TEESWORKS

LACKENBY ENVIRONMENTAL STATEMENT

VOLUME 2: CHAPTER F
WATER MANAGEMENT AND FLOODING

DECEMBER 2020

Lackenby, South Tees Environmental Statement

Chapter F: Water Management

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Contents

F1.0 Introduction

F1.1 This chapter of the Environmental Statement ('ES') has been prepared by JBA Consulting (JBA) on behalf of the applicant, South Tees Development Corporation ('STDC'). It assesses the proposed development described in Chapter B and it considers the effects of the proposed development on Water Management and Flooding surrounding the site.

F1.2 The chapter describes the existing environment in relation to hydrology and hydrogeology and assesses the potential impacts of the construction and operation of the proposed development on hydrology (surface water quality, levels and flows) and hydrogeology (groundwater quality and levels).

F1.3 The geological descriptions within this section provide context for the sensitivity of the hydrogeology assessment only. Existing potential contamination and its potential interrelationship with human health and groundwater quality is considered in Section F4.0 of this chapter.

F1.4 The baseline situation is considered before the likely environmental effects of the proposed development are identified, both during construction and operational phases of the proposed development. Mitigation measures to reduce any negative environmental effects are identified as appropriate, before the residual environmental effects are assessed.

F1.5 This chapter is supported by the following technical appendices:-

1 **Appendix F1:** Summary of Consultation with statutory consultees; and

2 **Appendix F2:** Flood Risk Assessment (FRA).

About the Author

F1.6 The Water Management and Flooding Environmental Statement Chapter has been prepared by JBA Consulting on behalf of STDC, following commission in November 2020. JBA Consulting is a member of the IEMA Environmental Impact Assessment (EIA) Quality Mark.

Table 1.1 Core Staff Competencies

Team Member	Role and Qualifications
Samantha Cogan – 5 years' professional experience in hydrology, flood risk assessment and sustainable drainage. MSc, BSc	Lead Flood Risk Author
Alice Gent - 7 years' professional experience in environmental management including geomorphology and river restoration, flood risk assessment, EIA and SEA. BSc CEnv MCIWEM C.WEM	Lead Flood Risk Author
René Dobson - over 25 years' experience in the engineering sector and over 20 years of specialist experience in water and environmental engineering in the UK and Ireland BEng CEng MICE	Lead Flood Risk Reviewer
Eleanor Williams - 15 years' professional experience in hydrogeology and EIA. CGeol, FGS, BSc, PhD	Lead Hydrogeology Author
Mike McDonald – 30 years' professional experience in hydrogeology and brownfield land reclamation, including iron and steel manufacturing facilities BSc, MSc, PhD, CGeol, FGS.	Lead Hydrogeology Reviewer

Dorian Latham - over 30 years' experience in delivering multi discipline projects for both the public and private sector, including numerous statutory Environmental Statements and non-statutory Environmental Report for public and private clients in the role of report editor and technical reviewer, but provides specialist knowledge to the Ecology, Water Quality / Water Framework Directive and Cumulative Impacts sections. Dorian is the National EIA and Environmental Lead for JBA Consulting. BA PhD CEnv FCIEEM	Lead EIA Reviewer

F2.0 Policy Context

Overview

F2.1 This section provides an overview of the issues from the relevant planning policies and policy guidance which have been considered in assessing potentially significant effects related to the water environment.

F2.2 A summary of policies and legislation is set out in the below tables. Further details are then provided, including on their relevance to this ES chapter.

Table 2.1 Policy Issues considered in preparing the water environment assessment

Policy Reference	Policy Issues
National Planning Policy Framework (NPPF) (revised, 2019) (Ref 37)	
Paragraph 17	Achieving Sustainable Development principles (para 8c) include contributing to protecting and enhancing the natural environment and minimising pollution.
Section 14, Paragraph 150a	New development should be planned to avoid increased vulnerability to the range of impacts arising from climate change including flood risk and water supply. When new development is brought forward in areas which are vulnerable, care should be taken to ensure that risks can be managed through suitable adaptation measures, including through the planning of green infrastructure.
Section 14, Paragraphs 155-165	Inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk (whether existing or future). Where development is necessary in such areas, the development should be made safe for its lifetime without increasing flood risk elsewhere. Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate.
Section 15, Paragraph 170e	New and existing development should not contribute to or be put at unacceptable risk from, or be adversely affected by, unacceptable levels of water pollution.
National Planning Practice Guidance (Ref 38)	Multiple benefits for people and the environment can be achievable through good design and mitigation. For example, flood risk can be reduced and biodiversity and amenity improved by designing development that includes permeable surfaces and other sustainable drainage systems, removing artificial physical modifications (for example, weirs and concrete channels) and recreating natural features. Water quality can be improved by protecting and enhancing green infrastructure and further information on this can be found in the planning practice guidance on the Natural Environment. Good design and mitigation measures can be secured through site specific policies for allocated sites and through non-site-specific policies on water infrastructure and protecting the water environment. For example, they can be used to ensure that new development and mains water and wastewater infrastructure provision is aligned and to ensure new development is phased and not occupied until the necessary works relating to water and wastewater have been carried out. Local planning authorities can use planning conditions and / or obligations to secure mitigation and compensatory measures where the relevant tests are met. Planning obligations can be used to set out requirements relating to monitoring water quality, habitat creation and maintenance and the transfer of assets where this

	mitigates an impact on water quality. The guidance supports the NPPF.
Redcar and Cleveland Borough Council (RCBC) Local Plan (May, 2018) (Ref 51)	
Policy SD1: Sustainable development	Protect the quality and availability of water resources and maximise the efficient use of water.
Policy SD7: Flood and water management	Flood risk will be taken into account at all stages in the planning process to avoid inappropriate development in areas at current or future risk.

F2.3 The legislation relevant to the assessment of effects of the proposed development on the water environment is summarised below.

Table 2.2 Legislation relevant to the assessment of the water environment

Legislation	Description
Water Environment (Water Framework Directive (WFD)) (England and Wales) Regulations 2017 (Ref 35)	The WFD came into force in 2000 and is the most substantial piece of EU water legislation to date. All new activities in the water environment will need to take the Directive into account. The Directive imposes legal requirements to protect and improve the water environment. The EU WFD was transposed into law in England and Wales by the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003. The 2003 regulations were consolidated and replaced with the Water Environment (WFD) (England and Wales) Regulations 2017. The Directive requires that Environmental Objectives be set for all surface and ground waters in England and Wales to enable them to achieve Good Status (or Good Ecological Potential for Heavily Modified and Artificial Water Bodies)
Water Act 2003 (Ref 27)	This Act was a revision of the Water Resources Act (1991) which stated that it is an offence to cause or knowingly permit polluting, noxious, poisonous or any solid waste matter to enter controlled waters. The Act sets out regulatory controls for water abstraction, discharge to water bodies, water impoundment and protection of water resources. Elements of the Water Resources Act 1991 have now also been superseded by the Environmental Permitting (England and Wales) Regulations 2010 (Ref 29).
Environmental Permitting (England and Wales) Regulations 2010 (Ref 29)	This provides a consolidated system for environmental permits and exemptions for activities which include discharges to surface waters. It also sets out the powers, functions and duties of the regulators.
Groundwater Regulations 1998 (Ref 25)	These require the prevention of List I substances (such as mercury, cadmium, polyaromatic hydrocarbons) entering groundwater and the control of List II substances (such as heavy metals, nutrients, phenols) to avoid pollution of groundwater. Within the context of the WFD, the groundwater daughter directive was brought into force in January 2009, which will seek to prevent deterioration in groundwater quality.
The Land Drainage Act 1991 & 1994 (Ref 23 & 24)	This places responsibility for maintaining flows in watercourses on landowners and gives Local Authorities powers to serve a notice on landowners to ensure works are carried out to maintain flow of

	watercourses.
Floods and Water Management Act 2010 (Ref 30)	This sets out the Government's proposals to improve flood risk management, water quality and ensure water supplies are more secure. In December 2009, the Flood Risk Regulations were published, which transpose the EU Floods Directive into UK law and these cover the flood issues from the Floods and Water Management Bill.

F2.4 Other policy, regulatory and best practice guidance of relevance to this assessment includes the following:

- EA Principles and Practice for the Protection of Groundwater (GP3) (Ref 31);
- EA Pollution Prevention Guidance (PPG) Notes1 (Ref 31):
  - PPG 3 Use and design of oil separators in surface water drainage systems
  - PPG 6 Working at construction and demolition sites;
  - PPG 7 The safe operation of refuelling facilities;
- GOV.UK Guidance for pollution prevention for businesses (superseding relevant PPGs) (Ref 58):
  - a Polluting substances;
  - b Activities that produce contaminated water;
  - c Correct use of drains;
  - d Storing materials, products and waste;
  - e Unloading and moving potential pollutants;
  - f Construction, inspection and maintenance.
- Construction Industry Research and Information Association (CIRIA) Report C532: Control of Water Pollution from Construction Sites (Ref 44);
- CIRIA Report C502: Environmental Good Practice on Site (Ref 6);
- CIRIA Report 515: Groundwater Control – design and practice (Ref 7);
- CIRIA Report C753: The SuDS manual (Ref 8 & 9);
- BS6031: 2009 Code of Practice for Earth Works (Ref 3);
- Good Practice Guide for Handling Soils (MAFF, 2000) (Ref 42);
- Local and Regional Land Drainage Bylaws;
- Redcar and Cleveland Strategic Flood Risk Assessment (RCBC, 2016) (Ref 49 & 50); and
- River Tees Catchment Flood Management Plan (EA, 2009) (Ref 12).

Requirements of Flood Risk Legislation, Policy and Guidance

F2.5 There are a number of pieces of legislation relating to flooding as shown in the flow diagram below. The EU Floods Directive 2007 was interpreted into the England and Wales legislation Flood Risk Regulations 2009 (Regulations) (Ref 28) and the Flood and Water Management Act 2010 (Act) (Ref 30).

[1] It is noted that the PPG notes are now withdrawn but are nonetheless applied in the absence of direct replacement guidance notes.

F2.6 The Regulations identify and take action in areas with the most significant flood risks and require the following to be produced:

1 A preliminary Flood Risk Assessment Report providing a high-level overview of flood risk from local flood risk sources and identifying the Flood Risk Areas;

2 Flood hazard maps and flood risk maps for Flood Risk Areas; and

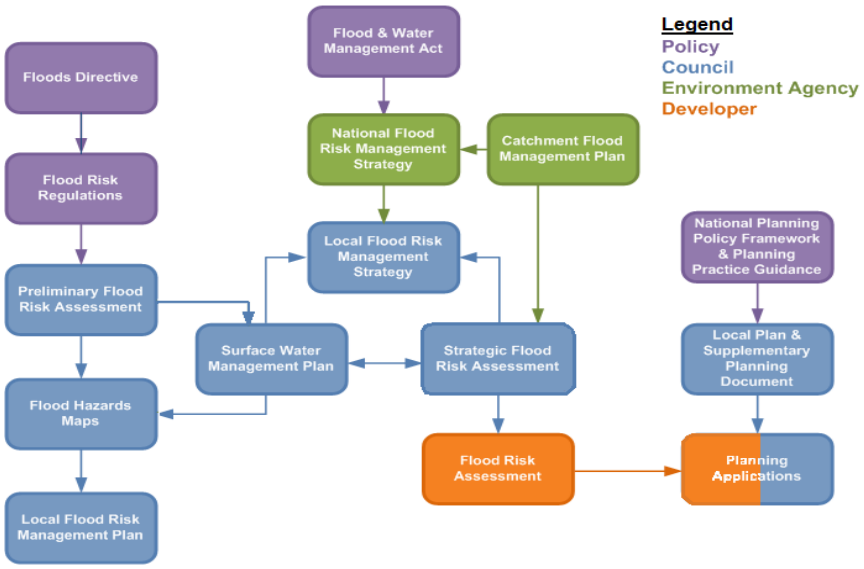
3 Flood risk management plans for Flood Risk Areas.

F2.7 The purpose of the Act is to:

1 Introduce the concept of flood risk management and the framework for the delivery of flood and coastal erosion risk management through national and local strategies; and

2 Provide definitions, for example "flood", "surface runoff", "Risk Management Authorities", "Lead Local Flood Authority" (LLFA).

Figure 2.1 Key documents and strategic planning links with flood risk



National Planning Policy

F2.8 The new NPPF (Ref 37) was published in July 2018 and updated was in June 2019. The NPPF sets tests to protect people and property from flooding which all local planning authorities are expected to follow. It must be taken into account in the preparation of local plans and is a material consideration in planning decisions. Where these tests are not met, national policy is clear that new development should not be allowed. The main steps to be followed are set out below which, in summary, are designed to ensure that if there are better sites in terms of flood risk, or a proposed development cannot be made safe, it should not be permitted.

F2.9 The NPPF is accompanied by PPG notes (Ref 38) which are updated to reflect changes to NPPF.

F2.10 The key changes in the 2019 NPPF compared to the 2012 NPPF include:

1 Strategic policies should also now consider the 'cumulative impacts in, or affecting, local areas susceptible to flooding' (para 156), rather than just to or from individual development sites (see Section 6.5 of the main report);

2 Future risk from climate change. The 'sequential approach should be used in areas known to be at risk now or in the future from any form of flooding' (para 158) (see Sections 6.6 of the main report and Appendix B);

3 Natural Flood Management. 'Using opportunities provided by new development to reduce the causes and impacts of flooding (where appropriate through the use of natural flood management techniques)' (para 157c) (see Section 5.7.4 of the main report and Appendix B);

4 Sustainable Drainage Systems (SuDS). 'Major developments should incorporate sustainable drainage systems unless there is clear evidence that this would be inappropriate' (para 165) (see Section 6.7 of the main report);

5 Emergency planning. Emergency plans are required as part of a FRA that includes safe access and egress routes (para 163e) (see Section 7 of the main report); and

6 The Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG) sits alongside the NPPF and sets out detailed guidance on how this policy should be implemented.

Flood Risk and Coastal Change Planning Practice Guidance (FRCC-PPG)

F2.11 At the time of writing, the current FRCC-PPG was published on 6 March 2014 (Gov.uk, 2014) (Ref 32).

F2.12 Whilst the NPPF concentrates on high level national policy, the FRCC-PPG is more detailed. The practice guidance advises on how planning can take account of the risks associated with flooding and coastal change in plan making and the development management process. This is in respect of local plans, Strategic Flood Risk Assessments (SFRAs), the sequential and exception tests, permitted development, site-specific flood risk, Neighbourhood Planning, flood resilience and resistance techniques and the vulnerability of development to make development safe from flooding.

Local Flood Risk Management Policy and Guidance

Strategic Flood Risk Assessment

F2.13 Redcar and Cleveland Borough Council published the following:

F2.14 A Level 1 SFRA (Ref 50) in 2010 - this was then revised in 2016 using up-to-date flood risk information together with the most current flood risk and planning policy available from the NPPF and Flood Risk and Coastal Change Planning Practice Guidance2 (FRCC-PPG). The purpose of the SFRA was to initiate the sequential risk-based approach to the allocation of land for development and inform the Adopted Local Plan and Detailed Policies.

F2.15 As Level 2 SFRA (Ref 49) in 2010 - a detailed model was created to supersede the broad scale EA tidal flood risk mapping. The new model took into account natural and manmade restrictions to tidal flooding including the sand dune system at Coatham Sands and the disused railway embankment at Warrenby.

F2.16 In the Level 2 SFRA (Ref 49), when these natural and manmade barriers to flooding are modelled, this 'existing risk' scenario shows that the site is at very low risk from coastal or fluvial flooding. Flood depth and hazard results show that this site could be developed safely. A conservative estimate of undefended flood risk (all barriers to tidal flooding removed) showed that the site is at very low risk of flooding from coastal or fluvial sources. The site lies above the 1 in 200 coastal flood risk level plus sea level rise allowance and within Flood Zone 1. There is however a residual risk of surface water flooding and therefore the proposed development may

increase the rate and volume of runoff. This will need to be attenuated to reduce the risk of flooding to proposed and existing properties. Flood risk can therefore be seen as a more 'residual risk' which can be managed through mitigation measures such as sustainable drainage strategies, with opportunities to create blue-green networks to reduce flow paths at the site. In conclusion, the site as assessed in the Level 2 SFRA should be suitable for the proposed development subject to a detailed flood risk assessment (FRA).

Redcar and Cleveland Local Plan

F2.17 The Redcar and Cleveland Local Plan (Ref 51) was adopted in May 2018 and the SFRA provides the evidence base to make decisions on where to direct new development to ensure development is located in sustainable locations. The adopted Local Plan sets out the long-term land allocations and other planning policies that will guide development proposals in the borough and against which planning applications are determined.

F2.18 Policy outlined in the Local Plan, in relation to flood risk and water management, aim to reduce flood risk, promote water efficiency measures, and protect and enhance water quality through mechanisms.

Local Plan Key Policies

F2.19 There are multiple policies within the Local Plan (Ref 51) that are applicable to the site. A selection of the key policies is highlighted below:

1 "All development proposals will be expected to be designed to mitigate and adapt to climate change, taking account of flood risk by:" "ensuring opportunities to contribute to the mitigation of flooding elsewhere are taken"; "prioritising the use of sustainable drainage systems (SuDS)"; "ensuring the full separation of foul and surface water flows" and "ensuring development is in accordance with the Redcar and Cleveland Strategic Flood Risk Assessment".

2 "For previously developed sites, the peak runoff rate from the development to any drain, sewer or surface water body for the 1-in-1 year rainfall event and the 1-in-100 year rainfall event, must be as close as reasonably practicable to the greenfield runoff rate from the site for the same rainfall event but should never exceed the rate of discharge from the development prior to redevelopment for that event";

3 "Where the drainage system discharges to a surface water body that can accommodate uncontrolled surface water discharges without any impact on flood risk from that surface water body (e.g. the sea or River Tees) the peak flow control standards and volume control standards [attenuation requirement] need not apply." This may be the case for development in the SIZ3 site that where there is discharge into drainage channels which flow directly into the River Tees without any constraints;

4 "The drainage system must be designed and constructed so surface water discharged do not adversely impact the water quality of receiving water bodies, both during construction and when operational. New development should seek to improve water quality where possible, as well maintaining and enhancing the biodiversity and habitat of watercourses";

5 "The Council has a duty to have regard to the Northumbrian River Basin Management Plan[(RBMP) (Ref 36)] to ensure the protection and improvement in quality of the water environment. This is also in accordance with the overall objective of the Water Framework Directive [WFD] to achieve "good ecological status" in all waterbodies (including surface, ground and coastal waters) and not allow any deterioration from their current status"; and

6 "Wherever possible, measures to deal with flood risk and drainage should identify opportunities to maintain and enhance the biodiversity and habitat of watercourses through protecting or restoring natural channel morphology. Actions should also be taken to remove modifications to restore a more natural watercourse and associated biodiversity. Where such removal is not possible or not in the public interest, mitigation measures must be taken to create a more natural watercourse, improve habitats and enhance biodiversity".

Tees Valley Sustainable Drainage Systems Design Guide and Local Standards

F2.20 To enable the practical implementation of the policies outlined in the local plan, a working group from the Local Authorities of Darlington, Hartlepool, Middlesbrough, Redcar & Cleveland and Stockton Borough Councils (Tees Valley Authorities) published the Tees Valley Authorities Local Standards for Sustainable Drainage (2017) (Ref 41).

F2.21 The working group have recently updated the guide to provide an overview of SuDS techniques, policy requirements and produce Tees Valley specific local standards. The document is due to be formally published in 2020 and has been produced to strongly promote the use of sustainable drainage systems and help manage increased surface water runoff from the proposed development to help mitigate flood risk.

F2.22 A Flood Risk and Surface Water Management Strategy is currently being developed for the whole Teesworks area, due in 2021. This will provide a plan for surface water and drainage management for each site within the Teesworks Area and will include details about any changes to current water management and drainage as well as aspirations for improvements and multiple benefits which can be derived. This plan needs to align with the requirements of the Tees Valley SuDS Design Guide and Local Standards.

Climate Change Resilience

F2.23 Addressing climate change is one of the core land use planning principles which the NPPF (Ref 37) expects to underpin both plan-making and decision-taking. The NPPF states that planning should proactively help the mitigation of, and adaption to, climate change including the management of water and flood risk. These requirements are then filtered to a development level through the Local Plan (Ref 51) and SFRA (Ref 49 & 50) which outline the key factors developments must meet in order to gain planning permission.

Flood Risk and Water Management

F2.24 In terms of flood risk, the NPPF sets the current best practice for the application of allowance for climate change. The climate change allowances (prediction) of anticipated change are provided for:

1 Peak River Flow;

2 Peak Rainfall Intensity; and

3 Sea level Rise.

F2.25 Climate change allowances are used for flood risk assessments and design parameters.

Peak River Flows

F2.26 Peak river flow allowances show the anticipated changes to peak flow by river basin district. Redcar is located within the Northumbria river basin district. The application of allowance

category is subject to the Flood Risk Vulnerability Classification and Flood Zone, now and in the future.

Table 2.3 EA Peak river flow allowances, Northumbrian River Basin District (use 1961 to 1990 baseline)

Allowance category	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	20%	30%	50%
Higher central	15%	20%	25%
Central	10%	15%	20%

Rainfall Intensity

F2.27 With respect to surface water flood risk mapping and design of drainage systems (including blue-green networks and minor watercourses with a catchment of less than 5 km^2) the allowances outlined in Table F2.4 below shall be used. The proposed development design life is to be taken as a minimum of 50 years and construction is due to commence in 2028 and is anticipated to be completed in 2031. Current climate change predictions extend to 2115 which is beyond the proposed life of the development. However, as a conservative approach, and because the proposed development has a design life of a minimum of 50 years, the default design parameters are to design for the 20% total potential change in peak rainfall intensity and sensitivity check for the 40%, to consider the future impacts in relation to water management and drainage.

Table 2.4 Peak rainfall intensity allowance in small and urban catchments (use 1961 to 1990 baseline)

Applies across all of England	Total potential change anticipated for the '2020s' (2015 to 2039)	Total potential change anticipated for the '2050s' (2040 to 2069)	Total potential change anticipated for the '2080s' (2070 to 2115)
Upper end	10%	20%	40%
Central	5%	10%	20%

Drought Resistance

F2.28 Current climate predictions show an increased likelihood both in frequency and length, of periods of rainwater scarcity and potential drought conditions. The ability to harvest and reuse rainwater could help in adding resilience by maintaining business continuity during these periods. The rainwater harvesting must be designed using rainfall data and shall take into account the different potential requirements of rainwater by the different businesses which will operate on the site. Improved rainwater harvesting will produce resilience and reduce reliance on piped water infrastructure.

Sea Level Rise

F2.29 There are a range of allowances for each epoch for sea level rise in Northumbria derived from the EA table are shown in Table 2.5.

Table 2.5 EA Sea level allowance for each epoch for Northumbria

Allowance	2000 to 2035 (mm)	2036 to 2065 (mm)	2066 to 2095 (mm)	2096 to 2125 (mm)	Cumulative rise 2000 to 2125 (metres)
Higher central	4.6 (161)	7.5 (225)	10.1 (303)	11.2 (236)	1.03

Upper end	5.8 (203)	10 (300)	14.3 (429)	16.5 (495)	1.43

F2.30 Since the original Tees tidal model was developed by the EA and the above table was published JBA has undertaken an update to the model on behalf of the EA. The update to the model was based on the UKCP18 uplift values utilising 2017 for a base year for extreme sea levels. The tables below summarise the results of the updated modelling on the uplift (mm) per epoch.

Table 2.6 Tees Tidal UKCP18 Tees Tidal Uplift Value

Uplift	Epoch	Updated uplift value (mm)
Present day uplift	2017-2019	0.011
UKCP18 2030 uplift	2019-2030	0.071
UKCP18 2050 uplift	2019-2050	0.249
UKCP18 2070 uplift	2019-2070	0.488
UKCP18 2100 uplift	2019-2100	0.947

Table 2.7 Tees Tidal UKCP18 Tees Tidal Climate Change Uplift Levels

Events	2017-2019 (present day)	2030	2070	2100
T2 (2 year)	3.45	3.52	3.94	4.40
T100 (100 year)	3.98	4.05	4.47	4.93
T200 (200 year)	4.08	4.15	4.57	5.03
T1000 (1000 year)	4.33	4.40	4.82	5.28

Roles and Responsibilities

F2.31 The responsibilities for the Risk Management Authorities (RMA) under the Flood and Water Management Act (Ref 30) and the Flood Risk Regulations (Ref 28) are summarised below

Environment Agency as an RMA

1 Has a strategic overview role for all forms of flooding at the national level;

2 Has the power to request information from any partner in connection with its risk management functions;

3 Must exercise its flood or coastal erosion risk management functions in a manner consistent with the National Strategy and Local Strategies;

4 Must be consulted on Local Strategies, if affected by the strategy, by the LLFA; and

5 Must help advise on sustainable development.

RCBC LLFA as an RMA

6 Must develop, maintain, apply and monitor a strategy for local flood risk management. This must be consulted on with all RMAs, the public and all other partners with an interest in local flood risk, and must comply with the national strategy;

7 Is required to coordinate and share information on local flood risk management between relevant authorities and partners;

8 Is empowered to request information from others when it is needed in relation to its flood risk management functions;

9 Must investigate flooding incidents in its area where it considers it necessary or appropriate;

10 Has a duty to establish and maintain a record of structures within its area that have a significant impact on local flood risk;

11 Is empowered to designate structures and features that affect flooding;

12 Has powers to undertake works to manage flood risk from surface runoff, groundwater and ordinary watercourses;

13 Must exercise its flood and coastal erosion risk management functions in a manner consistent with the National Strategy and the Local Strategy;

14 Must aim to contribute to sustainable development;

15 Is a statutory consultee on planning applications for major developments with surface water drainage considerations; and

16 Should consider flooding issues that require collaboration with neighbouring LLFAs and other RMAs.

Northumbrian Water as an RMA

17 Has a duty to act in a manner that is consistent with the National Strategy and have regard to Local Strategies;

18 Must be consulted on Local Strategies, if affected by the strategy, by the relevant LLFA;

19 Has a duty to be subject to scrutiny from LLFAs;

20 Has a duty to cooperate and share information with other RMAs;

21 Is responsible for managing the risks of flooding from surface water and foul or combined sewer systems providing drainage from buildings and yards.

Highways Service (RCBC) as an RMA

22 Has a duty to act consistently with the National Strategy and Local Strategies;

23 Has responsibility for ensuring effective drainage of local roads in so far as ensuring drains and gullies are maintained; and

24 Must be consulted on Local Strategies, if affected by the Strategy, by the relevant LLFA.

The Local Community

25 Must be consulted on Local Strategies by the LLFA; and

26 Have a key role in ensuring local strategies are capable of being successfully delivered within the community. They should actively participate in this process and be engaged by the LLFA.

Riparian Owners

27 A riparian owner is someone who owns land or property alongside a river or other watercourses including a culvert; and

28 Riparian owners have statutory responsibilities including: maintaining riverbeds and banks; allowing the flow of water to pass without obstruction; and controlling Invasive Non Native Species (INNS).

Developers

F2.32 Have a vital role in ensuring effective local flood risk management by avoiding development in areas at risk of flooding. Local Strategies should form a key element of local planning guidance

F3.0 Assessment Methodology & Significance Criteria

Assessment Methodology

F3.1 This chapter provides an assessment of water management and flooding, incorporating the elements required for a FRA (see Appendix F2 of the ES) as well as examining drainage and hydrogeology. It will therefore closely relate to and reference details included in the Ground Conditions and Remediation chapter (Chapter G) of the ES.

F3.2 The assessment entails a review of existing baseline conditions, consideration of future baseline conditions and an assessment of the beneficial and adverse effects which will result from the change in conditions. Due to the outline nature of the planning application which this ES accompanies, the details of the proposed development are not currently defined and so a number of assumptions have been made (detailed in paragraph F3.14).

F3.3 The assessment is necessary to meet the requirements of the NPPF (Ref 37), the EIA Regulations (Ref 33 & 39) and to support the outline planning application. It will therefore contain necessary details to be consistent with the reporting requirements detailed within the NPPF. The aim of this document is to present relevant information in a clear format that can be reviewed by the Local Planning Authority and the EA to enable them to make an informed decision in commenting on and determining the planning application. It does not guarantee that planning permission will be granted or that proposed development will be acceptable to the EA.

Data Gathering Methodology

F3.4 The assessment undertaken for water management and flooding is desk-based. Data gathered for the assessment originates from three main sources:

1 The most up to date information available on publicly accessible websites and mapping has been used to determine the existing baseline conditions on the site, and in the immediate surrounding area. This has allowed identification of sensitive receptors in both the surface water and groundwater environment, which will need consideration during the design of the site.

2 The assessment is supported by the collection and interpretation of data and information requested from the EA (Environment Agency, 2020a) (Ref 17) and the Roads Department at RCBC (Hill, 2020)(Ref 59) as part of the data request submitted for the preparation of the Teesworks Flood Risk and Surface Water Management Strategy (see paragraph F2.21). They both provided hydrological information in January 2020 in relation to a different planning application whose site is within the boundary of the site which is subject of this ES. The information they provided related to a 2 km radius around the application site for the proposed Grangetown Prairie, Energy Recovery Facility Development (planning reference R/2019/0767/OOM). The request included groundwater abstractions, surface water abstractions, water quality data, discharges and private water supply records. Since the data is publicly available, the data have also been used for the site. The key data and sources of information collected are listed in Table F3.1.

3 The assessment also draws on information provided in previous reports and site investigations which have been completed for the site. Details of these are provided in the table below, referenced where noted in the text and listed in the References section at the end of this chapter.

Table 3.1 Sources of information used for the Hydrology, Hydrogeology and Geology

Source	Data
Ordnance Survey (OS) mapping at 1:50,000 and 1:25,000 scales (Ref 46).	Topography: elevation, relief.
Cranfield University's National Soils Resources Institute Soilscapes website (Ref 10).	Soil type and land use.
Magic Map (Ref 43) Natural England website (Ref 47)	Nature Conservation Sites: Special Areas of Conservation (SACs). Special Protection Areas (SPAs). Sites of Special Scientific Interest (SSSI). EA groundwater vulnerability
The National River Flow Archive (Ref 4)	Climate: rainfall.
EA maps (Ref 14) EA Catchment data explorer (Ref 15) The National River Flow Archive	Surface Water. Surface water courses and flood risk Water quality. River flows.
British Geological Survey (BGS) GeoIndex (Ref 2) Wood (2019), Former Steelworks Land, South Tees - Outline Remediation Strategy (Ref 57) Enviros (2007). Corus Cleveland Prairie Teesside Site Phase 1 Environmental Review. Graphite Resources Ltd. (Ref 27) Wardell (2007). Ground Contamination. Graphite Resources Ltd. (Ref 55)	Solid and drift geology. Site geology and historic land use.
Wood (2019), Former Steelworks Land, South Tees - Outline Remediation Strategy (Ref 57) Enviros (2004), Soil and Groundwater Baseline Characterisation Study Teesside Works - Interpretive Report (Ref 20) Allied Exploration & Geotechnics (2018), The Former SSI Steelworks, Redcar – Ground Investigation Contract – Final Factual Report (Ref 1). Data requested from the EA (2020b, 2020c) (Ref 18 & 19) EA Source Protection Zones and 2009 River Basin Management Plans (Groundwater) (Ref 14)	Groundwater levels. Groundwater vulnerability. Groundwater quality. Abstractions and discharges.
Data requested from RCBC (email from David Kettlewell, 16/11/20).	Private water supplies
EA Flood Risk and Coastal Change guidance (Ref 32).	Peak flow allowances for the Northumbrian River Basin District, sea level rise (SLR), offshore wind speed and extreme wave height allowance tidal uplift and peak rainfall intensity allowances
British Hydrological Society, Chronology of British Hydrological Events Google Newspaper Archives SFRA reports for Redcar, 2010 and 2016 (Ref 50 & 51) National Library of Scotland online mapping (Ref 48)	Flood history and historical land use

Source	Data
Defra / EA Flood and Coastal Defence R&D Programme: R&D Outputs: Flood Risks to People, FD2321/TR2 Guidance Document, 2006 (Ref 11)	Emergency access and egress best practice guidance

F3.5 Significance Criteria

F3.6 The methodology for the assessment of potential impacts follows the generic EIA methodology guided by IEMA (2016) (Ref 40) and current government guidance (Gov.uk, 2020) (Ref 39), and is based on the following principles:

1 Receptor sensitivity (very high, high, medium, low, very low) (see Table F3.2);

2 The magnitude (severity) of the effect (major, moderate, minor, no change) (Table F3.3)

3 The type of effect (long-term, short-term, or intermittent; positive, negative or neutral); and

4 The probability of effect occurring.

Table 3.2 Receptor sensitivity

Sensitivity	Criteria	Examples
Very High	Feature with a high quality and rarity at an international scale, with little potential for substitution. Medium to high flood risk.	Conditions supporting sites with international conservation designations (SAC, SPA, Ramsar sites), where the designation is based specifically on aquatic features. Land use types defined as essential civil infrastructure such as hospitals, fire stations, emergency depots etc.
High	Feature with a high yield and / or quality and rarity at a national scale, with a limited potential for substitution. Low to medium flood risk.	Highly productive aquifers and surface water resources typically used for public water supplies. Public water supplies. Conditions supporting a SSSI. Sites with freshwater fish protected areas. Water quality of receptor water body: Supporting WFD element type (e.g. Priority Substances) classified as 'High', ''Good' or Pass'. Land use types defined as schools, care homes, ground-based electrical and telecommunications equipment.
Medium	Feature with a medium yield and/or quality at a regional scale, or good quality at a local scale, with some potential for substitution.	Medium productivity aquifer and surface water resources typically used for smaller public water supplies or industrial water supplies. Industrial water supplies. Conditions supporting local nature conservation interest (e.g. Local Nature

Sensitivity	Criteria	Examples
	Low flood risk.	Reserve [LNR]), where the interest features are water-dependent. Water quality of receptor water body: Supporting WFD element classified as at least 'Good' in all cases. Other property types, including dwellings.
Low	Feature with variable yield and/or quality at a local scale, with potential for substitution. Negligible flood risk.	Low productivity aquifer and surface water resources typically used for private water supplies or not utilised. Livestock supplies; springs; ponds/lagoons; non-statutory groundwater-dependent conservation sites. Water quality of receptor water body: Supporting WFD element type classified as less than 'Good' in any situation (any supporting element). Undeveloped or agricultural land from a flood risk point of view.
Very Low	Feature with poor yield and / or quality at a local scale, with good potential for substitution.	Unproductive strata. Water quality of receptor water body: Supporting WFD element type classified as 'Poor' or 'Bad', with severely restricted ecosystems and pollution. Small surface water bodies such as drainage ditches and ephemeral ponds that are too small to be classified under WFD and have limited ecological potential due to being artificial or heavily-modified.

Table 3.3 Overview of magnitude of change

Magnitude	Criteria	Examples
Major	Results in complete loss of receptor or major impact on feature, of sufficient magnitude to affect its use / integrity, and which may be irrecoverable or slow to recover.	Major reduction in groundwater levels, flow or quality, reducing use and water body status. Major reduction in groundwater levels or water quality leading to a marked deterioration in conditions that support groundwater dependent terrestrial ecosystem (GWDTE) features. Deterioration in river flow regime, morphology or water quality, leading to sustained, permanent or long-term breach of relevant SSSI conservation objectives (COs), or downgrading of WFD status (deterioration in current thresholds as defined by current WFD status, including supporting WFD elements). Complete loss of resource or severely reduced resource availability to other water users. Change in flood risk resulting in potential loss of life or damage to nationally critical infrastructure.
Moderate	Results in some loss of receptor, or noticeable impact on feature, of sufficient magnitude to affect its use / integrity in some circumstances. Has limited potential to recover.	Moderate reduction in groundwater levels, flow or quality, reducing use and water body status in some circumstances. Moderate reduction in groundwater levels or water quality leading to some deterioration in conditions that support GWDTE features. Deterioration in river flow regime, morphology or water quality, leading to periodic, short-term and reversible breaches of relevant SSSI conservation objectives, or downgrading of WFD status (deterioration in current thresholds as defined by current WFD status, including supporting WFD elements). Water quality status may impact upon potential future thresholds in relation to objective WFD status – potential for prevention of waterbody reaching its future WFD objectives. Minor reduction in resource availability for other water users. Change in flood risk resulting in potential for major damage to property and infrastructure.

Magnitude	Criteria	Examples
Minor	Results in minor impact on feature, with insufficient magnitude to affect its use / integrity in most circumstances. May be fully recoverable.	Measurable reduction in groundwater levels, flow or quality, but with limited consequences in terms of use and water body status. Measurable reduction in groundwater levels or water quality, leading to a minimal change in conditions that support GWDTE features. Measurable deterioration in river flow regime, morphology or water quality, but remaining generally within SSSI COs, and with no change of WFD status (of overall status or supporting element status) or compromise of Environmental Quality Standards (EQSs). No change in resource availability for other water users. Increase in flood hazard in areas with no flood risk receptors e.g. increased flooding of agricultural land. Change in flood risk resulting in potential for minor damage to property and infrastructure.
No/ Negligible change	No perceptible change in the baseline situation.	N/A

F3.8 In terms of the EIA Regulations (Ref 33), it is only those impacts that are likely to have significant positive and/or negative environmental effects that require detailed assessment. As the EIA Regulations guide the assessor to focus on effects that are likely to be significant, the outcome of the assessment of a given effect on a particular receptor in its simplest form would be that it is significant or not significant. However, there may be instances where it is appropriate to further sub-divide the category of 'Not Significant', for example by use of the terms 'Negligible' in terms of the level of effect. The use of the category of 'Negligible' may for example be used in acknowledgement that there are instances whereby there may be an effect, albeit that this is not likely to be significant - and this approach may better facilitate assessment of cumulative effects where cumulatively several slight effects could be significant. With this consideration in mind, **Error! Reference source not found.** illustrates a matrix, which has been used for guidance in the assessment of significance. Where 'Substantial', 'Moderate', 'Minor' or 'Negligible' is referenced as a level of effect, this can be either Beneficial or Adverse.

F3.9 Having defined a level of effect, professional judgement, in combination with guidance and standards are then applied to identify which of those levels of effect are then considered to be equivalent to significant effects when discussed in terms of the EIA Regulations (Ref 33). Those levels of effect which are shaded in **Error! Reference source not found.** equate to those considered 'Significant' under the EIA Regulations with the others constituting no effect or an effect which is 'Not Significant'.

Table 3.4 Derivation of the level of effect

		Receptor sensitivity				
		Very High	High	Medium	Low	Very Low
Magnitude of change	Major	Substantial	Substantial	Substantial	Moderate	Minor
	Moderate	Substantial	Substantial	Moderate	Minor	Neutral/ Negligible
	Minor	Moderate	Moderate	Minor	Neutral/ Negligible	Neutral/ Negligible
	No/ Negligible Change	Neutral/ Negligible	Neutral/ Negligible	Neutral/ Negligible	Neutral/ Negligible	Neutral/ Negligible

Key: Shaded Cell = Significant in terms of EIA Regulations.
Unshaded cell = Not significant in terms of EIA Regulations.

F3.10 Effects that are forecast to be Moderate or Substantial are considered to be Significant for the purpose of this assessment.

F3.11 It should be noted that the type of categorisations illustrated in **Error! Reference source not found.** provide a guide only, and may be moderated based upon professional judgement and experience. In particular, the divisions between categories of receptor sensitivity, magnitude of change, and level of effect should not be interpreted as definitive, and the lines that represent the boundaries between categories should in many cases be considered as 'blurred'. Where the level of effect is considered to be minor or less, these are generally not deemed significant in terms of the EIA Regulations (Ref 33). However, depending on the receptor being considered, it is possible that some potentially minor effects could be judged as significant in terms of the EIA Regulations, and where this is judged to be the case, the rationale for this conclusion has been provided in this chapter.

Consultation

F3.12 Lichfields has informally scoped the proposed development with Officers at RCBC, agreeing that Water Management and Flooding during the construction and operational phases should be scoped into the assessment. This is not a formal Scoping Opinion under the EIA Regulations. A description of this scoping is provided in Chapter A of the ES and the Scoping Note issued to RCBC and relevant correspondence is provided at Appendix A2.

F3.13 Consultation has also been undertaken with Northumbrian Water, the Environment Agency and Natural England, as discussed in **Error! Reference source not found.** below. It should be noted that the consultation initially focussed on the Flood Risk and Surface Water Management Strategy for the wider Teesworks area, which is being developed concurrently with this ES for the proposed development. Therefore, consultation consists of high level comments provided for the strategy and the confirmation that these comments can be applied to this site. These have also been referenced in the FRA (see Appendix G2 of the ES). It is anticipated that further consultation will be undertaken with these organisations during the strategy and the detailed design development of the proposed development.

F3.14 Full details of the information provided in the informal scoping note are provided in Appendix A2 and the responses received in relation to Water Management and Flood Risk are provided in Appendix F1 to the ES.

Table 3.5 Summary of relevant consultee consultation

Consultee	Consultation
Redcar and Cleveland Borough Council2	Drainage - proposals will be determined and included as part of the Flood Risk and Surface Water Management Strategy and further developed at design stage of the project. Noted to be acceptable in principle Flooding - The proposed finished floor level for the site is to be a minimum of 5.03mAOD which is equivalent to the 1 in 200 year coastal flood risk and sea level rise allowance to the 2100 design scenario. The site currently lies within Flood Zone 1 which means it has a chance of flooding of less than 0.1% - equivalent to the 1000 year event. Current ground levels generally range from 9mAOD to 11mAOD which would mean that there are no areas at risk from inundation. A high-level site-specific FRA is being undertaken for the site. Noted to be acceptable in principle Local and National plans and policies - have been considered. Noted. Climate change – the ES will consider the impact of climate change on water levels (as per the baseline assessment using government guidance). Need confirmation that wave overtopping and freeboard are not considered significant. Noted. Water quality – In line with the Tees Valley design guidance (Ref 53) all surface water runoff will require SuDS treatment and attenuation prior to discharge into the Tees or local watercourses. Pollution control measures advised in the water strategy, such as bunding of potential sources of contamination, will be implemented in order to prevent potential contamination incidents to the Tees. Note that SuDS are a general aspiration for the Teesworks area, and the feasibility of SuDS will be commented on in the below sections of this ES chapter.
Northumbrian Water	Blue green strategies need to be discussed with the Lead Local Flood Authority for this area as they are responsible for the governance on the management of surface water. In terms of ascertaining available capacity available in Northumbrian Water's network to accommodate flows from the proposed development, a request should be submitted to the Northumbrian Water Pre-Planning Enquiry Application should be made which will incur a fee. It is anticipated that this will be undertaken by the team developing the Flood Risk and Surface Water Management Strategy for the site (outwith this project scope for the SIZ3 site).
Natural England	Consultation has not been undertaken to date with Natural England in relation to Water Management and Flood Risk, however it is anticipated that an assessment of cumulative effects will need to be considered as well as the impact of climate change on the water environment. Consultation with Natural England shall therefore be undertaken when details are known about the drainage strategy. Consultation shall be undertaken as part of the required assessments (WFD Assessment) that shall be undertaken prior to construction (as detailed in the Mitigation Section of this Chapter).
Environment Agency3	Consultation has been sought with the EA. As full details of the proposed development are not available at this time, further consultation will be required as the site develops. The EA's 'Planning advice for developers - Frequently Asked Questions' document, summarises the environmental issues for which the EA are responsible and forms free advice at the pre-application stage. Further guidance and site specific advice can be provided for a fee chargeable per hour, but as the form for this requires details of the site layout and proposed works (details which are not yet available), this has not been undertaken for this high level assessment for the site. The key points in the guide are: that a FRA is required; LLFA consultation is required for surface water management; SuDS should be carefully considered; land contamination and pollution prevention needs to be considered; if a proposal affects surface waterbodies a WFD assessment is

2 Email from Nigel Hill of Redcar and Cleveland Borough Council dated 24th Nov 2020.
3 Email from Caitlin Newby of the Environment Agency dated 26th Nov 2020.

Consultee	Consultation
	required demonstrating how the development will prevent deterioration and improve the waterbody's ecological status; the opposition of the EA to culverting. It is therefore anticipated that a WFD assessment will be requested once Flood Risk and Surface Water Management Strategy and design is developed, to assess the impact of discharges to the Tees and protected areas in and surrounding the site. Also, an environmental permit is required for any activity that may pollute the air, water or land; increase flood risk; or adversely affect land drainage and work on or near main rivers requires a permit. The River Tees is designated as a main river but as the other watercourses (open and culverted) across the site are not main rivers, the EA guidelines advise contacting the local council or internal drainage board to check if land drainage consent is required. Permits are generally required for: any activity within 8 metres of the bank of a main river (or 16 metres if it is a tidal main river) and any activity within 8 metres of any flood defence structure or culvert on a main river (or 16 metres on a tidal river).

Assumptions and Limitations

F3.15 The following assumptions and limitations have been made when considering the future baseline conditions as well as the design and construction of the proposed development: -

1 As the planning application is submitted in outline, the final site layout and drainage details are not known at this stage. The chapter is therefore a high-level assessment of water management and flooding and the detailed drainage and Flood Risk and Surface Water Management Strategy will be considered at the reserved matters stage of the planning process. This point is picked up in Section F6.0: Mitigation and Monitoring;

2 The Flood Risk and Surface Water Management Strategy and drainage plan, with the exception of modified discharge infrastructure, will not change the physical nature of the Tees bank;

3 Construction works are not anticipated to be undertaken within 16m of the tidal Tees (the minimum limit under which an Environmental Permit for construction works near a tidally influenced river is required) as the site lies more than 16m from the Tees;

4 Environmental Permits will likely be required for the proposed activities on site including for the drainage and discharge of surface water to the Tees and possibly including industrial or manufacturing activities on site;

5 Ground conditions will not have significantly changed from the latest contamination and ground investigation reports undertaken prior to 2019; and

F3.16 No works associated with demolition shall be undertaken to below ground infrastructure until details of the culvert / pipe conveying Boundary Beck beneath the site are ascertained from ground surveys. Any necessary works to Boundary Beck culvert and Kinkerdale Beck culvert, including diversions, will be undertaken via demolition consents.

F4.0 Baseline Conditions

F4.1 The site is located in the South Industrial Zone (SIZ - SIZ3) of the Teesworks area as part of the Lackenby development. The site is 35.8ha (358,000m²) in size and comprises brownfield land which includes buildings and structures associated with the former SSI BOS and CONCAST steelworks and Tata Steel's vacant coil plate mill. The site topography is generally flat apart from the small mounds to the south and west of the site associated with previous steelmaking facilities. Elevations at the site are mostly between 9mAOD to 11 mAOD. There are varying surface elevations across the site including a cluster of high elevation regions to the south east of the site which are a legacy of the previous steelworks, observed from topographic survey data gathered on site, which lie approximately 1m above average ground levels. This description is detailed in Section 2.1 of the FRA (Appendix F2).

Climate

F4.2 The Flood Estimation Handbook (FEH) (Ref 54) gives the Standard Percentage Runoff (SPR) near the site as being approximately 37%. The SPR is the percentage of rainfall responsible for the short-term increase in river flow during and/or following a rainfall event.

F4.3 The Baseflow Index ('BFI') for the area (excluding the Estuary) is 0.39. This is the proportion of total local streamflow which is mostly groundwater input.

F4.4 The FEH also includes long-term average rainfall data for catchments in the UK. For the catchment in which the site is located, the Standard Annual Average Rainfall ('SAAR') is 619-mm/yr.

F4.5 In summary, the area experiences less rainfall than the national average (885 mm), with moderate runoff rates and a moderate proportion of groundwater input to river flow.

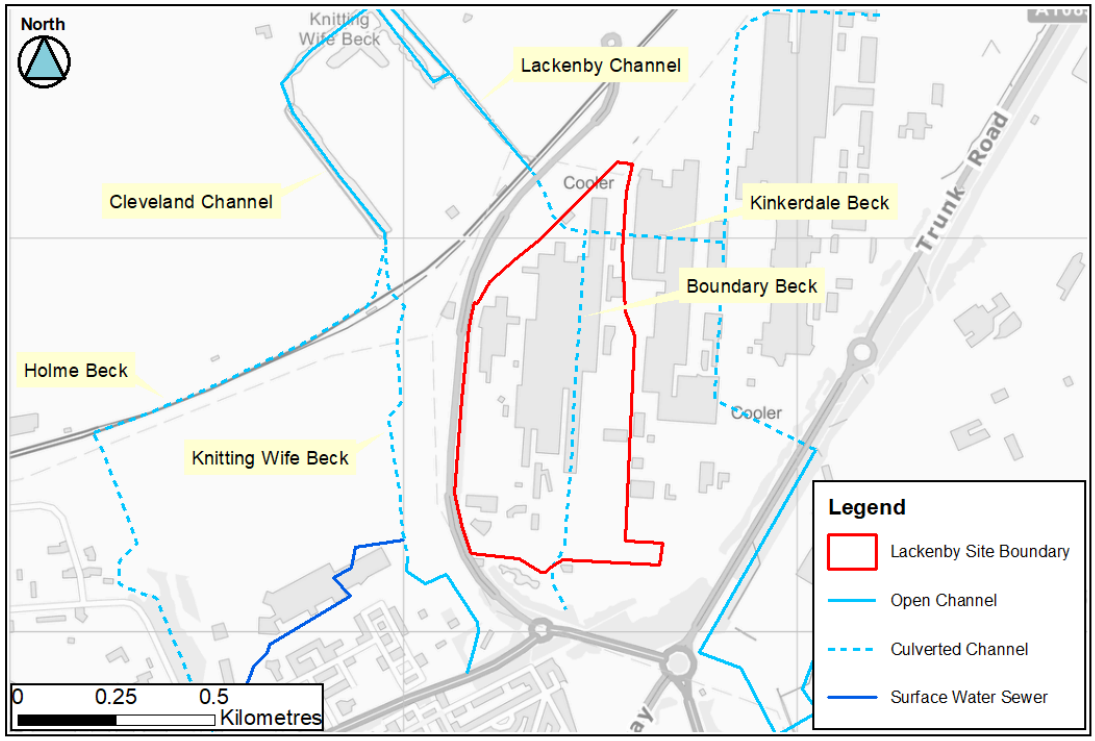
Surface Water Bodies

F4.6 The site lies within the catchment of the River Tees that lies approximately 2km north east of the site. It is also within the catchment of one waterbody – the Lackenby channel, into which the two culverted watercourses within the site drain. The Lackenby channel discharges into the River Tees via the Lackenby outfall.

F4.7 The main watercourse through the site is the Boundary Beck culvert. Within the northern area of the site, Boundary Beck converges with the Kinkerdale culvert. Flows from these watercourses join the Lackenby channel north-west of the site in an area associated with iron and steel production. In the Lackenby channel downstream of the confluence with the Cleveland channel there is an in-channel structure assumed to act as a tidal weir. Beyond the weir the Lackenby channel is a deep large open channel that drains to a culvert of unknown dimension which conveys flows below Teesport to an outfall on the River Tees.

F4.8 The hydrological catchment of the Boundary Beck down to NZ 55222 21911 has an area of approximately 7.5km². The larger Lackenby channel catchment, which encompasses the Boundary Beck, down to NZ 54600 22950 has an area of approximately 8.3km². The catchment drains from the south-east to the north-west. It rises on Eston Moor to the south east of the site at elevations of 240mAOD and drains north west, declining to an elevation of approximately 10-11 mAOD at the site. The FARL value of 0.844 for the catchment indicates there is capacity for water storage within the catchment, this includes the reservoirs either side of the A174 and the wide open Cleveland channel that runs parallel to the Lackenby channel north west of the development site.

Figure 4.1 Open and culverted waterbodies at and surrounding the site



Flood Risk

Introduction

F4.9 There are several potential sources of flooding that could impact any site; these are fluvial (originating from a watercourse), coastal, groundwater, surface water (pluvial), sewers and blocked culverts and infrastructure failure.

F4.10 The Flood Risk Assessment undertaken for the site forms Appendix F2 of this chapter. The key findings from the assessment are summarised below.

Fluvial Flooding

F4.11 The site is at very low risk from fluvial flooding. The site is entirely in Flood Zone 1, meaning it has a less than 1 in 1000-year annual probability of flooding from river or sea. The flood extents for this mapping are created using coarse scale UK wide fluvial modelling, and incorporates more detailed modelling of specific rivers undertaken for the EA. The watercourses through the site are too small to be included in the coarse modelling and will not have previously been modelled by the EA so any fluvial flooding from these will not be captured in this mapping. However, there is unlikely to be any fluvial flooding on site due to the nature of the culverted watercourses and the elevation of the site. There are open channels to the north west of the site where the Cleveland and Lackenby channels are present however any flooding from these channels is unlikely to reach the site.

Coastal and Tidal Flooding

F4.12 The site is at a very low risk from coastal flooding. As part of the Level 2 Strategic Flood Risk Assessment (SFRA) (Ref 49), a detailed model was created to supersede the broad scale EA tidal flood risk mapping. The modelling shows inundation along the A1053 Tees Dock Road from coastal sources however this will not occur within the site.

Surface Water Flooding

F4.13 The site is at a moderate risk from surface water flooding. The EA flood map (in the FRA in Appendix F2) shows the site is at some risk from surface water flooding. There is no clear area of flow path present, just many small areas of isolated extent in low spots. High level modelling of surface water undertaken as part of the Phase 1 study for the Teesworks Water Management Strategy indicates there are areas of the site that may be susceptible to surface water flooding, due to variations in surface elevations. These areas are also shown on the Level 2 SFRA (Ref 49). The Level 2 SFRA also indicated that the potential access roads to and from the site are susceptible to surface water flood risk. Two potential access roads are identified for the site – one to the southern site boundary, which joins the A1053, and one from the south western site boundary, which is off Tees Dock Road. The SFRA Level 2 mapping (Ref 49) indicates that the access point from the southern site boundary onto the A1053 is at low susceptibility to surface water flooding along the A1035. However, mapping indicates that the access point from the south western site boundary leads into an area of high susceptibility to surface water flooding, however this risk is associated with the A1053.

Climate Change

F4.14 Tidal flood levels, fluvial flows, sea level and rainfall are all predicted to increase with climate change, in accordance with EA defined flood risk guidance (Ref 32). Climate change allowances have been considered. 5.03mAOD represents the 200 year Coastal Flood Risk + Sea Level Rise Allowance to 2100 design scenario. As previously noted, the proposed development design life is to be taken as 50 years but as a conservative approach these climate change projections to 2100 and beyond have been used to consider the future impacts in relation to water management and drainage. According to the detailed model created to supersede the broad scale EA tidal flood risk mapping (which takes into account sea level rise), the site is not deemed to be within the extent of coastal flooding and therefore risk is very low.

F4.15 In accordance with Planning Practice Guidance (Ref 38), the proposed development is considered to be in the 'Less vulnerable' category, therefore, the proposed development is appropriate in Flood Zone 1 (outside of 1000 year flood).

Water Framework Directive (WFD)

F4.16 Any activity which has the potential to have an impact on the ecology of a water body will need consideration in terms of whether it could cause deterioration in its Ecological Status or Potential and impact the water body's ability to achieve its WFD Objectives through a Water Framework Directive (WFD) Assessment. For each water body, three different status objectives are identified within the River Basin Management Plan (RBMP) (Ref 36). These are the overall status objective, the ecological status or potential objective and the chemical status objective. A default objective for all water bodies is to prevent the deterioration in the Ecological Status (or Ecological Potential for Heavily Modified and Artificial Water Bodies) of the water body, as detailed in the Water Framework Directive (Directive 2000/60/EC) (Ref 35).

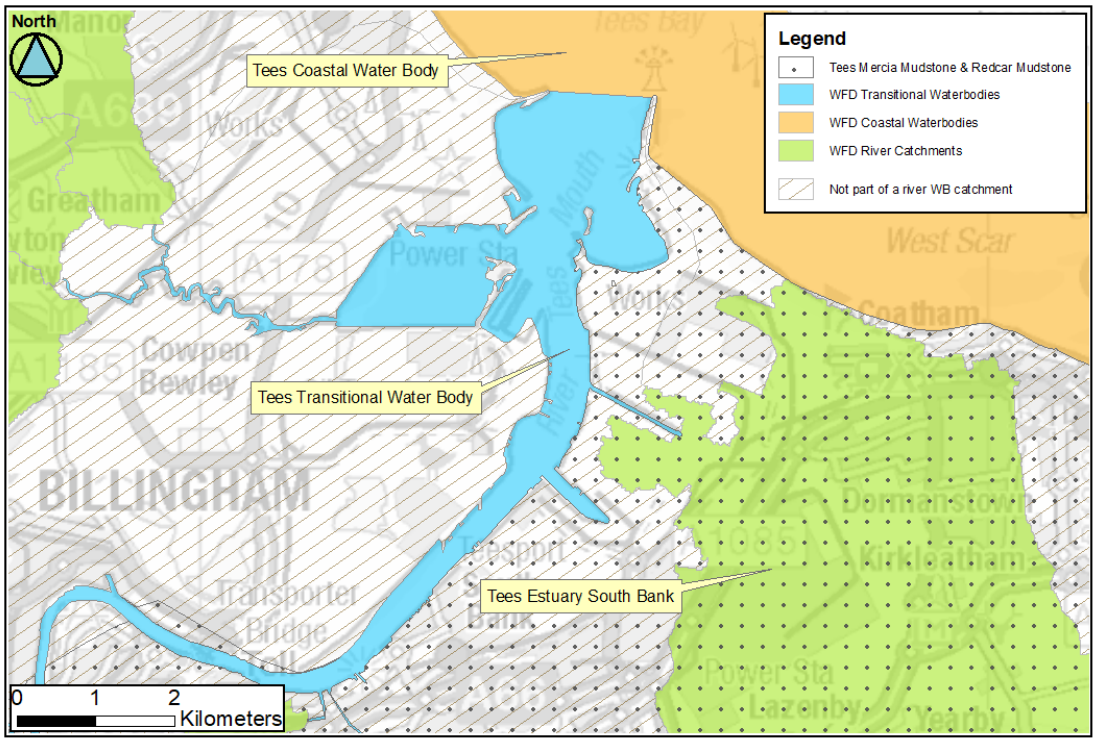
F4.17 The four WFD water bodies relevant to the site are outlined in the table below.

Table 4.1 WFD Water Bodies

Water Body ID	Water Body Name	Hydromorphological designation	Current Overall Status	Overall Status Objective
GB40302G701300	Tees Mercia Mudstone and Redcar Mudstone	N/A (Groundwater Body)	Poor	Poor (2015)
GB103025072320	Tees Estuary (S Bank)	Heavily modified	Moderate	Good (2027)
GB510302509900	Tees	Heavily modified	Moderate	Moderate (2015)
GB650301500005	Tees Coastal	Heavily modified	Moderate	Good (2027)

F4.18 The site is located within the Tees Mercia Mudstone and Redcar Mudstone Groundwater water body (GB40302G701300), 1.3km south east of the Tees (transitional water body) (GB510302509900), 4.4km south west of Tees Coastal water body (GB650301500005) and is 0.1km north west of Tees Estuary (S Bank) water body (GB103025072320) as shown below in **Error! Reference source not found.**. The Tees Estuary (S Bank) WFD water body is facing pressures from priority hazardous substances and physical modification from urbanisation.

Figure 4.2 WFD waterbodies surrounding the site



F4.19 Under the WFD, the EA has produced nine 'RBMP' for England to manage water quality targets and river basin planning, with the Northumbrian River Basin Management Plan being relevant to the site.

Geology and Soils

F4.20 Whilst the underlying geology is not considered to be a receptor, the geological environment controls the behaviour and quality of the groundwater and potential pathways to receptors and

is, therefore, described as part of the baseline conditions at the site. A more detailed description is found in Chapter G (Ground Conditions) which also considers existing contamination sources and their impacts on water body receptors.

F4.21 The site lies on ground reclaimed from the sea. The site is covered by a layer of Made Ground predominantly comprising deposits of slag of variable thickness and composition. This reflects the historic development of the site for the iron and steel making industry along the South Tees corridor (for more details of ground conditions and remediation, see Chapter G of this ES).

F4.22 Below the Made Ground, the BGS Geoindex (Ref 2) indicates that the superficial deposits across the site comprise glaciolacustrine deposits of clay and silt (Figure F4.2). To the north, deposits comprise Tidal Flat deposits (of sand, silt and clay) overlain by Made Ground.

F4.23 Nine borehole records across the site from Geoindex (from NZ52SE13551/2 in the north, to NZ52SE176 in the south) indicate that slag lies within the topsoil, and overlies laminated brown silty clays (Tidal Flat deposits), which extend beneath this to ~7-9 m below ground level (mbgl) over Boulder Clay, to rock head at ~9-10 mbgl.

F4.24 Historical data indicate that the boundary between the Glaciolacustrine and Tidal Flat deposits lies further north than that indicated by the BGS (Ref 5).

F4.25 The UK Soil Observatory viewer indicates that the Soilscapes Mapping for England and Wales category for the site is for slowly permeable, seasonally wet, slightly acid but base-rich loamy and clayey soils in the south of the site, and loamy and clayey soils of coastal flats with naturally high groundwater, in the north of the site.

F4.26 The bedrock geology of the site comprises mudstones of the Mercia Mudstone Group, with the Penarth Mudstone Group and the Redcar Mudstone Formation to the southeast (Figure F4.3). The Mercia Mudstones overlie the Sherwood Sandstones which occur at some 400-500 mbgl.

F4.27 Intrusive investigations have been undertaken across the site, associated with historic phases of work on the site. This includes outputs of work undertaken in 2005 and summarised in the Phase 1 Environmental Review carried out for the site by Enviros (2007) (Ref 21). A more detailed summary of the ground conditions reported from this investigation is provided within their report. Other reports have since summarised site conditions (CH2M, 2017; Allied Exploration & Geotechnics, 2018) (Ref 5 & 1).

F4.28 The ground conditions generally concur with those in published data, although there is uncertainty whether the Glaciolacustrine deposits are dominated more by Tidal Flat deposits. Nonetheless, limited Made Ground is indicated on the BGS online mapping, yet the site's extensive industrial history suggests Made Ground to be extensive.

F4.29 A summary of the geological units is presented in Table F4.2.

Table 4.2 Summary of geological units present at site

Unit	Description	Average Depth (mbgl)	Aquifer Type
Made Ground	Variable Light grey to dark grey slag with cobbles and boulders	Up to ~4	N.A.
Tidal Flat deposits	Firm laminated brown silty CLAY	Up to ~6	Undifferentiated Secondary Aquifer
Glaciolacustrine deposits	Firm brown or grey mottled silty CLAY	In pockets, up to ~6	Unproductive
Glacial Till	Firm or stiff, locally soft to firm, locally hard, reddish brown, locally dark brown locally fissured silty sandy gravelly CLAY with rare sand layers.	Up to ~10	Unproductive
Mercia Mudstone Group	Reddish brown occasionally green weathered MUDSTONE	To depth	Secondary B
Penarth Group	Grey/black MUDSTONES, some LIMESTONES/SANDSTONES	To depth	Secondary B
Redcar Mudstone Formation	Grey fossiliferous fissile MUDSTONES and SILTSTONES	To depth	Secondary undifferentiated

F4.30 The area is identified as being of low geological hazard risk (shrink swell, running sands, landslide), and is not located within a Coal Mining Area.

Figure 4.3 Bedrock Geology

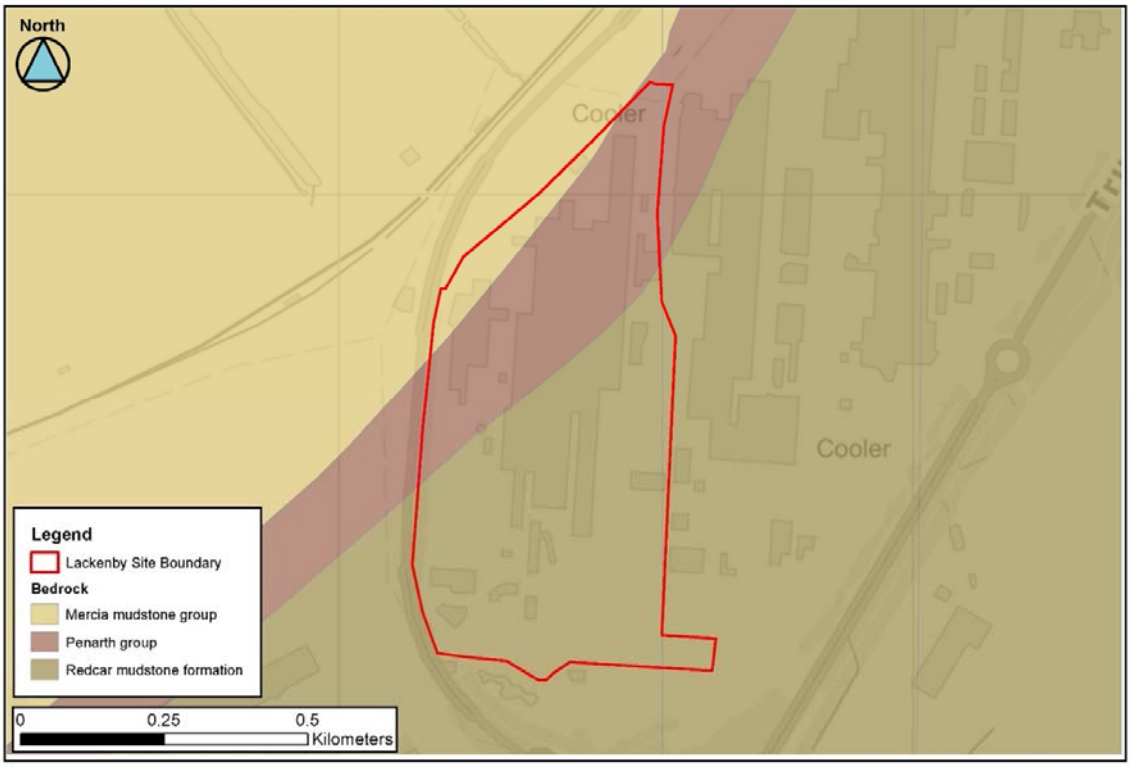
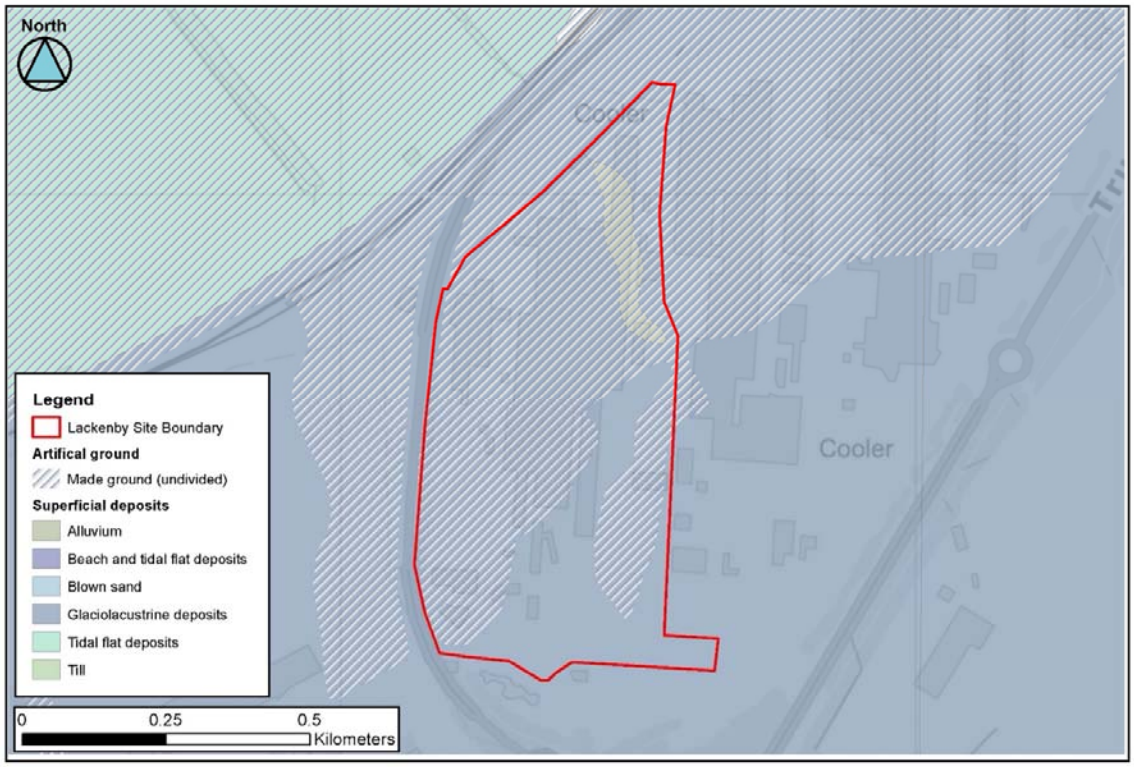


Figure 4.4 Superficial Geology



Land Quality

F4.31 Existing land quality and its potential impacts on receptors is considered in the ground conditions and remediation chapter (Chapter G of this ES). The site is covered with extensive deposits of Made Ground and contains a number of potential sources of contamination.

Hydrogeology

Aquifer Classification

F4.32 The Mercia Mudstone Group and Penarth Group are classified as a Secondary B aquifer, defined by the EA as predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers. In this case, the largely argillaceous sequence with occasional sandstones yields less than 0.5 L/s of water that can be highly mineralised. The Redcar Mudstone Formation is classified as a Secondary (undifferentiated) aquifer, which 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 lithology. Here, the largely mudstone dominated sequence forms only local aquifers yielding small supplies.

F4.33 The Tidal Flats deposits are also classified as a Secondary (undifferentiated) aquifer.

F4.34 The local water table lies within the Made Ground layer between 1-3 mbgl (Ref 1). This water is likely to be perched on the underlying deposits, with a limited groundwater gradient due to the flat topography.

F4.35 The conceptual understanding of the overall groundwater functioning of the site is for direct recharge through the Made Ground, which is of varying permeability. Below this, the ground is likely to be mainly saturated within the Tidal Flat/Glaciolacustrine deposits and underlying Glacial Till and bedrock mudstone. Groundwater heads within the more permeable units are likely to vary across the site and the more permeable horizons may not be laterally continuous across the site, so there may be local variations in groundwater elevation. Nonetheless, parts of the site are likely to be in hydraulic connectivity with the River Tees, particularly through the Tidal Flat/Glaciolacustrine sand/gravel horizons, and a potential pollution linkage may exist between the two. There may also be some limited discharge of baseflow from the Mercia Mudstone Secondary B aquifer to the River Tees, which is likely to form the most significant groundwater discharge boundary in this area for all permeable strata.

Groundwater Quality

F4.36 Groundwater vulnerability beneath the site is low/medium-low. This relates to the vulnerability of the secondary undifferentiated Tidal Flat deposits aquifer.

F4.37 The groundwater quality of the Tees Mercia Mudstone and Redcar Mudstone groundwater body (ID GB40302G701300) has been assessed by the EA in 2016 as having a WFD status of 'Poor' in the Northumbrian RBMP (Ref 15). This appears to be due to the general chemical status in relation to the ironstone mining history of the area and due to risk of nitrate contamination (Ref 16).

F4.38 Source Protection Zones (SPZs) (inner, outer and total catchment) are defined around abstraction boreholes that are used for public water supply (see below), to help monitor the risk of contamination from any activities that might cause pollution in the area. The closer the activity, the greater the risk is likely to be. The zones are used in conjunction with the EA's GP3 to set up pollution prevention measures and monitor the activities of potential polluters near public water supply boreholes. The site does not lie within a defined SPZ, nor is within 5 km of one.

F4.39 Numerous ground investigations have been undertaken across the site (see Chapter G Ground Conditions and Remediation). For example, CH2M (Ref 5) summarised that elevated concentrations of sulphates have been observed in the groundwater, although the samples were deemed to have 'acceptable levels for the proposed end use of commercial/industrial'. Nonetheless, the groundwater quality is poor overall, reflecting the protracted history of industrial activities on the site.

Abstractions and Discharges

F4.40 Available information from the EA indicates that there are several abstractions within 5 km of the site (Ref 19) and are shown on Figure F4.4. Of these, the groundwater abstractions are all located on the north side of the River Tees and, due to the hydraulic barrier formed by the River Tees, it is unlikely that any of these abstractions have their catchment within the site of the proposed development.

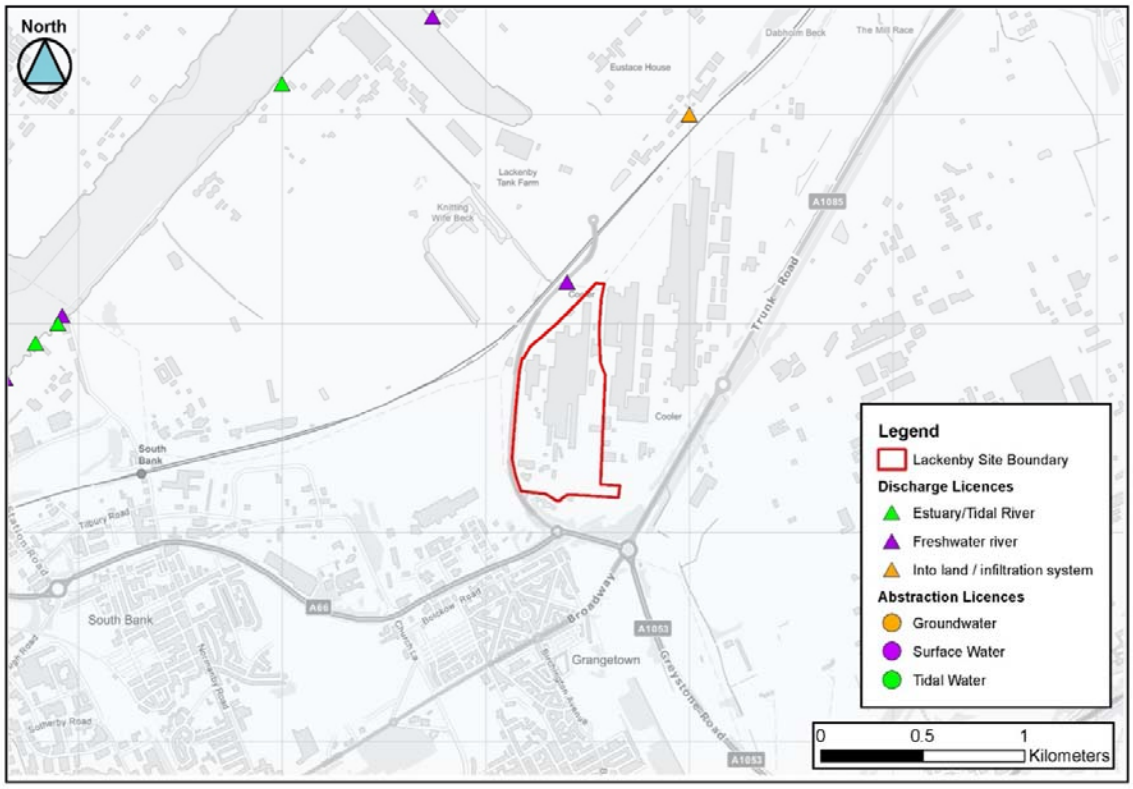
F4.41 The nearest licenced abstraction lies on the south bank of the River Tees, downgradient of the site. The abstraction on the south bank of the River Tees is for dust suppression and power station cooling.

F4.42 Discharge data provided by the EA (Ref 19) indicate that there are numerous active consented permits within the vicinity of the site which are shown on **Error! Reference source not found.**. None of the discharges lie within the site. All the discharges are for sewage or trade effluent, issued to ground/infiltration, surface water or tidal water receiving water bodies.

F4.43 On the basis of the above information, no abstractions or discharges are deemed to be potentially impacted by the proposed development. None of the other discharge-receiving waterbody locations are likely to have their flows or water quality altered by the proposed development.

F4.44 RCBC confirmed that there are no abstractions for private water supply within 2 km of the site. Whilst every effort has been made to locate private water supplies, there is the potential for unrecorded private supplies to be present but this unlikely given the local hydrogeological conditions (e.g. historic contamination and poor aquifers).

Figure 4.5 Abstractions and Discharges



Nature Conservation Sites

F4.45 There are no sites designated for geological importance within the footprint of the proposed development.

Summary of Receptors and their Sensitivity

F4.46 From consideration of the baseline characterisation, a sensitivity classification has been allocated to each identified water environment receptor, and these are set out in **Error! Reference source not found.**. The receptor sensitivity allocated is based upon the

definitions set out within **Error! Reference source not found.** and utilising professional judgement.

Table 4.3 Sensitivity of water environment and human health receptors

Receptor	Rationale	Sensitivity
Surface water		
River Tees estuary	Under the EA's Catchment Explorer, as noted in Section F4.17 the Tees estuary is comprised of three WFD waterbodies – Tees Estuary (S Bank) (inland), Tees (the transitional waterbody) and Tees Coastal (coastal waterbody) and all are classified as being of 'Moderate' ecological potential and 'Failing' chemical status with an overall classification of 'Moderate' in 2016. Reasons for the classifications include diffuse and point source pollution from contaminated water body bed sediments, trade / industrial activity and sewage discharge. In addition, the whole estuary area holds an international designation (Teesmouth and Cleveland Coast SSSI) and the site lies within a zone of interest for the SSSI. Therefore, the sensitivity of the Tees estuary is considered to be very high.	Very high
Kinkerdale Beck (culvert) and Boundary Beck (culvert)	These two waterbodies have been altered historically so they are both culverted beneath the site. The channels are too small to be classified under WFD as they have limited ecological potential. As such, the sensitivity of these watercourses is considered to be very low.	Very Low
Cleveland and Lackenby Channels	These channels are interconnected, and therefore taken together as one receptor. In effect, they are now part of the rerouted Holme Beck, with limited ecological potential. In addition, the Cleveland Channel is anticipated to be filled with highly contaminated water and sediments in light of the contamination of the surrounding ground and heavy industry. For both watercourses, the channels are too small to be classified under WFD as they have limited ecological potential. As such, the sensitivity of these watercourses is considered to be very low.	Very Low
Groundwater		
Mudstone bedrock aquifers	The site sits on a bedrock aquifer of low-moderate groundwater potential. Although the current overall status of the WFD groundwater body which dominates the site is 'Poor', the overall groundwater resource only yields limited amounts of groundwater, as a Secondary B/ undifferentiated aquifer, and is therefore regarded as of low sensitivity.	Low
Superficial aquifers (Made Ground, Glaciolacustrine deposits, Tidal Flats and Glacial Till)	The site sits on superficial deposits overlying the bedrock which are classified as a Secondary (undifferentiated) aquifer. Due to the Poor aquifer status, lack of resource potential, and presence of known contaminants at the site, and lack of local use for abstraction, it is therefore regarded as being of low sensitivity.	Low

F4.47 Whilst the Cleveland and Lackenby Channels flow into the Tees transitional WFD waterbody that is then connected to the Tees Coastal WFD waterbody. This Tees Coastal WFD Water body is located some distance (4.9km) downstream of the Tees transitional water body. Thus, due to the extent of distance between the Tees Coastal WFD water body and the Cleveland and

Lackenby Channels (and the small water bodies which flow into these channels), the hydrology is unlikely to be connected and so the Tees Coastal WFD water body is therefore scoped out of further assessment.

F4.48 In addition, the Tees Estuary (S Bank) WFD waterbody is also scoped out of further assessment since Lackenby or the waterbodies which run through Lackenby are not hydrologically connected to the Tees Estuary (S Bank) WFD waterbody. (As shown in **Error! Reference source not found.**)

F4.49 The Boundary Beck and Kinderdale Beck are hydrologically connected to the Lackenby Channel which discharges to the Tees (transitional) WFD waterbody. Thus the Tees (transitional) WFD waterbody remains scoped into this assessment.

F4.50 Whilst the watercourses to the west of the site (Knitting Wife Beck and Holme Beck) shown in Figure F4.1 drain to the Lackenby Channel along with the Boundary Beck and Kinkerdale Beck, these latter two waterbodies are not directly connected and so have been scoped out of this assessment.

F4.51 Previous intrusive investigations and site history has confirmed that, the site of the proposed development is generally devoid of natural surface soil resources, and that significant deposits of Made Ground are present across the entire site and surrounding landholding. Therefore, due to the historic industrial nature of the site and absence of natural surface soils, soils are not an agricultural resource and are not considered to be a sensitive receptor in this respect. Therefore, a soils impact assessment has not been carried out.

Future Baseline

F4.52 The site is allocated for general employment use in the RCBC Local Plan.

F4.53 The two main influences on the future hydrological and hydrogeological regime of the site and surrounding area are climate change and local land use change, which have the potential to change the river flow regime (through changes in rainfall patterns and storm surges as a result of climate change and sea level rises) and ground permeability and runoff/infiltration (through changes in land use).

F4.54 The UK Climate Projections (UKCP18) (Ref 45) indicate that as a result of climate change, it is projected that, in general, winters will become wetter and summers drier. The EA via the Gov.UK website provides recommended climate change sensitivities for peak river flow, peak rainfall intensity and sea level rise. Potential climate change sensitivities can be used to derive appropriate design levels above which the proposed development shall be constructed. The lifespan of the proposed development is assumed to be at a minimal 50 years, but as the final layout and design is yet to be finalised, a conservative approach has been taken and the data examined up to 2100. Details of the estimated increases to peak river flow, peak rainfall intensity and sea level rise are provided at paragraph F2.25.

F4.55 The effect of these projections regarding decreased summer rainfall and increased winter rainfall is likely to be greater seasonality of flows and water levels, with greater susceptibility to both drought and extreme flood events. The increased frequency of floods increases the likelihood of morphological changes in watercourses.

F4.56 In the absence of the proposed development, or any other development, proceeding, it is anticipated that the land use, management of the site and condition of the water bodies at the site and in the surrounding area would remain the same as the current baseline as described above and in the FRA (Appendix F2).

F4.57 It is considered unlikely that the site will remain in its current state given the its allocation for general employment use in the RCBC Local Plan (Ref 51), and the aspirations of STDC as outlined in the South Tees Regeneration Master Plan (as described in sections B4.0 and B5.0 of Chapter B of the ES) (Ref 52). It is considered likely that an employment development of a similar nature and scale to the proposed development would come forward on the site in the absence of the proposed development. It is likely that this would have similar effects on the future baseline as the proposed development.

F5.0 Potential Effects

Embedded Mitigation

F5.1 A full list of the mitigation measures embedded into the proposed development is provided in Section B8.0 of Chapter B. Those relevant to the water environment are set out below.

During Construction

F5.2 A Framework Construction Environment Management Plan ('CEMP') which sets out key measures and principles that will be adhered to during the construction phase forms part of the embedded mitigation for the proposed development during the construction phase. The measures in the Framework CEMP will be taken forward in detailed CEMPs for each phase of construction. A full list of CEMP measures and principles is provided at paragraph B7.31 in Chapter B (Site Description and Scheme Proposals), those which are relevant to the water environment are listed below.

1 The Environment Agency, CIRIA and Pollution Prevention Guidance will be implemented throughout the construction period; with adherence to the following in particular:
   - i EA Principles and Practice for the Protection of Groundwater (GP3) (Ref 31);
   - ii Pollution Prevention Guidance (PPG) Notes (as referenced in Section G2.4). Many of these are superseded however some still apply to England (Ref 31);
   - iii GOV.UK Pollution prevention for businesses (Ref 58);
   - iv CIRIA Report C532: Control of Water Pollution from Construction Sites (Ref 44);
   - v CIRIA Report C502: Environmental Good Practice on Site (Ref 6);
   - vi CIRIA Report 515: Groundwater Control – design and practice (Ref 7); and
   - vii CIRIA Report C753: SuDS Manual (Ref 9).
2 A Construction Stage Surface Water Management Plan ('SWMP') will be incorporated into the site so that run off can be carefully controlled using temporary drainage;
3 Mitigation will be included to prevent and mitigate against any accidents, including but not limited to, spills, storage of soils and control of construction related dust and the construction of site hoarding to reduce the impact on ecological sensitive receptors. Measures will be implemented to prevent sediment, dust, surface water run-off and other substances from entering watercourses. Details will be recorded of the soils, chemicals and oils used during the construction process;
4 Plant and machinery will be well maintained to reduce the risk of oil spillages or similar and electrical equipment such as transformers and switchgear are to be located above predicted flood levels as per guidance;
5 An emergency response protocol will be developed by contractors so that any accidents of spillages are intercepted;
6 Avoid site run off of water and mud; and
7 Any disposal of contaminated waste will be undertaken in accordance with the Waste Management Licencing Regulations 1994 and the Duty of Care Requirements.

F5.3 Of the other embedded mitigation measures that shall be in place during the construction phase (detailed in the CEMP) the following is relevant to the water environment:

1 Further ground investigation surveys will be undertaken in order to identify the need, or otherwise, for additional remediation work;

2 Regarding movement of materials across the site, site activities should be undertaken to avoid the creation of contaminant/groundwater migration pathways where possible. It is noted that the site will be cut-and-fill neutral, and movement of materials would be covered within the CEMP by a Construction Transport Management Plan (CTMP). Any disposal of contaminated waste will be undertaken in accordance with the Waste Management Licencing Regulations 1994 and the Duty of Care Requirements;

3 For any piling works, a piling risk assessment will be undertaken.

During Operation

F5.4 The parameters plan includes a minimum Finished Floor Level ('FFL') of 10.0m AOD. This is above the level of flood risk. Recommendations for the Finished Floor Levels in relation to flood risk are detailed in Section G6 Mitigation and Monitoring.

Major Hazards and Accidents

F5.5 Assessment of major hazards and accidents was introduced by the 2014/52/EU EIA Directive, which was subsequently put into UK legislation in May 2017 (Ref 34). The primary objective of the relevant legislation is:

> *"The characteristics of development must be considered with particular regard to— (f) the risk of major accidents and/or disasters relevant to the development concerned, including those caused by climate change, in accordance with scientific knowledge; (g) the risks to human health (for example, due to water contamination or air pollution)." (Ref 33 - Pg 71)*

F5.6 A major accident is an event which results in immediate or delayed serious environmental effects to human health, welfare and/or the environment. Major accidents can be caused by disasters resulting from both man-made and natural hazards. The environmental impacts of hazards and accidents should be reported alongside the routine effects arising during construction and operation of developments. The location of proposed developments, the likelihood of accidents occurring, and the potential environmental effects must be identified and mitigated against. In accordance with the requirements of Planning Regulations, an assessment of the risk of Major Accidents and Natural Disasters relevant to the site has been undertaken, along with the identification of mitigation, where necessary, which is required in order to prevent or alleviate the adverse effects of such events on the environment.

Table 5.1 Potential major accidents and the impact level

Accident	Hazard	Risk before Mitigation	Relevance of accident to chapter	Embedded mitigation	Impact level after mitigation
Natural					
Lightning	Structure damage, potential subsequent fires, explosions	A lightning strike could cause harm to people on-site and cause damage to site infrastructure. Lightning could also present a source of ignition to flammable materials. A subsequent major fire could cause harm	Not relevant.	N/A	N/A

Accident	Hazard	Risk before Mitigation	Relevance of accident to chapter	Embedded mitigation	Impact level after mitigation
		to people both on and off-site			
Additional accidents: Earthquake/ Seismic event. Landslide	Structure damage, potential subsequent fires, explosions	The impact of seismic event and/or landslide of significant magnitude could cause a major accident and damage to site infrastructure and harm to people both onsite and off-site.	Not relevant.	N/A	N/A
Man-made					
Fire and/or explosion	Natural gas – loss of gas from supply pipeline.	Fire and/or explosion could result in significant harm, up to and including fatalities, to people on Site. Potential to harm people and businesses off-site via heat burns and impact injuries from explosions. The environmental impact of a major fire could impact the Teesmouth and Cleveland Coast SPA/Ramsar site and the Teesmouth and Cleveland Coast SSSI through thermal radiation and firewater run-off through firewater reaching watercourses. Firewater run-off reaching areas of unmade ground could contain contaminants which would be harmful to groundwater.	Not relevant.	N/A	N/A
Fire	Diesel fuel oil – release of flammable liquid from storage, pipework or vehicles on-site. Ignition of diesel, released due to failure of primary containment, could result in a localised pool fire if the	A diesel pool fire from vehicles on-site as part of the distribution aspect of the development could result in harm to people on-site and damage to structures and assets. The environmental impact of a major fire could impact the Teesmouth and Cleveland Coast SPA/Ramsar site and the Teesmouth and Cleveland Coast SSSI through thermal radiation and firewater run-off	Relevant.	CEMP will be implemented on-site to reduce the risk of site pollution and of spillages from plant and machinery.	Low

Accident	Hazard	Risk before Mitigation	Relevance of accident to chapter	Embedded mitigation	Impact level after mitigation
	vapour found a source of ignition.	through firewater reaching watercourses. Firewater run-off reaching areas of unmade ground could contain contaminants which would be harmful to groundwater.			
Discharge, spillage or longer-term seepage of untreated wastewater, fuel, chemicals solvents etc into watercourse or groundwater table	Equipment failure, Fuel spillage during unloading/delivery operations, Loss from pipelines and flooding of site resulting in uncontrolled discharge.	The environmental impact of an untreated wastewater and other pollutants discharging into the watercourse could impact the Teesmouth and Cleveland Coast SPA/Ramsar site and the Teesmouth and Cleveland Coast SSSI. Untreated wastewater and other pollutants reaching areas of unmade ground could contain contaminants which would be harmful to groundwater.	Relevant.	CEMP will be implemented on-site to reduce the risk of site pollution and of spillages from plant and machinery.	Low
Vehicle collisions on site	Employee negligence and failure of vehicular operations.	Potential for traffic accidents through construction and operation of the site. Small number of people would be affected and its likely injuries would be minor.	Not Relevant.	N/A	N/A

F5.7 The major hazard and accidents applicable to this chapter are severe weather and climate change. Both hazards are discussed in further detail within the FRA (Appendix F2) with consideration to NPPF current best practice (Ref 37) for the application of allowance for climate change (Section 2.21-2.28) and where necessary taken into account in this chapter through the recommendation that finished floor levels are above 5.03mAOD – the 1:200 year coastal and tidal flood risk level with an allowance for climate change. As such they are discounted from this major hazard and accident section as nothing over and above the items discussed are expected. Other major hazards identified as relevant are fire arising from Diesel and other flammable liquids used and stored on site and discharge, spillage or seepage of untreated waste water or chemicals into the groundwater table or water course. However, the risk of both these types of major accident occurring is mitigated to 'low' by the measures embedded in the CEMP, and they are therefore scoped out of further assessment.

Phasing

F5.8 The proposed development will be brought forward by STDC in phases based on market demand for the employment uses proposed. Construction is due to commence in 2028 with the first floorspace delivered in 2029. The construction period totals 3 years with completion anticipated in 2031. The details of the phasing are not specifically relevant to the assessment of

impacts during construction and operation, but are relevant in relation to the assessments which will be required for each area of phasing within the site – these will each require a detailed Flood Risk Assessment and Drainage Impact Assessment as well as WFD Assessment – as detailed in Section F6 – Mitigation and Monitoring.

During Construction

Introduction

F5.9 This section outlines the potential effects that would be anticipated to occur (from the proposed activities) on the water environment during the construction phase of the proposed development, prior to the implementation of any additional mitigation measures i.e. those not included as embedded measures within the design of the proposed development.

Surface Watercourses – Flows

F5.10 Surface water flows could potentially be impacted during the excavation and placement of site material and increase of hard surfaces (e.g. for site compounds) and compacted areas from construction vehicles. Cleveland and Lackenby Channels have relatively large trapezoidal channels and are not located within the site boundary. The introduction of further material to these channels via on-site to off-site surface water flows could decrease the channel capacity and change the morphology of channels, but by following the CIRIA and pollution prevention guidance in Paragraph F5.2, the effect would be reduced.

F5.11 In addition, without the management of drainage and surface waterbodies, the potential for localised areas of surface water flooding across the site (as set out in the FRA provided at Appendix G2), remains possible at high rainfall / high flow events.

F5.12 The magnitude of change on surface water flows during the construction phase is considered to be minor. The receptor sensitivity of the Cleveland and Lackenby Channels, Kinkerdale Beck Culvert and Boundary Beck Culvert is very low and so the effect would be Negligible Adverse, and Not Significant.

F5.13 The Tees transitional WFD waterbody has a very high sensitivity, however since there would be no/negligible change there would be a Negligible Adverse and Not Significant effect.

Surface Watercourses – Water Quality

F5.14 The Cleveland and Lackenby Channels have a very low quality due to the levels of contamination across the Teesworks area and heavy industry. The potential for pollution of surface water is primarily when high levels of suspended solids and/or leachates from Made Ground have the potential to enter local watercourses during earthworks, but this will be minimised through following the CIRIA and Pollution Prevention Guidelines detailed in embedded mitigation. A potential pollution pathway exists from the site through the shallow groundwater system, which could reach the Tees transitional WFD waterbody and other surface water bodies, such as Cleveland and Lackenby Channels. This may occur from runoff associated with construction activities e.g. through generation of silt borne run-off during groundworks, accidental spills and leaks from construction plant. The FRA (Appendix F2) notes that the groundwater vulnerability map available via the Defra MAGIC Map (Ref 43) indicates that the site is within an area of medium-high risk from groundwater (where 'high' equates to areas able to easily transmit pollution to groundwater with high leaching soils). During site preparation (where the construction compound will be developed with waste and fuel storage areas) and construction, there is the potential for spillages and leaks and so moderate magnitude of change. Areas adjacent to the Lackenby Channel and Cleveland Channel are shown in the FRA flood maps to

be at risk from high magnitude coastal flooding with an allowance for sea level rise. Whilst these areas are excluded from the site boundary, modelling shows inundation along the A1053 Tees Dock Road (bounding the site to the east) from coastal sources. The parameter plan (at Appendix B 3) shows that this road is likely to be used for accessing the site. Since fuels, oils and chemicals would be stored on-site during certain phrases of works (e.g. for re-fuelling of plant and equipment), spillages and leakages could occur. The potential spillages and leakages are likely to be localised. However depending on location, spillages and leakages could occur in areas at risk of surface water flooding which would present a risk to the surface water quality in times of high magnitude events.

F5.15 The magnitude of change on surface water quality during the construction phase is considered to be minor, due to the commitment to adhere to the measures included in the CEMP during the construction phase. The receptor sensitivity of the Cleveland and Lackenby Channels, Kinkerdale Beck Culvert and Boundary Beck Culvert is very low and so the effect would be Negligible Adverse, and not significant.

F5.16 The Tees transitional WFD waterbody has a very high sensitivity, however the proposed development avoids changes to the bank of the River Tees, which limits the potential for direct and thus significant impacts. Thus there would be no/negligible magnitude of change and so there would be a Negligible Adverse and Not Significant effect.

Groundwater Aquifer - Flows

F5.17 For the anticipated construction activities, as detailed in Chapter B of this ES, the ground surface would largely be expected to remain above the groundwater table, and it is unlikely that groundwater would be encountered as part of these works. Reduced infiltration may be expected where areas of hardstanding across the site are increased and so potential adverse effects on aquifer recharge. Nonetheless, given that groundwater is not used as a resource, the magnitude of the effect of excavation on groundwater flow is deemed to be minor. Alongside a receptor sensitivity category for the superficial aquifer of low, the level of effect is therefore Negligible Adverse and Not Significant.

Groundwater – Water Quality

F5.18 Effects on groundwater quality could result from excavations and earthworks as well as spillages and leaks of fuels, oils and chemicals. This could result in potential pollution to underlying aquifers with potential pathways through the Made Ground to the River Tees. This may arise from runoff associated with construction activities (e.g. through generation of silt borne run-off during groundworks, activation of contamination pathways, accidental spills and leaks from construction plant as well as accidental spillage from construction operations). Overall, due to the presence of Glacial Till underlying the Glaciolacustrine deposits, Tidal Flats and Made Ground, the bedrock aquifer is considered to be in limited hydraulic continuity with the shallow groundwater system and the surface waters in the Tees estuary. Nonetheless, some continuity cannot be ruled out, and so potential impacts to the bedrock aquifer from pollution are deemed to be of minor magnitude without embedded mitigation. With the implementation of the CEMP, this would reduce but still be of minor magnitude. Alongside a receptor sensitivity category for the aquifer as low, the level of effect is therefore Negligible Adverse, and Not Significant.

During Operation

Surface Watercourses - Flows

F5.19 During the operation of the site, there are potential adverse effects on drainage patterns and surface water, principally in relation to a change in runoff patterns and drainage associated with the finalised nature of the site development.

F5.20 However, the site currently comprises hard standing so the magnitude of change on surface water flows during the operation phase is considered to be minor. The receptor sensitivity of the Cleveland and Lackenby Channels, Kinkerdale Beck Culvert and Boundary Beck Culvert is very low and so the effect would be Negligible Adverse, and Not Significant.

F5.21 The Tees estuary has a very high sensitivity, but it is considered that there would be no/negligible magnitude of change and so there would be a Negligible Adverse and Not Significant effect.

Surface Watercourses – Water Quality

F5.22 Without collection and discharge of surface water through a new drainage and water management system, the magnitude of change for water quality is considered to be moderate. The receptor sensitivity of the Cleveland and Lackenby Channels, Kinkerdale Beck Culvert and Boundary Beck Culvert is very low and so the effect would be Negligible Adverse, and Not Significant.

F5.23 The Tees estuary has a very high sensitivity, but there would be no/negligible magnitude of change and so there would be a Negligible Adverse and Not Significant effect.

Groundwater Aquifer - Flows

F5.24 The aquifer is not used locally as a resource for abstraction and is of limited potential. However, the change to the ground surface (increased areas of hardstanding occupying the site) potentially limits the volume of direct recharge to the aquifer. As such, the potential magnitude of change for groundwater flows during operation is minor. The site is located near the River Tees, a very significant groundwater discharge boundary. Alteration of the potential path of rainfall-recharge is likely to occur as a result of changes to recharge on site, changing the pathway from through the contaminated ground to the Tees, to via the drainage system to the Tees. Both of these paths are relatively short. Hence, for these low sensitivity groundwater receptors the level of effect is Negligible Adverse and Not Significant.

Groundwater – Water Quality

F5.25 The change in ground surface to increased hardstanding reduces the potential for any contaminated surface runoff to reach the superficial or bedrock aquifer during the operational phase. In addition, any re-placement of material in the construction phase to create the new development ground surface means that rainfall-infiltration through the Made Ground could introduce potential contaminants to groundwater. However, conversely, removal and treatment of contaminant hotpots would improve groundwater quality of the superficial aquifer at the site. Nonetheless, the potential for accidental spillage from operations remains. Overall, the magnitude of change for groundwater quality during operation is minor, and the level of effect on the low sensitivity groundwater receptors is Negligible Beneficial and Not Significant.

F6.0 Mitigation and Monitoring

Introduction

F6.1 The proposed development will likely be developed in phases starting in 2028 and with an anticipated completion in 2031. Whilst a high level Flood Risk Assessment has been prepared to supplement this assessment (within Appendix F2), the following documentation shall be prepared for each phase of development and submitted at the Reserved Matters stage of the planning process, when detailed design of the scheme is known. As such, the documents shall be agreed in advance of construction for each phase of proposed development to mitigate significant adverse impacts:

i A detailed FRA and Drainage Impact Assessment (DIA) with drainage strategy (for both foul and surface water);

ii A Surface Water Management Plan (SWMP); and

iii A WFD Assessment.

F6.2 All of the assessments noted above shall take into account climate change for the duration of the development (50 years).

F6.3 The SWMP will adhere to the following documents and guidance (in paragraph F6.4) to mitigate adverse effects of the development, in addition to NPPF (Ref 37), RCBC Local Plan (Ref 51) and the Regulations noted above in the Policy section of this chapter.

F6.4 The requirement to prepare and agree a Remediation Strategy has been set out in Chapter G and implemented with regards to groundwater through a monitoring regime. This monitoring would be subject to the design and review of relevant consultees but would typically involve recording of water levels and collection of samples encompassing seasonal variability.

F6.5 Secondary mitigation (in addition to the documents in F6.1) shall include the following with regards to the water management at the site:

a the design shall be prepared in line with the requirements of:

i CIRIA The SuDS Manual C753 (Ref 9);

ii Sewers for Adoption (Ref 56) (Northumbrian Water currently use version SfA6 but will likely migrate to SfA8 during the time of the development of the design for the proposed development;

iii Local Authority SuDS Officer Organisation. Non statutory technical standards for sustainable drainage: Practice Guidance; (Ref 41) and

iv Tees Valley Local Authorities Local Standards for Sustainable Drainage (Ref 53).

v The design of water management shall include consideration of design features to remove silt and other suspended solids, as well as capture any spills/oil and grease, prior to discharge;

b Where reasonably practicable the runoff rate from the site shall be reduced as far as possible in line with drainage guidance (noted in paragraph F6.4 a) in light of the large extent of low permeability surfaces;

c Confirmation will be required to be obtained for capacity of discharge to Northumbrian Water systems. This will be dealt with at the Reserved Matters stage of the planning process once the detailed design of the scheme is known;

d Hydraulic modelling shall be required as part of the site-specific design of drainage and overland and exceedance flow paths;

e The design shall take account of climate change projections and comply with current best practice;

f The timing of excavation and replacement of ground materials shall be sensitive to avoiding poor weather conditions;

g New drainage will be designed to current standards with allowances for additional rainfall and surface water flows under a climate change scenario. Permits shall be obtained for works and signed off by the Environment Agency;

h The water management and drainage design will not include infiltration SuDS such as soakaways, in order to limit mobilisation of contamination. Drainage channels and/or networks will be lined with a geomembrane to prevent connection of surface water with contaminated ground material;

i Any harvested rainwater will need to be protected for re-use so that it is not contaminated; and

Any activity that has the potential to have an impact upon any of the Quality Elements will need consideration in terms of whether it could cause a deterioration in the status of a water body. The activity will also need to be considered in terms of whether it will compromise the ability of the water body to reach Good Ecological Status or Good Ecological Potential. Future Environmental Permits and Reserved Matters planning applications for the site will require WFD Assessments to support them. Those assessments will determine the effects of the proposed facility on ecological, hydromorphological and chemical quality and identify any potential impacts that could cause deterioration in the current status of the water body or could hinder the water body from meeting its WFD objectives in the future. A WFD Assessment shall be undertaken for each site within the Lackenby site and shall be undertaken prior to construction.

During Construction and During Operation

F6.6 The table below sets out the proposed mitigation and monitoring measures for the construction and operational phase of the proposed development.

Table 6.1 Rationale for incorporation of environmental measures

Receptor	Potential Impact	Additional Mitigation - Construction	Additional Mitigation - Operation
Tees (transitional) WFD waterbody, Kinkerdale Beck Culvert, Boundary Beck Culvert and the Cleveland and Lackenby Channels	Increased risk of flooding from Flows - increased surface runoff reaching watercourses	Site specific drainage strategy will inform the details of the CEMP. Appropriate measures to be agreed with the Council to manage localised depressions on site, which results in areas of pluvial flooding at high rainfall events until the ground surface is constructed.	Implementation of the SWMP for each phase of the proposed development will improve the management of water compared to the baseline conditions, whilst also taking into account potential changes in rainfall from climate change. Changes to the water courses will be applied and signed off via the Environmental Permit process. It is anticipated that there may be additional discharges to the Tees required (in addition to the outfall to the Tees from the Lackenby Channel). At present it is not

Receptor	Potential Impact	Additional Mitigation - Construction	Additional Mitigation - Operation
			yet known if there is a flap on the outfall to control the tidal influences, however it is anticipated that discharges to the Tees will be regulated under an environmental permit.
Tees (transitional) WFD waterbody, Kinkerdale Beck Culvert, Boundary Beck Culvert and the Cleveland and Lackenby Channels	Increased runoff to watercourses and drains due to increased roadways and areas of hardstanding could affect channel morphology.	The timing of excavation and replacement of ground materials shall be sensitive to avoiding poor weather conditions.	Through the FRA, DIA with drainage strategy and the SWMP, the potential effects of the proposed development will seek to be minimised by reducing the runoff rate from the site as far as possible in light of the large extent of low permeability surfaces. The drainage strategy will take account of climate change.
Tees (transitional) WFD waterbody, Kinkerdale Beck Culvert, Boundary Beck Culvert and the Cleveland and Lackenby Channels	Change in water quality from increased sediments in surface runoff.	The site is cut and fill neutral so ground material would be retained within the site. The timing of excavation and replacement of ground materials shall be sensitive to avoiding poor weather conditions. Additional mitigation in relation to the contamination of the ground is discussed in the Ground Conditions Chapter (Chapter G).	The drainage strategy will include consideration of design features to remove silt and other suspended solids, as well as capture any spills/oil and grease, prior to discharge. The large extent of low permeability surface proposed for the site will 'cap' underlying contaminated land. The drainage strategy will not include infiltration SuDS such as soakaways, in order to limit mobilisation of contamination. Harvested rainwater as part of the design would need to be protected for re-use so that it is not contaminated. Once the site design is available, a WFD Assessment shall be undertaken for the entire site and then for each phase of the development the WFD Assessment should be updated. Any conveyance and storage features will be lined with a geomembrane to prevent connection of surface water with contaminated ground material and consider the risk of contamination of local groundwater through increased percolation. Any discharges to the Tees will require an environmental permit and should lead to an improvement in the water quality.

Receptor	Potential Impact	Additional Mitigation - Construction	Additional Mitigation - Operation
Tees (transitional) WFD waterbody, Kinkerdale Beck Culvert, Boundary Beck Culvert and the Cleveland and Lackenby Channels	Change in water quality from a change in land use or drainage patterns at consented discharge locations.	Placement of oil-water interceptors at outfalls from the site	No overall changes to local drainage patterns around discharge locations are anticipated. Consultation will be required with the LLFA and the EA for direct discharges to the Tees.
Tees (transitional) WFD waterbody, Kinkerdale Beck Culvert, Boundary Beck Culvert and the Cleveland and Lackenby Channels	Potential failure of wastewater infrastructure to cope with additional flows from the proposed development resulting in a deterioration in the quality of surface waters and groundwater (affecting WFD chemical status).		Infrastructure on or under the site that does not have the required capacity will be required to be replaced / improved to meet guidance and planning requirements. New drainage will be designed to current standards with allowances for additional rainfall and surface water flows under a climate change scenario. Permits shall be obtained for works and signed off by the Environment Agency. The drainage strategy will set out how to accommodate any groundwater input to the culverts that are present at the site. A WFD Assessment will need to be undertaken once the drainage strategy is developed. The WFD Assessment shall be undertaken for the entire site and then for each phase of the development the WFD Assessment should be updated.
Secondary bedrock and superficial aquifers (groundwater recharge)	Groundwater recharge to the Secondary Aquifers may be reduced as a result of the increase in roadways, and areas of hardstanding.	No additional mitigation identified.	No additional mitigation identified.
Secondary aquifers (groundwater quality)	Groundwater quality may be impacted by changes in pathways of soils during excavation and re-placement of materials.	Groundwater monitoring would determine whether the potential for mobilisation of contaminants is likely, prior to groundworks activities such as excavation. This monitoring would be subject to the design and review of relevant consultees but would typically involve recording of water levels and collection of samples encompassing seasonal variability, commencing prior to construction.	The SWMP will not include infiltration SuDS such as soakaways, in order to limit mobilisation of contamination. Groundwater monitoring would determine whether the potential for mobilisation of contaminants is likely, prior to groundworks activities such as excavation.

Receptor	Potential Impact	Additional Mitigation - Construction	Additional Mitigation - Operation
	Beneficial changes to the groundwater system during the construction phase.	No additional mitigation identified.	The drainage strategy will reduce the potential for mobilisation of contaminants on site due to reduction in recharge.
Surface waters and groundwater	Potential for mobilisation (e.g. leaching) of contaminants from soils encountered during construction phase.	No additional mitigation identified.	No additional mitigation identified.

F7.0 Residual Effects

Introduction

F7.1 Embedded mitigation is detailed in Section F5.0. Potential Effects and additional mitigation is detailed in Section F6.0. Mitigation and Monitoring. This section contains an assessment of the residual effects which remain after this mitigation is applied during the construction and operational phases of the proposed development.

During Construction

Surface Watercourses - Flows

F7.2 The receptor sensitivity of the Cleveland and Lackenby Channels, Kinkerdale Beck Culvert and Boundary Beck Culvert is very low. There is an opportunity for improved attenuation, as noted in the Section F6.0 Mitigation and Monitoring. The magnitude of change on surface water flows during the construction phase is considered to be minor and so the effect of the improvements to the current conditions would be Negligible Beneficial and Not Significant

F7.3 The Tees estuary has a very high sensitivity, mitigation would not result in any changes, therefore the residual effect there would be no/negligible magnitude of change and so there would be a Negligible Adverse and Not Significant effect.

Surface Watercourses – Water Quality

F7.4 The mitigation measures are detailed in the mitigation section (in particular the avoidance of connection between surface water and contaminated land).

F7.5 The magnitude of change on surface water quality during the construction phase with regards to residual effects is considered to be Moderately Beneficial for the receptors of the Cleveland and Lackenby Channels, Kinkerdale Beck Culvert and Boundary Beck Culvert which have a sensitivity rated very low and so the effect would be Negligible Beneficial, that is not significant, as shown in Table F3.4 .

F7.6 The Tees estuary has a very high sensitivity, but the magnitude of change is considered to be no/negligible change and thus there would be a Negligible Beneficial and Not Significant effect. The additional mitigation outlined above will change the effect from adverse to beneficial

Groundwater Aquifer - Flows

F7.7 Receptor sensitivity category for the bedrock and superficial aquifers is low, and the magnitude of change will be minor, so the level of effect is therefore Negligible Adverse, and Not Significant. The additional mitigation outlined above will not change the effect of the proposed development from that assessed in the Potential Effects section, which only considers the embedded mitigation measures.

Groundwater Aquifer - Water Quality

F7.8 Excavations associated with the proposed development would be of a superficial nature, within the Made Ground and are not anticipated to extend downwards into the underlying Glaciolacustrine deposits superficial aquifer. Also, the use of site-won and imported soil-based materials during construction would comply with the agreed re-use criteria, which would be set out in site construction documentation, such as the remediation strategy.

F7.9 During future piling activities associated with site redevelopment, groundwater quality within the aquifer units may be affected where there is potential to generate viable pollutant linkage between the potentially contaminated shallow soils (Made Ground) and groundwater. This may impact on the aquifer units below and any surface waters to which they are hydraulically connected. However, the work would be undertaken in accordance with relevant EA guidance and a piling risk assessment for the site.

F7.10 Given that fuels, oils and chemicals would be stored on-site during certain phrases of works (e.g. re-fuelling of machinery), spillages and leakages could occur. The potential spillages and leakages are likely to be localised. However, depending on location, they may present a risk to groundwater quality. This is likely to result no magnitude of change given the on-site management protocols that would be adopted such as the drainage strategy. For the low sensitivity aquifer receptors, this would result in a Negligible Adverse level of effect of pollution which would be deemed to be Not Significant.

F7.11 Overall, any effects on groundwater quality are likely to be of minor magnitude of change, given the on-site management protocols that would be adopted under the CEMP. Combined with a low sensitivity receptor gives a Negligible effect, which is Not Significant.

During Operation

Surface Watercourses - Flows

F7.12 The magnitude of change on surface water flows during the operation phase with regard to residual effects is considered to be minor. The receptor sensitivity of the Cleveland and Lackenby Channels, Kinkerdale Beck Culvert and Boundary Beck Culvert is very low and so the effect would be Negligible Beneficial, and Not Significant.

F7.13 The Tees estuary has a very high sensitivity. Mitigation would not result in any changes, therefore the residual effect there would be no/negligible magnitude of change and so there would be a Negligible Adverse and Not Significant effect.

Surface Watercourses – Water Quality

F7.14 The magnitude of change on surface water quality during the operation phase with regards to residual effects is considered to be moderate for the receptors of the Cleveland and Lackenby Channels, Kinkerdale Beck Culvert and Boundary Beck Culvert which have very low sensitivity and so the effect would be Negligible Beneficial and Not Significant.

F7.15 The Tees estuary has a very high sensitivity, but the magnitude of change is considered to be no/negligible change and thus there would be a Negligible Beneficial and Not Significant effect.

Groundwater Aquifer - Flows

F7.16 The additional mitigation outline above does not change the effect arising from the proposed development from that assessed in the Potential Effects section, which only considers the embedded mitigation measures. Receptor sensitivity category for the superficial and bedrock aquifers is low, and the magnitude of the effects will be minor, so the level of effect is therefore Negligible Adverse, and Not Significant.

Groundwater Aquifer - Water Quality

F7.17 In the operational phase, the site will have been subject to the work undertaken in the construction phase remediation strategy. The SWMP should also include for the provision of non-infiltration SuDS. Together, this should reduce the overall risk from on-site contamination

and its potential for mobilisation. This should result in a minor magnitude of change from the implementation of the mitigation measures and result in Minor Beneficial effect which is Not Significant.

F8.0 Summary & Conclusions

F8.1 The table below summarises the receptors, potential effects, additional mitigation measures and residual effects in relation to water management and flooding.

Table 8.1 Summary of Effects

Receptor	Impact	Potential Effects (taking account of embedded mitigation)	Additional Mitigation and Monitoring	Residual Effects
During Construction				
Surface Water				
River Tees estuary (Tees WFD waterbody)	Flows - Increased runoff	Negligible Adverse and Not Significant.	Implementation of the Drainage Strategy to reduce runoff rates whilst taking into account potential changes in rainfall from climate change through appropriate use of sustainable drainage during construction. The timing of excavation and re-placement of ground materials shall be sensitive to avoiding poor weather conditions. It is anticipated that in addition to the outfall to the Tees from the Lackenby Channel there may be additional discharges to the Tees from blue green networks. The developer will need to comply with the requirements of the FRA in order that no impacts arise from flooding due to increased surface runoff from the site to the surface water bodies. Appropriate measures to be agreed with the Council to manage localised depressions on site, which result in areas of pluvial flooding at high rainfall events until the ground surface is constructed.	Negligible Beneficial and Not Significant. Permanent

Receptor	Impact	Potential Effects (taking account of embedded mitigation)	Additional Mitigation and Monitoring	Residual Effects
	Water quality - Mobilisation of contaminants and sediment	Negligible Adverse and Not Significant.	The drainage design will inform the CEMP and remove silt and other suspended solids, as well as capture any spills/oil and grease, prior to discharge. The timing of excavation and re-placement of ground materials should be sensitive to avoiding poor weather conditions.	Negligible Beneficial and Not Significant. Permanent
	Water Quality - Spillages and leakages causing pollution	Negligible Adverse and Not Significant.	Foul water to be directed to mains sewer. WFD Assessment shall be undertaken prior to construction	
Other surface water bodies (Kinkerdale Beck Culvert, Boundary Beck Culvert and the Cleveland and Lackenby Channels)	Flows - Increased runoff	Negligible Adverse and Not Significant	The drainage design will reduce runoff rates whilst taking into account potential changes in rainfall from climate change. Low permeability concrete surfaces are proposed for the majority of the ground across the site. Run off will be collected and passed through appropriate SuDS treatment that will be lined with a geomembrane to prevent connection of surface water with the contaminated ground. The timing of excavation and re-placement of ground materials shall be sensitive poor weather conditions and shall be managed. The developer will need to comply with the requirements of the FRA in order that no impacts arise on flow volumes.	Negligible Beneficial and Not Significant Permanent

Receptor	Impact	Potential Effects (taking account of embedded mitigation)	Additional Mitigation and Monitoring	Residual Effects
	Water Quality - Mobilisation of contaminants and sediment	Negligible Adverse and Not Significant	Implementation of Drainage Strategy to remove silt and other suspended solids, as well as capture any spills/oil and grease, prior to discharge. The timing of excavation and re-placement of ground materials shall be sensitive to avoiding poor weather conditions. Foul water directed to mains sewer. Implementation of appropriate pollution prevention measures e.g. CIRIA guidance: Control of water pollution from construction sites. Guidance for consultants and contractors (C532D).	Negligible Beneficial – Not Significant Permanent
	Water Quality - Spillages and leakages causing pollution	Negligible Adverse and Not Significant		
Groundwater				
Mercia Mudstone aquifer	Reduced infiltration	Negligible Adverse and Not Significant	No further mitigation is proposed.	Negligible Adverse and Not Significant.
	Pollution from spills Contaminant pathways activated	Negligible Adverse and Not Significant Negligible Adverse and Not Significant	Implementation of measures identified in the remediation strategy. Groundwater monitoring would be ongoing, to determine whether the potential for mobilisation of contaminants is likely, prior to groundworks activities such as excavation. This monitoring would be subject to the design and review of relevant consultees but would typically involve recording of water levels and collection of samples encompassing seasonal variability, commencing prior to construction.	Negligible Adverse and Not Significant.

Receptor	Impact	Potential Effects (taking account of embedded mitigation)	Additional Mitigation and Monitoring	Residual Effects
Superficial aquifer	Reduced infiltration	Negligible Adverse and Not Significant	No further mitigation proposed.	Negligible Adverse and Not Significant
	Pollution from spills Contaminant pathways created	Negligible Adverse and Not Significant Negligible Adverse and Not Significant	Implementation of measures identified in the remediation strategy. Groundwater monitoring would be ongoing, to determine whether the potential for mobilisation of contaminants is likely, prior to excavation. This monitoring would be subject to the design and review of relevant consultees but would typically involve recording of water levels and collection of samples encompassing seasonal variability, commencing prior to construction.	Negligible adverse and Not Significant
During Operation				
Surface Water				
River Tees estuary (Tees WFD waterbody)	Flows - Increased runoff	Negligible Adverse and Not Significant.	A FRA, DIA and Surface Water Management Plan, environmental permits for each phase of the proposed development prior to construction. Runoff rate to be reduced as far as possible in light of the large extent of impermeable surfaces. The drainage strategy shall take account of climate change. New drainage will be designed to current standards with allowances for additional rainfall and surface water flows under a climate change scenario. Permits shall be obtained for works and signed off by the Environment Agency.	Negligible Beneficial and Not Significant. Permanent

Receptor	Impact	Potential Effects (taking account of embedded mitigation)	Additional Mitigation and Monitoring	Residual Effects
	Water Quality - Spillages and leakages causing pollution	Negligible Adverse and Not Significant.	The drainage design will not include infiltration SuDS such as soakaways, in order to limit mobilisation of contamination. Any conveyance and storage features will be lined with a geomembrane to prevent connection of surface water with contaminated ground material and consider the risk of contamination of local groundwater through increased percolation. Harvested rainwater will need to be protected for re-use so that it is not contaminated. A WFD Assessment shall be undertaken for each phase of the development prior to construction. Discharges to the Tees will require an environmental permit and liaison with the Marine Management Organisation (MMO) and should lead to an improvement in the water quality.	Negligible Beneficial and Not Significant Permanent
Other surface water bodies (Kinkerdale Beck Culvert, Boundary Beck Culvert and the Cleveland and Lackenby Channels)	Flows - Increased runoff	Negligible Adverse and Not Significant	An FRA, DIA and Surface Water Management Plan, environmental permits for each phase of the development at Lackenby prior to construction. Runoff rate to be reduced as far as possible in light of the large extent of impermeable surfaces. The drainage strategy shall take account of climate change. New drainage will be designed to current standards with allowances	Negligible Beneficial and Not Significant.

Receptor	Impact	Potential Effects (taking account of embedded mitigation)	Additional Mitigation and Monitoring	Residual Effects
			for additional rainfall and surface water flows under a climate change scenario. Permits shall be obtained for works and signed off by the Environment Agency. A WFD Assessment shall be undertaken for each phase of the development prior to construction.	
	Water Quality - Spillages and leakages causing pollution	Minor Adverse and Not Significant.	Any Surface water channels would be lined with a geomembrane. This will mitigate the potential pollution pathway to the surface water and so there would be no contact with contaminated ground. In addition, harvested rainwater will need to be protected. As most of the site is made ground the proposed SuDS and any new drainage shall be lined or subject to local investigation to minimise infiltration into contaminated parts and translocation of the contaminants into wider environment. Any storage for rainwater shall be lined or in tanks that are suitably protected against ingress from contaminated soils. This will prevent contamination during storage. A WFD Assessment shall be undertaken for each phase of the development prior to construction.	Negligible Beneficial and Not Significant Permanent
Groundwater				

Receptor	Impact	Potential Effects (taking account of embedded mitigation)	Additional Mitigation and Monitoring	Residual Effects
Mercia Mudstone aquifer	Reduced infiltration resulting in lower flows	Negligible Adverse and Not Significant	No further mitigation proposed	Negligible Adverse and Not Significant
	Pollution from spills	Negligible Beneficial and Not Significant	The SWMP and DIA will include the provision of non-infiltration SUDs.	Minor Beneficial and Not Significant
Superficial aquifer	Reduced infiltration	Negligible Adverse and Not Significant	No further mitigation proposed	Negligible Adverse and Not Significant
	Pollution from spills Reduced generation of contaminated groundwater from Made Ground	Negligible Beneficial and Not Significant	The SWMP and DIA will include the provision of non-infiltration SUDs.	Minor Beneficial and Not Significant

F8.2 There will be no significant Adverse effects remaining after mitigation and there will be Negligible Beneficial effects for the River Tees estuary (WFD transitional water body) during construction and operation. The straightened and culverted watercourses through and surrounding the site present constraints to the proposed development but can also provide significant opportunities. The drainage strategy for the site will seek to provide a plan for managing and improving the current baseline conditions on site with respect to the water environment. Works shall be done under an environmental permit.

F8.3 In relation to groundwater, the site has limited groundwater resource potential. The proposed development should lead to an overall improvement of groundwater conditions through the implementation of a remediation strategy, and other embedded/additional mitigation. SuDS shall also be used to protect and enhance the environment. As most of the site consists of Made Ground, the proposed SuDS and any new drainage shall be lined or subject to local investigation to minimise infiltration into potentially contaminated soils. Any storage for rainwater shall be lined or in tanks that are suitably protected against ingress from contaminated soils. This will prevent contamination during storage.

F8.4 This assessment has been undertaken as a high-level analysis of flood risk to the site. Consultation with the Risk Management Authorities – Redcar and Cleveland Council LLFA, Northumbrian Water, Environment Agency, Highways Services is being undertaken as part of the development of the Flood Risk and Surface Water Management Strategy and engagement with these organisations should continue throughout the design of the proposed development.

F9.0 Abbreviations & Definitions

1 AEP Annual Exceedance Probability
2 ALTBAR Mean catchment altitude (m above sea level)
3 ASCII American standard character set for information interchange
4 BFIHOST Base Flow Index estimated from soil type
5 BGS British Geological Survey
6 CEMP Construction Environment Management Plan
7 CTMP Construction Transport Management Plan
8 DEFRA Department of the Environment, Food and Rural Affairs (formerly MAFF)
9 DPLBAR Index describing catchment size and drainage path configuration
10 DPSBAR FEH index of mean drainage path slope
11 DIA Drainage Impact Assessment
12 DTM Digital Terrain Model
13 EA Environment Agency
14 EIA Environmental Impact Assessment
15 FARL FEH index of flood attenuation due to reservoirs and lakes
16 FEH Flood Estimation Handbook
17 FRA Flood Risk Assessment
18 GWDTE Groundwater Dependent Terrestrial Ecosystem
19 LiDAR Light Detection And Ranging
20 mAOD metres Above Ordnance Datum
21 NGR National Grid Reference
22 NPPF National Planning Policy Framework
23 OS Ordnance Survey
24 OS NGR Ordnance Survey National Grid Reference
25 PDF Portable Document Format
26 PPG Planning Policy Guidance
27 PROPWET FEH index of proportion of time that soil is wet
28 Ramsar The intergovernmental Convention on Wetlands, signed in Ramsar, Iran, in 1971
29 SAAR Standard Average Annual Rainfall (mm)
30 SFRA Strategic Flood Risk Assessment
31 SPRHOST Standard percentage runoff estimated from soil type
32 SSSI Site of Special Scientific Interest
33 SuDs Sustainable Urban Drainage System
34 SWMP Surface Water Management Plan

F10.0

References

1 Allied Exploration & Geotechnics Ltd (2018). The Former SSI Steelworks, Redcar – Ground Investigation Contract – Final Factual Report.

2 BGS (2020). British Geological Survey, GeoIndex. [online]. Available at: <https://www.bgs.ac.uk/GeoIndex/home.html> [Accessed 9th November 2020].

3 BSI (2009). BSI 6031:2009 Code of practice for earthworks. [pdf] BSI. Available at: <https://geotechnicaldesign.info/download/bs6031-2009.pdf> [Accessed 1st December 2020].

4 CEH (2020). UK National River Flow Archive. [online] Available at: <https://nrfa.ceh.ac.uk/> [Accessed 18th June 2020].

5 CH2m (2017). TS3 Grangetown Prairie – Phase 1 Geo-Environmental Desk Study.

6 CIRIA Report C502 (1999). PUB C502 Environmental good practice on site. London: CIRIA.

7 CIRIA Report C515 (2000). Groundwater control – design and practice (update of C515) (RP990). London: CIRIA. Now superseded by CIRIA (2016). C750 Groundwater control: design and practice. 2nd edition, London: CIRIA.

8 CIRIA (2007) Report C697: The SuDS manual [online]. Superseded by Report C753 (Ref 9).

9 CIRIA (2015) SuDS Manual C753 [online] Available at: https://www.ciria.org/Memberships/The_SuDs_Manual_C753_Chapters.aspx [Accessed 19th November 2020]

10 CSAI (2020). Soilscapes Soil Types Viewer - National Soil Resources Institute. Cranfield University. [online]. Available at: <http://www.landis.org.uk/soilscapes/> [Accessed 18 June 2020].

11 DEFRA (2006) Defra / EA Flood and Coastal Defence R&D Programme: R&D Outputs: Flood Risks to People, FD2321/TR2 Guidance Document [online] Available at: <http://randd.defra.gov.uk/Default.aspx?Menu=Menu&Module=More&Location=None&Completed=0&ProjectID=12016> [Accessed 19th November 2020].

12 Environment Agency (2009). River Tees: Catchment flood management plan. [online] GOV.UK. Available at: <https://www.gov.uk/government/publications/river-tees-catchment-flood-management-plan> [Accessed 1st December 2020].

13 Environment Agency (2013). Living on the Edge, 4th Edition, June 2013.

14 Environment Agency (2018). What's in your Backyard? [online] Available at: <http://www.environment-agency.gov.uk/maps/> [Accessed 9th November 2020].

15 Environment Agency (2019a). Catchment Data Explorer. [online]. Available at: <http://environment.data.gov.uk/catchment-planning/ > [Accessed 18th November 2020].

16 Environment Agency (2019b). Tees Mercia Mudstone and Redcar Mudstone - Summary. [online] Catchment Data Explorer. Available at: <http://environment.data.gov.uk/catchment-planning/OperationalCatchment/1228/Summary> [Accessed 18th November 2020].

17 Environment Agency (2020a). Email correspondence data request with Joy Kean dated 17 January 2020.

18 Environment Agency (2020b). Data request for Consented Discharges to Controlled Waters with Conditions. [online]<https://data.gov.uk/dataset/55b8eaa8-60df-48a8-929a-060891b7a109/consented-discharges-to-controlled-waters-with-conditions>

19 Environment Agency (2020c). Data request for Environment Agency Register Licence Abstracts [online]<https://data.gov.uk/dataset/f3684ee9-4c81-4ccd-a658-7f8d9dc70706/environment-agency-register-licence-abstracts>

20 Enviros (2004), Soil and Groundwater Baseline Characterisation Study Teesside Works - Interpretive Report.

21 Enviros (2007). Corus Cleveland Prairie Teesside Site Phase 1 Environmental Review.

22 European Union (2007). Diective 2007/60/EC of the European Parliament and of the Council of 23 October 2007 on the assessment and management of flood risks. [pdf], Available at: <https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2007:288:0027:0034:EN:PDF> [Accessed 1st December 2020].

23 GOV.UK (1991). Land Drainage Act 1991: SI 1991/59. [online] GOV.UK. Available at: <https://www.legislation.gov.uk/ukpga/1991/59> [Accessed 1st December 2020].

24 GOV.UK (1994). Land Drainage Act 1994. [pdf]. Available at: <https://www.legislation.gov.uk/ukpga/1994/25/pdfs/ukpga_19940025_en.pdf> [Accessed 1st December 2020].

25 GOV.UK (1998). The Groundwater Regulations 1998: S 1998/2746. [online] GOV.UK, Available at: <https://www.legislation.gov.uk/uksi/1998/2746/contents/made> Accessed 1st December 2020].

26 GOV.UK (2000). Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000: establishing a framework for Community action in the field of water policy: SI 2000/60. [online] GOV.UK. Available at: <https://www.legislation.gov.uk/eudr/2000/60/contents> [Accessed 1st December 2020].

27 GOV.UK (2003). Water Act 2003 [online] GOV.UK. Available at: <https://www.legislation.gov.uk/ukpga/2003/37/contents> [Accessed 9th November 2020].

28 GOV.UK (2009). The Flood Risk Regulations 2009. [online] GOV.UK. Available at: <https://www.legislation.gov.uk/uksi/2009/3042/contents/made> [Accessed 18th November 2020].

29 GOV.UK (2010a). The Environmental Permitting (England and Wales) Regulations 2010: SI 2010/675. [online] GOV.UK. Available at: <https://www.legislation.gov.uk/uksi/2010/675/contents/made> [Accessed 1st December 2020].

30 GOV.UK (2010b). Flood and Water Management Act 2010: SI 2010/29. [online] GOV.UK. Available at: <https://www.legislation.gov.uk/ukpga/2010/29/contents> [Accessed 1st December 2020].

31 GOV.UK (2013). Groundwater protection:Principles and practice (GP3). [online] GOV.UK. Available at: <https://www.gov.uk/government/publications/groundwater-protection-principles-and-practice-gp3> [Accessed 1st December 2020]. Now superseded by GOV.UK (2017). Groundwater protection. [online] GOV.UK. Available at: <https://www.gov.uk/government/collections/groundwater-protection> [Accessed 1st December 2020].

32 GOV.UK (2014). Flood Risk and coastal change guidance [online] GOV.UK. Available at: <https://www.gov.uk/guidance/flood-risk-and-coastal-change> [Accessed 9th November 2020].

33 GOV.UK (2017a). The Town and Country Planning (Environmental Impact Assessment) Regulations 2017 [online] GOV.UK. Available at: <https://www.legislation.gov.uk/uksi/2017/571/contents/made> [Accessed 30th November 2020].

34 GOV.UK (2017b). The Health and Safety (Miscellaneous Amendments and Revocation) Regulations 2017. [online] Available at: <https://www.legislation.gov.uk/uksi/2017/304/contents/made> [Accessed 18th November 2020].

35 GOV.UK (2017c). The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017: SI 2017/407. [online] GOV.UK. Available at: <https://www.legislation.gov.uk/uksi/2017/407/contents/made> [Accessed 1st December 2020].

36 GOV.UK (2018). Northumbria river basin district river basin management plan. [online] Available at: <https://www.gov.uk/government/publications/northumbria-river-basin-district-river-basin-management-plan> [Accessed 18th November 2020].

37 GOV.UK (2019a). National Planning Policy Framework. [online] GOV.UK. Available at: <National Planning Policy Framework - GOV.UK> [Accessed 18th November 2020].

38 GOV.UK (2019b). Planning practice guidance. [online] GOV.UK, Available at: <https://www.gov.uk/government/collections/planning-practice-guidance> [Accessed 1st December 2020].

39 GOV.UK (2020). Environmental Impact Assessment guidance. [online] GOV.UK. Available at: <https://www.gov.uk/guidance/environmental-impact-assessment> [Accessed 18th November 2020].

40 IEMA (2016).

41 Local Authority SuDS Officer Organisation (2016) Non-Statutory Technical Standards for Sustainable Drainage: Practice Guidance [online]. Available at: https://www.susdrain.org/files/resources/other-guidance/lasoo_non_statutory_suds_technical_standards_guidance_2016_.pdf [Accessed 18th November 2020].

42 MAFF (2000). Land use and planning: Good practice guide for handling soils. Cambridge: FRCA.

43 MAGIC (2020). MAGiC Interactive Mapping. [online]. Available at: <https://magic.defra.gov.uk/MagicMap.aspx> [Accessed 9th November 2020].

44 Masters-Williams, H., Heap, A., Kitts, H., Greenshaw, L., David, S., Fisher, P., Hendrie, M., Owens, D. (CIRIA), (2001). Control of water pollution from construction sites: Guidance for consultants and contractors (CIRIA C532). [pdf] CIRIA, Available at: <https://www.ciria.org/ProductExcerpts/C532.aspx> [Accessed 1st December 2020].

45 Met Office (2018) UK Climate Projections (UKCP18) [online] Available at: <https://www.metoffice.gov.uk/research/approach/collaboration/ukcp/index> [Accessed 18th November 2020].

46 Microsoft (2020). Bing Maps. [online] Bing Maps, maps courtesy of Ordnance Survey. Available at: <https://www.bing.com/maps/> [Accessed 9th November 2020].

47 Natural England (2020). Designated Sites View. [online] Available at: <https://designatedsites.naturalengland.org.uk/> [Accessed 18th November 2020].

48 National Library of Scotland (2020). National Library of Scotland, Map Images. [online]. Available at: <https://maps.nls.uk/> [Accessed 9th November 2020].

49 Redcar & Cleveland Borough Council (2001). Level 2 Strategic Flood Risk Assessment (SFRA).

50 Redcar & Cleveland Borough Council (2016). Level 1 Strategic Flood Risk Assessment (SFRA), updated version in March 2016.

51 Redcar & Cleveland Borough Council (2018). Redcar & Cleveland Local Plan, Adopted May 2018.

52 South Tees Development Corporation & CH2m (2019) South Tees Regeneration Master Plan.

53 Tees Valley Authorities (2015). Tees Valley Authorities Local Standards for Sustainable Drainage. [online] Available at: https://www.stockton.gov.uk/media/6235/flooding-webpage-update-jane-salisbury-25-02-2016-3msg.pdf [Accessed 23rd June 2020].

54 UK Centre for Ecology & Hydrology (2008) Flood Estimation Handbook ('FEH') [online]. Available at: <https://www.hydrosolutions.co.uk/software/flood_estimation_handbook/> [Accessed 9th November 2020] Original version published 1999, updated version published in 2008.

55 Wardell (2007). Ground Contamination. Graphite Resources Ltd

56 Water UK/WRc plc (2018) Sewers for Adoption: A design and Construction Guide for Developers – Eighth Edition [online] Available at: <https://www.water.org.uk/wp-content/uploads/2018/10/SfA-8-Master-2.pdf> [Accessed 19th November 2020].

57 Wood (2019). Former Steelworks Land, South Tees - Outline Remediation Strategy

58 GOV.UK (2019). Pollution prevention for businesses. [online] GOV.UK. Available at: <https://www.gov.uk/guidance/pollution-prevention-for-businesses#storing-materials-products-and-waste> [Accessed 3rd December 2020].

59 Hill (2020), Email Correspondence to Joy Kean (Received 30th January 2020).