A large building to the north of the Teesport is labelled a Transit Shed and the adjacent area is a depot and warehouse. A further warehouse is located at ~NGR E:455149 N:522864 adjacent to Teesport and north east of the Oil Supply Terminal.	
EC2_C_10000_Ordnance Survey Plan - 1993 EC2_C_10000_10K Raster Mapping - 2000	The area formerly occupied by eight settling ponds is shown with several conveyors assumed to be a waste management operation. By 2000 the new lagoon development west of the old settling pond shows considerable expansion and variation in lagoon location / operation. The old settling lagoon is labelled Teesside Works; drains and ponds are evident on the north, west and east of the structure. An unnamed facility has been constructed at ~NGR E:456026 N:523492. This corresponds with the address of a chemical manufacturing company making corrosion inhibitors and drilling emulsifiers for the North Sea Oil and Gas Industry.	

Man Made Features

10.8.124 Historical Ordnance Survey (OS) maps show man made features across the wider site area associated with historical land uses summarised below. Geo-environmental constraints identified from historical land use, provided by Landmark in digital format are shown in Figure: 10-10 Contaminated Land – Point (ES Volume II, Document Ref. 6.3), Figure: 10-11 Contaminated Land – Line (ES Volume II, Document Ref. 6.3) and Figure: 10-12 Contaminated Land – Polygon (ES Volume II, Document Ref. 6.3). Further detail of potential sources of contamination, based on the historical OS maps, are presented in Figure: 10-23 Historical Features (Sheets 1 to 3) (ES Volume II, Document Ref. 6.3).

PCC Site

10.8.125 The man-made features below are predominantly associated with the historical land reclamation and various works (slag, macadam, iron and steel) that occurred on site:

- Reclaimed land;
- Residential properties (no longer present);
- Water Tank (no longer present);
- Railways/ Tramways (historical and existing);
- Railway sidings;
- South Gare Breakwater (no longer present);
- Slag heaps (no longer present);
- Tar Macadam (& Slag) Works + industrial buildings;
- Rifle Range (no longer present);
- Pond (since infilled);
- Redcar Iron and Steel Works (no longer present);
- Meter Houses (no longer present);
- Reservoirs (no longer present);
- Water Tower (no longer present);
- Water Coolers (no longer present);
- Chimneys (no longer present);
- Tanks – associated pipeline;
- [Travelling] Crane (no longer present);
- Drainage network (no longer present);
- Electrical substation (no longer present);
- Road infrastructure (historical and existing);
- Teesside Works (abandoned).

Utility Searches

10.8.126 A public utility services search has not been undertaken as part of this PSSR. A review of public utility services will need to be undertaken prior to ground investigation works in accordance with the requirements of the Construction (Design and Management) (CDM) Regulations 2015. Prior to any intrusive works service clearance work required at each investigation location is to be undertaken in accordance with Health and Safety Executive (HSE) guidance note HSG/47 (Third edition) publication – Avoiding Danger from Underground Services.

Regulatory Information

10.8.127 Figure: 10-9 Hazardous (ES Volume II, Document Ref. 6.3) displays the pertinent hazardous substance features within the site and Figure 10-15: Discharge (ES Volume II, Document Ref. 6.3) shows the distribution of various discharge consents types and pollution incidents to controlled waters across the site.

10.8.128 The Envirocheck Report and Site Sensitivity maps are included in Annex B. Details of regulatory information within 200m of the Site is summarised in Table 10A-21.

Table 10A-21: Regulatory Information

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
PCC Site			
Planning Hazardous Substance Consent	Name: Sahaviriya Steel Industries UK Ltd Location: Blast Furnace And Coke Ovens, Trunk Road, Redcar Hazardous Substance: Unknown at time of report Dated: 1st April 2011		2G151
CO_2 Export Pipeline			
No Discharge Consents, Pollution Incidents to Controlled Waters or Hazardous Substances entries are recorded on or within 200m of the site area.			
Water Supply and Discharge Connection Corridors			
Discharge Consent	British Steel Engineering Steels Iron & Steel Industries Reference: **AJ0094** Issued: 18th June 1993 Revoked: Not Supplied Location: Steel House, REDCAR, Cleveland, TS10 5QW Type: Trade Effluent Discharge-Cooling Water (Direct) Receiving Water: North Sea		2I1
Discharge Consent	Corus Construction Industrial Making of basic metals/ Iron & Steel/ Foundry/ Casting		2I2

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Reference: **256/0905** Issued: 12th March 1993 Revoked: 23rd June 1994 Location: British Steel Redcar Works, Redcar Type: Sewage Discharges - Unspecified - Water Company Receiving Water: North Sea		
Discharge Consent	British Steel Plc Making of basic metals/ Iron & Steel/ Foundry/ Casting Reference: **256/X/0648** Issued: 30th September 1987 Revoked: 12th March 1993 Location: British Steel Redcar Works, Redcar Type: Unspecified Receiving Water: Tees Estuary		2I2
CO_2 Gathering Network and Natural Gas Connection Corridors			
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 8th July 2002 Revoked: 20th August 2002 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		1F2

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 25th August 2000 Revoked: 31st December 2000 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		1F2
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 25th August 2000 Revoked: 24th April 2001 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		1F2
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 25th August 2000 Revoked: 31st May 2001 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		1F2

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 25th August 2000 Revoked: 19th February 2002 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		1F2
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 25th August 2000 Revoked: 7th March 2002 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		1F2
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 25th August 2000 Revoked: 11th March 2002 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		1F2

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 25th August 2000 Revoked: 7th July 2002 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		1F2
Discharge Consent	Operator: Northumbrian Water Limited Sewage Disposal Works - Water Company Reference: **254/1458** Issued: 24th September 1996 Revoked: 2nd July 1997 Location: Bran Sands Treatment Plant, Bran Sands Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut(Saline Waters)		1F2
Discharge Consent	Operator: Northumbrian Water Limited Sewage Disposal Works - Water Company Reference: **254/1458** Issued: 24th September 1996 Revoked: 2nd July 1997 Location: Bran Sands Treatment Plant, Bran Sands Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut(Saline Waters)		1F2

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
Discharge Consent		Operator: Enron Teesside Operations Limited WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **254/C/0211** Issued: 14th December 1973 Revoked: 2nd April 1993 Location: Saltholme Farm, Port Clarence Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Receiving Water: Tees, Tributary Of	1F4
Discharge Consent		Operator: Cleveland County Fire Brigade WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **254/D/0256** Issued: 27th November 1970 Revoked: 14th July 1992 Location: Billingham Fire Station, Billingham Type: Trade Discharge - Process Water Receiving Water: Greatham Creek, Tributary Of	1F5
Discharge Consent		Operator: Cleveland County Fire Brigade Reference: **254/D/0250/5512** Issued: 27th November 1970 Location: BILLINGHAM Type: Engineering Receiving Water: Greatham Creek; Tributary Of	1F5
Discharge Consent		Operator: Cleveland County Fire Brigade WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **254/D/0250** Issued: 6th November 1970 Revoked: 14th July 1992	1F5

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Location: Billingham Fire Station, Billingham Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Receiving Water: Greatham Creek, Tributary Of	
Discharge Consent		Operator: Phillips Petroleum Co UK Ltd MAKING OF COKE + REFINED PETROLEUM PRODUCTS Reference: **254/D/0044** Issued: 19th November 1965 Revoked: 22nd April 1983 Location: Phillips - Imperial Petroleum Ltd,, Saltholme, Port Clarence Type: Trade Discharge - Process Water Receiving Water: Holme Fleet, Tributary Of	1F6
Discharge Consent		Operator: Phillips Petroleum Co UK Ltd MAKING OF COKE + REFINED PETROLEUM PRODUCTS Reference: **254/D/0044** Issued: 19th November 1965 Revoked: 22nd April 1983 Location: Phillips - Imperial Petroleum Ltd,, Saltholme, Port Clarence Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Receiving Water: Holme Fleet, Tributary Of	1F6
Discharge Consent	Operator: Shanks & Mcewan (Southern Waste) MAKING OF CHEMICALS + CHEMICAL PRODUCTS Reference: **254/1530** Issued: 24th April 1998 Revoked: 3rd August 2004		1G9

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Location: Shanks & Mcewan, Middlesbrough Type: Trade Effluent Receiving Water: The River Tees		
Discharge Consent	Operator: Shanks & Mcewan (Southern Waste) MAKING OF CHEMICALS + CHEMICAL PRODUCTS Reference: **254/1530** Issued: 24th April 1998 Revoked: 31st January 2000 Location: Shanks & Mcewan, Middlesbrough Type: Trade Effluent Receiving Water: The River Tees		1G9
Discharge Consent	Operator: Vopak WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **254/0921** Issued: 20th April 1989 Revoked: 26th July 1994 Location: Seal Sands Chemical Company Ltd, Seal Sands, Middlesbrough Type: Trade Effluent Receiving Water: Tees		1G9
Discharge Consent		Operator: Seal Sands Chemicals Ltd Basic Industry, Chemicals Inorganic Reference: **AL6956** Issued: 16th June 1994 Location: Seal Sands Road, MIDDLESBROUGH, Cleveland, TS2 1UB Type: Trade Effluent Discharge-Treated Effluent Receiving Water: Tees	1G12

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
Discharge Consent		Operator: Fine Organics Ltd MAKING OF CHEMICALS + CHEMICAL PRODUCTS Reference: **254/0289** Issued: 25th May 1989 Revoked: 11th January 1994 Location: Fine Organics Ltd, Teesside Site, Seal Sands, Middlesbrough Type: Trade Effluent Receiving Water: Tees	1G14
Discharge Consent		Operator: Vopak WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **254/B/0316** Issued: 30th January 1985 Revoked: 26th July 1994 Location: Seal Sands Storage Ltd, Seal Sands, Middlesbrough Type: Trade Discharge - Process Water Receiving Water: Tees	1G15
Discharge Consent		Operator: Monsanto Ltd WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **254/B/0117** Issued: 30th May 1969 Revoked: 30th August 1990 Location: Acrylonitrile Plant, Seal Sands, Teesside Type: Trade Effluent Receiving Water: Tees	1G20
Discharge Consent		Operator: Monsanto Ltd WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES)	1G20

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Reference: **254/B/0118** Issued: 30th May 1969 Revoked: 30th August 1990 Location: Acrylonitrile Plant, Seal Sands, Teesside Type: Trade Effluent Receiving Water: Tees	
Discharge Consent		Operator: Monsanto Ltd WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **254/B/0119** Issued: 30th May 1969 Revoked: 30th August 1990 Location: Acrylonitrile Plant, Seal Sands, Teesside Type: Trade Effluent Receiving Water: Tees	1G20
Discharge Consent		Operator: Phillips Petroleum Co UK Ltd WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **254/0231** Issued: 13th December 1985 Revoked: 6th August 2004 Location: Fine Organics Ltd, Middlesbrough Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Receiving Water: Tees	1H2
Discharge Consent	Operator: Northumbrian Water Limited STORM TANK/CSO ON SEWERAGE NETWORK (WATER COMPANY) Reference: **254/1935** Issued: 15th February 2019 Location: Tees Dock Road Cso, Coal Depot, Tees Dock Road, Middlesbrough, Ts6 6ue		2C1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		
Discharge Consent	Operator: Northumbrian Water Limited STORM TANK/CSO ON SEWERAGE NETWORK (WATER COMPANY) Reference: **254/1935** Issued: 23rd March 2010 Revoked: 14th February 2019 Location: Tees Dock Road Cso, Coal Depot, Tees Dock Road, Middlesbrough, Ts6 6ue Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1814** Issued: 3rd March 2005 Revoked: 12th October 2006 Location: Tees Dock Rd Sso, Grangetown Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C1
Discharge Consent	Operator: Northumbrian Water Limited Sewage Disposal Works - Water Company Reference: **254/1814** Issued: 3rd March 2005 Location: Tees Dock Rd Sso, Grangetown Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/0800** Issued: 21st September 1989 Revoked: 15th January 1991 Location: Tees Dock Rd Sso, Grangetown Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C1
Discharge Consent		Operator: BOC Gases Ltd MAKING OF CHEMICALS + CHEMICAL PRODUCTS Reference: **254/1423** Issued: 26th July 2012 Location: British Oxygen Company (BOC) Limited, Tees Dock Road, Middlesbrough Type: Trade Discharges - Cooling Water Receiving Water: Land	2C2
Discharge Consent	BOC	Operator: BOC Ltd Reference: **QC 254/1423** Issued: 19th October 1995 Location: Tees Dock Road, MIDDLESBROUGH Type: Cooling Water Receiving Water: Land	2C2
Discharge Consent	BOCBOC	Operator: BOC Limited Basic Industry, Chemicals Inorganic Reference: **QC.254/1423** Issued: 19th October 1995 Location: BOC Limited, Tees Dock Road, MIDDLESBROUGH, Cleveland, TS6 7RT Type: Trade Effluent Discharge-Cooling Water	2C2

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		(Direct) Receiving Water: Soakaway	
Discharge Consent	BOC	Operator: BOC Gases Ltd MAKING OF CHEMICALS + CHEMICAL PRODUCTS Reference: **254/1423** Issued: 18th October 1995 Revoked: 25th July 2012 Location: BOC Limited, Tees Dock Road, Middlesbrough Type: Trade Discharges - Cooling Water Receiving Water: Land	2C2
Discharge Consent	Operator: Northumbrian Water Limited STORM TANK/CSO ON SEWERAGE NETWORK (WATER COMPANY) Reference: **254/1935** Issued: 15th October 2006 Revoked: 31st March 2010 Location: Tees Dock Road Cso, Coal Depot, Tees Dock Road, Middlesbrough, Ts6 6ue Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C3
Discharge Consent	Operator: Northumbrian Water Limited STORM TANK/CSO ON SEWERAGE NETWORK (WATER COMPANY) Reference: **254/1935** Issued: 15th October 2006 Revoked: 31st March 2010 Location: Tees Dock Road Cso, Tees Dock Road, Dormanstown, Middlesbrough Type: Sewage Discharges - Stw Storm		2C3

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		
Discharge Consent	Operator: Northumbrian Water Limited STORM TANK/CSO ON SEWERAGE NETWORK (WATER COMPANY) Reference: **254/1812** Issued: 21st February 2005 Revoked: 12th October 2006 Location: Tees Dock Road Cso, Coal Depot, Tees Dock Road, Middlesbrough, Ts6 6ue Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C3
Discharge Consent	Operator: Northumbrian Water Limited STORM TANK/CSO ON SEWERAGE NETWORK (WATER COMPANY) Reference: **254/E/0112** Issued: 27th April 1956 Revoked: 21st February 2005 Location: Tees Dock Road Cso, Coal Depot, Tees Dock Road, Middlesbrough, Ts6 6ue Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C3
Discharge Consent		Operator: Dorman, Long And Company Ltd WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **254/E/0051** Issued: 9th October 1953 Revoked: 12th January 2014	2D4

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Location: Lackenby Steel Works, Lackenby, Grangetown, Middlesbrough Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Receiving Water: Dabholm Beck	
Discharge Consent		Operator: Dorman, Long And Company Ltd MAKING OF BASIC METALS/IRON+STEEL/FOUNDRY/CASTING Reference: **254/E/0045** Issued: 14th August 1953 Revoked: 30th September 1996 Location: Lackenby Steel Works, Hydraulic Pum, Lackenby Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Receiving Water: Dabholm Beck	2D4
Discharge Consent		Operator: Dorman, Long And Company Ltd MAKING OF BASIC METALS/IRON+STEEL/FOUNDRY/CASTING Reference: **254/E/0046** Issued: 14th August 1953 Revoked: 1st January 1993 Location: Lackenby Steel Works, Hydraulic Pum, Lackenby Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Receiving Water: Dabholm Beck	2D4
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 25th November 2010		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 25th November 2010 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping Station - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 25th November 2010 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 25th November 2010 Revoked: 31st August 2011 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 25th November 2010 Revoked: 31st August 2011 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 25th November 2010 Revoked: 31st August 2011 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping Station - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 14th October 2008 Revoked: 24th November 2010 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 14th October 2008 Revoked: 24th November 2010 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 14th October 2008 Revoked: 24th November 2010 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping Station - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 7th May 2008 Revoked: 31st March 2009 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 7th May 2008 Revoked: 31st March 2009 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited Sewage Disposal Works - Water Company Reference: **254/1920** Issued: 7th May 2008 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Unspecified - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 7th May 2008 Revoked: 31st March 2009 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 7th August 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 7th August 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 7th August 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 10th September 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 10th September 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 10th September 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th November 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th November 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th November 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 10th January 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 10th January 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 10th January 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th November 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th November 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th November 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 28th February 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 28th February 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 28th February 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th January 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping Station - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th January 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th January 2007 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th April 2008 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th April 2008 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 30th April 2008 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 7th May 2008 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 7th May 2008 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 31st March 2006 Revoked: 7th May 2008 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 30th March 2006 Revoked: 30th March 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 30th March 2006 Revoked: 30th March 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 30th March 2006 Revoked: 30th March 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 30th March 2006 Revoked: 31st July 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 30th March 2006 Revoked: 31st July 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1920** Issued: 30th March 2006 Revoked: 31st July 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Pumping		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 5th February 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 5th February 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Unspecified - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 5th February 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Overflow/Storm Tank - Water Company Receiving Water: The Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 31st May 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 31st May 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Unspecified - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 31st May 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Overflow/Storm Tank - Water Company Receiving Water: The Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 30th June 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 30th June 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Unspecified - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 30th June 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Overflow/Storm Tank - Water Company Receiving Water: The Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 25th July 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 25th July 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Unspecified - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 25th July 2004 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Overflow/Storm Tank - Water Company Receiving Water: The Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 31st January 2005 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 23rd October 2005 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 8th November 2005 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Effluent - Water Company Receiving Water: The Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 8th November 2005 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited Sewage Disposal Works - Water Company Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 8th November 2005 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Unspecified - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 12th February 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Effluent - Water Company Receiving Water: The Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited Sewage Disposal Works - Water Company Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 12th February 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Unspecified - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 12th February 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 31st March 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Effluent - Water Company Receiving Water: The Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited Sewage Disposal Works - Water Company Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 31st March 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Unspecified - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 31st March 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **25/04/1630** Issued: 21st August 2002 Revoked: 11th October 2006 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Effluent - Water Company Receiving Water: The Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited Sewage Disposal Works - Water Company Reference: **25/04/1630** Issued: 21st August 2002 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Unspecified - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited Sewage Disposal Works - Water Company Reference: **25/04/1630** Issued: 21st August 2002 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: The Dabholm Gut		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1469** Issued: 15th August 1997 Revoked: 30th December 1998 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Trade Discharges - Process Effluent - Water Company (Wtw) Receiving Water: Dabholm Gut Trib Of Tees		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1466** Issued: 20th January 1997 Revoked: 4th February 2002 Location: Portrack Sewage Treatment Works, Stockton On Tees Type: Unspecified Receiving Water: Tees(Saline Estuary)		2F1
Discharge Consent	Operator: Northumbrian Water Limited Sewage Disposal Works - Water Company Reference: **254/1458** Issued: 24th September 1996 Revoked: 12th June 2000 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut(Saline Waters)		2F1
Discharge Consent	Operator: Northumbrian Water WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1458** Issued: 24th September 1996 Revoked: 24th August 2000 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Trade Effluent Receiving Water: Dabholm Gut(Saline Waters)		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
Discharge Consent	Operator: Northumbrian Water WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1458** Issued: 24th September 1996 Revoked: 24th August 2000 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut(Saline Waters)		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1458** Issued: 24th September 1996 Revoked: 30th June 1998 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Dabholm Gut(Saline Waters)		2F1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1387** Issued: 17th January 1995 Revoked: 30th June 1998 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Type: Trade Effluent Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/1387** Issued: 17th January 1995 Revoked: 30th December 1998 Location: Bran Sands Treatment Works, Wilton, Redcar & Cleveland Type: Trade Effluent Receiving Water: Dabholm Gut		2F1
Discharge Consent		Operator: ICI Chemicals & Polymers Ltd Basic Industry, Chemicals Organic Reference: **254/1409** Issued: 29th December 1994 Revoked: 4th January 1997 Location: ICI Chemicals & Polymers Limited Wi, Middlesbrough Type: Unspecified Receiving Water: Dabholm Gut	2F1
Discharge Consent		Operator: ICI Chemicals & Polymers Ltd Basic Industry, Chemicals Organic Reference: **254/1357** Issued: 1st October 1993 Revoked: 3rd November 1993 Location: ICI Chemicals & Polymers Limited Wi, Middlesbrough Type: Unspecified Receiving Water: Dabholm Gut Estuary	2F1
Discharge Consent	Operator: Enron Teesside Operations Limited		2F1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	MAKING OF CHEMICALS + CHEMICAL PRODUCTS Reference: **254/0169** Issued: 27th May 1987 Revoked: 2nd January 1992 Location: ICI Plc, Wilton, Wilton, Middlesbrough Type: Trade Discharge - Process Water Receiving Water: Tees		
Discharge Consent	Operator: Northumbrian Water Limited PUMPING STATION ON SEWERAGE NETWORK (WATER COMPANY) Reference: **25/04/1646** Issued: 1st November 2000 Revoked: 28th May 2007 Location: Eston Pumping Station, Adjacent To Bran Sands Stw, Tees Dock Road, Type: Sewage Discharges - Pumping Station - Water Company Receiving Water: Dabholm Gut		2F4, 2G2
Discharge Consent		Operator: Hodgson Specialities Ltd Sewage Disposal Works – Other Reference: **254/0988** Issued: 1st February 1991 Revoked: 17th June 1994 Location: Hodgson Specialities Ltd, Middlesbrough Type: Unspecified Receiving Water: Dabholm Gut	2F4
Discharge Consent		Operator: Hodgson Specialities Ltd WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES)	2F4

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Reference: **254/0988** Issued: 23rd January 1991 Revoked: 15th June 1994 Location: Hodgson Specialities Ltd, Middlesbrough Type: Trade Discharges - Site Drainage Receiving Water: Dabholm Gut	
Discharge Consent		Operator: Hodgson Specialities Ltd WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **254/0988** Issued: 23rd January 1991 Revoked: 15th June 1994 Location: Hodgson Specialities Ltd, Middlesbrough Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Receiving Water: Dabholm Gut	2F4
Discharge Consent	Operator: Tees & Hartlepool Port Authority WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **QC.25/04/1578** Issued: 28th April 1999 Location: The Entrance Facility Riverside Ro Ro Terminal, Boulby Road, Teesport, Type: Sewage Discharges - Final/Treated Effluent - Not Water Company Receiving Water: Land (River Tees)		2F5
Discharge Consent		Operator: Enron Teesside Operations Limited WWTW (NOT WATER CO) (NOT STP AT A PRIVATE PREMISES) Reference: **254/B/0095** Issued: 22nd September 1967 Revoked: 5th October 1990	2F8

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Location: Reclamation Works At Bran Sands, Wilton Type: Trade Effluent Discharge-Boiler Blowdown Receiving Water: Dabholm Gut	
Discharge Consent		Operator: Enron Teesside Operations Limited MAKING OF CHEMICALS + CHEMICAL PRODUCTS Reference: **254/B/0082** Issued: 26th May 1967 Revoked: 21st September 1967 Location: Reclamation Works At Bran Sands, Wilton Type: Trade Effluent Discharge-Boiler Blowdown Receiving Water: Dabholm Gut	2F9
Discharge Consent	Operator: Northumbrian Water Limited WWTW/SEWAGE TREATMENT WORKS (WATER COMPANY) Reference: **254/E/0286** Issued: 28th October 1960 Revoked: 17th January 2002 Location: Eston Trunk Sewer Outfall, Eston Type: Sewage Discharges - Final/Treated Effluent - Water Company Receiving Water: Tees		2F10
Discharge Consent	Operator: National Grid Transco SUB-STATION/ELECTRICITY/GAS/AIR CONDITIONING SUPPLY Reference: **25/04/1799** Issued: 7th October 2004 Revoked: 25th March 2011 Location: Tod Point 275kv Substation, Trunk Road (West Of), Redcar, Cleveland, Ts10		2G1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Type: Trade Discharge - Process Water Receiving Water: Soakaway - Groundwater		
Discharge Consent	Operator: Northumbrian Water Limited PUMPING STATION ON SEWERAGE NETWORK (WATER COMPANY) Reference: **25/04/1646** Issued: 1st November 2000 Revoked: 16th January 2002 Location: Eston Pumping Station, Adjacent To Bran Sands Stw, Tees Dock Road, Type: Sewage Discharges - Pumping Station - Water Company Receiving Water: Dabholm Gut		2G2
Discharge Consent	Operator: Northumbrian Water Limited PUMPING STATION ON SEWERAGE NETWORK (WATER COMPANY) Reference: **25/04/1646** Issued: 1st November 2000 Location: Eston Pumping Station, Adjacent To Bran Sands Stw, Tees Dock Road, Type: Sewage Discharges - Pumping Station - Water Company Receiving Water: Dabholm Gut		2G2
Pollution Incidents to Controlled Waters	Belasis Beck, Zeneca Site, BILLINGHAM Pollutant: Chemicals - Acid Catchment: Tees Downstream Skerne To North Sea Receiving Water: Freshwater Stream/River Severity: Category 2 - Significant Incident Reference: **DD960003** Incident: 2nd January 1996		1A34
Pollution Incidents to Controlled Waters		Belasis Beck, BILLINGHAM	1E6

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Pollutant: Chemicals - Alkali Catchment: Tees Downstream Skerne To North Sea Receiving Water: Freshwater Stream/River Severity: Category 3 - Minor Incident Reference: **DD950425** Incident: 23rd November 1995	
Pollution Incidents to Controlled Waters		Tees Estuary, I.C.I. Wilton Pollutant: Chemicals - Other Organic Catchment: Tees Downstream Skerne To North Sea Receiving Water: Saline Estuary Severity: Category 3 - Minor Incident Reference: **DD960371** Incident: 8th December 1996	2F15
Pollution Incidents to Controlled Waters		Tees/Dabholm Gut, I.C.I. Wilton Pollutant: Chemicals - Solvents Catchment: Tees Downstream Skerne To North Sea Receiving Water: Saline Estuary Severity: Category 3 - Minor Incident Reference: **DD960250** Incident: 17th July 1996	2F15
Pollution Incidents to Controlled Waters		Tees, I C I Wilton, MIDDLESBROUGH Pollutant: Chemicals - Alkali Catchment: Tees Downstream Skerne To North Sea Receiving Water: Saline Estuary Severity: Category 3 - Minor Incident Reference: **DD950349** Incident: 26th September 1995	2F15
Pollution Incidents to Controlled Waters		ICI Wilton	2F15

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Pollutant: Unknown Catchment: Tees Downstream Skerne To North Sea Receiving Water: Groundwater Severity: Category 3 - Minor Incident Reference: **DD950248** Incident: 24th July 1995	
Pollution Incidents to Controlled Waters		ICI Wilton Pollutant: Unknown Catchment: Tees Downstream Skerne To North Sea Receiving Water: Pond/Lake Severity: Category 3 - Minor Incident Reference: **DD950169** Incident: 31st May 1995	2F15
Pollution Incidents to Controlled Waters	ICI Wilton Pollutant: Unknown Catchment: Tees Downstream Skerne To North Sea Receiving Water: Pond/Lake Severity: Category 3 - Minor Incident Reference: **DD950153** Incident: 22nd May 1995		2F16
Pollution Incidents to Controlled Waters		ICI Wilton Pollutant: Chemicals - Pesticides Catchment: Tees Downstream Skerne To North Sea Receiving Water: Freshwater Stream/River Severity: Category 1 - Major Incident Reference: **DD950089** Incident: 3rd April 1995	2F16
Pollution Incidents to Controlled Waters		Fleet Beck, Dormanstown, REDCAR	2G14

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Pollutant: Miscellaneous - Urban Runoff Catchment: Tees Downstream Skerne To North Sea Receiving Water: Freshwater Stream/River Severity: Category 3 - Minor Incident Reference: **DD960133** Incident: 26th April 1996	
Pollution Incidents to Controlled Waters		Fleet Beck, Dormanstown, REDCAR Pollutant: Not Given Catchment: Tees Downstream Skerne To North Sea Receiving Water: Freshwater Stream/River Severity: Category 3 - Minor Incident Reference: **DD960133** Incident: 26th April 1996	2G14
COMAH	BASF Plc, PO Box 62, Seal Sands, MIDDLESBROUGH, Cleveland, TS2 1TX Type: Upper Tier Reference: Not Supplied Status: Active		1F317
COMAH	Navigator Terminals Seal Sands Limited Seal Sand, Middlesbrough, Cleveland,TS2 1UA Unique ID 2308498		
COMAH		Fine Organics Limited, Seal Sands, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Type: Upper Tier Reference: **4148935** Status: Active	1F317

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
COMAH	CF Fertilisers UK Limited, North Tees, Huntsman Drive, Port Clarence, Middlesbrough, Cleveland, TS2 1TT Type: Upper Tier Reference: Not Supplied Status: Active		1F318
COMAH		Wood Group Psn Limited, Seal Sands, MIDDLESBROUGH, Cleveland, TS2 1UB Type: Upper Tier Reference: Not Supplied Status: Active	1G133
COMAH		Vertellus Specialities UK Limited, Seal Sands, Middlesbrough, Cleveland, TS2 1UB Type: Upper Tier Reference: Not Supplied Status: Active	1G133
COMAH		Inter Terminals Seal Sands Limited, Seal Sands Terminal, Seal Sands, MIDDLESBROUGH, Cleveland, TS2 1UB Type: Upper Tier Reference: Not Supplied Status: Active	1G133
COMAH	Enron Power Operations Ltd, Seal Sands Road, Seal Sands, MIDDLESBROUGH, Cleveland, TS2 1UB Type: Upper Tier Reference: Not Supplied Status: Record Ceased To Be Supplied Under COMAH Regulations		1G133

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
COMAH		Px (Tgpp) Limited, Teesside Gas Processing Plant, Seal Sands, MIDDLESBROUGH, Cleveland, TS2 1UB Type: Upper Tier BROUGH, Cleveland Type: Upper Tier Reference: Not Supplied Status: Active	1G133
COMAH	Ineos Nitriles (UK) Limited, Seal Sands, Po Box 62, Middlesbrough, Cleveland, Ts2 1TX Type: Upper Tier Reference: Not Supplied Status: Active		1G139
COMAH	BOC	BOC Limited, Tees Dock Road, Middlesbrough, Cleveland, TS6 7RT Type: Upper Tier Reference: Not Supplied Status: Active	2C174
NIHHS		BASF P O Box 62, Seal Sands, MIDDLESBROUGH, Cleveland, TS2 1TX Status: Not Active	1F319
NIHHS		Seal Sands Chemical Company Limited, Seal Sands Road, MIDDLESBROUGH, Cleveland, TS2 1UB Status: Not Active	1G143
NIHHS		Fine Organics Ltd., Seal Sands, MIDDLESBROUGH, Cleveland, TS2 1UB Status: Not Active	1G143
NIHHS		British Gas TransCo, Seal Sands Cavity Storage & Pressure Red, Tees Road, Seals Sand Status: Not Active	1G143

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
NIHHS		Enron Power Operations Ltd, Teesside Gas Processing Plant, Seal Sands, MIDDLESBROUGH, Cleveland Status: Not Active	1G143
NIHHS		Simon Storage, North Terminal Site, Seal Sands, MIDDLESBROUGH, Cleveland, TS2 1UB Status: Not Active	1G143
NIHHS		Simon Storage, South Terminal Site, Seal Sands, MIDDLESBROUGH, Cleveland, TS2 1UB Status: Not Active	1G143
NIHHS	BOC	British Oxygen Company (BOC) Limited, Tees Dock Road, Grangetown, MIDDLESBROUGH, Cleveland, TS6 7RT Status: Not Active	2C177
Planning Hazardous Substance Consent		Fine Organics Ltd, Seal Sands, STOCKTON ON TEES, Cleveland, TS2 Hazardous Substance: Unknown at time of report Dated: 18th October 2001	1F322
Planning Hazardous Substance Consent		Enron Power Operations Ltd, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Part C, Flammable Substance (Not in Parts A&B), Liquefied petroleum gas held at >1.4 bar where amount held is greater than or equal to 25 tonnes Dated: 9th May 1995	1F322
Planning Hazardous Substance Consent		Hexel Chemical Products Ltd, Seal Sands Road, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Sulphur trioxide Dated: 16th September 1992	1F322

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
Planning Hazardous Substance Consent		Phillips Petroleum Co (UK) Ltd, Seal Sands, Middlesbrough, Cleveland, Ts2 1uh Hazardous Substance: Part C, Flammable Substance (Not in Parts A&B), Liquefied gas or gases, flammable in air with a boiling point of <0C, where amount held >= 50tonnes Dated: 23rd November 1992	1F323
Planning Hazardous Substance Consent		Phillips Petroleum Co (UK) Ltd, Seal Sands, Middlesbrough, Cleveland, Ts2 1uh Hazardous Substance: Part C, Flammable Substance (Not in Parts A&B), Liquefied gas or gases, flammable in air with a boiling point of <0C, where amount held >= 50tonnes Dated: 23rd November 1992	1F323
Planning Hazardous Substance Consent		Phillips Petroleum Co (UK) Ltd, Seal Sands, Middlesbrough, Cleveland, Ts2 1uh Hazardous Substance: Part C, Flammable Substance (Not in Parts A&B), Liquefied petroleum gas held at >1.4 bar where amount held is greater than or equal to 25 tonnes Dated: 23rd November 1992	1F323
Planning Hazardous Substance Consent		Phillips Petroleum Co (UK) Ltd, Seal Sands, Middlesbrough, Cleveland, Ts2 1uh Hazardous Substance: Part C, Flammable Substance (Not in Parts A&B), Liquefied gas or gases, flammable in air with a boiling point of <0C, where amount held >= 50tonnes Dated: 23rd November 1992	1F323
Planning Hazardous Substance Consent		Phillips Petroleum Co (UK) Ltd, Seal Sands, Middlesbrough, Cleveland, Ts2 1uh	1F323

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Hazardous Substance: Highly flammable (highly flammable liquids which have a flash point <21C and which are not extremely flammable) Dated: 23rd November 1992	
Planning Hazardous Substance Consent	Conoco Phillips, Seal Sands, TS2 1UH Hazardous Substance: Combination of Dangerous Substances Dated: 26th October 1992		1F323
Planning Hazardous Substance Consent	Seal Sands Storage Ltd, Seal Sands Road, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Part A, Toxic Substance, Acetone Cyanohydrin (2-Cyanopropan-2-ol), where amount held is greater than or equal to 200 tonnes Dated: 25th August 1992		1F324
Planning Hazardous Substance Consent	Seal Sands Storage Ltd, Seal Sands Road, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Propylene oxide Dated: 25th August 1992		1F324
Planning Hazardous Substance Consent	Seal Sands Storage Ltd, Seal Sands Road, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Toxic Dated: 25th August 1992		1F324
Planning Hazardous Substance Consent		Px (Tggpp) Ltd, Seaton Carew Road, Port Clarence, Middlesbrough, Ts2 1ub Hazardous Substance: Liquefied extremely flammable gas (including LPG) and natural gas (whether liquefied or not)	1G147

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Dated: 28th October 2011	
Planning Hazardous Substance Consent		Px (Tgpp) Ltd, Gas Processing Plant, Seal Sands Road, Seal Sands, Middlesbrough, Ts2 Hazardous Substance: Combination of Dangerous Substances Dated: 4th August 2006	1G147
Planning Hazardous Substance Consent		Seal Sands Chemicals, Seal Sands, Billingham Hazardous Substance: Combination of Dangerous Substances Dated: 21st October 1999	1G147
Planning Hazardous Substance Consent		Seal Sands Storage, Seal Sands, Middlesbrough Hazardous Substance: Combination of Dangerous Substances Dated: 8th September 1999	1G147
Planning Hazardous Substance Consent		Enron Power Operations Ltd, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Part C, Flammable Substance (Not in Parts A&B), Gas or gases flammable in air, when held as a gas, where amount held is >= 15tonnes Dated: 9th May 1995	1G147
Planning Hazardous Substance Consent		Px, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Liquefied extremely flammable gas (including LPG) and natural gas (whether liquefied or not) Dated: 20th July 1994	1G147
Planning Hazardous Substance Consent		Px, Enron Plant, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Unknown at time of report	1G147

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Dated: 15th December 1993	
Planning Hazardous Substance Consent		Degussa, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Part A, Toxic Substance, Carbon disulphide, where amount held is greater than or equal to 20 tonnes Dated: 6th January 1993	1G147
Planning Hazardous Substance Consent		Degussa, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Chlorine Dated: 6th January 1993	1G147
Planning Hazardous Substance Consent		Amoco (UK) Exploration Co Ltd, Amoco Cats Terminal, Seal Sands Road, Seal Sands, Middlesbrough Hazardous Substance: Methanol Dated: 23rd December 1992	1G147
Planning Hazardous Substance Consent		Amoco (UK) Exploration Co Ltd, Amoco Cats Terminal, Seal Sands Road, Seal Sands, Middlesbrough Hazardous Substance: Part C, Flammable Substance (Not in Parts A&B), Gas or gases flammable in air, when held as a gas, where amount held is >= 15tonnes Dated: 23rd December 1992	1G147
Planning Hazardous Substance Consent		PX, Seal Sands, Stockton-on-Tees, Cleveland, TS2 1UB Hazardous Substance: Liquefied extremely flammable gas (including LPG) and natural gas (whether liquefied or not) Dated: 12th October 1992	1G147

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
Planning Hazardous Substance Consent		Seal Sands Storage Ltd, Seal Sands Road, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Highly flammable (highly flammable liquids which have a flash point <21C and which are not extremely flammable) Dated: 25th August 1992	1G147
Planning Hazardous Substance Consent		Enron Power Ops Ltd, Seal Sands, Stockton Hazardous Substance: Liquefied extremely flammable gas (including LPG) and natural gas (whether liquefied or not)	1G147
Planning Hazardous Substance Consent		Enron Power Ops Ltd, Seal Sands, Stockton Hazardous Substance: Liquefied extremely flammable gas (including LPG) and natural gas (whether liquefied or not)	1G147
Planning Hazardous Substance Consent		PX, Seal Sands, Stockton-on-Tees, Cleveland, TS2 1UB Hazardous Substance: Liquefied extremely flammable gas (including LPG) and natural gas (whether liquefied or not)	1G147
Planning Hazardous Substance Consent		Px, Enron Plant, Seal Sands, Cleveland Hazardous Substance: Combination of Dangerous Substances	1G147
Planning Hazardous Substance Consent	BASF Seal Sands, Billingham Hazardous Substance: Combination of Dangerous Substances Dated: 21st October 1999		1G156
Planning Hazardous Substance Consent	Petroplus, North Tees Site, Seaton Road, Port Clarence, Billingham Hazardous Substance: Combination of Dangerous Substances		1G157

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Dated: 20th October 1999		
Planning Hazardous Substance Consent		Amoco Cats Ltd, Amoco Cats Terminal Hazardous Substance: Methanol	1G163
Planning Hazardous Substance Consent		Seal Sands Storage, Seal Sands, Stockton Hazardous Substance: Part A, Toxic Substance, Acetone Cyanohydrin (2-Cyanopropan-2-ol), where amount held is greater than or equal to 200 tonnes	1G163
Planning Hazardous Substance Consent		Seal Sands Storage, Seal Sands, Stockton Hazardous Substance: Propylene oxide	1G163
Planning Hazardous Substance Consent	Hexel Chemical Products Ltd, Seal Sands Road, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Unknown at time of report Dated: 16th September 1992		1G165
Planning Hazardous Substance Consent	Seal Sands Storage Ltd, Seal Sands Road, Seal Sands, Middlesbrough, Cleveland, Ts2 1ub Hazardous Substance: Part B, Highly Reactive and Explosive Substance, Ammonium nitrate in aqueous solutions, where amount held is greater than or equal to 500 tonnes Dated: 25th August 1992		1G166
Planning Hazardous Substance Consent	BOC	BOC Ltd, Tees Dock Road, Grange Town, TS6 7RT Hazardous Substance: Liquefied extremely flammable gas (including LPG) and natural gas (whether liquefied or not)	2C182
Planning Hazardous Substance Consent		BOC Ltd, Tees Dock Road, Grangetown, MIDDLESBROUGH, Cleveland, TS6 7RT	2C183

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Hazardous Substance: Part B, Highly Reactive and Explosive Substance, Liquid Oxygen, where amount held is greater than or equal to 500 tonnes	
Planning Hazardous Substance Consent		BOC Ltd, Tees Dock Road, Grangetown, MIDDLESBROUGH, Cleveland, TS6 7RT Hazardous Substance: Part C, Flammable Substance (Not in Parts A&B), Liquefied petroleum gas held at >1.4 bar where amount held is greater than or equal to 25 tonnes	2C183
Planning Hazardous Substance Consent		BOC Ltd, Tees Dock Road, Grangetown, MIDDLESBROUGH, Cleveland, TS6 7RT Hazardous Substance: Part B, Highly Reactive and Explosive Substance, Hydrogen, where amount held is greater than or equal to 2 tonnes	2C183
Electrical Connection Corridor			
Discharge Consent	Operator: Northumbrian Water Limited Storm Tank/ CSO on Sewage Network (Water Company) Reference: **254/1935** Issued: 15th February 2019 Location: Tees Dock Road Cso, Coal Depot, Tees Dock Road, Middlesbrough, Ts6 6ue Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C1
Discharge Consent	Operator: Northumbrian Water Limited Storm Tank/ CSO on Sewage Network (Water Company) Reference: **254/1935** Issued: 23rd March 2010 Revoked: 14th February 2019		2C1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Location: Tees Dock Road Cso, Coal Depot, Tees Dock Road, Middlesbrough, Ts6 6ue Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		
Discharge Consent	Operator: Northumbrian Water Limited WWTW/Sewage Treatment Works (Water Company) Reference: **254/1814** Issued: 3rd March 2005 Revoked: 12th October 2006 Location: Tees Dock Rd Sso, Grangetown Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C1
Discharge Consent	Operator: Northumbrian Water Limited Sewage Disposal Works - Water Company Reference: **254/1814** Issued: 3rd March 2005 Location: Tees Dock Rd Sso, Grangetown Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C1
Discharge Consent	Operator: Northumbrian Water Limited WWTW/Sewage Treatment Works (Water Company) Reference: **254/0800** Issued: 21st September 1989 Revoked: 15th January 1991 Location: Tees Dock Rd Sso, Grangetown Type: Sewage Discharges - Stw Storm		2C1

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		
Discharge Consent		Operator: BOC Gases Ltd Making of chemicals + chemical products Reference: **254/1423** Issued: 26th July 2012 Location: BOC Limited, Tees Dock Road, Middlesbrough Type: Trade Discharges - Cooling Water Receiving Water: Land	2C2
Discharge Consent		Operator: BOC Ltd Reference: **QC 254/1423** Issued: 19th October 1995 Location: Tees Dock Road , MIDDLESBROUGH Type: Cooling Water Receiving Water: Land	2C2
Discharge Consent		Operator: BOC Limited Basic Industry, Chemicals Inorganic Reference: QC.254/1423 Issued: 19th October 1995 Location: BOC Limited, Tees Dock Road, MIDDLESBROUGH, Cleveland, TS6 7RT Type: Trade Effluent Discharge-Cooling Water (Direct) Receiving Water: Soakaway	2C2
Discharge Consent		Operator: BOC Gases Ltd Making of chemicals + chemical products Reference: **254/1423** Issued: 18th October 1995 Revoked: 25th July 2012 Location: BOC Limited, Tees Dock Road, Middlesbrough	2C2

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
		Type: Trade Discharges - Cooling Water Receiving Water: Land	
Discharge Consent	Operator: Northumbrian Water Limited Storm Tank/ CSO on Sewage Network (Water Company) Reference: **254/1935** Issued: 15th October 2006 Revoked: 31st March 2010 Location: Tees Dock Road Cso, Coal Depot, Tees Dock Road, Middlesbrough, Ts6 6ue Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C3
Discharge Consent	Operator: Northumbrian Water Limited Storm Tank/ CSO on Sewage Network (Water Company) Reference: **254/1935** Issued: 15th October 2006 Revoked: 31st March 2010 Location: Tees Dock Road Cso, Tees Dock Road, Dormanstown, Middlesbrough Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C3
Discharge Consent	Operator: Northumbrian Water Limited Storm Tank/ CSO on Sewage Network (Water Company) Reference: **254/1812** Issued: 21st February 2005 Revoked: 12th October 2006 Location: Tees Dock Road Cso, Coal Depot, Tees Dock Road, Middlesbrough,		2C3

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Ts6 6ue Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		
Discharge Consent	Operator: Northumbrian Water Limited Storm Tank/ CSO on Sewage Network (Water Company) Reference: **254/E/0112** Issued: 27th April 1956 Revoked: 21st February 2005 Location: Tees Dock Road Cso, Coal Depot, Tees Dock Road, Middlesbrough, Ts6 6ue Type: Sewage Discharges - Stw Storm Overflow/Storm Tank - Water Company Receiving Water: Kinkerdale Beck		2C3
Discharge Consent	Operator: Northumbrian Water Limited PUMPING STATION ON SEWERAGE NETWORK (WATER COMPANY) Reference: **25/04/1646** Issued: 1st November 2000 Revoked: 16th January 2002 Location: Eston Pumping Station, Adjacent To Bran Sands Stw, Tees Dock Road, Type: Sewage Discharges - Pumping Station - Water Company Receiving Water: Dabholm Gut		2G2
Discharge Consent	Operator: Northumbrian Water Limited PUMPING STATION ON SEWERAGE NETWORK (WATER COMPANY) Reference: **25/04/1646** Issued: 1st November 2000 Revoked: 28th May 2007		2G2

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
	Location: Eston Pumping Station, Adjacent To Bran Sands Stw, Tees Dock Road, Type: Sewage Discharges - Pumping Station - Water Company Receiving Water: Dabholm Gut		
Discharge Consent	Operator: Northumbrian Water Limited PUMPING STATION ON SEWERAGE NETWORK (WATER COMPANY) Reference: **25/04/1646** Issued: 1st November 2000 Location: Eston Pumping Station, Adjacent To Bran Sands Stw, Tees Dock Road, Type: Sewage Discharges - Pumping Station - Water Company Receiving Water: Dabholm Gut		2G2
Pollution Incidents to Controlled Waters		Fleet Beck, Dormanstown, REDCAR Pollutant: Miscellaneous - Urban Runoff Catchment: Tees Downstream Skerne To North Sea Receiving Water: Freshwater Stream/River Severity: Category 3 - Minor Incident Reference: **DD960133** Incident: 26th April 1996	2G14
Pollution Incidents to Controlled Waters		Fleet Beck, Dormanstown, REDCAR Pollutant: Not Given Catchment: Tees Downstream Skerne To North Sea Receiving Water: Freshwater Stream/River Severity: Category 3 - Minor Incident Reference: **DD960133** Incident: 26th April 1996	2G14

Relevant Feature	On site (within 25m)	Off-site (within 200m)	Enviro check Map ID
COMAH		BOC Limited, Tees Dock Road, Middlesbrough, Cleveland, TS6 7RT Type: Upper Tier Reference: Not Supplied Status: Active	2C174
NIHHS		BOC Limited, Tees Dock Road, Grangetown, MIDDLESBROUGH, Cleveland, TS6 7RT Status: Not Active	2C177
Planning Hazardous Substance Consent	BOC Ltd, Tees Dock Road, Grange Town, Ts6 7rt Liquefied extremely flammable gas (including LPG) and natural gas (whether liquefied or not)		2C182
Planning Hazardous Substance Consent	BOC Ltd, Tees Dock Road, Grangetown, MIDDLESBROUGH, Cleveland, TS6 7RT Part B, Highly Reactive and Explosive Substance, Liquid Oxygen, where amount held is greater than or equal to 500 tonnes		2C183
Planning Hazardous Substance Consent	BOC Ltd, Tees Dock Road, Grangetown, MIDDLESBROUGH, Cleveland, TS6 7RT Part C, Flammable Substance (Not in Parts A&B), Liquefied petroleum gas held at >1.4 bar where amount held is greater than or equal to 25 tonnes		2C183
Planning Hazardous Substance Consent	BOC Ltd, Tees Dock Road, Grangetown, MIDDLESBROUGH, Cleveland, TS6 7RT Part B, Highly Reactive and Explosive Substance, Hydrogen, where amount held is greater than or equal to 2 tonnes		2C183

10.8.129 Numerous features identified from the Regulatory Information included in the Envirocheck Report may constitute an unusual or onerous development constraint.

PCC Site

10.8.130 Figure: 10-9 Hazardous (ES Volume II, Document Ref. 6.3) and Figure: 10-15 Discharge (ES Volume II, Document Ref. 6.3) indicate there are no pertinent features on site or within 200m of the PCC Site. Therefore, it is considered at low risk of adverse impact from the entries in Table 10A-22. However, the Envirocheck data identifies a Planning Hazardous Substance Consent, located approximately 40m from the site, at the former Blast Furnace and Coke Ovens, possibly associated with the historical landfill site, with an unknown hazardous substance.

CO_2 Export Pipeline

10.8.131 There are no significant regulatory information features recorded on site or within 200m of the CO_2 Export Pipeline.

10.8.132 As there are no pertinent features on site, it is considered that the CO_2 Export Pipeline is at low risk from the entries in Table 10A-22.

Water Supply and Discharge Corridors

10.8.133 Seven Discharge Consents are shown on Figure: 10-15 Discharge (ES Volume II, Document Ref. 6.3) and recorded in the Envirocheck Report within the Water Connections Corridor site.

10.8.134 The Water Connections Corridor is considered at low risk from entries in Table 10A-22, as there are no potential hazardous substance features or pollution incidents documented within the site. It is considered unlikely that the discharge consents constitute an unusual or onerous development constraint.

CO_2 Gathering Network and Natural Gas connection Corridors

10.8.135 Figure: 10-9 Hazardous (ES Volume II, Document Ref. 6.3) and Figure: 10-15 Discharge (ES Volume II, Document Ref. 6.3) identify Discharge Consents, Pollution Incidents to Controlled Waters, Control of Major Accident Hazards Sites (COMAH), Notification of Installations Handling Hazardous Substances (NIHHS) and Planning Hazardous Substance Consents on and nearby the CO_2 Gathering Network and Natural Gas Connection Corridors site.

10.8.136 As the proposed CO_2 Gathering Network and Natural Gas Connection Corridors are intended to use existing pipelines and conduits, it is considered unlikely that the regulatory features identified will constitute an unusual or onerous development constraint.

Electrical Connection Corridor

10.8.137 Figure: 10-9 Hazardous (ES Volume II, Document Ref. 6.3) and Figure: 10-15 Discharge (ES Volume II, Document Ref. 6.3) identify a number of Discharge Consents, Pollution Incidents to Controlled Waters, COMAH sites, NIHHS and Planning Hazardous Substance Consents on and nearby the Electrical Connections Corridor site.

10.8.138 As the proposed Electrical Connection Corridor are intended to use existing electrical mainframe, it is considered unlikely that the regulatory features identified will constitute an unusual or onerous development constraint.

Sensitive Land Use

10.8.139 Sensitive land uses identified in the Envirocheck Report within the Site are summarised in Table 10A-22. Figure: 10.14 Sensitive Land Use presents the areas of Sensitive land Use across the site.

Table 10A- 22: Sensitive Land Use

Relevant Feature	Feature Information	Envirocheck Map ID (distance from red line boundary)
PCC Site		
No areas of Sensitive Land Use are located within the PCC Site.		
CO_2 Export Pipeline		
Ramsar Sites	Teesmouth And Cleveland Coast Reference: **UK11068** Total Area (m^2): 12537569.88	2G193 (0m)
Sites of Special Scientific Interest	Teesmouth And Cleveland Coast Reference: **1000263** Total Area (m^2): 29770346.88	2G194 (0m)
Special Protection Areas	Teesmouth And Cleveland Coast Reference: **UK9006061** Total Area (m^2): 12515083.54	2G195 (0m)
Water Supply and Discharge Connection Corridors		
Ramsar Sites Sites of Special Scientific Interest	Teesmouth And Cleveland Coast Reference: **UK11068** Total Area (m^2): 12537569.88	2F91, 2H5, 2I4 (0m)
Special Protection Areas	Teesmouth And Cleveland Coast Reference: **1000263** Total Area (m^2): 29770346.88	2I5 (0m)
Ramsar Sites	Teesmouth And Cleveland Coast Reference: **UK9006061** Total Area (m^2): 12515083.54	2F93, 2H7, 2I6 (0m)
CO_2 Gathering Network and Natural Gas Connection Corridors		

Relevant Feature	Feature Information	Envirocheck Map ID (distance from red line boundary)
National Nature Reserves	Teesmouth Reference: **1006937** Total Area (m^2): 3625243.52	1G289 (0m) 1F338 (0m)
Ramsar Sites	Teesmouth And Cleveland Coast Reference: **UK11068** Total Area (m^2): 12537569.88	1F339, 1G290 (0m) 1E74 (<250m) 1A203 (<250m)
Sites of Special Scientific Interest	Teesmouth And Cleveland Coast Reference: **1000263** Total Area (m^2): 29770346.88	1C83, 1D12, 1H36, 2D290, 2F92, 2G194 (0m) 1F340 (<250m)
Sites of Special Scientific Interest	Seal Sands Reference: **1000141** Total Area (m^2): 210585.36	1F341 (0m) 1G292 (<250m)
Electrical Connection Corridor		
Sites of Special Scientific Interest	Teesmouth And Cleveland Coast Reference: **1000263** Total Area (m^2): 29770346.88	2G194 (<250m)2D290 (<250m)

10.8.140 Sensitive Land Uses have been identified on the site in the Envirocheck Report, with land use constraints shown on Figure 10-14: Sensitive Land Use. The figure excludes relevant features off site of the proposed development. It is understood that baseline ecological surveys are to be undertaken on the site to determine the potential impact of the scheme on the nationally protected sites. Reporting of these will be under separate cover and is outside the scope of the Geology, Hydrogeology and Contaminated Land Assessment undertaken in this PSSR.

UXO

10.8.141 An Unexploded Ordnance (UXO) survey for the site has not been undertaken. However, an Unexploded Bomb Risk Map of the PCC Site was obtained from Zetica UXO (https://zeticauxo.com/downloads-and-resources/risk-maps/) dated 22/01/20, see Annex D.

10.8.142 The PCC Site map shows the site within a low risk area; low risk areas are defined as having ≤15 bombs per 1000 acres. Therefore, it is considered that the site is not at significant risk from Unexploded Bombs (UXB) and further additional searches or precautionary measures are not required.

10.8.143 There may be risk of UXO from firing from historical barracks which took place at the Pasley (Coatham) Battery and South Gare Battery, see (https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/39693/pasley_south_gare_batteries.pdf).

10.8.144 The online Zetica Risk Map shows the site, west of the River Tees, within a moderate risk area, whereas the site east of the River Tees falls within both low risk and moderate risk areas.

Geoenvironmental and Possible Contaminative Land

10.8.145 Contaminative land that may be associated with the man-made features and historical land uses described above are assessed under Section 10.10 which describes the site conceptual model and includes a preliminary environmental risk assessment in accordance with guidance provided in CIRIA C552 – ‘Contamination Land Risk Assessment, A Guide to Good Practice’.

10.9 Ground Conditions

Soils Anticipated

Introduction

10.9.1 Geological mapping shows a variety of superficial soils across the area as illustrated in Figure 10-1: Artificial Geology (ES Volume II, Document Ref. 6.3) and Figure 10-2: Superficial Geology. Ground conditions anticipated on the site based on BGS borehole records are detailed in Paragraphs 10.8.39 to 10.8.41, Tables 10A-5 to 10A-6.

10.9.2 Ground investigation confirm the anticipated ground conditions across parts of the Site will be undertaken in Q2/Q3 2021.

PCC Site

10.9.3 Existing available ground investigation data suggests Made Ground below the PCC Site and the surrounding area up to 9 m in depth. This is understood to comprise of a mixture of slag generated as waste from Iron and Steel manufacturing. The formation, composition and use of these materials are described below.

10.9.4 Ferrous slags are non-metallic by-products from the refining of iron ores. The main types of slag are produced during the manufacture of iron and steel: blast furnace slag and steel slag.

10.9.5 Blast furnace slag originates when iron ore is smelted to produce pig iron. Historically, two principal types have been produced: basic and hematite iron slags. In 2005, BRE IP8/05 reported that all UK production of blast furnace slag at that time (therefore including material from Teesside) was ‘basic’.

10.9.6 Steel slag is generated when pig iron is converted into steel. The main processes for making steel in the UK in 2005 were reported to be the basic oxygen converter which produces ‘basic oxygen steel’ (BOS), and the electric arc furnace which melts steel scrap with fluxes producing ‘electric arc furnace steel slag’ (EAF).

10.9.7 BRE IP8/05 reported that expansion of steel slag and some blast furnace slags can cause the ground to move, resulting in damage to buildings, structures, roads and services. The ground may heave and move laterally, possibly decades after deposition. Owing to the variability of the materials, ground movements are inherently uneven and the most severe problems occur due to differential movements.

10.9.8 Steel slags were reported to pose the greatest problems for development with numerous reported examples of damages caused to structures built on these materials. Older blast furnace slags which are different to composition to modern slags may also be highly expansive but the BRE reported that structural failures from expansion of this type of slag is believed to be uncommon. The blast furnace slag produced over the last few decades has a composition which meets the requirements of standard specifications and is not inherently expansive. This material was a valuable construction material. Much of the most of recent blast furnace slag was produced as air-cooled slag which was crushed for use as aggregate. This material is believed to have been widely used in bulk earthworks, granular foundation layers to form the foundation layers (e.g. capping and historically sub-base) below road pavements and areas of hardstanding across Teesside. Most of the remainder of this material was quenched with water to produce ground granulated blast furnace slag (GGBS), a cementitious material used instead of cement in the manufacture of concrete.

10.9.9 BRE IP8/05 states that steel slag consists primarily of calcium silicates together with oxides and compounds of iron, manganese, alumina and other trace elements. Steel slag is a random and variable material resulting from the vigorous reactions that occur during production and so its chemical composition is more variable between manufacturing processes and within individual steel production plants when compared to blast furnace slags.

10.9.10 Basic slags are named because they are low in silica. The BRE reported that three main reactions occurred from the hydrations of minerals in the slag, these are summarised below:

- Free lime hydration – Calcium oxide (free lime) found in steel making slags results from limestone (calcium carbonate) added during the steel-making process. The free lime reacts with moisture to form calcium hydroxide and leads to a large volume increase (~100%), and subsequently carbonates. The free lime may also react with sulfate present to form hydrated calcium sulfate (gypsum) which can then react expansively to form calcium sulfoaluminate.
- Periclase hydration – magnesium oxide (periclase), arising from added magnesian limestone or dolomite fluxes may react to form brucite and cause a large volume increase ~130%. The reaction is very slow, taking place over decades.
- Rusting – rusting of the free metal frequently present in steelmaking slags is caused by the range of hydrolysis reactions described by the broad terminology 'iron unsoundness'.

10.9.11 In their Geotechnical Risk Assessment Report (GRAR) Arcadis reported findings from the PCC Site site desk studies that a large quantity of ferrous slag (including blast furnace, steel slag as well as basic refractory slag) was produced at the site and used raised ground levels and reclaim land from the sea. Arcadis also reported that the majority of the slag produced would have comprised blast furnace slag with smaller percentages of BOS slag and refractory slag, but the exact proportions of each material is unknown. The Site Condition Report (SCR) prepared by Arcadis summarised the findings of petrographic analysis undertaken on selected samples of slag recovered during the advanced GI works undertaken across plots SSI1 and SSI2A. The slags were found to contain mixed deposits of blast furnace and steel slags with the former predominating. The analysis also indicated:

- Very small or small amounts of lime phase material in 11 of the 34 samples analysed. This material was identified by white crystallisation on some of the slag materials; these materials were considered by Arcadis to be at risk to free lime hydration.
- Very small or small amounts of basic refractories were noted in 4 of the 34 samples analysed. These materials contained periclase (magnesium oxide) and can therefore be subject to hydration.
- The free calcium oxide and periclase (magnesium oxide) levels within the slag samples were reported to be generally higher than the corresponding hydroxides Ca (OH)2 and brucite Mg(OH)2 indicating the slags retain a significant capacity for future expansion as demonstrated by expansion testing results.

10.9.12 Arcadis concluded that the majority of the slag deposits at the site are considered to be dominated by blast furnace slags but there is a minor fraction of steel slags containing minerals with future expansion potential. Additional testing was recommended due to the limited testing undertaken and given that the testing undertaken indicated expansion potential.

CO_2 Gathering Network Corridor – Section under the Tees Estuary

10.9.13 AEG carried out a ground investigation for the proposed deepening and extension of a river berth at Tees Dock in 2011. The investigation was undertaken for PD Teesport and specified by Royal Haskoning. The investigation comprised of 28 cable percussion boreholes, all of which were extended by rotary coring techniques, disturbed and undisturbed sampling and in-situ Standard penetration Tests (SPTs).

10.9.14 Site works were carried out between August and October 2011 in two phases. The cable percussive boreholes were sunk to depths between 2.0 m below bed level (BBL) and 15.5 m bgl. Twelve of the boreholes were drilled overwater. All boreholes were extended by rotary drilling to depths of 29.4 m BBL and 15.4 m bgl. The boreholes with backfilled on completion, no gas / groundwater monitoring instrumentation was installed on the site.

10.9.15 The boreholes were located on the south side of Tees Dock aligned in two west – east rows, one located across open water and one on land.

10.9.16 The closest boreholes located closest to the navigable channel of the River Tees were BH02 (overwater) and BH21 (on land). Borehole BH02 was drilled into the dock bed from a level of -12.94 m OD. A layer of very clayey very sandy gravel was encountered at bed level which extended to 3.5 m BBL. This depth coincided with a change from cable percussion to rotary drilling techniques. The soil was inferred to represent fine, sand and gravel sized particles of extremely weak red brown partially weathered mudstone (inferred to be Mercia Mudstone but not reported as such on the log). The underlying succession comprised extremely weak to very weak red brown and grey green partially weathered mudstone. Gypsum veins were recorded from 9m BBL (-21.94 m OD) to the base of the borehole at 30.5 m BBL (-43.44 m OD). Inspection of the core photos confirms the material to be Mercia Mudstone. There is a change in weathering grade assigned to the rock core which coincided with the presence of gypsum; material recovered above 9 m BBL was reported as weathering grade II or III but below 9m, the mudstone was recorded as weathering grade I. Borehole BH21 was drilled from a level of 4.95 m OD on the quay to the south of the dock. The borehole encountered Made Ground to 6.5 m bgl (-1.55 m OD). The material comprised of blocks to 0.1 m depth (4.85 m OD) underlain by concrete to 0.25 m bgl (4.70 m OD) and medium dense dark grey black sandy gravel with high cobble and brick content. Gravel included ash and slag and cobbles of slag were noted. The material became dense at 3 m bgl (1.95 m OD). This material was underlain by 0.5 m thick layer of dark grey silty sand which extended to 7.0 m depth (-2.05 m OD) and medium dense dark grey slightly clayey slightly gravelly sand to 8.25 m bgl (-3.30 m OD). The sand was reported as Possible Made Ground on the log and the underlying sand and gravel contained angular cubic tabular limestone, mudstone and sandstone, possibly indicative of unnatural origin. Soils interpreted to be glacial till were present between 8.25 and 10.3 m bgl (from -3.30 to -5.35 m OD). The material comprised stiff slightly sandy slightly gravelly clay. Mudstone was encountered at 10.3 m bgl (-5.35 m OD) some 7 m above the level at which was proved in BH02 drilled through the southern edge of the dock. The material was described as very weak red brown partially mudstone assigned weathering grade III to IVa. This material extended to the base of the cable percussive section of the borehole which terminated at 12.0 m bgl (-7.05 m OD). The borehole was extended by rotary methods and proved mudstone of varying strength and weathering state to 36.1 m depth (-31.15 m OD). Grade II mudstone was logged between 24.15 and 27.7 m bgl (-19.20 to -22.75 m OD). The material was recovered as weak red brown partially weathered mudstone noted to be occasionally grey and thinly laminated above 26.05 m bgl (-21.10 m OD). Gypsum veins were noted locally at 27.1 m bgl (-22.15 m OD). Below 27.7 m depth, grade I material was identified to the base of the borehole. Like in BH02 grade I material contained very closely spaced veins. There is good agreement in the level at which grade I mudstone was logged in both boreholes (BH02: -21.94 m OD & BH21: -22.25 m OD).

10.9.17 Old logs and an associated borehole plan presumably provided by PD Teesport were attached to the AEG report. There are two boreholes located at the northern end of Tees Dock, T1 (south west) and BH502 (north east).

10.9.18 Borehole T1 was drilled from a level of -1.14 m OD in January 1946. Soft brown and black organic silty clay was proved from the riverbed to 0.61 m depth (-1.75 m OD) and underlain by black and brown organic fine to medium sand to 3.81 m BBL (-4.98 m OD). These are interpreted to be Tidal Flat Deposits. These soils were underlain by soft-firm brown clay, small pieces of shale and claystones to 4.72 m depth (-5.89 m OD) which are inferred to be glacial till. Hard brown calcareous shale was encountered at 4.72 m below bed level (BBL (-5.89 m OD). This material is assumed to be the highly weathered surface of the Mercia Mudstone. Below 7.80 m depth (-8.94 m OD), the material was recovered as hard or harder red, green, red & green sometimes calcareous shale to the base of the borehole at 12.5 m BBL (or -13.64 m OD).

10.9.19 Borehole T502 was drilled in November 1970 as part of an investigation undertaken to determine ground conditions at the site of a proposed terminal to be constructed for the exit of potash from the Boulby mine. The borehole was drilled through the bed of the River Tees from a level of -7.01 m OD. Black silty sand was recovered from the riverbed to 3.96 m depth (-10.97 m OD) and underlain by red marl to the base of the borehole at 12.65 m BBL (-19.66 m OD). The sand is interpreted to represent the coarsest parts of the Tidal Flat Deposits with the underlying marl presumed to be Mercia Mudstone.

10.9.20 A review of selected holes drilled at the entrance to Tees Dock suggests that the proposed CO_2 Gathering Network Corridor is likely to be constructed through calcareous mudstones of the Mercia Mudstone on the southern side of the Estuary. However, it is understood that the crossing point under consideration is located to the north east (to the south of Bran Sands Lagoon), where BGS mapping (Figure: 10-3 Bedrock Geology (ES Volume II, Document Ref. 6.3) indicates that rocks of the Penarth Group and Redcar Mudstone may be present. Unlike the Mercia Mudstone, these units contain thin bands of ironstone, limestone and sandstone within a predominantly mudstone succession, which could impede or slow directional drilling.

Engineering Properties

10.9.21 None available. Ground investigation is required. This is scheduled to be carried out in mide 2021.

Significance of Geological Formations

10.9.22 The geology of the site is discussed in detail above. The site is known to be underlain by a variable complex sequence of Artificial Ground and Superficial Deposits. The Made Ground is expected to be variable in composition and depth and contaminated from the past land uses with which it was associated with. The superficial geology mainly comprises Tidal Flat Deposits underlain by variable glacial soils with Blown sands flanking the North Sea coastline. A plan showing the approximate thickness of the latter is shown on Figure 10-25: BGS Buried Valleys. The underlying bedrock is concealed below the site varying from predominantly water bearing sandstones of the Triassic Sherwood Sandstone in the west to mainly mudrocks of the Redcar Mudstone in the south east. The strata are known to dip gently to the east. There are few known faults, the one notable feature is the Saltholme Fault, discussed in Section 4.2.4.7, identified in anhydrite workings from the mothballed mine near Billingham. Other faults are likely to be present.

Groundwater Conditions

Introduction

10.9.23 Groundwater levels are unknown across the CO_2 Export Pipeline, Water Connection Corridors and the CO_2 Gathering Network and Natural Gas Connection Corridors and ground investigation is required. Groundwater level and quality data is available from ground investigations undertaken across parts of the PCC Site. The data sources are outlined below and discussed in detail in Section 3 of this report.

10.9.24 It is anticipated groundwater may be shallow and tidally influenced below the CO_2 Export Pipeline and Water Connections Corridors adjacent to the coastline. Data gathered from parts of the SSI Redcar Steelworks (including the PCC Site) confirms that groundwater may be shallow and subject to some tidal influence depending on proximity to the North Sea coast and / or Tees Estuary.

PCC Site

10.9.25 The 'Former SSI Steelworks, Redcar: Priority Areas within SSI Landholdings Contract 1 and 2a - Contract 1 and 2A Site Condition Report' (Arcadis, 2018 – 'the SCR') provides an overview of groundwater conditions for the PCC Site and adjoining areas to the south and west. Groundwater was encountered in 148 of 294 trial pits, with a higher frequency in the west of the reporting area.

10.9.26 Ground investigation under the direction of CH2M Hill Ltd and Arcadis found water levels in boreholes and trial pits at an elevation of between 4.5 m OD and 1.5 m OD according to the SCR.

10.9.27 Two rounds of groundwater monitoring are also summarised in the SCR as recorded in Table 10A-23 below.

Table 10A- 23: Groundwater Level Monitoring

Ground Type	Range in Depth to Groundwater Visit 1 (m bgl)	Range in Depth to Groundwater Visit 2 (m bgl)	Range in Groundwater Elevation Visit 1 (m OD)	Range in Groundwater Elevation Visit 2 (m OD)
Made Ground only	4.90 – 1.80	4.85 – 1.80	4.12 – 2.32	4.22 – 2.37
Made Ground and Superficial Deposits	4.50 – 1.60	4.59 – 1.64	5.47 – 2.32	5.48 - 2.29
Alluvium (Tidal Flat Deposits)	4.60 – 3.10	4.60 – 3.52	4.12 – 2.92	3.7 - 2.93
Mercia Mudstone	5.00 - 4.80	5.20 – 4.40	2.42 – 1.55	2.42 – 1.35

Source: Page 14 of "The Former SSI Steelworks, Redcar - Contract 1 and 2A: Site Condition Report" (Arcadis, 2018)

10.9.28 The SCR states that, *"groundwater in wells screened across the Made Ground alone, the Made Ground and Superficial Deposits, and the Alluvium were all broadly consistent with elevations generally higher in the south east of the site and indicating a flow direction towards the north west."*

10.9.29 Groundwater levels were measured in the Gas Monitoring programme by AEG. These have been plotted, in the figures included as Annex E:

- November 2017;
- December 2017;
- February 2018;
- April 2018;
- May 2018.

10.9.30 The best data obtained was for February 2018. These show that the groundwater direction could actually be north northeast (i.e. towards the coast). The tabulated values for groundwater elevation and groundwater depth for February 2018 are provided in Table 10A-24.

Table 10A- 24: Groundwater Level Monitoring Summary (February 2018)

Monitoring Well	Ground Level (m OD)	Depth to Water (m bgl)	Water Level (m OD)
S1-BH01_6	6.55	3.4	3.15
S1-BH01_24	6.55	5.2	1.35
S1-BH02_7	7.09	4	3.09
S1-BH03_6.5	7.17	3.93	3.24
S1-BH04_5	5.68	1.96	3.72
S1-BH05_5	5.72	1.8	3.92
S1-BH06_6	7.09	3.47	3.62
S1-BH07A_7.05	8.95	3.47	5.48
S1-BH08_5	6.58	3.6	2.98

Monitoring Well	Ground Level (m OD)	Depth to Water (m bgl)	Water Level (m OD)
S1-BH09_6	6.69	4.4	2.29
S1-BH09_25	6.69	4.4	2.29
S1-BH10_7.05	6.7	3.7	3
S1-BH11A_7	5.48	1.78	3.7
S1-BH12_5	573	2.1	3.63
S1-BH13A_8	8.23	4.2	4.03
S1-BH14_8	8.31	4.6	3.71
S1-BH15_5.1	7.22	3.87	3.35
S1-BH16_7	6.93	4	2.93
S1-BH17_6	6.95	3.27	3.68
S1-BH18_6	7.36	3.3	4.06
S1-BH19_7	6.98	3	3.98
S1-BH2OB_4	7.22	3	4.22
S1-BH2OB_9	7.22	3.52	3.7
S2-BHA1_5.5	7.22	4.85	2.37
S2-BHA1_21	7.22	4.8	2.42
S2-BHA2_7	7.12	4.4	2.72
S2-BHA3_7	7.4	4.59	2.81
S2-BHA4_4.5	7.53	4.59	2.94
S2-BHA4_10	7.53	4.6	2.93
S2-BHA5_5.1	4.53	1.64	2.89
S2-BHA6_7.1	7.16	3.54	3.62

Source: 4153 & 4154 Area A Former Steelworks Redcar Contract 1 & 2 (Area A) (Final report), AEG June 2018

10.9.31 The site is not level and, generally, the ground is higher on the axis of the reclaimed South Gare area along the former central east - west tramway, although the ground level does fall adjacent to the coast and towards the estuary, remote from the PCC Site. Therefore, it is not obvious why groundwater would be found at a shallower depth in the west of the survey area, if groundwater is flowing to the north west (as proposed by Arcadis). It is possible that bias has occurred due to trial pits achieving a greater depth on the west side of the survey area.

10.9.32 Groundwater levels may be anomalous due to bridging between different geological formations, with long well screens or poor well construction, inflow of water trapped within drains, foundations and tunnels, and delay in achieving quasi-steady state conditions due to low permeability, large diameter well storage and sealing of wells with a gas tap.

10.9.33 An anomalous water level is found at S1-BH07A in the south east of the PCC Site. The monitoring well in S1-BH07A is screened within the Made

Ground from 1 m bgl down into the underlying Tidal Flat Deposits (sand with shells) to a depth of 7.05 m bgl. The water level in S1-BH07A is more than 1 m higher than surrounding wells (level of 5.48 m OD, depth of 3.47 m bgl in February 2018). For geotechnical purposes, it would be preferable to measure water levels in piezometers with a short response zone installed separately within the different formations.

10.9.34 Interpretation of the groundwater levels should be circumspect as the central east to west strip of the PCC Site does not contain any monitoring points, and monitoring has not been undertaken across the site during the summer. However, it is apparent that water levels were generally lower in the north of the PCC Site than the south. Assuming hydraulic continuity, the most likely direction for groundwater flow within the PCC Site is northwards or north northeast towards the coast.

10.9.35 With the obvious exception of S1-BH07A, there is a tendency for deeper wells to have slightly lower groundwater levels, however long well screens and bridging between the Made Ground and underlying Tidal Flat Deposits may be masking a bigger difference between “perched” groundwater in Made Ground and the underlying aquifer.

10.9.36 Data from previous investigations suggests groundwater is generally present at a depth of about 3.0 m and a level of 3.7 m OD in the south of the PCC Site and at a depth of 3.1 m and a level of 2.9 m OD in the north of the PCC Site.

10.10 Preliminary Engineering Assessment

General

10.10.1 The Proposed Development comprises the development of a Combined Cycle Gas Turbine (CCGT) gas-fired generating station and gas, electricity and cooling water connections, with post-combustion carbon capture and compression plant, together with a gathering station for carbon dioxide (CO_2) from the generating station and other industrial sources, low-pressure CO_2 pipeline connections to potential industrial sources, and a high pressure CO_2 pipeline for the onward transport of CO_2 to an offshore geological storage site in the North Sea.

10.10.2 An assessment of the geotechnical and geo-environmental characteristics of the site to inform future development has been made. Comments are based on interpretation of the documentary records obtained to date and will need to be reviewed when ground investigation works are completed.

10.10.3 Historical and current geotechnical and geo-environmental constraints, on or in close proximity to the site have been identified and are presented on Figures as listed below (see ES Volume II, Document Ref. 6.3):

- Figure 10-1 Artificial Geology;
- Figure 105 Quarrying and Landfill;
- Figure 10-7 Infilled Land - Non Water;
- Figure 10-8 Infilled Land – Water;

- Figure 10-10 Contaminated Land – Point;
- Figure 10-11 Contaminated Land – Line;
- Figure 10-12 Contaminated Land – Polygon;
- Figure 10-13 Historic Tanks;
- Figure 10-14 Sensitive Land Use;
- Figure 10-15 Discharge;
- Figure 10-16 Flood Risk;
- Figure 10-19 BGS Flood Susceptibility;
- Figure 10-20 Risk of Flooding from Rivers and Seas;
- Figure 10-23 Historical Features (Sheets 1 to 3). General Site Preparation Works

10.10.4 Evidence from the historical Ordnance Survey (OS) mapping has shown the site to have been subject to a long history of industrial and potentially contaminative uses. Contaminated soils including the presence of asbestos may be present within Made Ground encountered. In order to comply with the CDM Regulations 2015, the Principal Designer will have to be informed of the results of this study and future phases of investigation. Appropriate precautions must be undertaken by construction workers to ensure that they comply with CDM requirements.

10.10.5 This section provides generic engineering recommendations and is not intended to discuss the design of individual earthworks, foundations or pavement subgrade California Bearing Ratio (CBR) as the design is not yet finalised and a scheme specific ground investigation has not yet been undertaken. A detailed assessment of laboratory testing or material properties available from previous ground investigations has not been undertaken. Further assessment will be required following the proposed ground investigation.

Excavations

10.10.6 Temporary excavations within the Made Ground and superficial deposits will be required. Superficial deposits may be loose and variable in nature, are likely to be unstable and, dependent upon depth, may require continuous support. Alternatively, temporary excavation faces will have to be battered back to a safe angle as determined on site or require continuous support.

10.10.7 Excavations extending below ground level are likely to encounter groundwater inflows particularly from coarse soils or water bearing granular layers within fine (clay, silt) and after prolonged periods of wet weather. Such materials will require continuous support. For shallow excavation below groundwater, pumping from sumps in the base of excavations may be feasible.

10.10.8 Construction within historical landfills should be avoided / limited in order to minimise ground disturbance and inflows of potentially contaminated groundwater into excavations and the need to handle / dispose of potentially contaminated material.

Ground Improvement

10.10.9 Excavation and replacement of Made Ground is likely to be required at the PCC Site, where large obstructions are encountered or where expansive materials are identified. Excavation of Made Ground above the groundwater table should be fairly straight forward but excavation below this depth may be complicated and require de-watering and / or stabilisation, both of which can add significant costs to construction. An added complication is the possibility that groundwater is subject to tidal fluctuations below parts of the PCC Site (and adjoining connections which are located close to the North Sea coastline and / or the Tees Estuary). Significant changes in water levels due to tidal fluctuations could hinder construction. However, preliminary tidal monitoring across parts of the PCC Site suggested limited tidal influence but it was noted that the monitoring well screens straddled across the Made Ground and Tidal Flat Deposits and as a result may mask trends within the different geological units.

10.10.10 In-situ ground improvement such as dynamic compaction and high energy impact compaction may help to solve some of the likely settlement issues associated with the Made Ground but will not solve other problems such as the presence of obstructions and may not be feasible due to adverse environmental impact from the noise and vibration generated.

Earthworks

10.10.11 At the time of writing this report, information on proposed levels and hence requirements for cut and fill activities were not known. It is considered likely that the scheme development will actively work towards achieving an earthworks balance. The suitability of excavated materials for re-use will be assessed as part of the proposed ground investigation works. All earthworks operations will need to be undertaken in accordance with BS6031:2009 'Code of Practice for Earthworks' and Highways England (HE) guidelines including Design Manual Roads and Bridges (DMRB) Series 600 'Earthworks'. Ground investigation is required to determine the geotechnical properties of earthworks material for re-use.

10.10.12 It is important that the site won material is, where possible, not classified as waste as this will limit the options for re-use on site and will have a significant impact on the cost of disposal of the material and environmental impact of the development. Ground investigation and testing followed by a Quantitative Risk Assessment and development of a Remediation Strategy in accordance with the Land Contamination Risk Management guiding principles (Environment Agency, 2020), BS10175:2011 + A2:2017 and the Environment Agency's guiding principles for land contamination in assessing risks to controlled waters, GPLC1 is required.

10.10.13 In order to adequately control the re-use of materials such as soils and crushed concrete, metal and wood, suitable controls should be in place and developed and implemented as part of a Construction Environmental Management Plan (CEMP), a Site Waste Management Plan, Materials Management Plan and an Asbestos Management Plan.

Services

10.10.14 Existing services could be affected by the development depending upon their location. The location of any services should be determined prior to design development and confirmed before undertaking ground investigation in accordance with the requirements of CDM Regulations 2015. Prior to any intrusive works service clearance work required at each investigation location is to be undertaken in accordance with HSE guidance note HSG47 (Third edition) publication – Avoiding Danger from Underground Services.

10.10.15 Where groundwater is encountered, service excavations may need to be battered back to a safe angle as determined on site or require continuous support as described above.

10.10.16 Proposed services could be affected by made ground with high concentrations of PAHs. Where high PAHs are present appropriate measures should be taken and services will need to be laid in trenches, infilled with clean inert bedding materials, where appropriate separated by suitable geotextiles and protected.

10.10.17 Consideration should be given to the use wrapped steel, wrapped ductile iron, copper and PE barrier pipe with an aluminium barrier layer (PE-Al-PE) for services and water supplies in contaminated soils.

Gas Exclusion

10.10.18 Potentially harmful gases may be generated by Made Ground or landfill material and could cause harm to ground workers during construction. Gas monitoring in the Made Ground areas to assess the potential risk to ground workers during excavation / construction is proposed as part of ground investigation works.

10.10.19 A programme of ground gas monitoring has been undertaken by AEG for the PCC Site with most combined gas and groundwater wells being monitored three or four times at most. None of the visits was undertaken after a period of sustained falling pressure.

10.10.20 Concentrations of methane and carbon dioxide are below screening limits of 1%v/v and 5%v/v, respectively. Gas Screening Values for ground gas flow rates met CIRIA guidelines for Characteristic Situation 1. The only slightly anomalous results, one for oxygen of 4.5%v/v in S2-BHA1(5.5m) and 9.6%v/v in S2-BH09 (6.0m), and one for carbon dioxide concentration of 2.5%v/v in S2-BHA2 (7m) were encountered west of the PCC Site.

10.10.21 There do not appear to be off-site sources of landfill gas in close vicinity (<200 m from the PCC Site). The soil descriptions provided do not indicate a significant putrescible organic content in made ground, nor do the historical land uses suggest that ground gas will be a problem.

10.10.22 It is concluded that the gas monitoring programme might be considered incomplete by the regulator since gas concentrations have not been measured during critical conditions of falling barometric pressure. Additional gas monitoring during periods of sustained falling barometric pressures, and installation of additional gas wells at potential gassing sources and at the location of sensitive structures may be necessary.

10.10.23 Gas vapour monitoring should be considered if "hotspots" of free phase organic compounds containing VOCs are detected.

Embankments

10.10.24 It is not known whether permanent earthworks embankments are to be formed as part of the development. However, low height landscaping / noise mitigation bunds are expected to be formed to screen the main generation site from any adjacent residential housing. In addition, local cut and fill bulk earthworks to create level development platform areas is likely to be required. Details will be finalised during detailed design. Preliminary geotechnical risks identified with this activity are discussed in the. Geotechnical Risk Register.

Subgrade

10.10.25 The extent of access roads and hardstanding areas to be created as part of the development are currently unknown. However, the following broad guidance for preliminary pavement road foundation design is provided. This is based on guidance with HD25/94 (now partially superseded by Interim Advice Note 73/06 (2009)).

- In-situ Cohesive Material – likely to comprise a mixture of Cohesive Made Ground, fine grained Tidal Flat Deposits, Glaciolacustrine Deposits – Clay and Silt or Glacial Till. Material behaviour will be controlled by plasticity and undrained shear strength when exposed on site. However, a CBR value of <2.5% is considered likely. Improvement by modification using cement and / or lime or through excavation and replacement with granular material will be necessary.
- Imported General Cohesive material – likely to be controlled by material plasticity and undrained shear strength on site. A CBR value of 2.5% can be assumed at this stage.
- Imported General Granular or Selected Granular Material - where these are proposed to form the subgrade, a CBR value >20% can be assumed.

10.10.26 CBR values will require confirmation and ground investigation is recommended to assess the ground conditions and determine CBR values below proposed pavements.

10.10.27 Where expansive ferrous slag is proved below proposed pavements there is a risk that this may cause heaving of the pavement resulting is rough, undulating or crack pavement surfaces. Ground investigation to determine the mechanical properties of slag to evaluate its swelling behaviour is recommended.

Structures

10.10.28 Piled foundations are likely to be required for heavily loaded structures on site, or those that are sensitive to movement for example rotating equipment. Given the nature of the Made Ground and superficial deposits, it is likely that piles will need to be augured or bored into underlying competent bedrock. There are likely to issues with augering because of the obstructions on site – consideration may be given to probing ahead of piling operations in combination with the use of rotary bored piles.

10.10.29 Structure floor slabs and connecting services / infrastructure may also need to be piled to reduce differential movements, particularly for settlement sensitive structures with tight serviceability limit requirements.

10.10.30 Groundwater is anticipated to be relatively shallow across the site although ground investigation data (including post site works monitoring) is only available for parts of the PCC Site. Temporary casing would be required to support the pile bores within thick granular (coarse) Made Ground and Tidal Flat Deposits below groundwater level and pile bores would therefore need to be filled with water or drilling mud to balance external water pressures to avoid base disturbance during drilling. Allowance should also be made for placing concrete by tremie.

10.10.31 The presence of thick deposits of slag at the PCC Site may have potential to generate ground displacements (heave and / or lateral expansion) as a result of chemical changes and / or variations in groundwater level. Expansion of ferrous slag proved by ground investigations to be present at the SSI Redcar Steelworks (including the PCC Site) could result in unpredictable additional uplift and lateral loading on piles after installation. Piled foundations will need to be designed to accommodate additional loading or could be sleeved over the expected zone of swelling. However, this form of construction would be more expensive than conventional piled foundations and should be allowed for in the geotechnical and construction risk registers.

10.10.32 Generally, slag will have a high acid neutralisation capacity and acid corrosion due to sulphate or sulphide (usually calcium sulphide) content is unlikely to be a problem. However, the possible impact of brackish water and high chloride content on steel also needs to be considered, especially if ground movement (vertical heave and / or lateral expansion) could lead to cracks forming in steel reinforced concrete.

10.10.33 The possible presence of unexploded ordnance (UXO) will also impact piling during construction. An anomaly was proven during magnetometer surveys carried out before boreholes were drilled at the PCC Site. Probing will be required at each pile position before the start of pile construction to prove the absence of UXO buried in natural soils below the more recent deep cover of Made Ground. Although the anomaly was encountered at PCC Site it is considered there is a risk of encountering UXO across most parts of the wider site. Pre-construction clearance will likely require the use of a deep intrusive magnetometer survey.

10.10.34 Shallow foundations, particularly large raft foundations should be considered where appropriate. Raft foundations have the advantage of being relatively settlement tolerant due to their rigidity and are therefore able to accommodate relatively large differential settlements / heave before structural distress occurs. Tying adjacent individual foundations together could also be considered as a means of reducing the likelihood of differential settlement occurring between adjacent structures. However, this form of construction is likely only to be suitable for lightly loaded structures where serviceability limits are not critical.

Contaminated Land

10.10.35 The framework for assessing contamination risk needs to be developed as a conceptual model for the site in order to capture the relevant site characteristics including uncertainty. This requires an examination of the 'Source-Pathway-Receptor' linkages to define construction, human health and environmental risk associated with existing and future conditions.

10.10.36 The risk assessment is based on guidance provided in CIRIA C552 - Contamination Land Risk Assessment, A Guide to Good Practice. At this stage, the risk assessment is of a preliminary nature as site specific ground investigation and laboratory test results are not available. The risk assessment is based on information obtained in this geotechnical and geo-environmental study and should be updated as further information becomes available.

10.10.37 The risk assessment is performed in accordance with the precautionary principle, in which a pathway is assumed to exist unless there is reasonable contrary evidence. The risk associated with each source-receptor linkage is a product of the probability that a significant pathway exists and the severity of the potential impact. For preliminary risk assessment the adopted method for risk evaluation is a qualitative method and involves classification of:

- magnitude of the potential consequence (severity) of risk (Table 6.3 - CIRIA 552), classified as: Severe, Medium, Mild, Minor.
- magnitude of the probability (likelihood) of risk occurring (Table 6.4 - CIRIA 552), classified as High Likelihood, Likely, Low Likelihood, Unlikely.

10.10.38 Assuming that a pathway is present, the consequence of exposure depends on the concentrations of the contaminants as well as the exposure route and the sensitivity of the receptor. This principle drives the Department for Environment, Food & Rural Affairs (DEFRA) Contaminated Land Exposure Assessment model (CLEA). It is necessary therefore, to consider the potential hazard a chemical may pose as well as the normal range of concentrations likely for the land use, the efficiency of delivery by the anticipated pathway of direct contact, ingestion, dust or vapour inhalation, and the sensitivity of the receptor, be that adult or child etc. For preliminary risk assessment, the adopted consequence of exposure has taken into account a reduction in consequence from exposure due to the reasonable limitation of source concentration, the directness of the exposure route and the sensitivity of the receptor. For the typical range of contaminant concentrations expected in coal ash for example, this might reduce the consequence of exposure for an adult worker from Medium, which reflects a chronic risk, conservatively to Mild. This is intermediate between Medium and Minor, the latter according to CIRIA guidance reflecting a non-permanent health impact.

10.10.39 A comparison of consequence against probability is undertaken to indicate the risk presented by each pollutant linkage. The probability indicates the likelihood that an exposure route may exist. This depends on whether the impacted soils are likely to be present, or indeed exposed, and also the probability that the potential receptor will come in contact with enough of the contamination to be impacted. The principal factors governing probability of exposure are the likely distribution of contaminants and the possible activities that may lead to exposure.

10.10.40 Overall risk is calculated in accordance with Table 6.5 – CIRIA 552, reproduced below in Table 10A-25:

Table 10A- 25: Reproduction of Table 6.5 – CIRIA 552

		CONSEQUENCE			
		Severe	**Medium**	**Mild**	**Minor**
PROBABILITY	**High Likelihood**	Very high risk	High risk	Moderate risk	Moderate / low risk
	Likely	High risk	Moderate risk	Moderate / low risk	Low risk
	Low Likelihood	Moderate risk	Moderate / low risk	Low risk	Very low risk
	Unlikely	Moderate / low risk	Low risk	Very low risk	Very low risk

Receptors

10.10.41 The proposals include a substantial development of permanent structures with facilities for industrial workers at the PCC Site, and corridor routes for additional pipelines and electrical connections mainly along existing pipeline corridors. The sensitive receptors for exposure to ground contamination are ground workers involved in construction across the site and permanent workers at the PCC Site. There is also a potential risk to maintenance workers, although since the infrastructure outside the PCC Site is mostly above ground this risk is considered to be most pertinent to the PCC Site, Water Connection Corridors and the CO_2 Export Pipeline. No abnormal risk from exposure to contaminants in soil or groundwater has been assumed for workers maintaining above-ground facilities.

10.10.42 Members of the general public (offsite) have been considered within the risk assessment to aid transparency, however, since no significant exposure to soils or groundwater is envisaged if works are carried out in accordance with environmental regulations, there should be no contaminant linkage.

10.10.43 The risk to fauna and flora from contamination on the site is minimal for the completed works since the main facilities are to be constructed on industrial land and there are limited pathways for contact with contaminated soil. Protection and reinstatement of existing natural resources should be considered as part of ecological mitigation works.

10.10.44 The main surface water receptors are the Tees Estuary / Tees Bay and the North Sea. Within the PCC Site and CO_2 Export Pipeline it is expected that site drainage will seep into underlying fill and within preferential pathways such as relict drains towards the Tees Bay / North Sea. Drainage from the Water Connection Corridors is likely to split with drainage from the northern portion going to the North Sea, and drainage from the western portion going to the Tees Estuary / Tees Bay. Seal Sands is a flat area that historically had a high water table and a network of natural channels and man-made drains. Disturbance of contaminated soil or groundwater adjacent to the Tees Estuary / North Sea could have a direct impact on water quality, whilst due to the greater distance of travel by ground or by watercourse there is likely to be significant attenuation for most contaminants before drainage reaches the receiving water. Nevertheless, it is considered unsatisfactory for development to release trapped contamination or to speed up the delivery of latent contamination to controlled waters.

10.10.45 The groundwater conditions vary across the site. Generally, the succession is Made Ground over laminated clays and stiff glacial till. The Made Ground is mainly composed of estuary dredgings or slag within reclaimed areas, where it commonly overlies Tidal Flat Deposits composed of layers of clay, sand and gravel. Commercial waste and industrial waste from other sources such as chemical works have been landfilled in the Seal Sands and Bran Sands areas of the CO_2 Gathering Network and Natural Gas Connection Corridors. Coastal areas have deposits of blown sand and active dunes. Alluvial deposits are found within relict and existing Tees Estuary channels and tributaries. The Made Ground may form a perched water table, especially where it overlies old mud flats within the Seal Sands and Bran Sands areas. This could be significant if a flow path is created by construction between contaminated water in the Made Ground and cleaner water in the underlying Tidal Flat Deposits aquifer. Similarly, water within the windblown sand deposits could be affected by the release of trapped contaminants from the former Teesside Works / coking works and Redcar Iron & Steel works on the South Gare. Both the Tidal Flat Deposits and the Blown Sand deposits are classified by the Environment Agency as Secondary (A) Aquifers, except in the west of the map where the Tidal Flat Deposits are shown as a Secondary Undifferentiated Aquifer. This inconsistency appears to arise from a slightly different description of the deposit in two different BGS 1:50,000 editions. The presence of clay within the silt and sand noted to the west has led to this alternative classification (of A or B), however based on local borehole information the most appropriate (and conservative) classification for risk assessment is as a Secondary (A) Aquifer for the entire site. The Glacial Till (diamicton) comprises stiff clay with sand, gravel, cobbles and boulders, and also sand layers that may locally store and transmit appreciable quantities of groundwater. Due to the variable water conductance of these deposits they are classified by the Environment Agency as Secondary Undifferentiated deposits, and interpretation of local characteristics is required to determine if these are an aquifer that could store or transmit significant amounts of water and contaminants. Glaciolacustrine Deposits comprising laminated clays are classified as non-productive strata. In the short and medium term these do not transmit significant quantities of contaminants and therefore they generally act as barriers to contaminant movement.

10.10.46 The mudstones of the Redcar Formation are classified as a Secondary Undifferentiated Aquifer which means that similarly to Glacial Till they may locally store and transmit appreciable amount of water depending in this case on the degree of fracturing. Variability in fracturing may permit contaminants for example hydrocarbons to enter, however, they may not easily escape, which could have serious ramification for anybody wishing to clean up historical contamination. Mercia Mudstone and Penarth Groups have been classified as Secondary (B) Aquifers, which means they are rarely an adequate water resource except for small supplies, although they may become polluted and slowly release contaminants. Generally Secondary (B) aquifers are considered to be insensitive to pollution. The underlying Sherwood Sandstone is classified as a Principal Aquifer. Due to the combined (but variable) thickness of overlying deposits of Glaciolacustrine deposits, Glacial Till, Redcar, Penarth and Mercia Mudstone and the anticipated upward gradient of groundwater flow within the Sherwood Sandstone towards the coast there is no significant pollutant pathway anticipated between Made Ground and the underlying Principal Aquifer. The site is not within an Environment Agency Source Protection Zone.

10.10.47 The geology of the PCC Site and Water Connection Corridors based on BGS boreholes comprises Made Ground mainly of slag with possible estuary dredgings in the south and west, overlying Tidal Flat Deposits, these provide a likely pathway to the Blown Sands and North Sea, however they have limited resource potential due to the brackish nature of the water and industrial legacy of the site. The Tidal Flat Deposits are therefore considered to be more of a pathway than a sensitive receptor and the emphasis is preventing additional or accelerated release of contaminants reaching the foreshore and North Sea. The CO_2 Export Pipeline is anticipated to have a similar succession.

10.10.48 The variability of the ground conditions and the size of the site makes it difficult to generalise concerning the sensitivity of groundwater resources over the pipeline corridors. Much of the area within pipeline corridors is underlain by Glaciolacustrine Clays and Silts, Glacial Till and Redcar Mudstone Formation, and under these conditions there is not expected to be a significant pollution pathway between contaminated soils and bedrock. Furthermore, given the nature of the proposed (mainly above ground) development and the small footprint of earthworks compared with the size of the surrounding industrial land uses and long history or salt works, railways, iron & steel manufacture, coking works, land reclamation / landfilling, production of bulk inorganic chemicals, plastics, petroleum refining and storage, and production of specialty chemicals, it is considered that the groundwater is relatively insensitive to the proposed development. Mitigation for protection of groundwater is warranted where there are active pollutant sources such as leaking tanks, or proposed earthworks could lead to a release of latent contamination in the ground for example by creation of a preferential pathway pollution migration, for example by open hole (uncased) drilling from Made Ground into an underlying aquifer.

10.10.49 Mitigation may be required to protect infrastructure such as concrete, steel, plastic water pipes, barrier membranes and buildings from contamination in soil and groundwater including acids, alkalis, hydrocarbons, sulphates, chlorides, nitrates and hazardous ground gas.

Contaminant Sources

10.10.50 Potential sources of contamination associated with historical industrial land use across the site are summarised below.

Brine Works

10.10.51 Early records of salt production at Coatham Marsh and Cowpen relate to production by evaporation of sea water. Records dating from the fourteenth century referenced at https://englandsnortheast.co.uk/billingham/ (15 January 2020) describe how sea coal was used locally as fuel, and salt was produced by heating huge shallow pans made of lead containing seawater. The centre of production moved to Greatham between Hartlepool and Billingham and salt making reached great heights in the fifteenth and sixteenth centuries. By 1650 the salt cotes at Greatham had been rendered useless by the tides, and the main centre of salt production moved to South Shields, where there was a plentiful supply of coal to heat the saltwater.

10.10.52 The Teesside salt (Sodium Chloride) industry developed in the second half of the nineteenth century. According to G.A. North (1975) "Teesside's Economic Heritage", Bolckow and Vaughan found a 100 ft (30 m) thick bed of rock salt (halite) at a depth of 1,300 ft (400 m) below the Cleveland Works, South Bank. Later in 1874, Bell Bros. found rock salt at a depth of 1,100 ft (335 m) on the northern bank of the Tees at their Port Clarence Works. These deposits are part of the thick evaporites laid down in Zechstein Sea during Middle to Late Permian times 250 million years ago. Commercial extraction of rock salt commenced in 1882 following introduction of hydraulic extraction methods pioneered in Alsace, France. Over 80% of the salt production was from brine wells on the northern side of the Tees between Port Clarence, Haverton Hill and Graythorpe. Initial processing of salt from brine occurred by the evaporation method from open pans. In 1883 salt production on Teesside was approximately 3,000 tons but by the mid-1890s it exceeded 300,000 tons, two thirds of which was exported, mainly to Tyneside (one imperial ton is approximately 1.016 metric tonnes).

10.10.53 Although production of salt declined in inter-war years, it was used in creation of alkali products. Sodium and chlorine together with intermediate chemicals obtained from salt were used as raw materials in the production of other chemicals during this vital period of development for the Teesside chemical industry. Brunner Mond, who had holding in the Teesside salt industry, became part of the new company called Imperial Chemical Industries (I.C.I).

10.10.54 The main contaminants from this industry are assumed to be Sodium Chloride and other common evaporites such as sulphates, other halides and borates from escaped brine, as well as coal combustion products from pump engines and heating plant, e.g. ash and clinker containing metals and PAHs. As well as using Durham coal some salt pans are reported to be heated by gas, which is a product of the iron industry.

Synthetic Ammonia Works (Billingham)

10.10.55 An Ammonia Works was established at Billingham out of a need to produce synthetic ammonia for production of explosives during World War I, according to an article written by John Britling in Johnson Matthey Technol. Rev., 2018, 62, (1), 32. (https://www.technology.matthey.com/article/62/1/32-47/)

10.10.56 Following the end of the war the plant was purchased by Brunner Mond & Co. and set up as a subsidiary called Synthetic Ammonia and Nitrates Ltd, which became part of ICI in December 1926. The ammonia plants built at Billingham in the 1920s and 1930s employed the classic Haber-Bosch process based on coke. “Water Gas” rich in hydrogen and “Producer Gas” rich in Nitrogen were obtained by passing alternate streams of steam and then air through gas generators containing hot coke. These streams were purified using iron oxides to remove hydrogen sulphide and a shift converter to convert most of the Carbon Monoxide to Carbon Dioxide and Hydrogen. Carbon Dioxide was removed by scrubbing with counter circulating water and then washed with Copper Liquor to remove residual Carbon Monoxide and Carbon Dioxide. Hydrogen and Nitrogen were recombined in the Haber Process at high temperature and pressure in the presence of an Iron catalyst to generate Ammonia. Ammonium Nitrate fertiliser was manufactured from Ammonia and Nitric Acid, which is generated from catalytic oxidation of Ammonia. When combined with precipitated chalk this was used to produce the first granular fertiliser “nitro-chalk”. Ammonium Sulphate fertiliser was manufactured from Ammonia, Carbonic Acid and Anhydrite (Calcium Sulphate), which was mined below the site. Anhydrite from Billingham was also used to produce sulphuric acid in the dry kiln process which produced solid “clinker” as a by-product. This was then ground down to a fine powder to form the basis of standard Portland cement.

10.10.57 By the late 1950s increasing costs of coal and the intrinsic inefficiency of syngas generation from coke had made this process uncompetitive. Initially the coke-oven process was replaced by partial oxidation in high pressure oil gasification units using heavy fuel oil and later a Naphtha feed, which is a produce of petroleum refining. In 1959 a serious explosion occurred in Billingham’s partial oxidation plant and the plant was eventually replaced by the more competitive steam reforming technology for syngas production. Prior to discovery of Gas and use of Methane as a feedstock, this process was also carried out using Naphtha. North Sea gas was provided on an interruptible supply basis in the 1970s. To cope with peak demand, an alternative feedstock was provided from liquified petroleum gas (LPG) propane stored in underground salt caverns. Further advances in ammonia production technology were developed by Billingham-based engineers, however these were implemented at other sites.

10.10.58 The contaminants of concern associated with the Ammonia Works are wastes from coal reforming and combustion (principally PAHs), ammonia liquors and ammonium salts, metals, acids, alkalis, naphtha, fuel oils, PCBs, asbestos.

Coking Works (associated with the early chemical industry and iron & steel works)

10.10.59 Coal carbonisation and production of town gas for electricity generation, chemical feedstock or heating is responsible for the production of numerous potentially contaminative biproducts and wastes including coal tar, ammonium sulphate, pure benzene and toluene, naphthalene, nickel, zinc, thiocyanate, phenols and other acids and organic compounds.

10.10.60 Ammoniacal liquor and coal tars wastes / products are commonly stored in underground tanks or "wells". Liquors contain free cyanides (easily liberated) and fixed or complex cyanides, thiocyanate, ferrocyanate, as well as other salts of ammonium, chloride, sulphate and thiosulphate. Spent iron oxide generated from gas purification containing complex cyanide "Prussian Blue" may have been exported to a sulphuric acid manufacturer assuming economical quantities of sulphur, or it was commonly disposed of on site. Slaked Lime may also have been used for gas purification resulting in "Foul Lime" with a potential for generation of Hydrogen Sulphide gas.

10.10.61 Other potential contaminants according to DoE Industry Profiles include acids, alkalis, metals, metalloids, asbestos, sulphur compounds, PAHs (especially in coal tar), BTEX including the manufactured fuel Benzol, phenols, cresols, xylenols, and numerous other organic chemicals including heterocyclic compounds.

Railways

10.10.62 The DoE Industry Profile for Railway Land indicates imported fill was often utilised during construction of the railways where there was a shortfall of natural excavated material. Imported fill often included waste material containing clinker and ash. Given the context of the site, it is probable that wastes from the iron & steel works will have been utilised in railway construction. Boiler ash generated by steam locomotives was also often used to form ballast along many railway lines. Other potential sources of contaminants that may be encountered on railway land include herbicides, polychlorinated biphenyls (PCBs) utilised in electrical transformers, and general spills of materials used or transported, which may include fuels, oils, paraffin, solvents, antifreeze liquids such as ethylene glycol, creosotes, paints etc. Metal fines, ash and asbestos are also frequently present on railway land. There is a limited potential for point sources of contamination to exist associated with leaks or spills from railway traffic, however the impact of these is likely to be localised. Concentrations of contaminants (if present) are likely to be relatively low and acute or chronic health risks are not anticipated for future site users. It is impossible to anticipate the likely distribution of contaminants from accidental release therefore precautionary control measures are likely to be necessary for ground workers.

10.10.63 The main contaminants associated with railway land are listed in Table 10A-26 provided from the DoE Industry :Profile

Table 10A- 26: DoE Railway Engineering Works - Main Groups of Contaminants and their probable locations

Main group of potential contaminants	Likely locations
Asbestos	Removal from locomotives and carriages often occurred outside workshops. Buildings, boilers and pipework. On-site landfills and waste burning sites. May be distributed across site.
Metals, metalloids and their compounds	On-site landfills, ash pits, waste storage areas (including waste oils) and areas of made ground. Locomotive cleaning, foundries, workshop areas (e.g. fabrication, construction, painting, plating, electrical, maintenance, dismantling, 'scrapping lines', repair etc).
Acids	Widespread use throughout sites (e.g. storage areas, plating shops, fabrication workshops, repair workshops, paint shops, cleaning areas etc.)
Alkalis	Cleaning and degreasing areas.
Inorganic chemicals	All: ash pits and on-site waste storage/disposal.
	Ammonium chloride: boiler fabrication, welding areas.
	Boron: maintenance and repair shops (corrosion inhibitors associated with, for example, antifreezes).
	Cyanide: foundries and smith's shops (metal hardening), gas works.
	Sulphates/sulphides: ash storage/disposal, gas works.
Organic chemicals	Fuel oils: fuel and oil storage and pipework, fuelling and de-fuelling areas, dismantling areas, waste storage and on-site waste disposal.
	Lubricating oils: storage areas, maintenance and repair shops, waste storage areas, on-site waste disposal.
	Greases: on-site waste disposal.
	Chlorinated solvents: degreasing shops, metal working areas, paint shops etc, waste storage areas and on-site waste disposal areas.

Main group of potential contaminants	Likely locations
	Non-chlorinated solvents: storage areas, repair shops, maintenance shops, paint shops etc, waste storage and waste disposal.
	Phenols: ash storage/disposal, gasworks.
	PAHs: ash storage/disposal, waste oil storage, waste disposal sites, gasworks areas.
	PCBs: electrical transformers and capacitors.
	Antifreezes: storage areas, repair shops, maintenance shops, waste storage and disposal areas.
	Coal: fuel storage.

Tar Macadam Slag Works

10.10.64 Coal Tars contains a wide variety of compounds however the main risk drivers are considered to be PAHs including benzo(a)pyrene, which is used as a surrogate marker for coal tar carcinogenicity. Other contaminants of particular concern to water resources include BTEX and other petrol and diesel range petroleum hydrocarbons present in fuels, and phenols, cresols, xylenols, heterocylic compounds etc found in coal tars.

Iron & Steel Works

10.10.65 The 1995 DoE Industry Profile for Iron and Steel Works (Metal Manufacturing refining and finishing works), breaks operations down into the following activities;

Ore preparation

- Coke making
- Iron making
- Steel making
- Casting
- Rolling and Finishing

10.10.66 Modern foundries combine the iron ore, coke and limestone together with recycled dry dust from furnace cleaning and metal oxide scale from rolling mills in a Sinter Plant to form sinter. In the past it is expected that mixing of raw materials would have occurred in a more haphazard manner in the foundry.

10.10.67 The process of coke making is considered separately in the section for coking works.

10.10.68 Iron ore containing iron oxides along with gangue minerals such as oxides of calcium, silicon, phosphorus and sulphur is reduced to iron saturated with carbon from the coke, and a slag formed by absorption of the gangue materials into the limestone-based flux. The iron was historically cast as “pigs” in a casting plant, however in a modern integrated plant it is sent directly to the steel furnaces as hot metal.

10.10.69 Steel is an alloy of iron with carbon (less than 2%) and manganese (less than 1%) although other alloy metals are used to produce specific properties, for example, stainless steel contains 8 - 25% of chromium. Steel was first manufactured at an industrial scale in England using the Bessemer Process which utilises a converter vessel with a refractory lining, air (containing oxygen), which is used to burn off the carbon in pig iron, and limestone flux to remove further impurities. It was found expedient to add carbon back into the steel in order to control the carbon fraction. Originally for steel-making it was necessary to import low-phosphorus iron ore and converter linings were manufactured using clay, with production of an acid slag from the limestone flux. This process was adapted to use local iron ore, which was high in phosphorus, with a switch to a dolomite refractory lining to produce basic slag.

10.10.70 Bessemer Converters were replaced by the Open Hearth Furnace, whose main advantage was that they did not expose the steel to excessive nitrogen, which could cause the steel to become brittle. DoE reports that 80% of steel manufacturing during the first half of the twentieth century use Open Hearth Furnaces. The Open Hearth system is a batch process using a melt of heavy scrap metal, pig iron and if necessary, iron oxide. Once the steel is melted, slag forming agents such as limestone are added. The oxygen in impurities and the added iron oxide remove the carbon until the desired carbon content has been achieved.

10.10.71 By the end of the twentieth century, according to DoE most (75%) UK steel making used either the Basic Oxygen Furnace (BOF) or Electric Arc Furnace (EAF). The principal material used in BOF is hot metal from scrap and iron which is de-carbonised using a water cooled oxygen lance. During the “blow” with high purity oxygen, lime is introduced to form a slag with impurities in the metal. EAF consists of a circular refractory-lined bath with a swivelling roof through which electrodes can be lowered into position above the scrap in the furnace. Arc furnaces are charged with clean scrap, limestone and possibly a source of carbon, and melted as quickly as possible. Other metals such as nickel, molybdenum and chromium are added if the scrap is deficient in order to manufacture specialised steels. An oxygen lance may be used to remove excess carbon. It is also reported that EAF was widely used to make large quantities of more common steels.

10.10.72 Once molten steel has been tapped from the furnace it is generally cast into ingots or special castings, or directly into slabs, blooms or billets by the continuous casting process.

10.10.73 Semi-finished steel from the steel making plant is formed in rolling mills into products for the marketplace. Rolling mills can be considered in the two categories of hot rolling and cold rolling plants. During hot rolling the steel is exposed to the atmosphere resulting in the development of oxide scale (mill scale). This may be removed quickly using high-pressure water which requires recovery and effluent treatment at the plant. Cold rolling is a secondary operation which takes hot rolled strips and rolls them using a stable oil / water emulsion to reduce friction and dissipate heat. The emulsion becomes contaminated with dirt / iron particles and a portion must be discarded from circulation to avoid build-up of contamination.

10.10.74 Steel is subjected to a variety of finishing processes to meet market demand including acid pickling, painting, galvanising, tinning and plastic coating. Acid pickling generally precedes cold rolling and may use sulphuric acid, hydrochloric acid, or a mixture of hydrofluoric and nitric acids (for special steels).

10.10.75 The wastes from iron making comprise mainly blast furnace slag, dry dust from gas cleaning, wet solids from gas cleaning and refractory waste from ladles and runners. Slag has traditionally been used as a building material, the raw material for slag furnace cement and aggregates for roads and land reclamation. Dray dust may generally be re-used however the wet residues from the gas cleaning process are difficult to re-use due the presence of lead, zinc and alkalis, and the general practice has been to let them dry out in large lagoons for recycling or disposal. The effluent water from the associated slurry requires treatment prior to recycling or discharge.

10.10.76 Steel making wastes include acid or basic slag, scrap, dust and slurries and refractory material. Steel slags have been also been used as a construction material, for example in road making, and may also have been used for site backfill and reclamation. Due to the high phosphorus content of some ores, (basic) steel slag may contain more than 15% phosphorous pentoxide. These slags were ground and sold as fertiliser.

10.10.77 Fume cleaning is an integral part of steel making; specific quantities of around 10 to 15 kg of dust or slurry arise from each tonne of manufactured steel. Although the fines contain around 50% iron, the presence of lead, zinc and other metals makes them unsuitable for recycling in the blast furnace and it is reported by DoE that since the 1970s most of the slurry has been lagooned on site or landfilled.

10.10.78 Scrap waste and mill scale from rolling mills is generally recycled as an integral part of steel making. Some of the finer scale may become contaminated with hydrocarbons and would be generally discharged to lagoon and eventual disposal. A number of methods of dealing with oily waste have been tried including solvent extraction e.g. using halogenated solvents. Other refractory wastes arising from soaking pits, reheating furnaces and similar equipment in the rolling mill are generally disposed of according to DoE to on-site landfills or tips. Used oil is generally refined by specialist contractors or incinerated.

10.10.79 Spent sulphuric acid, hydrochloric acid and sodium hydroxide from pickling are generally regenerated at large plants, however at smaller sites they may be neutralised prior to disposal. The wastes from galvanising and tinning processes are produced only in small quantities compared to the other wastes as a whole.

10.10.80 Other wastes commonly found in on-site tips that are not directly attributed to the iron & steel processes include; building and demolition rubble, slurries from water treatment plants, insulation material such as asbestos (including roofing and cladding for pipes) and empty chemical containers. Transformers and other electrical equipment may contain PCBs.

10.10.81 The DoE finds that metals and metal compounds and the products of coke making, and metal finishing are the most significant contaminants at iron and steel works. The distribution of these contaminants will be dependent on the type of process and material storage taking place on the site. Leakage may have occurred from tanks and pipework carrying products or waste. It is highlighted that in old-established sites, contaminants may be present in on-site landfills, lagoons or soakaways. Storage of oily scrap could have led to ground contamination.

10.10.82 The DoE summary of common contaminants for iron and steel works is provided in Table 10A-27.

Table 10A- 27: DoE Metal manufacturing, refining and finishing works – iron and steelworks - Main groups of contaminants and their probable locations

Contaminants		Location				
Main groups	Individual Compounds	Coke Making	Iron Making	Steel Making	Casting	Rolling & Finishing
Metal and metalloids[1]	Iron		X	X	X	X
	Aluminium					X
	Arsenic			X		
	Chromium			X		
	Lead		X	X		X
	Manganese			X		X
	Molybdenum			X		X
	Nickel			X		X
	Tin					X
	Vanadium					X
	Zinc		X	X		X
Inorganic compounds	Fluoride		X	X		
	Ammoniacal liquor	X				
	Cyanide	X	X			
	Thiocyanate	X				
	Sulphates	X	X	X		
	Phosphates			X		
Acids / alkalis		X				X
Asbestos		X	X	X	X	X
Organic compounds	Fuels and oils			X	X	X
	Tar	X				
	PAHs	X				
	Phenols	X				
	PCBs		X	X	X	X

[1] The most likely forms are compounds or alloys.

[2] See also DoE Industry Profile: 'Gas works, coke works and other coal carbonisation plants'.

[3] see also DoE Industry Profile: 'Metal manufacturing, refining and finishing works: electroplating and other finishing works'.

Shaded boxes indicate areas where contamination is most likely to occur.

Mycoprotein Manufacture

10.10.83 Quorn mycoprotein (meat substitute) was launched in 1985 by Marlow Foods, a joint venture between Rank Hovis McDougall (RHM) and Imperial Chemical Industries (ICI), and is now owned by Monde Nissin Corporation. Previously ICI had manufactured Pruteen animal feed using petroleum as a source of food, however, this proved uneconomical and a fermenter was converted for producing protein for human consumption from glucose, minerals, biotin and ammonia (as a Nitrogen source) with Fusarium venenatum fungus (http://www.misac.org.uk/PDFs/MiSAC_Briefings_1.pdf).

Cement Manufacture

10.10.84 Cement is manufactured by combining minerals containing a high percentage of calcium (usually carbonate) and lower-calcium minerals containing silicon, aluminium and iron. Clinker is formed by heating the principal ingredients in a kiln, which is then crushed and mixed with subsidiary amounts of additives such as limestone and gypsum powder to make cement.

10.10.85 The Pioneer Works at Haverton Hill were started (c.1903) at a location adjacent to the River Tees east of the Tees Salt Works, approximately 500300 m south east of western end of the CO_2 Gathering Network Corridor. Originally they are reported to have used chalk ballast (e.g. from coal trading ships) and Boulder Clay from Saltholme, Cowpen (https://www.cementkilns.co.uk/cement_kiln_billingham.html). As chalk ballast was found to be in short supply, Pioneer Works found it increasing expensive to import from alternative suppliers in Yorkshire or further afield. Trials were conducted in 1924-25 to replace chalk with waste calcium carbonate or “Sulphate Plant Mud” from Synthetic Ammonia and Nitrates Ltd (SA&N). The mud contained unreacted anhydrite and ammonia, and the clinker was also high in sulphate. In 1926 a new company was launched with SA&N money to finance a new kiln on the north end of the original Pioneer Works using the waste carbonate (labelled “Chemical Works” in 1954 mapping). ICI, the successor company to SA&N, bought the company out in 1928. In 1931 ICI started to manufacture clinker as a biproduct of sulphuric acid manufacture in the Anhydrite Process kiln bordering the site. Clinker from the Anhydrite Process and the conventional kilns on the Pioneer Works site were blended to manufacture finished cement. A second Anhydrite Process kiln was commissioned in 1935. Originally clinker was moved on an aerial ropeway, however, after commission of a third larger Anhydrite kiln in 1954 and decommissioning of the ropeway, clinker was moved by road.

10.10.86 The principal contaminants are associated with fuel (coal, hydrocarbons) and combustion products (TPH, PAH), alkali (e.g. clinker), sulphate, asbestos and metals.

Anhydrite Process – Sulphuric Acid Manufacture

10.10.87 ICI developed manufacture of Sulphuric Acid at Billingham in 1929 in an area bordering close to the Site (https://www.cementkilns.co.uk/waste.html#anhydrite) using anhydrite mined from Permian evaporitic deposits found below the site and surrounding area. The pithead was located within the site at ~NGR E:447730 N:522750. In this process, the Anhydrite was mixed with Boulder Clay and heated in reducing conditions to produce Sulphur Dioxide and Clinker. Sulphur Dioxide was then converted to Sulphur Trioxide in the Contact Process with oxygen in the presence of a Vanadium Pentoxide catalyst, after which the gas was dissolved in sulphuric acid for safety, and then water added to manufacture Sulphuric Acid.

10.10.88 Atmospheric pollution, primarily from the Anhydrite Process became a major concern after the Second World War. This led to the total demolition of the residential houses in Haverton Hill during the 1960s and 1970s with the bulk of its population being moved to nearby Billingham.

10.10.89 A fall in the price of elemental Sulphur and an increase in energy prices, together with a decline in demand for ammonium sulphate in fertilisers lead to closure of the Anhydrite Process plant in sometime in the 1970s (1971-1976 according to different sources).

10.10.90 The principal contaminants are associated with fuel (coal, hydrocarbons) and combustion products (TPH, PAH), alkali (e.g. clinker), acid (e.g. sulphuric acid), sulphate, asbestos and metals.

Anhydrite Mine

10.10.91 Mining is commonly associated with contamination from plant from spilt fuel and combustion products (that may be contaminated with harmful TPH / PAHs), PCBs used as dielectrics in electrical transformers, construction and demolition rubble including concrete. Asbestos was commonly used in construction and for specialist uses such as electrical and thermal insulation due to its thermal properties and resistance to fire. The 7m thick seam of anhydrite is unlikely to have generated much spoil, however anhydrite (calcium sulphate) is likely be present within Made Ground.

Table 10A- 28: Environmental Risk

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
A. ICI Synthetic Ammonia Works / Anhydrite Process Plant / Anhydrite Mine					
Metals, metalloids	1. Ingestion/ skin contact 2. Dust Inhalation 3. Vapour Inhalation 4. Explosion / Asphyxiation 5. Plant Uptake / Phytotoxicity 6. Leaching to surface water 7. Leaching to groundwater 8. Corrosion / chemical attack 9. Permeation of pipes 10. Exposure to contaminated water	Ground Workers (1,2,10)	Mild	Likely	Moderate / Low
		Site Users (1,2)	Mild	Low	Low
		General Public (off-site) (1,2)	Mild	n/a	n/a
		Fauna & Flora (5)	Minor	Low	Very low
		Surface Water (6)	Mild	Low	Low
		Groundwater (7)	Mild	Low	Low
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides		Ground Workers (1,10)	Severe	Low	Moderate
		Site Users (1,9)	Medium	Low	Moderate / Low
		General Public (off-site) (1)	Medium	n/a	n/a
		Fauna & Flora (5)	Mild	Low	Low
		Surface Water (6)	Medium	Low	Moderate / Low
		Groundwater (7)	Medium	Low	Moderate / Low
		Infrastructure (8,9)	Medium	Likely	Moderate
Oils, lubricants, greases (TPH - LRO)		Ground Workers (1)	None	n/a	n/a
		Site Users (1)	None	n/a	n/a
		General Public (off-site) (1)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Infrastructure (8)	None	n/a	n/a
Petroleum Fuel - (TPH - PRO, DRO)		Ground Workers (1,2,3,4,10)	Minor	Likely	Low
		Site Users (1,2,3,4,9)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Petroleum Fuel - (TPH - PRO, DRO)		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Infrastructure (4,8,9)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
Coal Tars (PAH, TPH), phenols, cresols, xylenols, heterocyclics		Ground Workers (1,2,3,10)	Medium	Likely	Moderate
		Site Users (1,2,3,9)	Medium	Low	Moderate / Low
		General Public (off-site) (1,2,3)	Medium	n/a	n/a
		Fauna & Flora (5)	Minor	Low	Very low
		Surface Water (6)	Mild	Low	Low
		Groundwater (7)	Mild	Low	Low
		Infrastructure (8,9)	Minor	Likely	Low
POPs: PCBs, dioxins, furans		Ground Workers (1,2)	None	n/a	n/a
		Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
Asbestos		Ground Workers (2)	Medium	Likely	Moderate
		Site Users (2)	Medium	Unlikely	Low
		General Public (off-site) (2)	Medium	Unlikely	Low
Coal Dust		Ground Workers (4)	None	n/a	n/a

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
		Site Users (4)	None	n/a	n/a
		Infrastructure (4)	None	n/a	n/a
Hazardous Gas		Ground Workers (4)	Mild	Low	Low
		Site Users (4)	Mild	Low	Low
		Infrastructure (4)	Mild	Low	Low
B. Brine Works					
Metals, metalloids	1. Ingestion / skin contact 2. Dust Inhalation 3. Vapour Inhalation 4. Explosion / Asphyxiation 5. Plant Uptake / Phytotoxicity 6. Leaching to surface water 7. Leaching to groundwater 8. Corrosion / chemical attack 9. Permeation of pipes 10. Exposure to contaminated water	Ground Workers (1,2,10)	Mild	Likely	Moderate / Low
		Site Users (1,2)	Mild	Low	Low
		General Public (off-site) (1,2)	Mild	n/a	n/a
		Fauna & Flora (5)	Minor	Low	Very low
		Surface Water (6)	Mild	Low	Low
		Groundwater (7)	Mild	Low	Low
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides		Ground Workers (1,10)	Mild	Likely	Moderate / Low
		Site Users (1,9)	Mild	Low	Low
		General Public (off-site) (1)	Mild	n/a	n/a
		Fauna & Flora (5)	Minor	Low	Very low
		Surface Water (6)	Mild	Low	Low
		Groundwater (7)	Mild	Low	Low
		Infrastructure (8,9)	Mild	Likely	Moderate / Low
C. Petroleum Refineries / Tank Farms / Fuel Storage					
Oils, lubricants, greases (TPH - LRO)	1. Ingestion / skin contact 2. Dust Inhalation	Ground Workers (1)	Minor	Likely	Low
		Site Users (1)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
	3. Vapour Inhalation 4. Explosion / Asphyxiation 5. Plant Uptake / Phytotoxicity 6. Leaching to surface water 7. Leaching to groundwater 8. Corrosion / chemical attack 9. Permeation of pipes 10. Exposure to contaminated water	General Public (off-site) (1)	Minor	n/a	n/a
		Fauna & Flora (5)	Minor	Low	Very low
		Infrastructure (8)	Minor	Likely	Low
Petroleum Fuel - (TPH - PRO, DRO)		Ground Workers (1,2,3,4,10)	Medium	Likely	Moderate
		Site Users (1,2,3,4,9)	Medium	Unlikely	Low
		General Public (off-site) (1,2,3)	Medium	n/a	n/a
		Infrastructure (4,8,9)	Mild	Likely	Moderate / Low
		Fauna & Flora (5)	Mild	Low	Low
		Surface Water (6)	Medium	Low	Moderate / Low
		Groundwater (7)	Medium	Low	Moderate / Low
General Organics (VOC / SVOC including Olefins)		Ground Workers (1,2,3,10)	Minor	Likely	Low
		Site Users (1,2,3,9)	Minor	Low	Very low
		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Surface Water (6)	None	n/a	n/a
		Groundwater (7)	None	n/a	n/a
		Infrastructure (9)	Minor	Low	Very low
Asbestos		Ground Workers (2)	Medium	Low	Moderate / Low
		Site Users (2)	Medium	Unlikely	Low
		General Public (off-site) (2)	Medium	Unlikely	Low
D. Tar Macadam Slag Works					
Metals, metalloids	1. Ingestion / skin contact 2. Dust Inhalation	Ground Workers (1,2,10)	Minor	Likely	Low
		Site Users (1,2)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Metals, metalloids	3. Vapour Inhalation 4. Explosion / Asphyxiation 5. Plant Uptake / Phytotoxicity 6. Leaching to surface water 7. Leaching to groundwater 8. Corrosion / chemical attack 9. Permeation of pipes 10. Exposure to contaminated water	General Public (off-site) (1,2)	Minor	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
Coal Tars (PAH, TPH), phenols, cresols, xylenols, heterocyclics		Ground Workers (1,2,3,10)	Severe	Likely	High
		Site Users (1,2,3,9)	Severe	Low	Moderate
		General Public (off-site) (1,2,3)	Severe	n/a	n/a
		Fauna & Flora (5)	Mild	Low	Low
		Surface Water (6)	Medium	Low	Moderate / Low
		Groundwater (7)	Medium	Low	Moderate / Low
		Infrastructure (8,9)	Mild	Likely	Moderate / Low
General Organics (VOC / SVOC including Olefins)		Ground Workers (1,2,3,10)	Mild	Likely	Moderate / Low
		Site Users (1,2,3,9)	Mild	Low	Low
		General Public (off-site) (1,2,3)	Mild	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Infrastructure (9)	Mild	Low	Low
POPs: PCBs, dioxins, furans		Ground Workers (1,2)	None	n/a	n/a
		Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
POPs: PCBs, dioxins, furans		Groundwater (7)	Minor	Low	Very low
Asbestos		Ground Workers (2)	Medium	Likely	Moderate
		Site Users (2)	Medium	Unlikely	Low
		General Public (off-site) (2)	Medium	Unlikely	Low
Hazardous Gas		Ground Workers (4)	Minor	Likely	Low
		Site Users (4)	Minor	Low	Very low
		Infrastructure (4)	Minor	Low	Very low
E. Iron / Steel / Coking Works					
Metals, metalloids	1. Ingestion / skin contact 2. Dust Inhalation 3. Vapour Inhalation 4. Explosion / Asphyxiation 5. Plant Uptake / Phytotoxicity 6. Leaching to surface water 7. Leaching to groundwater 8. Corrosion / chemical attack 9. Permeation of pipes 10. Exposure to contaminated water	Ground Workers (1,2,10)	Minor	Likely	Low
		Site Users (1,2)	Minor	Low	Very low
		General Public (off-site) (1,2)	Minor	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides		Ground Workers (1,10)	Minor	Likely	Low
		Ground Workers (2)	Medium	High	High
		Site Users (1,9)	Minor	Low	Very low
		Site Users (2)	Mild	Likely	Moderate / Low
		General Public (off-site) (1)	Minor	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
		Infrastructure (8,9)	Mild	Likely	Moderate / Low
Oils, lubricants, greases (TPH - LRO)		Ground Workers (1)	None	n/a	n/a
		Site Users (1)	None	n/a	n/a
		General Public (off-site) (1)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Infrastructure (8)	None	n/a	n/a
Petroleum Fuel - (TPH - PRO, DRO)		Ground Workers (1,2,3,4,10)	Mild	Likely	Moderate / Low
		Site Users (1,2,3,4,9)	Mild	Low	Low
		General Public (off-site) (1,2,3)	Mild	n/a	n/a
		Infrastructure (4,8,9)	Minor	Likely	Low
		Fauna & Flora (5)	Minor	Low	Very low
		Surface Water (6)	Mild	Low	Low
		Groundwater (7)	Mild	Low	Low
Coal Tars (PAH, TPH), phenols, cresols, xylenols, heterocyclics		Ground Workers (1,2,3,10)	Severe	Likely	High
		Site Users (1,2,3,9)	Severe	Low	Moderate
		General Public (off-site) (1,2,3)	Severe	n/a	n/a
		Fauna & Flora (5)	Mild	Low	Low
		Surface Water (6)	Medium	Low	Moderate / Low
		Groundwater (7)	Medium	Low	Moderate / Low
		Infrastructure (8,9)	Mild	Likely	Moderate / Low
General Organics (VOC / SVOC including Olefins)		Ground Workers (1,2,3,10)	Minor	Likely	Low
		Site Users (1,2,3,9)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Surface Water (6)	None	n/a	n/a
		Groundwater (7)	None	n/a	n/a
		Infrastructure (9)	Minor	Low	Very low
POPs: PCBs, dioxins, furans		Ground Workers (1,2)	None	n/a	n/a
		Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
Asbestos		Ground Workers (2)	Severe	Likely	High
		Site Users (2)	Medium	Likely	Moderate
		General Public (off-site) (2)	Medium	Unlikely	Low
Coal Dust		Ground Workers (4)	Minor	Likely	Low
		Site Users (4)	Minor	Low	Very low
		Infrastructure (4)	Minor	Low	Very low
Hazardous Gas		Ground Workers (4)	Mild	Likely	Moderate / Low
		Site Users (4)	Mild	Low	Low
		Infrastructure (4)	Mild	Low	Low
F. Olefins (cracking) - Chemical works					
Oils, lubricants, greases (TPH - LRO)	1. Ingestion / skin contact 2. Dust Inhalation	Ground Workers (1)	None	n/a	n/a
		Site Users (1)	None	n/a	n/a

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Oils, lubricants, greases (TPH - LRO)	3. Vapour Inhalation 4. Explosion / Asphyxiation 5. Plant Uptake / Phytotoxicity 6. Leaching to surface water 7. Leaching to groundwater 8. Corrosion / chemical attack 9. Permeation of pipes 10. Exposure to contaminated water	General Public (off-site) (1)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Infrastructure (8)	None	n/a	n/a
Petroleum Fuel - (TPH - PRO, DRO)		Ground Workers (1,2,3,4,10)	Minor	Likely	Low
		Site Users (1,2,3,4,9)	Minor	Low	Very low
		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Infrastructure (4,8,9)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
Coal Tars (PAH, TPH), phenols, cresols, xylenols, heterocyclics		Ground Workers (1,2,3,10)	Medium	Likely	Moderate
		Site Users (1)	Medium	Low	Moderate / Low
		Site Users (2)	Mild	Unlikely	Very low
		Site Users (3)	Minor	Unlikely	Very low
		Site Users (9)	Mild	Low	Low
		General Public (off-site) (1,2,3)	Medium	n/a	n/a
		Fauna & Flora (5)	Minor	Low	Very low
		Surface Water (6)	Mild	Low	Low
		Groundwater (7)	Mild	Low	Low
		Infrastructure (8,9)	Minor	Likely	Low
General Organics (VOC / SVOC including Olefins)		Ground Workers (1,2,3,10)	Mild	Likely	Moderate / Low
		Site Users (1,2,3,9)	Mild	Low	Low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
		General Public (off-site) (1,2,3)	Mild	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Infrastructure (9)	Mild	Low	Low
POPs: PCBs, dioxins, furans		Ground Workers (1,2)	None	n/a	n/a
		Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
Asbestos		Ground Workers (2)	Severe	Likely	High
		Site Users (2)	Severe	Unlikely	Moderate / Low
		General Public (off-site) (2)	Medium	Unlikely	Low
Hazardous Gas		Ground Workers (4)	Mild	Likely	Moderate / Low
		Site Users (4)	Mild	Likely	Moderate / Low
		Infrastructure (4)	Minor	Low	Very low
G. Power Generation & Distribution					
Oils, lubricants, greases (TPH - LRO)	1. Ingestion / skin contact 2. Dust Inhalation 3. Vapour Inhalation 4. Explosion / Asphyxiation 5. Plant Uptake / Phytotoxicity 6. Leaching to surface water	Ground Workers (1)	None	n/a	n/a
		Site Users (1)	None	n/a	n/a
		General Public (off-site) (1)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Infrastructure (8)	None	n/a	n/a

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
POPs: PCBs, dioxins, furans	7. Leaching to groundwater 8. Corrosion / chemical attack 9. Permeation of pipes 10. Exposure to contaminated water	Ground Workers (1,2)	None	n/a	n/a
		Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
H. Infilled Land					
Metals, metalloids	1. Ingestion / skin contact 2. Dust Inhalation 3. Vapour Inhalation 4. Explosion / Asphyxiation 5. Plant Uptake / Phytotoxicity 6. Leaching to surface water 7. Leaching to groundwater 8. Corrosion / chemical attack 9. Permeation of pipes 10. Exposure to contaminated water	Ground Workers (1,2,10)	Minor	Likely	Low
		Site Users (1,2)	Minor	Low	Very low
		General Public (off-site) (1,2)	Minor	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides		Ground Workers (1,10)	Minor	Likely	Low
		Site Users (1,9)	Minor	Low	Very low
		General Public (off-site) (1)	Minor	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Infrastructure (8,9)	Minor	Likely	Low
Oils, lubricants, greases (TPH - LRO)		Ground Workers (1)	None	n/a	n/a
		Site Users (1)	None	n/a	n/a

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Oils, lubricants, greases (TPH - LRO)		General Public (off-site) (1)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Infrastructure (8)	None	n/a	n/a
Coal Tars (PAH, TPH), phenols, cresols, xylenols, heterocyclics		Ground Workers (1,2,3,10)	Mild	Likely	Moderate / Low
		Site Users (1,2,3,9)	Mild	Low	Low
		General Public (off-site) (1,2,3)	Mild	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Infrastructure (8,9)	None	n/a	n/a
General Organics (VOC / SVOC including Olefins)		Ground Workers (1,2,3,10)	Minor	Likely	Low
		Site Users (1,2,3,9)	Minor	Low	Very low
		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Surface Water (6)	None	n/a	n/a
		Groundwater (7)	None	n/a	n/a
		Infrastructure (9)	Minor	Low	Very low
Asbestos		Ground Workers (2)	Mild	Likely	Moderate / Low
		Site Users (2)	Mild	Unlikely	Very low
		General Public (off-site) (2)	Mild	Unlikely	Very low
Organic Matter		Ground Workers (4)	Minor	Likely	Low
		Site Users (4)	Minor	Low	Very low
		Infrastructure (4)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Organic Matter		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	None	n/a	n/a
Hazardous Gas		Ground Workers (4)	Minor	Likely	Low
		Site Users (4)	Minor	Low	Very low
		Infrastructure (4)	Minor	Low	Very low
I. Railways					
Metals, metalloids	1. Ingestion / skin contact 2. Dust Inhalation 3. Vapour Inhalation 4. Explosion / Asphyxiation 5. Plant Uptake / Phytotoxicity 6. Leaching to surface water 7. Leaching to groundwater 8. Corrosion / chemical attack 9. Permeation of pipes 10. Exposure to contaminated water	Ground Workers (1,2,10)	Minor	Likely	Low
		Site Users (1,2)	Minor	Low	Very low
		General Public (off-site) (1,2)	Minor	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
pH, acids, alkalis, sulphate, chloride, ammonia, cyanides		Ground Workers (1,10)	Minor	Likely	Low
		Site Users (1,9)	Minor	Low	Very low
		General Public (off-site) (1)	Minor	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Infrastructure (8,9)	Minor	Likely	Low
Oils, lubricants, greases (TPH - LRO)		Ground Workers (1)	None	n/a	n/a
		Site Users (1)	None	n/a	n/a
		General Public (off-site) (1)	None	n/a	n/a

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Oils, lubricants, greases (TPH - LRO)		Fauna & Flora (5)	None	n/a	n/a
		Infrastructure (8)	None	n/a	n/a
Petroleum Fuel - (TPH - PRO, DRO)		Ground Workers (1,2,3,4,10)	Minor	Likely	Low
		Site Users (1,2,3,4,9)	Minor	Low	Very low
		General Public (off-site) (1,2,3)	Minor	n/a	n/a
		Infrastructure (4,8,9)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
Coal Tars (PAH, TPH), phenols, cresols, xylenols, heterocyclics		Ground Workers (1,2,3,10)	Mild	Likely	Moderate / Low
		Site Users (1,2,3,9)	Mild	Low	Low
		General Public (off-site) (1,2,3)	Mild	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low
		Infrastructure (8,9)	None	n/a	n/a
POPs: PCBs, dioxins, furans		Ground Workers (1,2)	None	n/a	n/a
		Site Users (1,2)	None	n/a	n/a
		General Public (off-site) (1,2)	None	n/a	n/a
		Fauna & Flora (5)	None	n/a	n/a
		Surface Water (6)	Minor	Low	Very low
		Groundwater (7)	Minor	Low	Very low

Source	Pathway	Receptor Linkage	Consequence	Likelihood	Risk
Asbestos		Ground Workers (2)	Mild	Likely	Moderate / Low
		Site Users (2)	Mild	Unlikely	Very low
		General Public (off-site) (2)	Mild	Unlikely	Very low

Magnitude of the potential Consequence (severity) of risk, Table 6.3, CIRIA C552.
Magnitude of the Probability (likelihood) of risk occurring, Table 6.4 - CIRIA C552.
Risk presented by each pollutant linkage, Table 6.5 – CIRIA C552.

10.10.92 Actions corresponding with the risk classification are calculated based on the requirements of Table 6.6 – CIRIA 552. The table indicates that any risk classified as moderate or higher will require further investigation or mitigation measures.

Asbestos

10.10.93 The risk to ground workers from inhalation of asbestos fibres during ground disturbance at the PCC Site, Water Connection Corridors, the Electrical Connection Corridor and CO_2 Gathering Network and Natural Gas Connection Corridors has been assessed as High. It is advised that unless proven otherwise, mitigation will be required to avoid an unacceptable risk during development. It is noted that 10% of samples within the PCC Site contained asbestos fibres, however, samples were generally too small to obtain a high probability of detecting pieces of asbestos containing materials (ACM), which if unbound could release significant quantities of fibres when disturbed. A survey by a specialist in asbestos identification in soils is advised for the PCC Site in order to ensure appropriate samples are taken for testing. Control measures are likely to be required for additional intrusive investigation and if the hazards are proven; mitigation will be required to eliminate, reduce, control or manage the risk, or in the last resort provide suitable personal protective equipment (PPE) / respiratory protective equipment (RPE) for ground workers.

10.10.94 A Moderate risk to ground workers has also been assessed for inhalation of asbestos fibres in the Billingham ICI Synthetics Ammonia Works / Anhydrite Process Works within the CO_2 Gathering Network Corridor at Haverton Hill. A survey by a specialist in asbestos identification in soils is advised in order to ensure appropriate samples are taken for testing. Further intrusive investigation is advised for soils (Made Ground) within these areas if groundworks are planned in order to design appropriate mitigation.

10.10.95 A Moderate risk from exposure by inhalation of asbestos fibres has been assessed for future site users at the PCC Site assuming Made Ground is exposed within landscaped areas. This risk could be mitigated by evaluation of “releasability” of fibres during soil disturbance (activity based testing); however, in practice it is expected that most area will be hardstanding and therefore provision of a designed cover layer is advised in areas of soft landscaping especially as this would provide a better growing medium for support of plants, including if necessary, a capillary break layer to prevent uptake of metals.

10.10.96 Asbestos is also commonly associated with Petroleum Refineries and Tank Depots, however, the risk from these to neighbouring areas such as the site is considered Moderate / Low. There may be a risk from uncontrolled disposal of asbestos adjacent to these areas; however, deposits would by nature be sporadic and difficult to predict. It would be advisable therefore to keep a watching brief for excavations adjacent to or on former petroleum sites including the Seal Sands and Teesport areas within the CO_2 Gathering Network and Natural Gas Connection Corridors and Electrical Connection Corridor for visible evidence of asbestos contamination.

10.10.97 Infilled land (including "Inert Landfills" constructed prior to EU Landfill Directives) and railway land across the site has been assessed as having a Moderate / Low risk to ground workers from exposure to asbestos fibres in soil. This risk could be mitigated through a watching brief by an environmental specialist in identification of asbestos in soil or through targeted investigation and sampling of locations where ground disturbance will take place.

10.10.98 It is recommended that a walkover survey by an asbestos specialist be carried out along the pipeline corridor routes to identify areas of concern for construction workers involved with laying or maintaining pipelines.

Coal Tars and other volatile and semi-volatile organic chemicals (PAH, TPH, VOCs & SVOCs)

10.10.99 Risk from exposure to coal tars and other organic pollutants from coking and Tar Macadam Works in the PCC Site and Water Connection Corridors is assessed as being High for ground workers. Geophysical investigation could be helpful to find possible buried tanks within the coking and tar macadam works. These may be point sources for ongoing release of pollutants therefore removal of any tanks (and contents) and surrounding contamination is advised regardless of whether these directly affect construction. Gross contamination by coal tars will be obvious and the risk can be managed during ground works, assuming there are appropriate management procedures, however further investigation would help quantify the amount of unsuitable material and the cost for treatment or offsite disposal.

10.10.100 A Moderate risk from exposure to PAH / TPH / VOCs / SVOCs has been assessed for ground workers in ICI Synthetic Ammonia Works area of Haverton Hill (CO_2 Gathering Network and Natural Gas Connection Corridors) and Wilton International complex (Natural Gas Connection Corridors). Whilst it is expected the former ICI Haverton Hill (Billingham) area was mainly involved with anhydrite mining and associated chemical works such as sulphuric acid and fertiliser manufacture, the Billingham ICI Synthetics Ammonia Works has a long history of ammonia production from coal, creosote and naphtha. Storage, processing and spillage or disposal of these or intermediate products could have occurred in the plant or tanks on or adjacent to the site. It is recommended that intrusive investigations be carried out prior to ground disturbance within the former ICI works at Haverton Hill.

10.10.101 A Moderate risk from exposure to PAH / TPH has been assessed for future site users in the PCC Site without mitigation from ingestion and dermal contact due to the former presence of Iron & Steel and Tar Macadam Works. Selection of suitable soils and confirmation testing could be employed to ensure that soft landscaped areas are suitable; however, in view of the risk from asbestos, it might be preferred to provide an engineered cover from clean imported material. A cost-benefit exercise could be carried out to determine if validation of soils and re-use in the cover layer or import of clean soils is preferable.

10.10.102 A Moderate / Low risk has been assessed for exposure to ground workers from PAH / TPH on railway land and infilled ground. This risk affects most if not all areas to a greater or lesser extent taking into account the likely presence of Made Ground across the site. Since it is not possible to eliminate this Moderate / Low risk by investigation, in most cases the use of appropriate PPE and suitable hygiene facilities for ground workers will be the most appropriate mitigation. If unexpected gross contamination is encountered (e.g. visible or olfactory evidence of tar or other hydrocarbons), then management procedures are advised to identify the nature and extent of contamination and design appropriate remediation by agreement with the Regulators.

10.10.103 A Moderate / Low risk has been assessed to groundwater and surface water receptors from leaching of TPH / PAH in the PCC Site and the Water Connection Corridors associated with the former Iron & Steel Works and the Coking Works. It is advised that point sources of contamination such as (un-decommissioned) buried tanks and any grossly contaminated surrounding soil be removed with as far as is practicable free-product above the water table. Subject to the ongoing review of regional groundwater quality, it is possible that a Foundation Works Risk Assessment will be necessary to evaluate appropriate foundation design of the PCC Site to avoid the creation of preferential pathways between point sources of pollution and sensitive groundwater receptors. Based on the long industrial history of the PCC Site and the environs, it is unlikely that the groundwater will be a sensitive receptor; however, development of the site could impact on the potential for future improvement, which is why identification and removal of point sources needs to be considered where viable. Given the general groundwater quality and the distance to surface receptor it is likely that the main risk to surface waters is by direct discharge from construction dewatering or uncontrolled runoff from the site during groundworks. These risks should be managed during construction to avoid pollution of local watercourses.

10.10.104 A Moderate / Low risk has been assessed in the PCC Site to construction materials and utilities from TPH / PAH / VOCs / SVOCs in soil and groundwater. Hydrocarbons in soil can adversely affect the hydration of concrete and lead to a reduction in concrete strength. Continuous Flight Auger (CFA) piling may be particularly sensitive to hydrocarbon contamination therefore (assuming this method is appropriate for slag / fused slag) it would be advisable to identify potential hydrocarbons and provide mitigation (for example removal of sources and / or increasing pile width). Hydrocarbons can also adversely affect drinking water through permeation of plastic pipes, and, also attack plastic membranes. Grossly contaminated material could be removed, and since ground may be affected by asbestos it would be advisable to lay utilities in clean material corridors, however, depending on the level of the water table it may also be necessary to select pipe materials and membranes that are resistant to chemical attack or permeation.

Hazardous Gas

10.10.105 A Moderate / Low risk has been assessed for ground workers from exposure to hazardous gas. Gas monitoring at the PCC Site suggests that in the areas monitored the risk is Low / Very Low, however, due to the variability of the ground it should be assumed that toxic, asphyxiating or explosive atmospheres could develop in confined spaces.

Petroleum Fuels, Naphtha and Benzol (DRO, PRO)

10.10.106 The risk from Diesel Range Organics (DRO) or Petrol Range Organics (PRO) (including naphtha) is considered Moderate for ground workers adjacent to fuel storage tanks on or off the site (especially in the case of Petroleum Refineries and Tank Farms). The principal exposure pathways are ingestion, dermal contact and inhalation although exposure from dust and risk of hazardous vapours need also to be considered. Risk to workers from contaminated water is considered a Low risk, however, presence of free-phase is a likely requisite for vapour risk. Exposure risk, if excavations are proposed near existing tanks or locations of former tanks it would be advisable to carry out ground investigation to determine whether there is a risk from ingestion, dermal contact, inhalation of toxic vapours or development of explosive or oxygen deficient atmospheres in confined spaces. Mitigation by excavation and pumping of tanks may be required if contaminations of petroleum are found at high concentrations, which for the proposed insensitive land usually requires free-product to be present.

10.10.107 A Moderate / Low risk has been assessed for PCC Site users, groundwater, surface water and infrastructure due to petroleum in soil adjacent to Petroleum Refineries, Tank Farms across the site or former and existing tanks on the PCC Site. The risk to surface water and groundwater is mainly an issue if the source is a leaking tank on the PCC Site since this could directly affect the development and failure to remove the tank and surrounding soil would lead to continued entry of hydrocarbons into controlled waters. Geophysical methods are recommended to identify and / or confirm locations of buried tanks. Targeted intrusive investigation is recommended at tank locations to determine if leakage has occurred and to provide information on the extent of the affected soils and free / residual product. Once tanks have been removed or otherwise decommissioned, it will be necessary to assess what impact the contamination may have on the selection and design of foundations and selection of construction materials. Petroleum can have an adverse impact on concrete strength, be chemically aggressive to plastic membranes and permeate water pipes.

Metals / Metalloids

10.10.108 The risk for dermal contact with metals and metalloids has been assessed as Moderate / Low for ground workers coming into contact with soils in the ICI chemicals works at Haverton Hill and Brineworks, both located in the vicinity of the CO_2 Gathering Network Corridor. Given the nature of the proposed works and the standard operating procedures for working in potentially contaminated sites it is considered that appropriate PPE and suitable hygiene facilities would provide adequate protection and no other mitigation is proposed.

pH, acids, alkalis, sulphate, chloride, ammonia, cyanides

10.10.109 A Moderate risk has been assessed for chemical attack on concrete associated with high concentrations of chloride in the Brine Fields / Saltholme Reservoir district (CO_2 Gathering Network and Natural Gas Connection Corridors), PCC Site, CO_2 Export Pipeline and the Water Discharge corridor due to chloride in brackish water from salt workings or the sea. High concentrations of sulphate / sulphide have also been reported for the PCC Site by Arcadis, however, this should be assessed in the context of high acid neutralisation capacity (ANC) of the alkali slag, which will probably mitigate the risk for development of acid driven corrosion. Conversely, chloride attacks the steel reinforcement itself. Mitigation for chloride attack on steel may need to be considered for example; epoxy coatings, having cathodic protection or by use of stainless steel-clad rebar.

10.10.110 A Moderate risk has also been assessed for attack on infrastructure by sulphate and nitrate associated with the ICI Synthetic Ammonia Plant and Anhydrite Process Plant (which as discussed above was involved in the production of sulphuric acid). Fertilisers ammonium sulphate and ammonium nitrate are known to be deleterious to concrete leading to a reduction in strength. Mitigation for acid attack on concrete usually involves selection of resistant cements, however, in the case of ammonium nitrate, the most common mitigation appears to be application of a coating to avoid contact.

10.10.111 A Moderate / Low risk has been assessed to users of the PCC Site from high pH in soils, which poses an exposure risk to eyes and lungs from contact with dust. Since risks associated with high pH and asbestos fibres in soil are both resolved by preventing erosion of soil and subsequent generation of airborne dust, it is likely that a single solution will be selected to address both problems.

Offsite Industries

10.10.112 In addition to assessment of the industry profiles and risks for activities undertaken on the site, there are several chemical works adjacent to the CO_2 Gathering Network and Natural Gas Connection Corridors that could potentially affect the works, however, the risks from exposure of ground workers to chemicals in the ground are considered Moderate / Low. Mitigation would be dependent on the results of the risk assessment process, however, given the nature of the proposed works if there is no active pollutant linkage the proposed methodology is to avoid disturbance and creation of a potential exposure pathway.

10.10.113 The eastern CO_2 Gathering Network and Gas Connection Corridor in Seal Sands run adjacent to chemical works associated with Monsanto Textiles (acrylic intermediates), Lianhetech (formerly fine industries) and Vertellus (agriculture, nutrition, pharmaceutical, fine chemicals, medical, personal care, plastics, coatings and many other industrial markets). The risk associated to the site from these industries is difficult to gauge but it is not expected that significant quantities of exotic chemicals will have been released to the site. Nevertheless, it is assumed that releases of industrial solvents and other common organic chemicals may have occurred; and the risk to the CO_2 Gathering Network and Natural Gas Connection Corridor from these is considered Moderate / Low. It would be prudent to carry out investigation and testing for SVOCs / VOCs adjacent to chemicals works in areas of proposed groundworks as a precaution.

10.10.114 A mycoprotein factory operates adjacent to the western CO_2 Gathering Network Corridor on Nelson Avenue (Belasis). The site is understood to have formerly been used by ICI to manufacture the animal feed Pruteen from methanol, ammonia, air, nutrients and bacteria. The current production uses plant derived glucose, biotin, nutrients, ammonia, air and fungus. The site is expected to be a Moderate / Low risk to the site due to the presence of plant and tanks adjacent to the pipelines although the risk is envisaged to be related mostly to potential leakage of fuels or presence of demolition rubble including potentially asbestos. If ground disturbance is planned in this area it would be advisable to carry out ground investigation to determine if soils are affected by contamination.

Conclusions

10.10.115 The review of potential contaminant linkages for development has indicated possible geo-environmental constraints across the site from contamination as would be expected for industrial land. The contamination risks identified in the Preliminary Sources Study (desk study) depend on the type of development proposed as well as the previous industry, therefore, they are considered here according to site area in Table 10A-29 to Table 10A-33, inclusive.

Table 10A- 29: PCC Site Contamination Risk

Industry	Substance / Class	Receptor	Risk	Mitigation Options
Teesside Works / Redcar Iron & Steel Works	Asbestos	Ground workers	High	Specialist survey Ground investigation Avoid disturbance Management solution Provide protection
		Site users	Moderate	Specialist survey Ground investigation Cover layer Treat soil Replace soil
	pH, acids, alkalis, sulphate	Ground workers	Moderate / low	Management solution Provide protection
		Infrastructure	Moderate / low	Ground investigation Management solution Provide protection
Tar Macadam Works / Redcar Iron & Steel Works	Coal tar PAH / TPH / VOCs / SVOCs	Ground workers	High	Geophysical survey (to locate tanks) Ground investigation Pumping / excavation
		Site users	Moderate	Ground investigation Cover layer Replace soil
		Ground water & surface water	Moderate / low	Ground investigation Management solution Remove point sources
		Infrastructure / utilities	Moderate / low	Ground investigation Clean trench material

Industry	Substance / Class	Receptor	Risk	Mitigation Options
				Management solution Remove point sources
Infilled Land	Asbestos	Ground workers	Moderate / low	Specialist survey Ground investigation Avoid disturbance Management solution Provide protection
	PAH / TPH /VOCs / SVOCs	Ground workers	Moderate / low	Management solution Provide protection
	Hazardous (ground) gas	Ground workers	Moderate / low	Management solution Provide protection
Railways Land	PAH / TPH / VOCs / SVOCs	Ground workers	Moderate / low	Management solution Provide protection
Petroleum Fuel Storage (also Benzol)	TPH	Ground workers	Moderate	Geophysics (to locate tanks) Ground investigation Pumping / excavation
		Site users	Moderate / low	Ground investigation Management solution Provide protection
		Infrastructure / utilities	Moderate / low	Ground investigation Clean trench material Management solution Remove point sources
		Surface water	Moderate / low	Ground investigation Pumping / excavation
Brackish Water	Chloride	Infrastructure	Moderate	Ground investigation Management solution Provide protection

Table 10A- 30: CO_2 Export Pipeline Contamination Risk

Industry	Substance / Class	Receptor	Risk	Mitigation
Infilled Land	Asbestos	Ground workers	Moderate / low	Specialist survey Ground investigation Avoid disturbance Management solution Provide protection
	PAH / TPH / VOCs / SVOCs	Ground workers	Moderate / low	Management solution Provide protection
Brackish Water	Chloride	Infrastructure	Moderate	Ground investigation Management solution Provide protection

Table 10A- 31: Water Connection Corridors Contamination Risk

Industry	Substance / Class	Receptor	Risk	Mitigation
Teesside Works / Redcar Iron & Steel Works	Asbestos	Ground workers	High	Specialist survey Ground investigation Avoid disturbance Management solution Provide protection
		Ground water & surface water	Moderate / low	Ground investigation Management solution Remove point sources
Teesside (Coking) Works	coal tar PAH / TPH / VOCs / SVOCs	Ground workers	High	Geophysics (to locate tanks) Ground investigation Pumping / excavation
Infilled Land	Asbestos	Ground workers	Moderate / low	Specialist survey Ground investigation Avoid disturbance

Industry	Substance / Class	Receptor	Risk	Mitigation
				Management solution Provide protection
	PAH / TPH / VOCs / SVOCs	Ground workers	Moderate / low	Management solution Provide protection
Coking Works	Coal tar PAH / TPH / VOCs / SVOCs	Ground workers	High	Geophysics (to locate tanks) Ground investigation Pumping / excavation
Railways Land	PAH / TPH / VOCs / SVOCs	Ground workers	Moderate / low	Management solution Provide protection
Brackish Water	Chloride	Infrastructure	Moderate	Ground investigation Management solution Provide protection

Table 10A- 32: CO_2 Gathering Network and Natural Gas Connection Corridors Contamination Risk

Industry	Substance / Class	Receptor	Risk	Mitigation
ICI Synthetic Ammonia Works / Anhydrite Process Plant, Haverton Hill	Asbestos	Ground workers	Moderate	Specialist survey Avoid disturbance Management solution provide protection
	PAH / TPH / VOCs / SVOCs	Groundworkers	Moderate	Ground investigation Avoid disturbance Management solution Provide protection
	metals/metalloids	Ground workers	Moderate / low	Management solution provide protection
	pH, acids, alkalis,	Ground workers	Moderate / low	management solution Provide protection

Industry	Substance / Class	Receptor	Risk	Mitigation
	Ammonium, sulphates, nitrates	Infrastructure	Moderate	Ground investigation Management solution Provide protection
Petroleum Refineries / Tank Farms	Asbestos	Ground workers (adjacent site)	Moderate / low	Specialist survey Avoid disturbance Management solution Provide protection
Infilled Land	Asbestos	Ground workers	Moderate / low	Specialist survey Ground investigation Avoid disturbance Management solution Provide protection
	PAH / TPH /VOCs / SVOCs	Ground workers	Moderate / low	Management solution Provide protection
Railways Land	PAH / TPH / VOCs / SVOCs	Ground workers	Moderate / low	Management solution Provide protection
	PRO / DRO	Ground workers	Moderate	Ground investigation Management solution Excavation Pumping
Saltholme Brine Works	Metals / metalloids	Ground workers	Moderate / low	Management solution Provide protections
	Chloride, sulphate	Infrastructure	Moderate	Ground investigation Management solution
Off-site specialised chemical industry (Seal Sands)	VOCs / SVOCs	Groundworkers	Moderate / low	Ground investigation Management solution

Table 10A- 33: Electrical Connection Corridor Contamination Risk

Industry	Substance / Class	Receptor	Risk	Mitigation
Teesside Works (Redcar)	Asbestos	Ground workers	High	Specialist survey Ground investigation Avoid disturbance Management solution Provide protection
		Site users	Moderate	Specialist survey Ground investigation Cover layer Treat soil Replace soil
Petroleum Refineries & Tank farms	Asbestos	Ground workers (adjacent site)	Moderate / low	Specialist survey Avoid disturbance Management solution Provide protection
	PRO / DRO	Ground workers	Moderate	Ground investigation Management solution Excavation Pumping
Infilled Land	Asbestos	Ground workers	Moderate / low	Specialist survey Ground investigation Avoid disturbance Management solution Provide protection
	PAH / TPH / VOCs / SVOCs	Ground workers	Moderate / low	Management solution Provide protection
Railways Land	PAH / TPH / VOCs / SVOCs	Ground workers	Moderate / low	Management solution Provide protection

10.10.116 A review of available information available for the PCC Site indicates a key geo-environmental risk relating to the possible presence of asbestos on site. Whilst not identified during the ground investigations, based on the presence of asbestos fibres and the site history, it is suspected that previously undetected asbestos containing material (ACM) will be present, which could have implications for selection of appropriate remedial techniques, foundation design, and disposal and treatment costs. In addition, it should be borne in mind that the made ground is reported to be potentially expansive due to chemical instability of slag and refractory materials, in addition to potential chemical attack on building materials from chemically aggressive soil and groundwater. High pH at the PCC Site is also a health risk to construction workers, and also to site users without mitigation.

Remedial Options

10.10.117 The main remedial options considered by Arcadis for asbestos contamination on the PCC Site are:

- Hand picking;
- Excavation and disposal; and
- Capping in situ.

10.10.118 It should be noted that asbestos is not a risk below hard standings as there would be no exposure from inhalation of fibres; therefore, the principal risks occur for exposure during construction and to future site users from asbestos in landscaped areas, and the risk for maintenance workers coming in contact with contaminated soils within service corridors.

10.10.119 Since asbestos fibres in soil were considered by Arcadis to be the risk driver, hand-picking was ruled out as an option since this only removes visible asbestos. Given that offsite disposal may be necessary, pre-treatment of waste by removing visible asbestos containing materials (ACM) could be a practical way of reducing the quantity of Hazardous Waste needing disposal. Additional information is required to establish the quantities of ACM present in order to provide a cost of this option.

10.10.120 Excavation and disposal were not considered suitable as a site-wide option for asbestos due to the quantity of impacted material (Made Ground). However, excavation may be required for specific structures or to address localised contamination. Further consideration could be given to the disposal option if the quantity of affected material within areas of landscaping and service corridors is minimal since only surface material need be replaced, usually in the order of 0.5 m (but a greater depth in the case of services).

10.10.121 If asbestos fibres and ACM in surface soils were reduced to an acceptable concentration this would still not necessarily mitigate the risk to site users from exposure to dust with high pH; therefore. both high pH and asbestos should be considered together when selecting an appropriate methodology.

10.10.122 Capping is an appropriate solution for asbestos in areas of landscaping. Capping should be thickest in service corridors and it would be advisable to place a geotextile separator and marker layer between Made Ground and imported soils in order to aid verification and reduce the future risk of inadvertent exposure. Capping raises site levels but eliminates or at least reduces the cost of disposal. Capping does not remove the risk from asbestos for subsequent redevelopment of the site. Capping has been considered beneficial to groundwater quality by reducing infiltration and therefore leachate entry to groundwater, however, it does not eliminate the cross-flow of groundwater.

10.10.123 Risks to workers, visitors, neighbours and the environment from asbestos during development should be managed through an Asbestos Management Plan. Selection of the appropriate piling techniques and requirements for disposal of arisings will need to consider the risk of asbestos fibres in soil and probable presence of ACM.

10.10.124 The risks from chemical attack on building materials such as concrete and steel are usually mitigated by design and selection of appropriate materials.

10.11 Comparison of Projects Options and Risks

General

10.11.1 Existing available ground investigation data suggests Made Ground below the PCC Site and the surrounding area up to 9m in depth. This is understood to comprise of a mixture of potentially expansive slag generated as waste from Iron and Steel manufacturing.

10.11.2 Made Ground was present in all boreholes from existing ground to a maximum depth of 2.0 m. The material generally comprised of a surface layer of concrete underlain by sandy gravel of ash, slag and occasional brick and mudstone or soft slightly sandy slightly gravelly clay. The gravel is often underlain by firm to stiff sometimes soft slightly sandy slightly gravelly clay. The colour of the clay was variable ranging from brown / red / orange brown to brown / grey / black mottled, the latter possibly indicative of contamination from the overlying coarse soil.

10.11.3 Geotechnical risk associated with each area of the proposed development is provided below.

Risk Register

10.11.4 A geotechnical risk register for the scheme is presented as Table 10A-36. The register lists the primary risks currently identified and assesses the impact of these risks on the project. For the purposes of this report, risk has been assessed with reference to ‘probability’, ‘impact’ and ‘risk rating’. Risk rating (R) = Probability (P) x Impact (I), see Table 10A-34.

Table 10A- 34: Risk Assessment Criteria

Likelihood (L)		Severity (S)				Risk (R = L X S)	
Very probable	5	Very High	5	Potential to halt project	OR	Potential for major claim or similar	17 to 25
Probable	4	High	4	Significant delay to overall project		Major impact on cost	13 to 16
Possible	3	Medium	3	Major delay on this task, but significant impact on overall project unlikely		Minor impact on cost	9 to 12
Unlikely	2	Low	2	Minor delay on this task, but significant impact on overall project unlikely		Minor impact on cost	5 to 8
Negligible	1	Very Low	1	No significant impact on task or project		Negligible impact on cost	1 to 4

Table 10A- 35: Geotechnical Risk Register

Identified Geotechnical Hazard/Risk	Cause	Risk before Control			Consequence	Mitigation Measures
		L	S	R (L*S)		
PCC Site						
Inadequate bearing resistance	Thick various types of Made Ground, of variable, (sometimes very loose and loose density) and chemical composition underlain by low strength, potentially highly	5	4	20	Collapse - Structural failure of buildings supported on shallow pad or spread foundations.	Development specific ground investigation. Adequate design for the ground conditions proved on site.

Identified Geotechnical Hazard/Risk	Cause	Risk before Control			Consequence	Mitigation Measures
		L	S	R (L*S)		
	compressible Tidal Flat Deposits and Glacio- lacustrine Deposits.				Injury to site workers, development users.	**Adopt piled foundations to transfer structure loads to soils or bedrock of adequate strength.**
Excessive total and / or differential ground displacement (settlement and / or heave)	Thick various types of Made Ground, of variable, (sometimes very loose, loose to very dense density) and chemical composition underlain by low strength, potentially highly compressible Tidal Flat Deposits and Glacio- lacustrine Deposits.	3	4	12	Excessive total and / or differential settlement. Structural damage caused by excessive ground displacement. Serviceability problems leading to structural damage / long term maintenance.	Development specific ground investigation. Adequate design for the ground conditions proved on site. **Adopt piled foundations to transfer structure loads to soils or bedrock of adequate strength.**
Heave	Chemical changes of slag-dominant material. [Walkover of SSI1 in the vicinity of the former sinter plant undertaken by Arcadis observed cracking of brickwork, movement / distortion of brick walls and uneven pavements]	3	4	12	Serviceability problems affecting foundations, ground bearing floor slabs, hardstanding areas, service roads and the connections / cross fall of buried utilities.	Development specific ground investigation. Adequate design for the ground conditions proved on site. **Adopt piled foundations to transfer structure loads to soils or bedrock of adequate strength. Consider use of sleeved piles to accommodate lateral expansion and / or heave.**
Collapse settlement	Infiltration of surface water. Inundation of poorly compacted Made Ground due to a permanent rise in groundwater levels. [Arcadis GRAR indicated there was evidence that 'hydraulic fill' (river dredging) was placed as part of pre-development site reclamation works].	3	4	12	Collapse - Structural failure. Excessive total and / or differential settlement.	Development specific ground investigation. Adequate design for the groundwater and ground conditions proved on site. **Adopt piled foundations to transfer structure loads to soils or bedrock of adequate strength.**

Identified Geotechnical Hazard/Risk	Cause	Risk before Control			Consequence	Mitigation Measures
		L	S	R (L*S)		
Unexploded ordnance (UXO)	Unexploded bombs (UXB) remaining from ordnance dropped during WWII, subsequently buried due to Made Ground associated with recent industrial development. There may be risk of UXO from firing from historical barracks which took place at the Pasley (Coatham) Battery and South Gare Battery. [Arcadis SCR reports that one anomaly was found in a borehole 11m bgl].	3	5	15	Explosion, injury or fatality (site personnel and / or the public). Damage to on site and third-party infrastructure. Construction delay; increase in cost and possible redesign.	Provision of detailed report for site from specialist UXO data provider. Adequate design. Re-route sections to reduce potential risk and UXO constraints. Specialist UXO clearance surveys undertaken as part of all future below ground works. Development of UXO management protocol during construction.
Difficult construction conditions – buried relict infrastructure - General	Obstructions in the Made Ground including gravel, cobble and boulder sized pieces of slag, very dense material, relict buried foundations, walls, ground slabs, tunnels and possibly pile foundations from former infrastructure. [Arcadis SCR reported the presence of a disused tunnel within the former Redcar Stores area (SSI 2A)].	5	3	15	Structural damage (cracking / spalling) to driven concrete or steel piles or loss of plan position and verticality tolerances. Unable to construct shallow foundations, ground slabs, road / hardstanding areas for utilities as planned. Possible redesign, construction delay, increase in cost.	Development specific ground investigation including geophysics. Adequate design. Consideration to the viability of undertaking targeted excavation and replacement of obstructions. Advanced probing / clearance works at proposed pile foundation positions.
Difficult foundation construction – potential volume expansion of	Future expansion of slag-dominant material	3	4	12	Unexpected compressive actions imposed on buried foundation, slabs and utilities leading to serviceability problems and possibly, structural damage / integrity problems.	Development specific ground investigation. Identification and treatment of the most prone types of slag. Adequate design

Identified Geotechnical Hazard/Risk	Cause	Risk before Control L	S	R (L*S)	Consequence	Mitigation Measures
slag dominant material						
Difficult foundation construction – pile foundations	Soft, variable, compressible and / or saturated soils Figure 10-2: Superficial Geology (ES Volume II, Document Ref. 6.3) shows that Blown Sand, Tidal Flat Deposits – Sand and Silt are present below the Artificial Ground].	4	4	16	Ground squeezing leading to 'necking' of pile shafts formed using continuous flight auger (CFA) techniques	Development specific ground investigation. Adequate design for the ground conditions proved on site. Appropriate techniques selection including balancing of pore water pressures at pile toes during construction. Consider adopting cased rotary bored piled foundations. Monitoring of pile installation process using automated rig systems including auger torque and flight rotation rates to ensure concrete injections match spoil removal, thus avoiding potential integrity problems. Use of trained and experienced rig operators.
Difficult foundation construction – pile foundations	Natural obstructions within the glacial drift soils present below the site. [Arcadis GRAR reported the presence of Glacial Till (Diamicton) below the PCC Site. Although cobbles and boulders were not recorded on the borehole logs, this may in part be due to the diameter of the drilling equipment used in the Advanced GI Works undertaken on STSC SSI1 & SSI2A land holdings].	3	2	6	Unable to achieve pile design toe levels. Construction results in damage piles, or piles which do meet specified out of plan and / or verticality tolerances. Construction delay; increase in cost and possible redesign.	Ground investigation. Adequate design for the ground conditions proved on site. Appropriate pile technique selection. Carry out advanced probing at pile positions. Consider use of cased rotary bored or ODEX piling techniques as alternative to contiguous flight auger (cfa) or driven precast concrete segmental piles.

Identified Geotechnical Hazard/Risk	Cause	Risk before Control L	S	R (L*S)	Consequence	Mitigation Measures
	Obstructions are expected to be present.					
Difficult foundation construction – pile foundations	Presence of strong bands of limestone and / or ironstone within solid succession. Figure 10-2: Superficial Geology (ES Volume II, Document Ref. 6.3) indicates Penarth Group and Redcar Mudstone Formation underlies the centre and east of the PCC Site].	3	3	9	Unable to achieve design pile toe levels. Damage to piling equipment (e.g. augers). Slow progress during construction, Construction delay, increase in cost, possible redesign.	Development specific ground investigation. Adequate design for the ground conditions proved on site. Appropriate technique selection, including consideration of unconfined compressive strength of bedrock and rig torque capacity. Consider use of rotary or ODEX piling techniques as alternative to contiguous flight auger (cfa) or driven precast concrete segmental piles.
Difficult construction conditions- buried utilities	Disused redundant and live buried services associated with past land use. New construction causes damage to existing buried infrastructure / services.	4	3	12	Severing / damaging utility. Settlement of utility / services. Restricted maintenance access to utility provider.	Adequate service survey / drawings to confirm status of utility. Utility diversion prior to construction of proposed structures and / or infrastructure. Alternatively, reposition proposed new build to avoid existing services.
Aggressive ground conditions	Aggressive elevated concentrations of sulphate and chloride and acidic or alkaline pH in soil or groundwater. [Arcadis GRAR reports Design Sulfate Class DS-5 and corresponding ACEC class AC-5].	5	3	15	Corrosion of buried steel leading to a loss in strength and / or excessive structural deflection. Sulphate attack to buried concrete resulting in a reduction in concrete strength. Serviceability problems leading to long term maintenance liability. Corrosion of polyethylene (PE) and PVC plastic pipes.	Development specific ground investigation. Adequate design. Consideration to the provision of permanent sleeving to protect piles installed through the most aggressive material (Slag dominant material). Consideration to the provision of Additional Protective Measures (APMs) to provide additional protection against sulfate attack. Utilities to be installed within clean inert pipe bedding material.

Identified Geotechnical Hazard/Risk	Cause	Risk before Control L	S	R (L*S)	Consequence	Mitigation Measures
						Consider the use wrapped steel, wrapped ductile iron, copper and PE barrier pipe with an aluminium barrier layer (PE-Al-PE) for services and water supplies in contaminated soils.
Contamination of controlled waters – groundwater	Piled foundations create source – pathway – receptor between contaminated groundwater and the underlying superficial and bedrock aquifers.	3	5	15	Release of leachable contaminants into underlying aquifers: Superficial – Secondary 'A' Aquifers (Blown Sand, Tidal Flat Deposits – Sand and Silt). Bedrock - Secondary 'B' Aquifer (Mercia Mudstone Group & Penarth Group) and the Secondary Aquifer (undifferentiated) Redcar Mudstone Formation. Construction delays; increase in cost. Reputational damage.	Ground investigation and groundwater quality testing and monitoring. Adequate design for the ground conditions proved on site. **Consultation with the Environment Agency and Redcar and Cleveland Borough Council.** **Preparation of a Foundation Works Risk Assessment.** Consider adopting cased rotary bored piled foundations to remove potential pathway between Made Ground and underlying aquifer.
Material re-use – unacceptable excavated soils	Material excavated to form development platforms not acceptable for re-use as bulk earthwork fill. Soft spots or areas exposed at development platform sub-formations. Material excavated during bulk earthworks undertaken on site is contaminated.	5	3	15	Disposal off site or in landscape / development screening mounds. Excavate soft spot / areas with well compacted acceptable material.	Development specific ground investigation. Adequate design. Assessment of earthworks volumes required / minimise surplus and create earthwork balance. Cost / risk allowance for waste disposal of contaminated soils including non-hazardous and hazardous waste to be allowed for in the Construction Risk Register. **Development of a Remediation Design Strategy and implementation of Materials Management Plan, Construction Environmental Management Plan,**

Identified Geotechnical Hazard/Risk	Cause	Risk before Control			Consequence	Mitigation Measures
		L	S	R (L*S)		
						Asbestos Management Plan and Verification Report on completion of the works.
CO_2 EXPORT PIPELINE						
Unexploded ordnance (UXO)	Unexploded bombs (UXB) remaining from ordnance dropped during WWII, subsequently buried due to Made Ground associated with recent industrial development. There may be risk of UXO from firing from historical barracks which took place at the Pasley (Coatham) Battery and South Gare Battery. There is a risk of small arms munition across Coatham Dunes associated with the former Rifle Range.	3	5	15	Explosion, injury or fatality (site personnel and / or the public). Damage to on site and third-party infrastructure. Construction delay; increase in cost and possible redesign.	Provision of detailed report for site from specialist UXO data provider. Adequate design. Re-route sections to avoid known UXO constraints. Specialist UXO clearance surveys undertaken as part of all future below ground works.
Difficult construction conditions – relict buried infrastructure	Obstructions in the Made Ground including gravel, cobble and boulder sized pieces of slag, relict buried foundations, walls, ground slabs, tunnels and possibly pile foundations with demolished former buildings.	5	3	15	Not possible to construct in-ground sections to depth or vertical alignment as planned. Construction delay; increase in cost and possible redesign.	Development specific ground investigation targeted at suspected relict buried foundations, walls, slabs and tunnels etc (identified from historical land use review) including non-intrusive geophysical surveys along proposed in-ground services. Adequate design, including identification of in-ground constraints from the review of historical land use carried out as part of the PSSR. Assess feasibility of re-routing sections to avoid problems. If re-routing is not practical, carry out advanced works ahead of main construction

Identified Geotechnical Hazard/Risk	Cause	Risk before Control L	S	R (L*S)	Consequence	Mitigation Measures
						including probing and / or limited earthworks to remove identified relict buried structures by undertaking targeted excavation and replacement of obstructions. Include cost / risk allowance for impeded construction progress in the Construction Risk Register.
Difficult construction conditions – tidal groundwater control	Shallow groundwater inflows [from wet, coarse soils].	4	3	12	Groundwater inflows into excavations, side slope instability, slumping or ravelling of slopes dug below ground, liquefaction or pumping of silts and / or sands under loading from earth moving plant. Construction delay; increase in cost and possible redesign.	Development specific ground investigation. Adequate design for ground and groundwater conditions proved on site. Temporary groundwater control measures will be required, such as sump pumping, well pointing or vacuum extraction systems. Include cost / risk allowance for slow construction progress in the Construction Risk Register.
Dewatering	Prolonged pumping of groundwater induces ground settlement and damages adjacent third-party infrastructure.	3	3	9	Construction delay; increase in cost and possible redesign. Litigation resulting from damage caused to third party infrastructure. Adverse effect on protected wildlife (dune habitat and migratory birds).	Ground investigation. Adequate design for the ground and groundwater conditions proved on site. Assess feasibility of rerouting to avoid settlement sensitive infrastructure. Design / implement a programme of geotechnical monitoring during construction with appropriate controls / actions. Liaison with third party infrastructure owner (and technical advisors) during design and construction.

Identified Geotechnical Hazard/Risk	Cause	Risk before Control			Consequence	Mitigation Measures
		L	S	R (L*S)		
Contamination of controlled waters	Surface water runoff into controlled waters. Contaminated groundwater generated / released during construction.	3	2	6	Adverse impact on water quality, with resultant impact on wildlife. Construction delay; increase in cost and possible redesign.	Ground investigation and groundwater quality testing and monitoring. Development and adherence to CEMP. Obtain temporary discharge licenses to permit discharge to existing NWL sewerage network if practical. Alternatively collect, store and treat on site.
Difficult construction conditions - buried utilities	Disused redundant and live buried services associated with past land use. New construction causes damage to existing buried infrastructure / services.	4	3	12	Severing / damaging utility. Settlement of utility / services. Restricted maintenance access to utility provider.	Adequate service survey / drawings to confirm status of utility. Utility diversion prior to construction of proposed structures and / or infrastructure. Alternatively, reposition proposed new build to avoid existing services. Use of existing above / below ground service conduits where possible.
Aggressive ground conditions	Aggressive elevated concentrations of sulphate and chloride and acidic or alkaline pH in soil or groundwater.	3	3	9	Corrosion of buried steel leading to a loss in strength and / or excessive structural deflection. Sulphate attack to buried concrete resulting in a reduction in concrete strength. Serviceability problems leading to long term maintenance liability. Corrosion of polyethylene (PE) and PVC plastic pipes.	Development specific ground investigation. Adequate design. Consideration to the provision of Additional Protective Measures (APMs) to provide additional protection against sulfate attack if BRE SD1 assessment indicates Design Sulfate Class DS-5 conditions are present. Utilities to be installed within clean inert pipe bedding material. Consider the use wrapped steel, wrapped ductile iron, copper and PE barrier pipe with an aluminium barrier layer (PE-Al-PE) for services and water supplies in contaminated soils.

Identified Geotechnical Hazard/Risk	Cause	Risk before Control			Consequence	Mitigation Measures
		L	S	R (L*S)		
Material re-use	Material excavated may be contaminated and / or unacceptable for re-use as bulk backfill above buried service utilities.	4	2	8	Disposal offsite.	Soils are unlikely to be acceptable for re-use. Ground Investigation. Contamination assessment of all chemical data. Cost / risk allowance for waste disposal of contaminated soils to be allowed for within construction risk register. Waste may be contaminated with Hazardous materials. **Development of a Remediation Design Strategy and implementation of Materials Management Plan, Asbestos Management Plan, Construction Environmental Management Plan and Verification Report on completion of the works**
WATER CONNECTIONS CORRIDORS						
Unexploded ordnance (UXO)	Unexploded bombs (UXB) remaining from ordnance dropped during WWII, subsequently buried due to Made Ground associated with recent industrial development.	3	5	15	Explosion, injury or fatality (site personnel and / or the public). Damage to on site and third-party infrastructure. Construction delay; increase in cost and possible redesign.	Provision of detailed report for site from specialist UXO data provider. Adequate design. Re-route sections to avoid known UXO constraints. Specialist UXO clearance surveys undertaken as part of all future below ground works.
Difficult construction conditions – relict buried infrastructure	Obstructions in the Made Ground including gravel, cobble and boulder sized pieces of slag, relict buried foundations, walls, ground slabs, tunnels and possibly pile foundations with demolished former buildings.	5	3	15	Not possible to construct in-ground sections to depth or vertical alignment as planned. Construction delay; increase in cost and possible redesign.	Development specific ground investigation targeted at suspected relict buried foundations, walls, slabs and tunnels etc (identified from historical land use review) including non-intrusive geophysical surveys along proposed in-ground services. Adequate design, including identification of in-ground constraints from the review of historical

Identified Geotechnical Hazard/Risk	Cause	Risk before Control L	S	R (L*S)	Consequence	Mitigation Measures
						land use carried out as part of the PSSR. Assess feasibility of re-routing sections to avoid problems. If re-routing is not practical, carry out advanced works ahead of main construction including probing and / or limited earthworks to remove identified relict buried structures by undertaking targeted excavation and replacement of obstructions. Include cost / risk allowance for slow construction progress in the Construction Risk Register.
Difficult construction conditions – groundwater control	Shallow groundwater inflows [from wet, coarse soils].	4	3	12	Groundwater inflows into excavations, side slope instability, slumping or ravelling of slopes dug below ground, liquefaction or pumping of silts and / or sands under loading from earth moving plant. Construction delay; increase in cost and possible redesign.	Development specific ground investigation. Adequate design for ground conditions proved on site. Temporary groundwater control measures will be required, such as sump pumping, well pointing or vacuum extraction systems. Include cost / risk allowance for slow construction progress in the Construction Risk Register.
Dewatering	Prolonged pumping of groundwater indicates settlement and damages adjacent third-party infrastructure.	3	3	9	Construction delay; increase in cost and possible redesign. Litigation resulting from damage caused to third party infrastructure.	Ground investigation. Adequate design for the ground conditions proved on site. Assess feasibility of rerouting to avoid settlement sensitive infrastructure. Design / implement a programme of geotechnical monitoring during construction with appropriate controls / actions. Liaison with third party infrastructure owner (and

Identified Geotechnical Hazard/Risk	Cause	Risk before Control			Consequence	Mitigation Measures
		L	S	R (L*S)		
						technical advisors) during design and construction.
Contamination of controlled waters	Surface water runoff into controlled waters. Contaminated groundwater generated / released during construction. Disturbance to contaminated sediment.	3	2	6	Adverse impact on water quality, with resultant impact on wildlife. Construction delay; increase in cost and possible redesign.	Ground investigation and groundwater quality testing and monitoring. Development and adherence to CEMP. Obtain temporary discharge licenses to permit discharge to existing NWL sewerage network if practical. Alternatively collect, store and treat on site. Pre-works sediment sampling as per Marine Licence requirements from the Marine Management Organisation (MMO).
Buried utilities	Disused redundant and live buried services associated with past land use. New construction causes damage to existing buried infrastructure / services.	4	3	12	Severing / damaging utility. Settlement of utility / services. Restricted maintenance access to utility provider.	Adequate service survey / drawings to confirm status of utility. Utility diversion prior to construction of proposed structures and / or infrastructure. Alternatively, reposition proposed new build to avoid existing services.
Aggressive ground conditions	Aggressive elevated concentrations of sulphate and chloride and acidic or alkaline pH in soil or groundwater.	3	3	9	Corrosion of buried steel leading to a loss in strength and / or excessive structural deflection. Sulphate attack to buried concrete resulting in a reduction in concrete strength. Serviceability problems leading to long term maintenance liability. Corrosion of polyethylene (PE) and PVC plastic pipes.	Development specific ground investigation. Adequate design. Consideration to the provision of Additional Protective Measures (APMs) to provide additional protection against sulfate attack if BRE SD1 assessment indicates Design Sulfate Class DS-5 conditions are present. Utilities to be installed within clean inert pipe bedding material.

Identified Geotechnical Hazard/Risk	Cause	Risk before Control L	S	R (L*S)	Consequence	Mitigation Measures
						Consider the use wrapped steel, wrapped ductile iron, copper and PE barrier pipe with an aluminium barrier layer (PE-Al-PE) for services and water supplies in contaminated soils.
Material re-use	Material excavated may be contaminated and unacceptable for re-use as bulk backfill above buried service utilities.	4	2	8	Disposal offsite.	Soils are unlikely to be acceptable for re-use. Ground Investigation. Contamination assessment of all chemical data. Cost / risk allowance for waste disposal of contaminated soils to be allowed for within construction risk register. Waste may be contaminated with Hazardous materials. **Development of a Remediation Design Strategy and implementation of Materials Management Plan, Asbestos Management Plan, Construction Environmental Management Plan and Verification Report on completion of the works**
CO_2 GATHERING NETWORK AND NATURAL GAS CONNECTION CORRIDOR						
Unexploded ordnance (UXO)	Unexploded bombs (UXB) remaining from ordnance dropped during WWII, subsequently buried due to Made Ground associated with recent industrial development.	3	5	15	Explosion, injury or fatality (site personnel and / or the public). Damage to on site and third-party infrastructure. Construction delay; increase in cost and possible redesign.	Provision of detailed report for site from specialist UXO data provider. Adequate design. Re-route sections to avoid known UXO constraints. Specialist UXO clearance surveys undertaken as part of all future below ground works.
Difficult construction conditions –	Obstructions in the Made Ground including gravel, cobble and boulder sized pieces of slag, relict buried	5	3	15	Not possible to construct in-ground sections to depth or vertical alignment as planned.	Development specific ground investigation targeted at suspected relict buried foundations, walls, slabs and tunnels etc

Identified Geotechnical Hazard/Risk	Cause	Risk before Control L	S	R (L*S)	Consequence	Mitigation Measures
relict buried infrastructure	foundations, walls, ground slabs, tunnels and possibly pile foundations with demolished former buildings.				Construction delay; increase in cost and possible redesign.	(identified from historical land use review) including non-intrusive geophysical surveys along proposed in-ground services. Adequate design, including identification of in-ground constraints from the review of historical land use carried out as part of the PSSR. Assess feasibility of re-routing sections to avoid problems. If re-routing is not practical, carry out advanced works ahead of main construction including probing and / or limited earthworks to remove identified relict buried structures by undertaking targeted excavation and replacement of obstructions. Use of existing above / below ground service conduits where possible. Include cost / risk allowance for slow construction progress in the Construction Risk Register.
Difficult construction conditions – peat	Presence of peat locally in or below utilities excavations. Figure 10-2: Superficial Geology (ES Volume II, Document Ref. 6.3) shows an elongate area of peat present across the route south east of Reservoirs near Saltholme].	3	2	6	Compressible formation susceptible to ground displacements (heave / settlement) during and after construction. Construction delay; increase in cost and possible redesign.	Development specific ground investigation. Adequate design for the ground conditions proved on site. Removal of soft spots and replacement with suitable compacted engineered fill material. Include cost / risk allowance for slow construction progress in the Construction Risk Register.
Difficult construction - buried utilities	Disused redundant and live buried services associated with past land use.	4	3	12	Severing / damaging utility. Settlement of utility / services.	Adequate service survey / drawings to confirm status of utility.

Identified Geotechnical Hazard/Risk	Cause	Risk before Control			Consequence	Mitigation Measures
		L	S	R (L*S)		
	New construction causes damage to existing buried infrastructure / services.				Restricted maintenance access to utility provider.	Utility diversion prior to construction of proposed structures and / or infrastructure. Alternatively, reposition proposed new build to avoid existing services.
Difficult construction conditions – groundwater control	Shallow groundwater inflows [from wet, coarse soils].	4	3	12	Groundwater inflows into excavations, side slope instability, slumping or ravelling of slopes dug below ground, liquefaction or pumping of silts and / or sands under loading from earth moving plant. Construction delay; increase in cost and possible redesign.	Development specific ground investigation. Adequate design for ground conditions proved on site. Temporary groundwater control measures will be required, such as sump pumping, well pointing or vacuum extraction systems. Include cost / risk allowance for slow construction progress in the Construction Risk Register.
Dewatering	Prolonged pumping of groundwater indicates settlement and damages adjacent third-party infrastructure.	3	3	9	Construction delay; increase in cost and possible redesign. Litigation resulting from damage caused to third party infrastructure.	Ground investigation. Adequate design for the ground conditions proved on site. Assess feasibility of rerouting to avoid settlement sensitive infrastructure. Design / implement a programme of geotechnical monitoring during construction with appropriate controls / actions. Liaison with third party infrastructure owner (and technical advisors) during design and construction.
Contamination of controlled waters	Surface water runoff into controlled waters. Contaminated groundwater generated / released during construction.	3	2	6	Adverse impact on water quality, with resultant impact on wildlife. Construction delay; increase in cost and possible redesign.	Ground investigation and groundwater quality testing and monitoring. Development and adherence to CEMP.

Identified Geotechnical Hazard/Risk	Cause	Risk before Control			Consequence	Mitigation Measures
		L	S	R (L*S)		
						Obtain temporary discharge licenses to permit discharge to existing NWL sewerage network if practical. Alternatively collect, store and treat on site.
Aggressive ground conditions	Aggressive elevated concentrations of sulphate and chloride and acidic or alkaline pH in soil or groundwater.	3	3	9	Corrosion of buried steel leading to a loss in strength and / or excessive structural deflection. Sulphate attack to buried concrete resulting in a reduction in concrete strength. Serviceability problems leading to long term maintenance liability. Corrosion of polyethylene (PE) and PVC plastic pipes.	Development specific ground investigation. Adequate design. Consideration to the provision of Additional Protective Measures (APMs) to provide additional protection against sulfate attack if BRE SD1 assessment indicates Design Sulfate Class DS-5 conditions are present. Utilities to be installed within clean inert pipe bedding material. Consider the use wrapped steel, wrapped ductile iron, copper and PE barrier pipe with an aluminium barrier layer (PE-Al-PE) for services and water supplies in contaminated soils.
Material re-use	Material excavated may be contaminated and unacceptable for re-use as bulk backfill above buried service utilities.	4	2	8	Disposal offsite.	Soils are unlikely to be suitable for re-use. Ground Investigation. Contamination assessment of all chemical data. Cost / risk allowance for waste disposal of contaminated soils to be allowed for within construction risk register. Waste may be contaminated with Hazardous materials. **Development of a Remediation Design Strategy and implementation of Materials Management Plan, Asbestos Management Plan, Construction Environmental**

Identified Geotechnical Hazard/Risk	Cause	Risk before Control L	S	R (L*S)	Consequence	Mitigation Measures
						Management Plan and Verification Report on completion of the works
ELECTRICAL CONNECTION CORRIDOR						
Unexploded ordnance (UXO)	Unexploded bombs (UXB) remaining from ordnance dropped during WWII, subsequently buried due to Made Ground associated with recent industrial development.	3	5	15	Explosion, injury or fatality (site personnel and / or the public). Damage to on site and third-party infrastructure. Construction delay; increase in cost and possible redesign.	Provision of detailed report for site from specialist UXO data provider. Adequate design. Re-route sections to avoid known UXO constraints. Specialist UXO clearance surveys undertaken as part of all future below ground works.
Difficult construction conditions – relict buried infrastructure	Obstructions in the Made Ground including gravel, cobble and boulder sized pieces of slag, relict buried foundations, walls, ground slabs, tunnels and possibly pile foundations with demolished former buildings.	5	3	15	Not possible to construct in-ground sections to depth or vertical alignment as planned. Construction delay; increase in cost and possible redesign.	Development specific ground investigation targeted at suspected relict buried foundations, walls, slabs and tunnels etc (identified from historical land use review) including non-intrusive geophysical surveys along proposed in-ground services. Adequate design, including identification of in-ground constraints from the review of historical land use carried out as part of the PSSR. Assess feasibility of re-routing sections to avoid problems. If re-routing is not practical, carry out advanced works ahead of main construction including probing and / or limited earthworks to remove identified relict buried structures by undertaking targeted excavation and replacement of obstructions. Use of existing overhead lines and below ground service infrastructure where possible.

Identified Geotechnical Hazard/Risk	Cause	Risk before Control L	S	R (L*S)	Consequence	Mitigation Measures
						Include cost / risk allowance for slow construction progress in the Construction Risk Register.
Difficult construction conditions – groundwater control	Shallow groundwater inflows [from wet, coarse soils].	4	3	12	Groundwater inflows into excavations, side slope instability, slumping or ravelling of slopes dug below ground, liquefaction or pumping of silts and / or sands under loading from earth moving plant. Construction delay; increase in cost and possible redesign.	Development specific ground investigation. Adequate design for ground conditions proved on site. Temporary groundwater control measures will be required, such as sump pumping, well pointing or vacuum extraction systems. Include cost / risk allowance for slow construction progress in the Construction Risk Register.
Dewatering	Prolonged pumping of groundwater indicates settlement and damages adjacent third-party infrastructure.	3	3	9	Construction delay; increase in cost and possible redesign. Litigation resulting from damage caused to third party infrastructure.	Ground investigation. Adequate design for the ground conditions proved on site. Assess feasibility of rerouting to avoid settlement sensitive infrastructure. Design / implement a programme of geotechnical monitoring during construction with appropriate controls / actions. Liaison with third party infrastructure owner (and technical advisors) during design and construction.
Contamination of controlled waters	Surface water runoff into controlled waters. Contaminated groundwater generated / released during construction.	3	2	6	Adverse impact on water quality, with resultant impact on wildlife. Construction delay; increase in cost and possible redesign.	Ground investigation and groundwater quality testing and monitoring. Development and adherence to CEMP. Obtain temporary discharge licenses to permit discharge to existing NWL sewerage network if practical.

Identified Geotechnical Hazard/Risk	Cause	Risk before Control L	S	R (L*S)	Consequence	Mitigation Measures
						Alternatively collect, store and treat on site.
Difficult construction conditions - buried utilities	Disused redundant and live buried services associated with past land use. New construction causes damage to existing buried infrastructure / services.	4	3	12	Severing / damaging utility. Settlement of utility / services. Restricted maintenance access to utility provider.	Adequate service survey / drawings to confirm status of utility. Use of existing overhead lines and below ground service infrastructure where possible. Utility diversion prior to construction of proposed structures and / or infrastructure. Alternatively, reposition proposed new build to avoid existing services.
Aggressive ground conditions	Aggressive elevated concentrations of sulphate and chloride and acidic or alkaline pH in soil or groundwater.	3	3	9	Corrosion of buried steel leading to a loss in strength and / or excessive structural deflection. Sulphate attack to buried concrete resulting in a reduction in concrete strength. Serviceability problems leading to long term maintenance liability. Corrosion of polyethylene (PE) and PVC plastic pipes.	Development specific ground investigation. Adequate design. Consideration to the provision of Additional Protective Measures (APMs) to provide additional protection against sulfate attack if BRE SD1 assessment indicates Design Sulfate Class DS-5 conditions are present. Utilities to be installed within clean inert pipe bedding material. Consider the use wrapped steel, wrapped ductile iron, copper and PE barrier pipe with an aluminium barrier layer (PE-Al-PE) for services and water supplies in contaminated soils.
Material re-use	Material excavated may be contaminated and unacceptable for re-use as bulk backfill above buried service utilities.	4	2	8	Disposal offsite.	Soils are unlikely to be suitable for re-use. Ground Investigation. Contamination assessment of all chemical data. Cost / risk allowance for waste disposal of contaminated soils to be allowed for within

Identified Geotechnical Hazard/Risk	Cause	Risk before Control			Consequence	Mitigation Measures
		L	S	R (L*S)		
						construction risk register. Waste may be contaminated with Hazardous materials. **Development of a Remediation Design Strategy and implementation of Materials Management Plan, Asbestos Management Plan, Construction Environmental Management Plan and Verification Report on completion of the works**

Annex A – Ground Investigation Specification

Schedule 2: Exploratory Holes – Update 29/04/2021

Hole No.	Type [1]	Co-ordinates		Scheduled depth (m)	Termination Criteria	Estimated Depth		Groundwater / Gas monitoring installation	Rationale for Exploratory Hole	Anticipated Access (TBC)
		Easting	Northing			Soils	Weathered mudstone			
Main Site:										
MS\BH01	Sonic and rotary	456956.3	525813.1	20+15 (Sonic and rotary)	Scheduled depth	22	13	50mm gas/groundwater monitoring standpipe (Made Ground)	To target Made Ground and Tarmacadam works. To prove Penarth Group with associated testing. To provide samples for geotechnical and geo-environmental testing. To confirm groundwater quality and ground gas concentrations.	Adjacent to road that runs through the site.
MS\BH02	Sonic and rotary	457195.8	525710.4	20+5 (Sonic and rotary)	Scheduled depth	22	3	Fully grouted vibrating wire piezometer (Made Ground, Tidal Flat Deposits, Glacial Till, Bedrock)	To target Tarmacadam works and provide samples for geotechnical and geo-environmental testing. To confirm groundwater regime.	Track which runs through the site.
MS\BH03	Sonic and rotary	457295.3	525581.6	20+5 (Sonic and rotary)	Scheduled depth	22	3	50mm groundwater monitoring standpipe, with diver (Tidal Flat Deposits/ Glacial Till)	To identify nature and depth of ground conditions within Iron Ponds To sample historic Made Ground (1870s). To provide samples for geotechnical and geo-environmental testing. To confirm groundwater regime and groundwater quality.	Track which runs through the site.
MS\BH04	Sonic and rotary	457415.1	525625.4	20+5 (Sonic and rotary)	Scheduled depth	22	3	50mm gas/groundwater monitoring standpipe (Made Ground)	To confirm Landfall succession. To provide samples for geotechnical and geo-environmental testing. To confirm groundwater quality and ground gas concentrations.	Track which runs through the site.

Hole No.	Type [1]	Co-ordinates		Scheduled depth (m)	Termination Criteria	Estimated Depth		Groundwater / Gas monitoring installation	Rationale for Exploratory Hole	Anticipated Access (TBC)
		Easting	Northing			Soils	Weathered mudstone			
MS\BH05	Sonic and rotary	456876.9	525580.9	20+10 (Sonic and rotary)	Scheduled depth	22	8	Dual install 50mm groundwater monitoring standpipe, with diver (Tidal Flat Deposits/ Glacial Till) and one within deeper bedrock	To prove extent and nature of old steel works foundations. To determine nature of Made Ground and underlying stratigraphy. To provide samples for geotechnical and geo-environmental testing. To confirm groundwater regime and groundwater quality in shallow and deeper aquifer	Adjacent to road that runs through the site.
MS\BH06	Sonic and rotary	457026.7	525516.9	20+15 (Sonic and rotary)	Scheduled depth	22	13	Fully grouted vibrating wire piezometer (Made Ground, Tidal Flat Deposits, Glacial Till, Bedrock)	Foundation coring through old steel works, determine nature of Made Ground and stratigraphy. To confirm depth and engineering properties of bedrock for piling. To provide samples for geotechnical and geo-environmental testing. To confirm groundwater regime. To perform insitu pressuremeter testing. To obtain preliminary high-level information to later establish parameters for machinery foundation design.	Adjacent to road that runs through the site.
MS\BH07	Sonic and rotary	457180.0	525434.8	20+15 (Sonic and rotary)	Scheduled depth	22	13	50mm groundwater monitoring standpipe, with diver (Tidal Flat Deposits/ Glacial Till)	To identify nature of the breakwater and natural stratigraphy. To confirm depth and engineering properties of bedrock for piling. To provide samples for geotechnical and geo-environmental testing. To confirm groundwater regime and groundwater quality. To perform insitu pressuremeter testing. To obtain preliminary high-level information to later establish parameters for machinery foundation design.	Track which runs through the site.

Hole No.	Type [1]	Co-ordinates		Scheduled depth (m)	Termination Criteria	Estimated Depth		Groundwater / Gas monitoring installation	Rationale for Exploratory Hole	Anticipated Access (TBC)
		Easting	Northing			Soils	Weathered mudstone			
MS\BH08	Sonic and rotary	457256.1	525352.9	20+10 (Sonic and rotary)	Scheduled depth	22	8	50mm gas/groundwater monitoring standpipe (Made Ground)	To target Made Ground and confirm stratigraphy and provide samples for geotechnical and geo-environmental testing. To confirm groundwater quality and ground gas concentrations.	Track which runs through the site.
MS\BH09	Sonic and rotary	456818.6	525522.8	20+15 (Sonic and rotary)	Scheduled depth	22	13	50mm gas/groundwater monitoring standpipe (Made Ground)	To identify nature of the breakwater and natural stratigraphy. To confirm depth and engineering properties of bedrock for piling. To confirm groundwater quality and ground gas concentrations. To perform insitu pressuremeter testing.	Track which runs through the site.
MS\BH10	Sonic and rotary	457025.5	525258.3	20+15 (Sonic and rotary)	Scheduled depth	22	13	Fully grouted vibrating wire piezometer (Made Ground, Tidal Flat Deposits, Glacial Till, Bedrock)	To determine nature of Made Ground, delineate breakwater and confirm stratigraphy. To confirm groundwater regime. To obtain preliminary high-level information to later establish parameters for machinery foundation design. To confirm depth and engineering properties of bedrock for piling.	Track which runs through the site.
MS\BH11	Sonic and rotary	457117.1	525293.6	20+15 (Sonic and rotary)	Scheduled depth	22	13	50mm gas/groundwater monitoring standpipe (Made Ground)	Prove nature of steelworks foundation and voids, potentially unstable ground - subject to specific safety assessment. To confirm depth and engineering properties of bedrock for piling. To provide samples for geotechnical and geo-environmental testing. To confirm groundwater quality and ground gas concentrations. To perform insitu pressuremeter testing. To obtain preliminary high-level information to later establish parameters for machinery foundation design.	Track which runs through the site.

Hole No.	Type [1]	Co-ordinates		Scheduled depth (m)	Termination Criteria	Estimated Depth		Groundwater / Gas monitoring installation	Rationale for Exploratory Hole	Anticipated Access (TBC)
		Easting	Northing			Soils	Weathered mudstone			
MS\BH12	Sonic and rotary	457208.2	525257.3	20+15 (Sonic and rotary)	Scheduled depth	22	13	Dual install 50mm groundwater monitoring standpipe, with diver (Tidal Flat Deposits/ Glacial Till) and one within deeper bedrock	To confirm extent and nature of clays and alluvial flat materials noted in historical records. To confirm depth and engineering properties of bedrock for piling. To provide samples for geotechnical and geo-environmental testing. To confirm groundwater regime and groundwater quality in the shallow and deeper aquifer. To obtain preliminary high-level information to later establish parameters for machinery foundation design.	Road that runs through the site.
MS\BH13	Sonic and rotary	456774.1	525178.7	20+5 (Sonic and rotary)	Scheduled depth	22	3	Dual install 50mm groundwater monitoring standpipe, with diver (Tidal Flat Deposits/ Glacial Till) and one within deeper bedrock	Confirm nature of 1970s fill material, prove bedrock. To confirm groundwater regime and groundwater quality in the shallow and deeper aquifer.	Track which runs through the site.
MS\BH14	Sonic and rotary	457081.2	525021.8	20+5 (Sonic and rotary)	Scheduled depth	22	3	50mm groundwater monitoring standpipe, with diver (Tidal Flat Deposits/ Glacial Till)	To facilitate Made Ground sampling, (structures showing signs of movement in area), prove bedrock. To provide samples for geotechnical and geo-environmental testing. To confirm groundwater regime and groundwater quality.	Track which runs through the site.
MS\BH15	Sonic	456595.1	524932.4	20+0	Scheduled depth	20	-	50mm gas/groundwater monitoring standpipe (Made Ground)	To confirm nature of the breakwater and natural stratigraphy. To allow southern extent groundwater monitoring. To provide samples for geo-environmental testing. To assess groundwater quality and ground gas concentrations.	Carpark at the site.

Hole No.	Type [1]	Co-ordinates		Scheduled depth (m)	Termination Criteria	Estimated Depth		Groundwater / Gas monitoring installation	Rationale for Exploratory Hole	Anticipated Access (TBC)
		Easting	Northing			Soils	Weathered mudstone			
MS\BH16	Sonic	456990.6	524875.0	20+0	Scheduled depth	20	-	Fully grouted vibrating wire piezometer (Made Ground, Tidal Flat Deposits, Glacial Till, Bedrock)	Target pellet plant demolition material. To provide samples for geo-environmental testing. To confirm groundwater regime.	Adjacent to road that runs through the site.
MS\BH17	Sonic	457147.0	524808.8	20+0	Scheduled depth	20	-	50mm gas/groundwater monitoring standpipe (Made Ground)	To confirm nature of the breakwater and natural stratigraphy, south eastern extent. To provide samples for geo-environmental testing. To confirm groundwater quality and ground gas concentrations.	Adjacent to road that runs through the site.
MS\BH18	Sonic and rotary	TBC	TBC	20+5 (Sonic and rotary)	Scheduled depth	22	3	TBC	Contingency.	TBC
MS\BH19	Sonic and rotary	TBC	TBC	20+5 (Sonic and rotary)	Scheduled depth	22	3	TBC	Contingency.	TBC
MS\BH20	Sonic and rotary	TBC	TBC	20+5 (Sonic and rotary)	Scheduled depth	22	3	TBC	Contingency.	TBC
MS\TP01	TP	456929.3	525768.1	4.5	Scheduled depth	4.5	-	-	To target foundations and provide bulk samples for geotechnical and geo-environmental testing.	TBC
MS\TP02	TP	456889.8	525677.1	4.5	Scheduled depth	4.5	-	-	To target foundations and provide bulk samples for geotechnical and geo-environmental testing.	TBC
MS\TP03	TP	457337.9	525513.5	4.5	Scheduled depth	4.5	-	-	To target foundations and provide bulk samples for geotechnical and geo-environmental testing.	TBC
MS\TP04	TP	457236.7	525365.4	4.5	Scheduled depth	4.5	-	-	To target foundations and provide bulk samples for geotechnical and geo-environmental testing.	TBC
MS\TP05	TP	457027.6	525372.1	4.5	Scheduled depth	4.5	-	-	To target foundations and provide bulk samples for geotechnical and geo-environmental testing.	TBC
MS\TP06	TP	457101.9	525336.6	4.5	Scheduled depth	4.5	-	-	To target foundations and provide bulk samples for geotechnical and geo-environmental testing.	TBC
MS\TP07	TP	457072.0	525228.9	4.5	Scheduled depth	4.5	-	-	To target foundations and provide bulk samples for geotechnical and geo-environmental testing.	TBC
MS\TP08	TP	457234.0	525164.3	4.5	Scheduled depth	4.5	-	-	To target foundations and provide bulk samples for geotechnical and geo-environmental testing.	TBC
MS\TP09	TP	457014.7	525046.4	4.5	Scheduled depth	4.5	-	-	To target foundations and provide bulk samples for geotechnical and geo-environmental testing.	TBC

Hole No.	Type [1]	Co-ordinates		Scheduled depth (m)	Termination Criteria	Estimated Depth		Groundwater / Gas monitoring installation	Rationale for Exploratory Hole	Anticipated Access (TBC)
		Easting	Northing			Soils	Weathered mudstone			
MS\TP10	TP	457138.9	524899.7	4.5	Scheduled depth	4.5	-	-	To target foundations and provide bulk samples for geotechnical and geo-environmental testing.	TBC
TP11	TP	TBC	TBC	4.5	Scheduled depth	4.5	-	-	Contingency.	TBC
TP12	TP	TBC	TBC	4.5	Scheduled depth	4.5	-	-	Contingency.	TBC
TP13	TP	TBC	TBC	4.5	Scheduled depth	4.5	-	-	Contingency.	TBC
TP14	TP	TBC	TBC	4.5	Scheduled depth	4.5	-	-	Contingency.	TBC
TP15	TP	TBC	TBC	4.5	Scheduled depth	4.5	-	-	Contingency.	TBC
Onshore CO_2 Export Pipeline Corridor:										
LF\BH01	Sonic and rotary	457474.1	525776.2	20+15 (Sonic and rotary)	Scheduled depth	20	15	Dual install 50mm groundwater monitoring standpipe, with diver (Tidal Flat Deposits/ Glacial Till) and one within deeper bedrock	To identify slag platform, Made Ground and natural stratigraphy. To provide samples for geo-environmental testing.	Public road which runs through the site.
LF\BH02	Sonic and rotary	457520.9	525839.1	20+15 (Sonic and rotary)	Scheduled depth	20	15	Fully grouted vibrating wire piezometer (Made Ground, Tidal Flat Deposits, Glacial Till, Bedrock)	To confirm stratigraphy, groundwater regime and to provide samples for testing. To provide samples for geo-environmental testing.	Public road which runs through the site.
LF\CPT01	CPT	457523.8	525853.8	25	Scheduled depth	25	-	-	To confirm ground conditions against nearby boreholes. To provide porewater pressure measurement in Tidal Flat Deposits, Blown Sand and Glacial Till. To provide samples for geo-environmental testing (inspection pits).	Public road which runs through the site.

Hole No.	Type [1]	Co-ordinates		Scheduled depth (m)	Termination Criteria	Estimated Depth		Groundwater / Gas monitoring installation	Rationale for Exploratory Hole	Anticipated Access (TBC)
		Easting	Northing			Soils	Weathered mudstone			
LF\CPT02	CPT	457553.4	525878.7	25	Scheduled depth	25	-	-	To confirm ground conditions against nearby boreholes. To provide porewater pressure measurement in Tidal Flat Deposits, Blown Sand and Glacial Till. To provide samples for geo-environmental testing (inspection pits).	Public road which runs through the site.
LF\CPT03	CPT	457762.3	525933.0	25	Scheduled depth	25	-	-	To confirm ground conditions against nearby boreholes. To provide porewater pressure measurement in Tidal Flat Deposits, Blown Sand and Glacial Till. To provide samples for geo-environmental testing (inspection pits).	Via beach.
LF\CPT04	CPT	457834.4	525934.2	25	Scheduled depth	25	-	-	To confirm ground conditions against nearby boreholes. To provide porewater pressure measurement in Tidal Flat Deposits, Blown Sand and Glacial Till. To provide samples for geo-environmental testing (inspection pits).	Via beach.
LF\CPT05	CPT	457921.4	525983.0	25	Scheduled depth	25	-	-	To confirm ground conditions against nearby boreholes. To provide porewater pressure measurement in Tidal Flat Deposits, Blown Sand and Glacial Till. To provide samples for geo-environmental testing (inspection pits).	Via beach.
LF\CPT06	CPT	458001.9	526043.5	25	Scheduled depth	25	-	-	To confirm ground conditions against nearby boreholes. To provide porewater pressure measurement in Tidal Flat Deposits, Blown Sand and Glacial Till. To provide samples for geo-environmental testing (inspection pits).	Via beach.
LF\TP01	TP	457391.9	525702.7	4.5	Scheduled depth	4.5			To confirm ground conditions. To determine excavatability, side wall stability and perched groundwater conditions within slag platform area.	Public road which runs through the site.

Hole No.	Type [1]	Co-ordinates		Scheduled depth (m)	Termination Criteria	Estimated Depth		Groundwater / Gas monitoring installation	Rationale for Exploratory Hole	Anticipated Access (TBC)
		Easting	Northing			Soils	Weathered mudstone			
LF\TP02	TP	457400.3	525735.0	4.5	Scheduled depth	4.5		-	To confirm ground conditions. To determine excavatability, side wall stability and perched groundwater conditions within slag platform area.	Public road which runs through the site.
LF\TP03	TP	457408.6	525776.0	4.5	Scheduled depth	4.5		-	To confirm ground conditions. To determine excavatability, side wall stability and perched groundwater conditions within slag platform area.	Public road which runs through the site.

[1] All boreholes to commence with a service inspection pit to 1.2 m bgl to check for buried services.

Abbreviations

MS – Main Site

LF – Landfall (Onshore CO_2 Export Pipeline Corridor area)

BH – Borehole (sonic drilling with rotary follow on)

TP – Trial Pit

CPT – Cone Penetration Tests (with pore pressure measurement)

Project Management Initials: RL Designer: RPA Checked: NF Approved: JT

Scale @ A3 1:6,000

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AECOM

PROJECT
NET ZERO TEESSIDE

CLIENT
NZT POWER AND NZNS STORAGE

KEY
- The Main Site
- Future Expansion Area
- CO2 Transport Corridor

Proposed Exploratory Hole (Priority 1)
- Sonic Drilled Borehole with Rotary Core Follow on
- Cone Penetration Test (CPT)
- Trial Pit

Proposed Exploratory Hole (Priority 2)
- Sonic Drilled Borehole
- Sonic Drilled Borehole with Rotary Core Follow on
- Cone Penetration Test (CPT)

Proposed Installation Type
- 50mm Gas \ Groundwater Standpipe
- 50mm Standpipe with Diver
- Dual 50mm Standpipe with Diver (Superficial & Bedrock)
- Vibrating Wire Piezometer

Previous Exploratory Holes with Installations (to be assessed)
- Previous Installation

Previous Exploratory Holes
- CP
- CP+RC
- TP

Historical Features
- Breakwaters

OS Waterline
- Mean High Water (Springs)
- Mean Low Water (Springs)

CATS Pipeline
- CATS Pipeline
- CATS Pipeline 50m Buffer

TITLE
PRELIMINARY EXPLORATORY HOLE LOCATION PLAN – MAIN SITE & ONSHORE CO2 EXPORT PIPELINE CORRIDOR

REFERENCE
NZT_210429_ STDC_PROPOSED GI_1

SHEET NUMBER	DATE
1 of 1	29/04/2021

Annex B - Envirocheck Report (included in digital copy only)

Annex C - Historical Maps (included in digital copy only)

Annex D – Unexploded Ordnance (UXO)

UNEXPLODED BOMB RISK MAP

zeticaUXO

SITE LOCATION

Map Centre: 457070,525275

LEGEND

High: Areas indicated as having a bombing density of 50 bombs per 1000acre or higher.

Moderate: Areas indicated as having a bombing density of 15 to 49 bombs per 1000acre.

Low: Areas indicated as having 15 bombs per 1000acre or less.

miltary	industry	UXO find
transport	dock	Luftwaffe targets
utilities	Bombing decoy	other

How to use your Unexploded Bomb (UXB) risk map?

The map indicates the potential for Unexploded Bombs (UXB) to be present as a result of World War Two (WWII) bombing.

You can incorporate the map into your preliminary risk assessment* for potential Unexploded Ordnance (UXO) for a site. Using this map, you can make an informed decision as to whether more in-depth detailed risk assessment* is necessary.

What do I do if my site is in a moderate or high risk area?

Generally, we recommend that a detailed UXO desk study and risk assessment is undertaken for sites in a moderate or high UXB risk area.

Similarly, if your site is near to a designated Luftwaffe target or bombing decoy then additional detailed research is recommended.

More often than not, this further detailed research will conclude that the potential for a significant UXO hazard to be present on your site is actually low.

Never plan site work or undertake a risk assessment using these maps alone. More detail is required, particularly where there may be a source of UXO from other military operations which are not reflected on these maps.

If my site is in a low risk area, do I need to do anything?

If both the map and other research confirms that there is a low potential for UXO to be present on your site then, subject to your own comfort and risk tolerance, works can proceed with no special precautions.

A low risk really means that there is no greater probability of encountering UXO than anywhere else in the UK.

If you are unsure whether other sources of UXO may be present, you can ask for one of our **pre-desk study assessments (PDSA)**

If I have any questions, who do I contact?

tel: **+44 (0) 1993 886682**

email: **uxo@zetica.com**

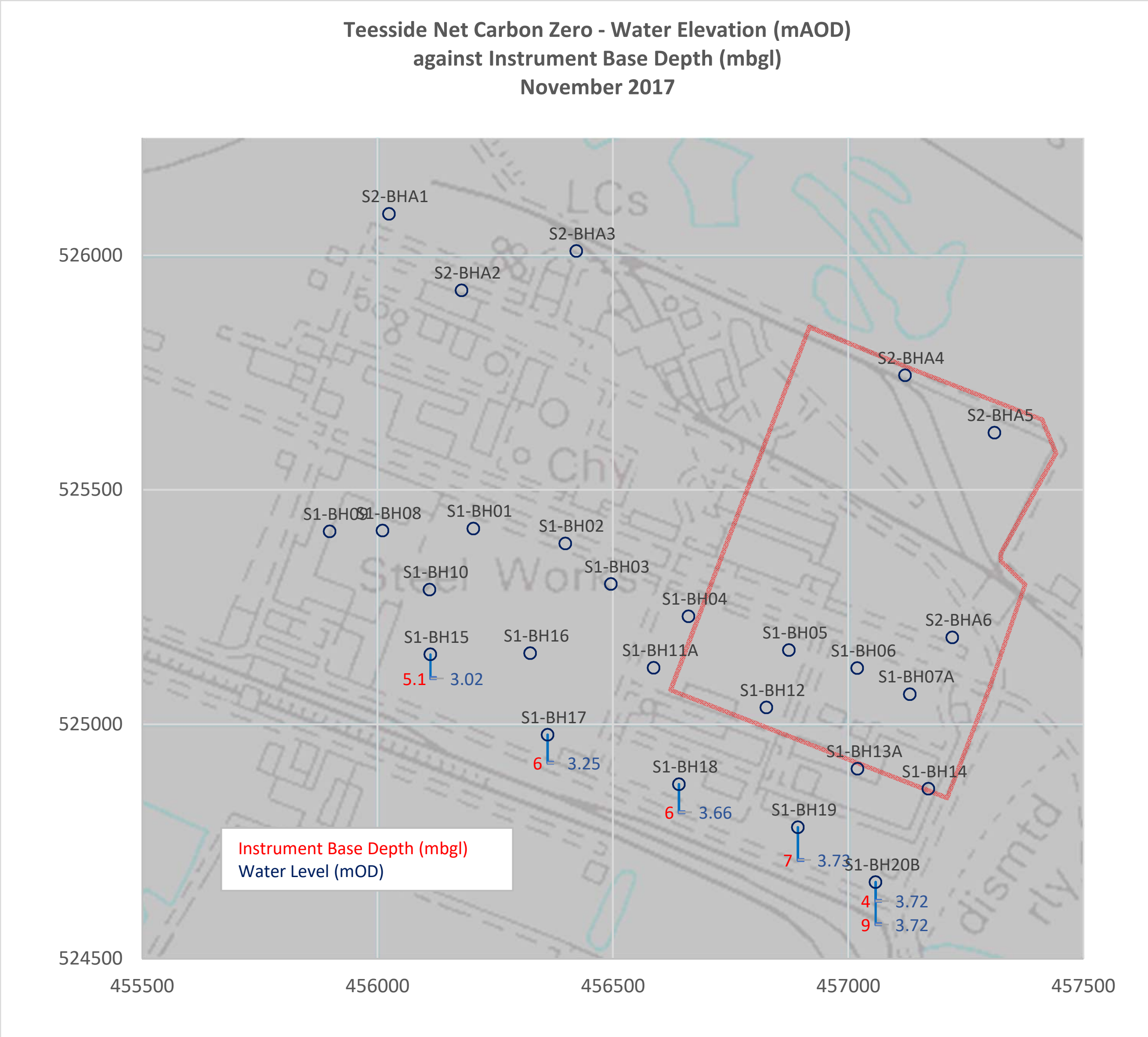
web: **www.zeticauxo.com**

The information in this UXB risk map is derived from a number of sources and should be used in conjunction with the accompanying notes on our website: **(https://zeticauxo.com/downloads-and-resources/risk-maps/)**

It is important to note that this map is not a UXO risk assessment and should not be reported as such when reproduced.

*Preliminary and detailed UXO risk assessments are advocated as good practice by industry guidance such as CIRIA C681 'Unexploded Ordnance (UXO), a guide for the construction industry'.

Annex E – Groundwater Levels Teesworks Site



Teesside Net Carbon Zero - Water Elevation (mAOD)
against Instrument Base Depth (mbgl)
November 2017
S2-BHA1
S2-BHA3
S2-BHA2
S2-BHA4
S2-BHA5
S1-BH09
S1-BH08
S1-BH01
S1-BH02
S1-BH03
S1-BH10
S1-BH04
S1-BH15
S1-BH16
S1-BH11A
S1-BH05
S1-BH06
S2-BHA6
S1-BH07A
S1-BH12
5.1
3.02
S1-BH17
6
3.25
S1-BH13A
S1-BH14
S1-BH18
6
3.66
S1-BH19
7
3.73
S1-BH20B
4
3.72
9
3.72
Instrument Base Depth (mbgl)
Water Level (mOD)
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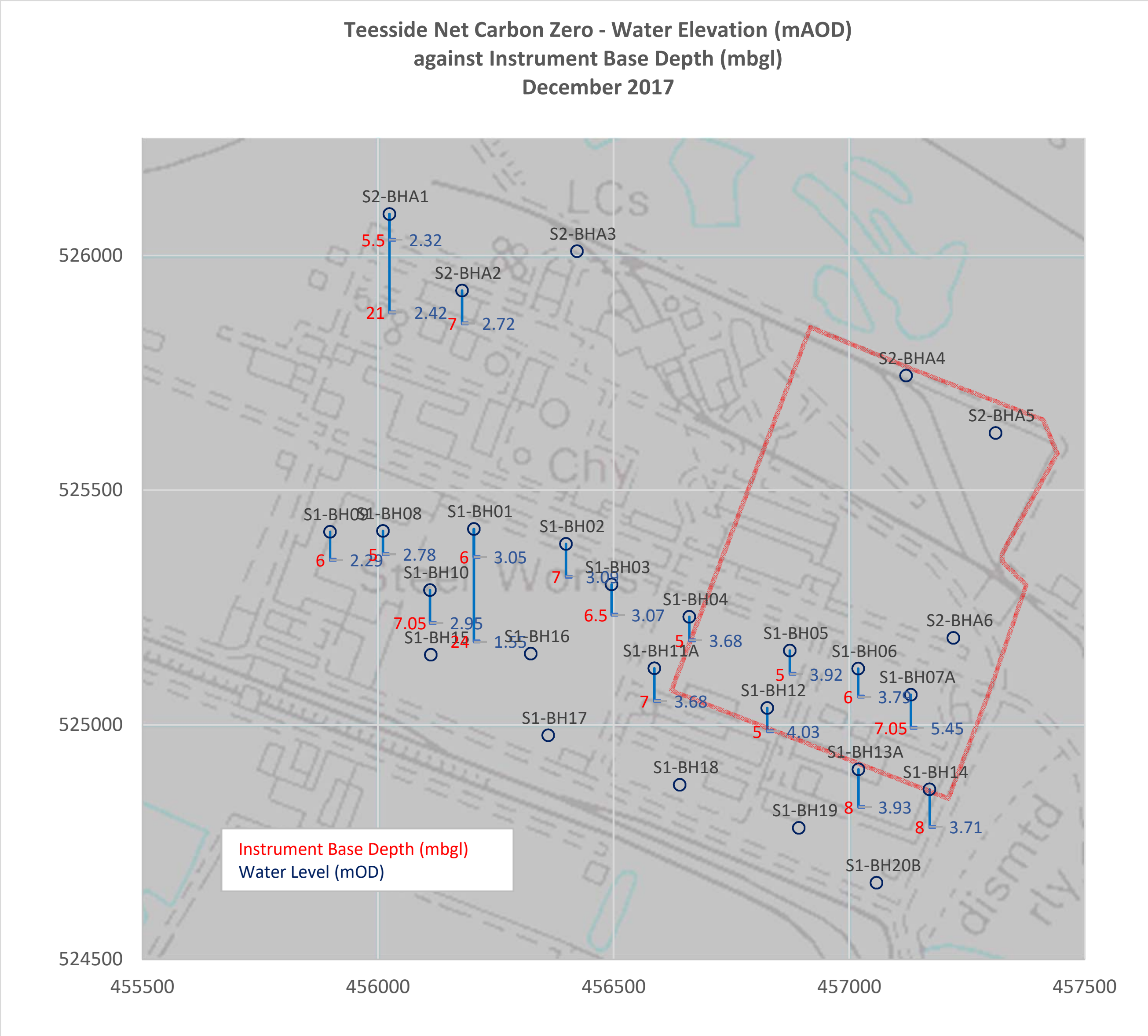
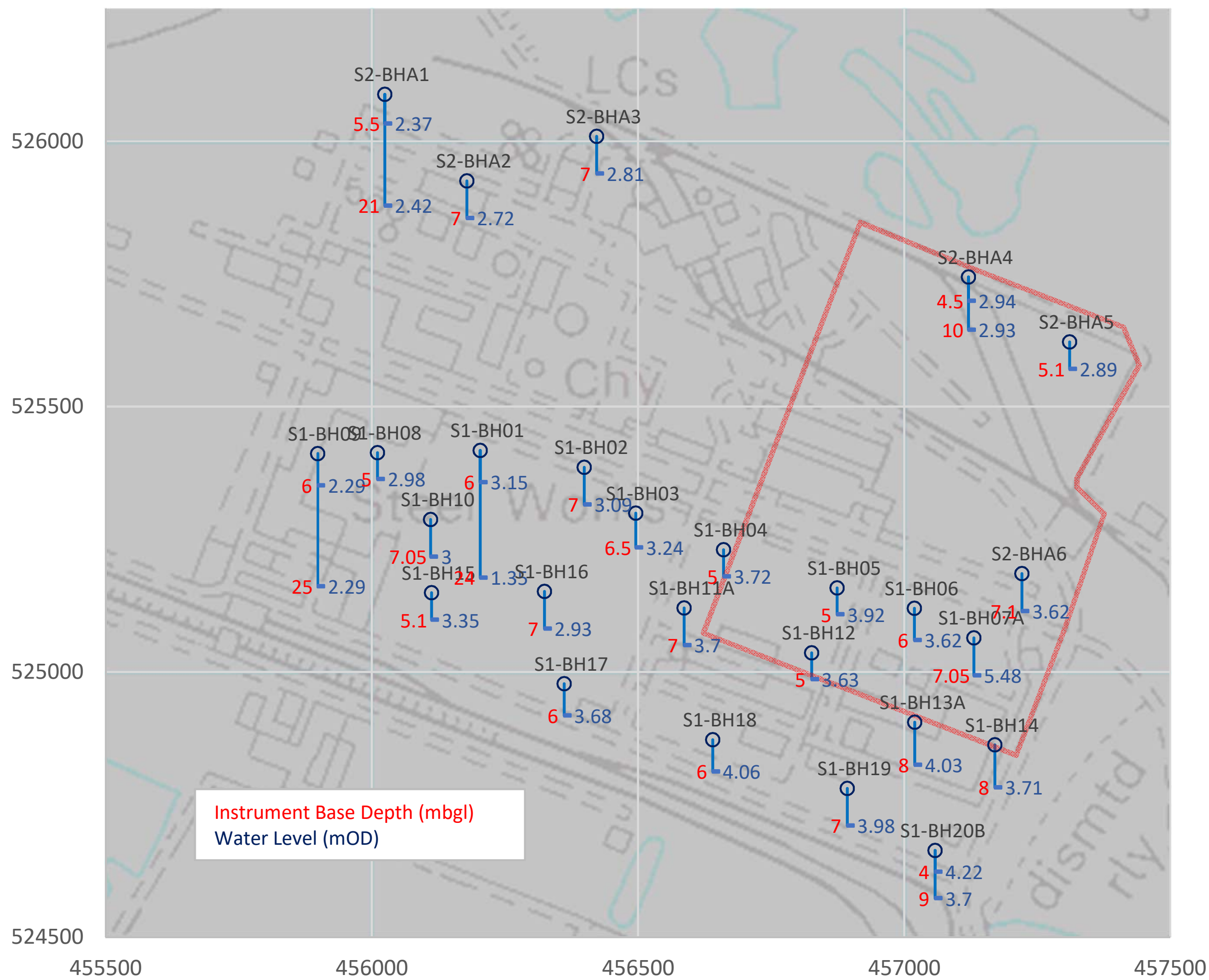
525500
525000
524500
455500
456000
456500
457000
457500

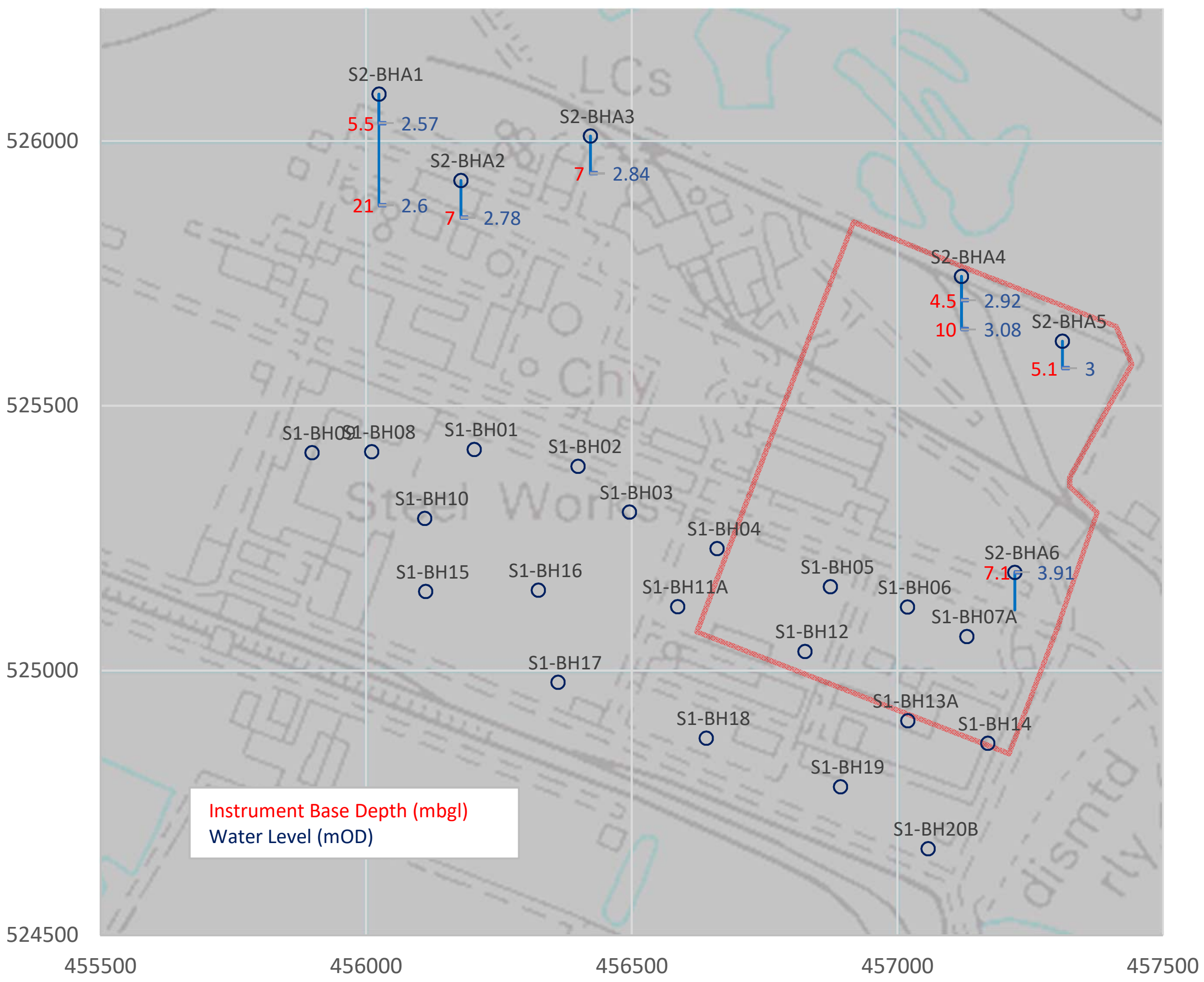


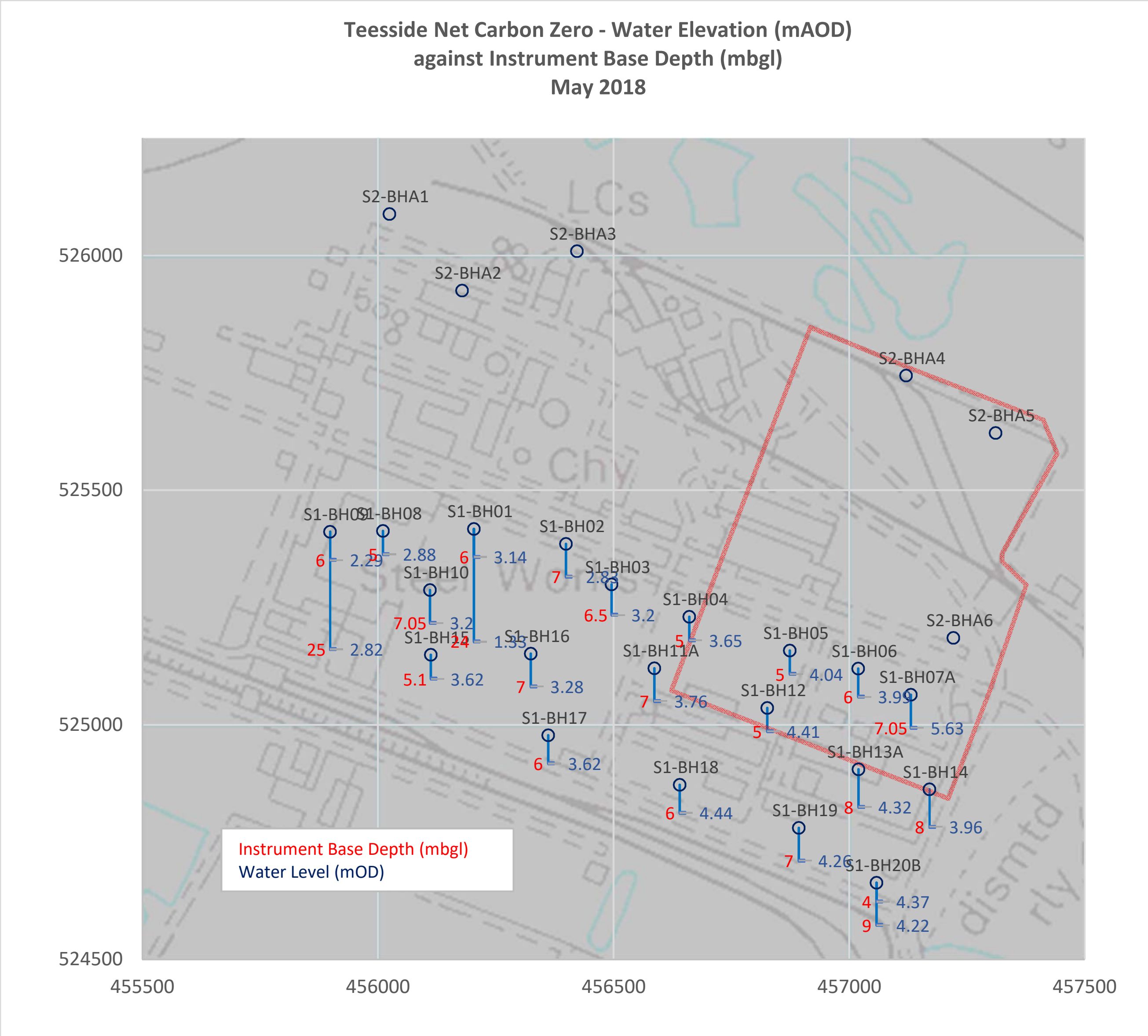
Teesside Net Carbon Zero - Water Elevation (mAOD)
against Instrument Base Depth (mbgl)
December 2017
526000
525500
525000
524500
455500
456000
456500
457000
457500
Instrument Base Depth (mbgl)
Water Level (mOD)
S2-BHA1
5.5
2.32
21
2.42
S2-BHA2
7
2.72
S2-BHA3
S2-BHA4
S2-BHA5
S2-BHA6
S1-BH09
6
2.29
S1-BH08
5
2.78
S1-BH01
6
3.05
24
1.55
S1-BH10
7.05
2.95
S1-BH15
S1-BH16
S1-BH02
7
3.09
S1-BH03
6.5
3.07
S1-BH04
5
3.68
S1-BH11A
7
3.68
S1-BH05
5
3.92
S1-BH06
6
3.79
S1-BH07A
7.05
5.45
S1-BH12
5
4.03
S1-BH13A
8
3.93
S1-BH14
8
3.71
S1-BH17
S1-BH18
S1-BH19
S1-BH20B

Teesside Net Carbon Zero - Water Elevation (mAOD) against Instrument Base Depth (mbgl) February 2018



Teesside Net Carbon Zero - Water Elevation (mAOD) against Instrument Base Depth (mbgl) April 2018





Teesside Net Carbon Zero - Water Elevation (mAOD)
against Instrument Base Depth (mbgl)
May 2018
526000
525500
525000
524500
455500
456000
456500
457000
457500
S2-BHA1
S2-BHA3
S2-BHA2
S2-BHA4
S2-BHA5
S2-BHA6
S1-BH09
S1-BH08
S1-BH01
S1-BH02
S1-BH03
S1-BH10
S1-BH04
S1-BH15
S1-BH16
S1-BH11A
S1-BH05
S1-BH06
S1-BH07A
S1-BH12
S1-BH17
S1-BH13A
S1-BH18
S1-BH14
S1-BH19
S1-BH20B
Instrument Base Depth (mbgl)
Water Level (mOD)

Annex F – Site Walkover

A site reconnaissance (walkover) was undertaken at the Teesworks Site (Redcar Steelworks) on the 18th and 19th March 2020 by representatives of BP and AECOM who were accompanied by a representative of the STDC. For the purposes of this Annex the site areas are described as the Proposed Onshore CO_2 Corridor, North Site Area and Steel Ponds, Central Site Area and South Site Area.

CO_2 Export Pipeline Corridor

The walkover commenced along the north boundary of the Site accessed from an South Gare Road to view the proposed area of the CO_2 Export Pipeline Corridor across the area of South Gare and Cotham Dunes.

Plates 1, 2 and 3 show areas of steel slag waste, most likely placed during the operation of the Redcar Iron and Steelworks (present between 1929 and 1973) tipped immediately north of the Site across the proposed Onshore CO_2 corridor. These areas of slag extend north to Blown Sands deposits of the natural beach sand and dune habitats, although these areas are also most likely underlain with man-made materials placed between 1856 and 1894, associated with early land reclamation and construction of defences from the North Sea.

Plate 1 – View looking north east showing areas of steel blast furnace waste slag with the existing offshore windfarm visible in the distance.

Plate 2 -Typical composition of the fused blast furnace slag.

It was noted that there are localised areas of spoil comprising large discarded fused slag and old concrete foundations from previous industrial development across this area, see Plate 3.

Plate 3 – View looking south west showing large concrete blocks thought to be foundations from previous land use within the Main Teesworks Site shown on the foreground, and the former blast furnace on the right-hand side of the photograph which is outside and adjacent to the east boundary of the site.

Land to the north of the Teesworks Site within the Onshore CO_2 Corridor was noted to include low lying marshy areas identified as ‘ponds’ on the Ordnance Survey (OS) mapping. At the time of the site walkover, the ponds situated to the north east of the

Site were generally dry or marshy, see Plate 4. These ponded areas are shown as different sizes over different dates of OS mapping, suggesting they are influenced by seasonal rainfall.

Plate 4 – View looking south west within the Onshore CO_2 corridor showing marshy pond areas north east of the Main Teesworks Site.

A larger and more permanent pond is present north of the unnamed road adjacent to the north west corner of the of the Main Teesworks Site. The bunded areas around the pond are formed of Made Ground primarily comprising waste slag materials from the former Redcar Iron and Steel Works, shown on Plate 5 below.

Plate 5 – View looking north west along unnamed road and permanent pond.

Trending north from the ponds and areas of historical slag infill is the Blown Sand beach and dune habitat, extending to the mean high-water tide and the North Sea.

Plate 6 – View looking south southwest showing the dune habitat in the area of the proposed CO_2 corridor showing the proposed Main Teesworks Site in the background.

North Site Area and Steel Ponds

Land in the north portion of the Main Teesworks Site comprises wasteland, former rail sidings, hardstanding and land previously used as a ‘steel ponding’ area.

The whole of the north east corner of the proposed Main Teesworks Site is occupied by an area of former ‘steel ponds’. Historically, when problems were encountered during steel production or where excess iron was produced that was unable to be processed by the Basic Oxygen Furnace Steelmaking (BOS) Plant, this molten iron was transported to this area and tilted as a ‘torpedo’’ to ‘pond’. The iron was then fractured and recycled back to the blast furnace. It is reported that there were a series of nine ‘ponds’ which covered an area of 8,000m2 with a capacity to hold 60,000t of iron. It is understood the pond areas were also used for the disposal of waste products from the Blast Furnace although the type of wastes are not known. The steel ‘pond’ area is shown on Plates 7 to 9.

Plate 7 – View looking north west along the alignment of the steel torpedo ‘pond area’. The tilt operation booths are seen yellow/black on the left handleft-hand side of the photograph (see insert showing Tilt Panel to the right), with running rails for the tippers shown on the edge of the ‘pond’ areas.

The former ‘pond’ area is now covered in various spoil heaps of blast furnace slag and crushed concrete, with metal detritus varying in size typical of gravel, cobbles and boulders across the area, see Plate 8. It was noted that there is no or little vegetation present across the former ponds. Land immediately south and south west of the ‘ponds’ was generally vegetated with grasses and included very large blocks of waste iron assumed to be associated with the practise of tipping of molten iron as described above, see Plate 9 for a typical ‘block’ observed.

Plate 8 - View looking north showing typical spoil heaps of iron slag waste material.

Plate 9 - Typical example of waste iron blocks discarded across land south of the torpedo pond area. Estimated size 5.0 X 5.0 X 1.5m.

Trending north west from the 'ponds' the land is noted to be generally level and covered in areas of sparse vegetation, gravel or concrete hardstanding. It is understood that this area was used as a disposal area and was used for storage of materials during operation of the former SSI Steelworks. Two specific areas of interest were noted on Site.

A localised area devoid of vegetation with the surface soils and detritus exhibiting a distinct blue colouration which is typical of cyanide contamination, and sometimes referred to as 'Blue Billy' was present within the approximate centre of the north site area, see Plate 10. This type of contamination is often associated with coal gasification (gas works) processors and also with coke works and manufacturing of coke for steelmaking. However, neither of these of these industries are recorded on historical OS mapping to have been present on the Site, with former Redcar Coke Ovens (RCO) and coke stocking area located some 200m to the west northwest. Therefore, the source of this contamination is unknown. However, groundwater monitoring data from previous ground investigations by others has identified cyanide contamination within groundwater in this area, so the source and extent of contamination should be determined by ground investigation.

Plate 10 – Surface soils discoloured blue typical of cyanide contamination.

The second area of interest comprises hardstanding and remnants of four hexagonal areas of hardstanding understood to be foundation bases located in the north east corner of the proposed Main Teesworks Site, see Plate 11. These footings are thought to possibly be a result of the initial intention to build a further 2 blast furnaces (outside, and to the north west of the proposed site boundary shown on the left hand side of the photograph) which were subsequently never constructed. It is understood the initial production forecast for the existing plant was originally intended to be three times the actual production capacity, but was scaled down due to economic demand at that time. The circular foundations do not include concrete within the centre as it is understood this would have housed a low collection point required as part of the production process.

Plate 11 - View looking west- north west showing remnant foundations and hardstanding.

A rail siding is present running along the north boundary of the proposed Main Teesworks Site running from the blast furnaces to the west-north-west trending east southeast towards the steel 'pond' area, see Plate 12. This forms part of the Hot Metal Route railway, which was used to transport the liquid metal in the Torpedo ladles to the BOS plant located approximately 7km to the south (within the wider SSI site). This route also links to numerous other rail lines associated with the various processes that took place on Site.

Plate 12 - Rail siding running along the north boundary of the Teesworks Site.

Central Site Area

The central area of the Site is separated from the north area described above by an internal site access road and former rail sidings. The areas of interest within the central area observed during the site walkover include the Blast Furnace Stockhouse, various maintenance workshops and stores, an area of open ground extending between the stock house and the Teesworks east site boundary and the RDL Stores buildings.

The area of open ground and the Blast Furnace Stockhouse is shown Plate 13. Access below or into any of the structures was not permitted during the walkover due to The CDM Regulations (2015) and Health and Safety restrictions. Safety barriers seen running across the foreground of the photograph delineate known service corridors, particularly for high voltage buried cables.

Plate 13 – View looking west showing area of open ground, Blast Furnace Stockhouse and associated buildings. The Blast Furnace is shown on the right hand side of the photograph which is outside and north west of the proposed site boundary.

The area immediately east of the Blast Furnace Stockhouse is currently covered by large stockpiles of mixed materials and slag (left hand side) and broken concrete slabs and foundations (right hand side) which it is understood from the STSC representative to be associated with demolition of former structures associated with the SSI works, see Plate 14. This area is also reported to have previously been used as a site wide diesel (and possibly other/s) refuelling area. It is unknown if the tanks and associated infrastructure and pipework still remain buried on the site. A number of historical cut-down structure stanchions are visible in the foreground of the photograph. These run along the alignment of the former large structure associated with the former Redcar Iron and Steelworks Steel Plant building (~1929 to 1973), see Plates 14 and 15.

Plate 14 – View looking west showing stockpiles, former refuelling area and historical cut-down structure stanchions.

Plate 15 – View looking north west showing cut-down structure stanchions along the alignment of the former Redcar Steel and Iron works Steel Plant building.

The area of open ground east of the Blast Furnace Stockhouse (see Plate 13) is known be underlain by number of buried structures, caverns and brick lined tunnels, these within the area of Herras fencing shown in the centre of the photograph. These predate the exisitng SSI plant layout and are most likely associated with the earlier former Redcar Iron and Steelworks site (present on site from 1929 to 1973). The buried structures and tunnels may be associated with steel melting hearths and ventilation tunnels with anecdotal evidence suggesting there were ten steel melting heaths on the site, although these are not shown on any historical OS mapping. The merits of undertaking geophysical investigations including Ground Penetrating Radar (GPR) and/or Resistivity techniques was discussed on site as a suitable for a Phase 1 investigation to aid determination of the location, direction and extent of these across this area. Access into the fenced areas was not permitted during the site walkover due to The CDM Regulations (2015) and Health and Safety restrictions, however there is little visible surface expression of these features as shown in Plate 16.

Plate 16 - Surface expression of buried structures and tunnels.

The south part of the central area is delineated by an overhead network of pipelines and a further internal access road. From discussion on site the overhead network carries a number of different materials for the industrial processes undertaken and include but not limited to fuel oils and the Cog Oven Gas (COG) main that is piped to South Bank from the coke ovens west and outside of the Site boundary, see Plate 17.

Plate 17 – View looking east south-east showing overhead COG and fuel oil pipelines. The RDL Stores building and associated canteen are located in the north east corner of the central area adjacent to the east boundary of the Site boundary, see Plate 18. It is reported that historically there may have been some storage tanks (contents unknown) west of the structures associated with stores.

Plate 18 – View looking north east showing RDL Stores and Canteen. A lighting column is visible on the right hand side of the photograph, with others

present elsewhere across the site. In some areas the columns have been removed and foundations are present at ground surface.

South Site Area

The southern portion of the Site is delineated by the internal access road to the north, with the south boundary delineated by the Sinter Plant, which is adjacent to but outside the south west corner and south boundary. The southern part of the Site primary comprises open soft landscaping vegetated areas, the South Tees Site Company (STSC) offices and associated car parking area, the Pellet Tunnel building, former maintenance workshop buildings, areas of hardstanding and some remnant foundation and hardstanding areas.

The structures in this area are of brick construction. Waste slag material is present widely across the whole site, with evidence of the expansive nature of this material visible through structure deformation and cracking in the walls of these buildings. Plate 19 shows the STSC offices and Plate 20 shows the Pellet Tunnel building.

Plate 19 – View looking north showing structure deformation and cracking on the STSC office building.

Plate 20 – View looking west showing deformation across the Pellet Tunnel building. It is noted that the extent and direction of the tunnels are not known at the time of this report issue, however STSC have indicated that these records should be available for release. The barriers leading to the structure again delineate the corridor of buried underground services and high voltage cables.

The area to the west of the office buildings comprises open vegetated soft landscaping bounded to the north by overhead equipment and the Blast Furnace Stockhouse, the Sinter Plant to the south, with conveyors and associated services to the east. The Sinter Plant is shown on Plate 21. The STSC representative described sinter to comprises small, irregular nodule shaped agglomerates of iron ore fines, limestone and coke which was used as a feedstock for the blast furnace.

Plate 21 - View looking south west showing the Sinter Plant adjacent to the south boundary of the proposed site.

The north portion of this part of the Site in bounded by the Blast Furnace Stockhouse. An area of remnant hardstanding is present across this area, see Plate 22. It is understood that it was originally intended to construct three sinter plants across this area, however due to economic conditions and demand only one of these was constructed, with this relict hardstanding possibly associated with this.

Plate 22 – View looking north west showing area of remnant hardstanding and the Blast Furnace Stockhouse.

Land to the east of the STSC offices generally comprise areas of grassland and an area of remnant hardstanding. The south east corner of this part of the Site was historically occupied by a Pellet Plant demolished in the 1980s, see Plate 23.

Plate 23 – View looking south west. The Pellet Plant was located across the grassland shown on the left hand side of the photograph. There is no visible surface evidence of the former structure. The chimney stack shown in the background is associated with the Sinter Plant and is located adjacent to, but outside of, the Teesworks southern site boundary.

It is understood that three Pellet Plants were originally proposed (as the Sinter Plants). A large area of remnant hardstanding is present north of the STSC offices and car park which is thought to be associated with the original intention to construct additional plants across this area, see Plate 24.

Plate 24 – View looking east southeast showing a hardstanding area. It was noted that the hardstanding surface is 'wavy' and cracked, again providing

evidence of heave inferred to have resulted from the presence of expansive slag materials below this area.

Further localised foundation bases were visible across this area, thought to be associated with former lighting columns, see Plate 25.

Plate 25 - View looking east southeast showing foundation base.

There are some large brick construction maintenance works present close to the south boundary of the Teesworks Site, see Plate 26.

Plate 26 – View looking east southeast showing a brick construction maintenance building.

A large storage tank reported to have a capacity for 200 tonnes diesel is located between the former Pellet Plant and the Sinter Buildings, see Plate 27. This is located adjacent to, but outside of the proposed south boundary of the Teesworks Site. The tank is located within a concrete bund which appeared to be of sound construction. The site representative from STSC confirmed that the tank was removed from service prior to SSI purchase of the site but was not fully emptied. It was noted that pipe cladding insulation materials were fibrous in nature and may represent an asbestos risk, see Plate 28. This would need to be established through testing although it is noted that the tanks will most likely be demolished as part of the STSC site clearance works.

Plate 27 – View looking west northwest showing diesel tank and surrounding concrete bund wall.

Plate 28 – Diesel tank connections and fibrous pipe lagging.