CONTENTS

TABLES

12.0 WATER ENVIRONMENT & FLOOD RISK

12.1 Introduction

12.1.1 This chapter of the Preliminary Environmental Information (PEI) Report presents the finding of a preliminary assessment of likely significant effects on the water environment and flood risk as a result of construction, operational and decommissioning phases of the Proposed Development, as described in **Chapter 4**: The Proposed Development (PEI Report Volume I), hereafter referred to as 'Proposed Development'.

12.1.2 The surface water environment includes water quality, water resources, hydromorphology, flood risk, and drainage. Groundwater and hydrogeology is considered in **Chapter 13**: Geology, Hydrogeology and Land Contamination (PEI Report Volume I).

12.1.3 The cumulative effects on the water environment, including flood risk of the Proposed Development, considering other committed developments in the vicinity are described in **Chapter 19**: Cumulative and Combined Effects (PEI Report Volume I).

12.1.4 Due to the interdisciplinary nature of effects, this chapter cross references other chapters including **Chapter 11**: Biodiversity and Nature Conservation and **Chapter 13**: Geology, Hydrogeology and Land Contamination (PEI Report Volume I) and is supported by the following figures and appendices:

- **Appendix 12A**: Flood Risk Assessment (including Section 5 – 6 - Conceptual Drainage Strategy (PEI Report Volume II);
- **Appendix 12B**: Water Framework Directive (WFD) Screening Report (including Annex C - Water Quality Data (PEI Report Volume II);
- **Figure 12-1 – Figure 12.5 which provide information on** surface and groundwater features, ecological designations, and flood risk (PEI Report Volume III).

12.2 Legislation Planning Policy and Guidance

12.2.1 A full overview of the legislative and policy context that is relevant to the Proposed Development is provided within **Chapter 7**: Legislative Context and Planning Policy (PEI Report Volume I).

12.2.2 A summary of the legislation and planning policy relevant to the assessment of potential impacts on the water environment from the Proposed Development is provided in this section. These have been taken into account in the assessment.

Legislation

12.2.3 The following UK Legislation is of relevance to the Proposed Development:

- Water Act (HMSO) 2014;
- Floods and Water Management Act (HMSO) 2010;

- Marine and Coastal Access Act (HMSO) 2009;
- Environment Act (HMSO) 1995;
- Land Drainage Act (HMSO) 1991;
- Water Resources Act (HMSO) 1991;
- Environment Protection Act (HMSO) 1990;
- Salmon and Freshwater Fisheries Act (HMSO) 1975 (as amended);
- Water Environment (Water Framework Directive) (England Wales) Regulations (HMSO) 2017;
- Environmental Permitting (England and Wales) Regulations (HMSO) 2016;
- Control of Major Accident Hazards (COMAH) Regulations (HMSO) 2015;
- Environmental Damage (Prevention and Remediation) Regulations (HMSO) 2015;
- Bathing Water Regulations (HMSO) 2013;
- Eels (England and Wales) Regulation (HMSO) 2009;
- Groundwater (England and Wales) Regulations (HMSO) 2009;
- Flood Risk (England and Wales) Regulations (HMSO) 2009;
- Control of Pollution (Oil Storage) (England) Regulations (HMSO) 2001; and
- Control of Substances Hazardous to Human Health (COSHH) Regulations (HMSO) 2002.

12.2.4 Under the various acts and regulations listed above, consents would be required from the Environment Agency for temporary construction and permanent operational discharges (i.e. water activity permits), and for certain works affecting main rivers[1] (i.e. flood risk activity permits (FRAP)), as well as any temporary dewatering, abstractions or impoundments and in-channel works related to construction activities (i.e. abstraction, impoundment or transfer licences).

12.2.5 Under the Environmental Permitting (England and Wales) Regulations (2016) an Environmental Permit (FRAP) is required from the Environment Agency if a regulated activity is to be undertaken on or near a main river, on or near a flood defence structure, or in a floodplain[2]. Exemptions do not generally apply, however, the Environment Agency may seek to 'disapply' the requirement for a FRAP where a separate regulatory approval process adequately considers flood risk. Typically, this can include the Marine Licensing assessment and consultation process under the Marine and Coastal Access Act 2009.

12.2.6 Whether assessed by the Environment Agency or considered under a parallel regulatory approval, the scope of the FRAP process includes any activity within 8m of

[1] A river maintained directly by the Environment Agency. Main Rivers are often larger watercourses.

[2] Floodplain refers to land adjacent to a watercourse that is subject to flooding

the bank of a main river, flood defence structure or culvert on a main river, or activities carried out on the floodplain of a main river, more than 8m from the river bank, culvert or flood defence structure where consent is not in place.

12.2.7 If water is required for construction works, then depending on the source of water, volumes required and duration of abstraction, an abstraction licence may be required from the Environment Agency. This can include dewatering of excavations, unless exemptions apply (e.g. for emergency situations) or for small volumes. A temporary abstraction licence is required to abstract more than 20 cubic metres (m^3) of water per day lasting less than 28 days, and a full abstraction licence is required to abstract more than 20m^3 of water per day for a period of more than 28 days. Any licence issued could contain conditions requiring abstraction to cease at times of low flows.

12.2.8 Land drainage consent will be required from Lead Local Flood Authority (LLFA) (for the Proposed Development Site - North Lincolnshire Council), or in some cases consent from the Internal Drainage Board (IDB). In this case, the IDB responsible for consent would be the Isle of Axholme and North Nottinghamshire Water Level Management Board (IoAaNNWLMB) who are responsible for certain works that may affect the flow in ordinary watercourses[3] under The Floods and Water Management Act 2010 and The Land Drainage Act 1991.

12.2.9 Regulated activities which are proposed to take place within the 'UK Marine Area' (Section 42, Marine and Coastal Access Act) may require a marine licence from the Marine Management Organisation (MMO) in accordance with the Marine and Coastal Access Act 2009. This includes works below mean high water spring tide[4] (MHWST).

Planning Policy Context

National Policy Statements

12.2.10 The Overarching National Policy Statement (NPS) for Energy (EN-1) (DECC 2011a) is relevant to this assessment with the main sections being:

- Section 4.10: Pollution control and other environmental regulatory regimes;
- Section 5.15: Water Quality and Resources. Stating that: "*Where the project is likely to have effects on the water environment, the applicant should undertake an assessment of the existing status of, and impacts of the proposed project on, water quality, water resources and physical characteristics of the water environment as part of the ES or equivalent."* (Paragraph 5.15.2); and
- Paragraph 5.15.3 which provides advice on what an Environmental Statement (ES) should describe including:
  - the existing quality of waters affected by the proposed project and the impacts of the proposed project on water quality, noting any relevant existing discharges, proposed new discharges and proposed changes to discharges;

[3] Ordinary watercourses are defined as all watercourses that are not main rivers

[4] The height of mean high-water springs is the average throughout the year of two successive high waters during those periods of 24 hours when the range of the tide is at its greatest

- existing water resources affected by the proposed project and the impacts of the proposed project on water resources, noting any relevant existing abstraction rates, proposed new abstraction rates and proposed changes to abstraction rates (including any impact on or use of mains supplies and reference to Catchment Abstraction Management Strategies (CAMS));
- existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics; and
- any impacts of the proposed project on waterbodies or protected areas under the WFD and source protection zones (SPZs) around potable groundwater abstractions.

12.2.11 The NPS for Fossil Fuel Electricity Generating Infrastructure (NPS EN-2) (DECC 2011b) is also of relevance which states that where a project is likely to have effects on water quality or resources, the applicant for development consent should undertake an assessment which should particularly demonstrate that appropriate measures will be put in place to avoid or minimise adverse impacts of abstraction and discharge of cooling water. The applicant for development consent should demonstrate measures to minimise adverse impacts on water quality and resources.

12.2.12 The NPS for Gas Supply Infrastructure and Gas and Oil Pipelines (EN-4) (DECC 2011c) is also relevant in that it describes the need for assessment of the water environment and potential mitigation measures.

UK Marine Policy Statement

12.2.13 The Marine Policy Statement (MPS) (Department for Environment, Food & Rural Affairs (DEFRA) 2011a) is the framework for preparing Marine Plans and taking decisions affecting the marine environment. It establishes a vision for the marine environment, which is for 'clean, healthy, safe, productive and biologically diverse oceans and seas'. The MPS underpins the process of marine planning, which establishes a framework of economic, social and environmental considerations in that will deliver these high-level objectives and ensure the sustainable development of the UK marine area.

12.2.14 The East Inshore and East Offshore Marine Plans (DEFRA, 2014) establishes the plan led system for the marine area in which the riverine parts of the Proposed Development Site are located. Both the MPS and the East Inshore Marine Plan are discussed further in **Chapter 7:** Legislative Context and Planning Policy (PEI Report Volume I).

National Planning Policy Framework

12.2.15 The National Planning Policy Framework (NPPF) (Ministry of Housing, Communities and Local Government (MHCLG) 2019), has three overarching objectives to contribute to the achievement of sustainable development, one of which is the 'environmental objective'. This objective includes the requirement of "helping to improve biodiversity, using natural resources prudently, and minimising waste and pollution" (Paragraph 8c). The NPPF also contains a number of statements which are relevant to water quality. These include:

- strategic policies should set out an overall strategy for the pattern, scale and quality of development, and make provision for conservation and enhancement of the natural, built and historic environment. This includes landscapes and green infrastructure, and planning measures to address climate change mitigation and adaptation (paragraph 20d);
- plans should take a proactive approach to mitigating and adapting to climate change, taking into account the long-term implications for flood risk, coastal change, water supply, biodiversity and landscapes, and the risk of overheating from rising temperatures. Policies should support appropriate measures to ensure the future resilience of communities and infrastructure to climate change impacts. Development should not cause unacceptable levels of water pollution and should help improve water quality wherever possible (paragraph 149); and
- planning policies should contribute and enhance the natural environment by preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as water quality, taking into account relevant information such as river basin management plans (RBMP) (paragraph 170e).

National Planning Practice Guidance

12.2.16 National Planning Practice Guidance (NPPG) (MHCLG 2020a) is a web-based resource that was launched in 2014 and provides guidance for local planning authorities on assessing the significance of water environment effects of proposed developments. The guidance highlights that adequate water and wastewater infrastructure is needed to support sustainable development.

12.2.17 The NPPF and the Flood Risk and Coastal Change guidance within the NPPG (published 2014) (MCHLG, 2014b) recommends that Local Plans should be supported by a Strategic Flood Risk Assessment (SFRA) and should develop policies to manage flood risk from all sources taking account of advice from the Environment Agency and other relevant flood risk management bodies, such as LLFA and IDB. Local Plans should apply a sequential, risk-based approach to the location of development to avoid, where possible, flood risk to public and property and manage any residual risk, taking account of the impacts of climate change.

Defra's '25 Year Environment Plan'

12.2.18 In 2018, Defra published the 25 Year Environment Plan (DEFRA, 2018) setting out the UK Government's goals for improving the environment within a generation and leaving it in a better state than we found it. The plan covers the provision of clean water; protection and enhancement of habitats, reducing the risk from environmental hazards and mitigating and adapting to climate change; using resources more sustainable and efficiently, managing exposure to chemicals and engagement with the natural environment.

12.2.19 The Plan includes specific goals to achieve good environmental status in our seas, reduce the environmental impact of water abstraction, meet the objectives of RBMP under the Water Framework Directive (WFD) EU 2000/60/EC (European Union, 2000)

reduce leakage from water mains, improve the quality of bathing waters, restore protected freshwater sites to a favourable condition, and do more to protect communities and businesses from the impact of flooding, coastal erosion and drought. At the heart of the Plan's delivery is the natural capital approach with the aspiring goal of a net gain in biodiversity from new development.

Future Water, The Government's Water Strategy for England

12.2.20 'Future Water - The Government's Water Strategy for England' (DEFRA, 2011b) sets out the Government's long-term vision for water and the framework for water management in England. It aims to enable sustainable and secure water supplies whilst ensuring an improved and protected water environment. 'Future Water' brings together the issues of water demand, supply and water quality in the natural environment as well as surface water drainage and river/ coastal flooding into a single coherent long-term strategy, in the context of the need to reduce greenhouse gas emissions.

12.2.21 The strategy also considers the issue of charging for water. The water environment and water quality have great economic, biodiversity, amenity and recreational value, playing an important role in many aspects of modern-day society, and thus the functions provided must be sustainably managed to ensure they remain available to future generations without compromising environmental quality.

Cooling Water Abstraction

12.2.22 There are a number of sources of guidance relating to optimal operation of direct cooled and cooling tower-cooled power stations in coastal and estuarine UK environments including 'Screening for Intake and Outfalls: a best practice guide' (Environment Agency, 2005). This document sets out a number of topics which should be considered, where appropriate, as part of the design development process for a new coastal/ estuarine generating station. The overall aim of the guide is to provide a synopsis of methods that are known to work effectively for screening of biota, as informed by a review of worldwide screening examples. The choice of cooling technique and the associated water source is selected in accordance with an appraisal of Best Available Techniques considering the BAT hierarchy and evaluating the efficiency benefits and environmental effects of the different techniques available.

Sustainable Drainage Systems Guidance

12.2.23 DEFRA published 'Non-statutory technical standards for sustainable (urban) drainage systems (SuDS)' in 2015 (DEFRA, 2015). SuDS provide a way to attenuate runoff from a site to the rate agreed with the Environment Agency to avoid increasing flood risk, but they are also important in reducing the quantities and concentration of diffuse urban pollutants found in the runoff.

12.2.24 The non-statutory technical standards set out that the peak runoff rates should be as close as is reasonably practicable to the greenfield rate but should never exceed the pre-development runoff rate. The standards also set out that the drainage system should be designed so that flooding does not occur on any part of a development site for a 1 in 30 year rainfall event, and that no flooding of a building (including basement) would occur during a 1 in 100 year rainfall event. It is also noted within the standards

that pumping should only be used when it is not reasonably practicable to discharge by gravity.

12.2.25 Industry good practice guidance on the planning for and design of SuDS is provided by:

- C753 - The SuDS Manual (Construction Industry Research and Information Association (CIRIA) 2015);
- Design Manual for Roads and Bridges (DMRB) (Highways England, 2020a) – CD 532: Vegetated Drainage Systems for Highway Runoff; and
- DMRB CG 501: Design of Highway Drainage Systems (Highways England, 2020b).

River Basin Management Plan

12.2.26 RBMP are prepared by the Environment Agency for six-year cycles and set out how organisations, stakeholders and communities will work together to improve the water environment. The most recent plans were published in 2015 (the second cycle) and will remain in place until after 2021. The waterbodies within the study area fall under the Trent Lower and Erewash and Idle and Torne Management Catchments within the Humber RBMP (DEFRA/ Environment Agency, 2018). Further details are provided in the Preliminary WFD Assessment (**Appendix 12B** in PEI Report Volume II).

Local Planning Policy

12.2.27 The Proposed Development is within the administrative area of North Lincolnshire Council. The existing North Lincolnshire Local Development Framework (North Lincolnshire Council (2011a) includes the following saved policies that are of relevance to the water environment:

- CS16: North Lincolnshire's Landscape, Greenspace and Waterscape – Requirement for development proposals to improve and address local deficiencies in the quality and quantity of accessible landscape, greenspace and waterscape, where appropriate;
- CS17: Biodiversity - Stewardship of North Lincolnshire's wildlife will be promoted through safeguarding protected sites, maintaining a network of local sites and corridors, ensuring development retains, protects and enhances biological features and ensuring development seeks a net gain in biodiversity;
- CS18: Sustainable Resource Use and Climate Change – Development will need to meet high water efficiency standards, incorporating new technology to recycle and conserve water. SuDS should be used where possible. The council will prevent development in high flood risk areas wherever possible and practicable. The council will ensure that development and land use in areas close to rivers responds appropriately to the character of the area, in the interests of preserving and making best use of limited resources; and
- CS19 Flood Risk - The council will support development proposals that avoid areas of current or future flood risk, and which do not increase the risk of flooding

elsewhere. Development in areas of high flood risk will only be permitted where it meets the following prerequisites:

- it can be demonstrated that the development provides wider sustainability benefits to the community and the area that outweigh flood risk;
- the development should be on previously used land. If not, there must be no reasonable alternative developable sites on previously developed land; and
- a flood risk assessment has demonstrated that the development will be safe, without increasing flood risk elsewhere by integrating water management methods into development.

12.2.28 In addition, development will be required, wherever practicable, to incorporate SuDS to manage surface water drainage.

12.2.29 A new Local Plan (North Lincolnshire Council Local Plan 2017 – 2036) is being prepared to replace the current North Lincolnshire Local Plan (North Lincolnshire Council, 2020), including a Core Strategy and the Housing and Employment Land Allocations Development Plan Documents. The new Local Plan policies and proposals will guide decisions and investment on development and regeneration up to 2036. The following policies of the draft Local Plan are of relevance to the water environment:

- Policy SS1p: Presumption in Favour of Sustainable Development – Creating and delivering sustainable growth lies at the heart of the spatial strategy for North Lincolnshire, with all new development contributing towards sustainable development;
- Policy DQE3p: Biodiversity and Geodiversity – All schemes shall, as appropriate to their nature and scale, protect, manage and enhance the network of habitats, species and sites of international, national and local importance (statutory and non-statutory), including sites that meet the criteria for selection as a Local Site. They shall also minimise and mitigate against impacts on biodiversity and geodiversity, deliver a net gain in biodiversity and/or geodiversity, and retain and enhance natural features such as river banks, watercourses, water bodies and natural features.
- Policy DQE6p: Managing Flood Risk – development will be supported where it avoids areas of current or future flood risk, and which do not increase the risk of flooding elsewhere. Development will be permitted provided that:
  - peak rate of run-off over the lifetime of the development, allowing for climate change, is no greater for the developed site than it was for the undeveloped site;
  - the post-development volume of run-off, allowing for climate change over the development lifetime, is no greater than it would have been for the undeveloped site. If this cannot be achieved, then the maximum discharge from the site should not exceed the calculated greenfield run off rate for all rainfall events up to and including the 1 in 100 year event plus allowance for climate change;
  - the development is designed so that the flooding of property in and adjacent to the development, would not occur for a 1 in 100 year event, plus an allowance for climate;

- the final discharge locations have the capacity to receive all foul and surface water flows from the development, including discharge by infiltration, into water bodies and into sewers;
- there is a management and maintenance plan for the lifetime of the development, which shall include the arrangements for adoption by any public authority, statutory undertaker or management company and any other arrangements to secure the operation of the Proposed Development throughout its lifetime; and
- the final destination of the discharge complies with the following priority order: firstly, to ground via infiltration; secondly, to a water body; and thirdly, to a surface water sewer.

- Policy DQE7p: Sustainable Urban Drainage Systems – Development proposals must include SuDS appropriate to the nature of the site. Compliance must be demonstrated with the Sustainable Drainage Systems and Flood Risk Guidance Document or successor documents. Furthermore, developers must take opportunities to integrate sustainable drainage with the development, create amenity, enhance biodiversity, and contribute to a network of green (and blue) open space. Surface water should be manged close to source and on the surface where practicable. Appropriate pollution control measures should be incorporated into drainage designs including multiple component treatment trains, and whole life management and maintenance of the drainage systems must be demonstrated.
- Policy DQE12p: Green Infrastructure Network - Development proposals must protect the linear features of the green infrastructure network that provides connectivity between green infrastructure assets, including public rights of way, bridleways, cycleways and waterways, and take opportunities to improve such features.

North Lincolnshire Council's SuDS and Flood Risk Guidance Document

12.2.30 North Lincolnshire Council, as LLFA, has produced a SuDS and Flood Risk Guidance Document Supplementary Guidance Document (SGD) (North Lincolnshire Council, 2017) providing developers and designers with guidance on SuDS and guidance on what type of SuDS are appropriate to a particular development, depending on the size and location. It also provides advice regarding adoption and maintenance of SuDS, riparian responsibilities and specific North Lincolnshire Council requirements, which include that:

- the LLFA drainage team should be consulted at pre-application stage;
- SuDS are required for all developments;
- no water should be stored above ground up to and including the 1 in 100 year event unless stored in a SuDS component;
- surface water runoff should be limited for all new developments to the greenfield runoff rate;
- storage components should not be constructed in private land;

- infiltration should only be viable for areas where the infiltration rate of soils are above 1 x 10-6m/s. Infiltration testing should be undertaken over a period of time, preferably over various seasons; and
- the level of betterment will be considered on a site by site basis for all brownfield sites.

North Lincolnshire Preliminary Flood Risk Assessment (PFRA)

12.2.31 North Lincolnshire Council, as LLFA, has produced a PFRA (North Lincolnshire Council 2011b) which reports on sources of flooding which the LLFA is responsible for:

- ordinary watercourses;
- surface water;
- groundwater; and
- artificial sources.

12.2.32 It sets out that the Environment Agency is responsible for flooding which results from the interaction of local sources and sources (tidal and main river). The PFRA does not include fluvial flood risk from main rivers, tidal flood risk and risk of flooding from large reservoirs.

12.2.33 The PFRA used locally agreed significance thresholds to assess the consequences of past and future flooding in North Lincolnshire and reviewed the local sources of flooding. Through an assessment of the potential consequences of this flooding, the PFRA concluded that there were no areas in North Lincolnshire which reached the national thresholds for the identification of Flood Risk Areas (i.e. 30,000 people at risk in one area).

North and North East Lincolnshire Strategic Flood Risk Assessment (SFRA)

12.2.34 North and North East Lincolnshire Council Level 1 SFRA was published in 2011 (North Lincolnshire Council, 2011c) to support the assessment of development sites in relation to flood risk. The SFRA was completed in consultation with the Environment Agency and IDB to provide information on the probability of flooding. The report also takes into account the impacts of climate change.

12.2.35 It is intended that the SFRA will be used by North Lincolnshire Council's planning and building control department to inform the application of the Sequential Test when allocating land or determining applications, in line with the NPPF.

12.2.36 The SFRA recognises that the western floodplain of the Trent, originally marshland, was reclaimed in the 16th and 17th Centuries and is very fertile, but relies on a complex drainage system, almost entirely pumped, to maintain water levels low enough for arable agriculture to take place.

North Lincolnshire Council Local Flood Risk Management Strategy (LFRMS)

12.2.37 As LLFA, North Lincolnshire Council has a responsibility to develop a LFRMS (North Lincolnshire Council, 2016) which sets out a clear plan for future flood risk

management in the region, ensuring people, businesses communities and other risk management authorities have an active role in how flood risk is managed.

12.2.38 The LFRMS sets out how the Council intends to manage local flood risks, as well as contribute to management from non-local sources, and to engage and inform residents on their own responsibilities, and enable them to contribute to the management of flood risk.

Isle of Axholme and North Nottinghamshire Water Level Management Board Byelaws

12.2.39 IDB operate in the low lying fen and valley areas, maintaining pumping stations and drainage channels to ensure that people are safe, and the risk of flooding is greatly reduced. The IoAaNNWLMB (the 'Board') covers an area of 28,737ha running from the Ouse following the west bank of the Trent moving south west down to Markham Moor.

12.2.40 The Isle of Axholme and North Nottinghamshire Water Level Management Board Byelaws and Land Drainage Act 1991 allow the Board to take action to ensure that free flow of water is unrestricted.

12.2.41 Watercourses maintained by the Board are cleaned out annually and it is important that access is preserved for machinery to enable this work to be undertaken. The Board's Byelaws prevent the erection of any building, structure (whether temporary or permanent) or planting of trees/ shrubs etc. within nine metres either side of a Board maintained watercourse irrespective of any planning permission. The Board's consent will be required to undertake works such as:

- works in, over, under or within nine metres of a Board maintained watercourse;
- installation of a culvert, weir or other like obstruction within any watercourse; and
- any works that increase the flow of surface water or treated foul effluent to any watercourse within the Board's district.

12.3 Assessment Methodology

Consultation

12.3.1 A Scoping report was submitted to the Planning Inspectorate on the 15 May 2020 and scoping responses were received on 26 June 2020. A copy of the Scoping report and Scoping opinion are provided within **Appendix 1A** and **Appendix 1B** respectively (PEI Report Volume II).

12.3.2 A summary of the comments relevant to this assessment are outlined in Table 12.1, along with indications of how they have been addressed within the PEI Report.

Table 12.1: Summary of consultation responses that have informed the scope and methodology of the water environment assessment

Consultee or organisation approached	Date and Nature of Consultation	Comments Raised	Response Provided in this chapter
Planning Inspectorate	June 2020 Scoping Opinion	*Study area:* Scoping Report paragraph 6.116 states that all impacts to surface and groundwater bodies in hydraulic connectivity with the Proposed Development Site will be included in the scope of the assessment. However, in paragraph 6.88 a 1km study area surrounding the Proposed Development site is depicted and a 5km area is also used in Figure 3C depicting water sources in relation to the location of the Proposed Development. It is therefore unclear what study area will be applied to the assessment. The ES should clearly set out what study area applied to the assessment; this should be based on the ZOI and effort should be made to agree the study area with the relevant consultation bodies.	For the purposes of the water quality assessment, a study area of circa 1km from the Proposed Development Site has been assessed in order to identify surface water bodies that could reasonably be affected by the Proposed Development. However, since watercourses flow, quality impacts may propagate downstream, and thus where relevant, the assessment also considers a wider study area based on professional judgement. Flood risk can impact upstream and downstream, and the assessment therefore considers a wider study area, where relevant. Professional judgement has been applied to identify the extent to which such features are considered. During statutory consultation, technical engagement with consultees including the Environment Agency, Canal and Rivers Trust (CRT) and other marine regulators, such as the MMO continues to be undertaken as required. Atmospheric deposition of nitrogen oxides NO_x) and ammonia emitted from the Proposed Power and Carbon Capture (PCC) Site may impact a wider area. Deposition is assessed against critical levels set for different ecosystems as per

Consultee or organisation approached	Date and Nature of Consultation	Comments Raised	Response Provided in this chapter
			the requirements of the Environment Act (1995). The significance of effects relating to atmospheric deposition to these sites is reported in **Chapter 8:** Air Quality and **Chapter 11**: Biodiversity and Nature Conservation (PEI Report Volume I).
Planning Inspectorate	June 2020 Scoping Opinion	*Baseline methodology:* The Scoping Report states that the baseline will be determined through information from previous assessments, supported by an updated desk-based study utilising water quality monitoring data from the EA. No additional surveys are proposed. Effort should be made to agree the approach with the relevant consultation bodies.	The baseline presented herein includes data provided by the Environment Agency with regard to water quality of receptors in the study area, water resources, licensed abstractions and discharge consents, pollution incidents, fisheries and aquatic ecology data and WFD information; alongside data collated from previous planning and consent applications and associated assessments, and publicly available data available online (e.g. Environment Agency Water Quality Archive and Catchment Data Explorer websites, British Geological Survey's Geoindex website). A walkover survey has also been undertaken of potentially affected waterbodies and is described within this chapter. As the EIA process progresses and the DCO application continues, further technical engagement will be undertaken with the Environment Agency and other marine regulators, such as the MMO, as required.

Consultee or organisation approached	Date and Nature of Consultation	Comments Raised	Response Provided in this chapter
Planning Inspectorate	June 2020 Scoping Opinion	*Climate Change Projections and flood defences:* The Strategic Flood Risk Assessment (SFRA) proposed to be used is the North Lincolnshire and North East Lincolnshire SFRA 2011 which will inform the FRA which in turn will inform the ES assessment. Although paragraph 6.120 states that climate change will be taken into account it does not explain how or what projections will be used. Additionally, in paragraph 6.105 the tidal flood defences are stated to provide a 1 in 200 level of protection but it is unclear as to whether this is based on 2011 data and if it incorporates up to date climate change projections. Therefore, this calls into question whether the defences still, or will continue to, provide the appropriate level of protection. The assessment should apply the most up-to-date UK Climate Change Projections (currently UKCP18) used in The National Planning Policy Guidance (NPPG) on Flood Risk Assessment and Climate Change Allowances to the ES assessment and make effort to agree the approach with the relevant consultation bodies. These projections should be used to inform the future baseline in the assessment and inform mitigation strategies over the lifetime of the Proposed Development; existing	Refer to **Appendix 12A:** Flood Risk Assessment (PEI Report Volume II) which outlines the basis of the FRA and the climate projections, data and assumptions used in the assessment. Information on In-Combination Climate Change Impacts (ICCI) is also presented in **Chapter 17**: Climate Change and Sustainability (Chapter 17 of this PEI Report).

Consultee or organisation approached	Date and Nature of Consultation	Comments Raised	Response Provided in this chapter
		and proposed flood defences should be detailed in the ES.	
Planning Inspectorate	June 2020 Scoping Opinion	*Tidal overtopping/breaching:* The site benefits from tidal flood defences as displayed on Figure 3C and explained in paragraph 6.104/5 of the Scoping Report; the ES should include an assessment on breach/overtopping of these defences where significant effects are likely to occur.	Refer to **Appendix 12A:** Flood Risk Assessment (PEI Report Volume II) which considers breach/ overtopping of defences, with a summary provided within this Section 12.6 of this chapter.
Planning Inspectorate	June 2020 Scoping Opinion	*Sensitive receptors:* The Scoping Report does not identify any sensitive receptors or explain how they will be identified. The ES should include a list of sensitive receptors identified within the appropriate study area and locate them on a figure.	Whilst other disciplines may consider 'receptor sensitivity', 'receptor importance' is considered in this chapter. This is because when considering the water environment, the availability of dilution means that there can be a difference in the sensitivity and importance of a water body. This is explained in more detail later in this section of the chapter. The importance of receptors identified within this chapter is reported in Table 12.16. The criteria for assessment of importance of receptors is outlined in Table 12.2.
Planning Inspectorate	June 2020 Scoping Opinion	*Drainage Strategy:* The Proposed Development will be located in the Isle of Axholme which relies on a complex network of drainage assets; effort should be made to agree	Consultation is being undertaken with the relevant stakeholders, including IDB and will continue as the DCO application process continues through the to the ES.

Consultee or organisation approached	Date and Nature of Consultation	Comments Raised	Response Provided in this chapter
		the drainage strategy approach with the relevant consultation bodies, including the EA.	
Planning Inspectorate	June 2020 Scoping Opinion	*Methodology and Significance criteria:* The Scoping Report states that standard significance criteria will be used but provides no further explanation and no methodology. The ES should include a methodology and criteria for assessing significance with explanation of how significance is determined and what is considered a 'significant effect'; this should be informed by appropriate guidance which should be referenced.	The methodology for determining significance of effects is outlined in Section 12.3 of this chapter. The classification and significance of effects has been determined using the principles of the guidance and the criteria set out in DMRB LA 113 (Highways England, 2019) adapted to take account of hydromorphology. Although these assessment criteria were developed for road infrastructure projects, this method is suitable for use on any development project and is considered to provide a robust and well tested method for predicting the significance of environmental effects for EIA.
Planning Inspectorate	June 2020 Scoping Opinion	*Modelling:* Any modelling undertaken to inform the ES assessment should be based on relevant guidance and effort should be made to agree the approach with the relevant consultation bodies. Modelling results should be provided with the ES.	No modelling has been undertaken at the PEI stage. The approach to assessment is explained in Section 12.6 of this chapter. The Applicant will seek to agree with stakeholders the requirements and scope of any modelling.
Planning Inspectorate	June 2020 Scoping Opinion	*CEMP:* The Construction Environmental Management Plan (CEMP) should include locations of dust generating construction works and details of preventative measures to limit the risk of pollution entering	Section 12.7 outlines mitigation measures for the construction, operation and decommissioning phases of the Proposed Development. The measures to control effects on the water environment, including flood risk during construction, will be detailed in the CEMP – a

Consultee or organisation approached	Date and Nature of Consultation	Comments Raised	Response Provided in this chapter
		waterways; effort should be made to agree these measures with the relevant consultation bodies.	Framework which will be provided as an appendix to the final Environment Statement.
Planning Inspectorate	June 2020 Scoping Opinion	*Site levels:* The ES should include existing and proposed site levels including access and egress routes and heights of any existing and proposed flood defences.	Please refer to **Appendix 12A:** Flood Risk Assessment (PEI Report Volume II).
Anglian Water	Response to PINS Scoping Opinion, June 2020	Reference is made to water abstraction and discharge forming part of the proposals for the main site. It is unclear whether there is a requirement for water services for the site and it is suggested that the Environmental Statement should include reference to water supply.	**Chapter 12: Water Resources and Flood Risk** (PEI Report Volume I) clearly outlines that water supply for use on site for all activities, with the exception of cooling water, will be supplied by Anglian Water.
Canal & River Trust	Response to PINS Scoping Opinion, June 2020	The Trust welcome the incorporation of a CEMP and advise that details should include any information on the location of dust generating works, the location of damping down and wheel wash areas and details of protective measures to be incorporated to limit risk of materials being blown into the canal. If proposed biodiversity enhancement measures next to the canal are installed before the compound is brought into use, it could provide a barrier to trap wind blown dust.	A Framework CEMP will be prepared for the ES outlining measures to limit the potential for dispersal and accidental releases of potential contaminants, soil derived dusts and uncontrolled run-off to occur during construction.
North Lincolnshire Council	Response to PINS Scoping	NLC state that the scoping report provided indicates an acceptable level of surface water drainage & flood risk	Further detail relating to surface water drainage and flood risk is provided in this chapter.

Consultee or organisation approached	Date and Nature of Consultation	Comments Raised	Response Provided in this chapter
	Opinion, June 2020	information that is required to be provided as part of DCO.	
Environment Agency	Response to PINS Scoping Opinion, June 2020	The ES should include a comprehensive drainage strategy, which considers both potential impact on flood risk and also potential hydrological impacts on receiving watercourses, including alterations in flow around discharge outlets and the impacts they may have on local water quality.	A Conceptual Drainage Strategy has been produced, provided in **Appendix 12A:** Flood Risk Assessment (PEI Report Volume II). Further consultation with the Environment Agency, the LLFA, and IDB proposed to agree details of the proposed approach to drainage.
Environment Agency	Response to PINS Scoping Opinion, June 2020	The EA advises that where the proposed preliminary Water Framework Directive (WFD) assessment identifies specific components of the development with the potential to impact WFD status/potential or prevent improvement of local watercourses, such components should be subject to comprehensive assessment with potential mitigation strategies identified.	**Appendix 12B:** Water Framework Directive Screening Report (PEI Report Volume II) identifies potential impacts upon WFD status and mitigation measures.
Environment Agency	Response to PINS Scoping Opinion, June 2020	The EA advises that the application needs to be supported by a FRA containing plans to identify rivers, water bodies (including existing culverts/drains on site), other geographical features and the floor plans of the Proposed Development highlighting uses. A topographical survey should be provided, including proposed site levels and the heights of existing flood defences should be included. Flood risk should be assessed from all	**Appendix 12A: Flood Risk Assessment** (PEI Report Volume II) identifies rivers, water bodies and other geographical features, these are shown on the supporting figures. **Appendix 12A** also details the heights of existing flood defences, no additional flood defences are proposed. **Appendix 12A** assesses flood risk from all sources and outlines mitigation measures to ensure the risk does not increase.

Consultee or organisation approached	Date and Nature of Consultation	Comments Raised	Response Provided in this chapter
		sources and consider breach, overtopping and climate change. Current and future flood management measures should be considered. It must be demonstrated that flood risk will not increase. If found to increase it may be required to implement floodplain compensation. The development is located on the Isle of Axholme for which a critical flood level of 4.1m AOD has been established, it is advised that all new developments are set with 300 mm freeboard above this level.	
Althorpe Parish Council	Response to PINS Scoping Opinion, June 2020	Althorpe Parish Council has expressed concern that abstraction of water could cause levels of water to be artificially high to allow abstraction and therefore make flood management on the Isle of Axholme more difficult. The Council is concerned about the effects on wildlife and water quality from abstraction water being returned to watercourses.	**Chapter 12: Water Resources and Flood Risk** and (PEI Report Volume I), along with **Appendix 12A:** Flood Risk Assessment and **Appendix 12B: WFD Screening Report** (PEI Report Volume II) provide details on water abstraction and potential impacts on flood risk and water quality.

Basis of Assessment

12.3.3 The following sources of information that define the Proposed Development have been reviewed and form the basis of this assessment:

- **Chapter 4:** The Proposed Development (PEI Report Volume I);
- **Chapter 5:** Construction and Management (PEI Report Volume I);
- **Appendix 12A:** Flood Risk Assessment (PEI Report Volume II) including Section 5 – 6 - Conceptual Drainage Strategy (PEI Report Volume II);
- **Appendix 12B**: WFD Screening Report (PEI Report Volume II) including Annex C - Water Quality Data (PEI Report Volume II);
- **Figure 1.1**: Site Location Plan (PEI Report Volume III); and
- **Figure 3.1:** Indicative DCO Site (PEI Report Volume III).

Baseline Data Collection

Study Area

12.3.4 For the purposes of the water quality assessment, a study area of circa 1km from the Proposed Development Site has been considered in order to identify surface water bodies that could potentially be affected by the Proposed Development. However, since watercourses flow, quality impacts may propagate downstream, and thus where relevant the assessment also considers a wider study area based on professional judgement. In this instance, the Proposed Development lies adjacent to the tidal River Trent. Given the size and length of the River Trent, it is unlikely that any further waterbodies downstream would be affected and thus the River Trent is considered the final receiving water body that could conceivably be affected.

12.3.5 As flood risk impact can also impact upstream and downstream, the assessment considers a wider study area, where relevant. Professional judgement has been applied to identify the extent to which such features are considered. Additional indirect effects may also occur to other water environment receptors distant from the study area through increased demand on potable water supplies and foul water treatment.

12.3.6 Air quality modelling for the Proposed Development has been undertaken to determine the potential for atmospheric deposition of NO_x and ammonia releases from the Proposed PCC Site to impact sensitive ecosystems. The study area for this assessment covers a wider area including the ponds at Crowle Borrow Pits Site of Special Scientific Interest (SSSI) and Hatfield Chase Ditch SSSI. Deposition is assessed against critical levels set for each particular ecosystem as per the requirements of the Environment Act (HMSO, 1995). The significance of effects relating to atmospheric deposition to these sites is reported in **Chapter 8:** Air Quality (PEI Report Volume I).

Desk Study

12.3.7 Desk based research has been undertaken to identify the waterbodies within and adjacent to the Proposed Development Site, and to gather and critically evaluate relevant data and information on their condition and attributes.

12.3.8 In summary, the key background reports, websites and data used include the following (all web sources last accessed in August 2020):

- British Geological Survey's Geological Mapping Viewer, 'Geoindex' (BGS, 2020);
- Environment Agency's Catchment Data Explorer (Environment Agency, 2020a);
- Environment Agency's Water Quality Archive (Environment Agency, 2020b);
- Environment Agency's Guidance on discharges to surface water and groundwater: environmental permits (Environment Agency, 2016);
- Environment Agency's Flood Risk Maps (Environment Agency, 2020c);
- Centre for Ecology and Hydrology (CEH)'s National River Flow Archive (CEH, 2020);
- Cranfield University's 'Soilscapes' (Cranfield University, 2020);
- Meteorological Office's Climate averages data (Met Office, 2020);
- DEFRA's Multi-Agency Geographic Information for the Countryside (MAGIC) website (DEFRA, 2020);
- Ordnance Survey (OS) maps and aerial photography (Bing, 2020);
- data requested from the Environment Agency with regard to water quality of receptors in the study area, water resources (licensed abstractions and discharge consents), pollution incidents, fisheries and aquatic ecology data and WFD information and data;
- information available through previous applications for Marine Consent associated with the operation and maintenance of the Keadby 1 Power Station intake and outfall; and
- information available in previous Section 36 Consent (including associated Environmental Statement (ERM, 2016) and planning applications relating to Keadby 2 Power Station.

Site Surveys

12.3.9 A site walkover was undertaken on 31 July 2020 by surface water quality specialists in warm, dry and sunny conditions following a week of dry weather. The walkover focused on surface waterbodies in the study area, observing their current character and condition, the presence of existing risks and any potential pathways for construction and operational impacts from the Proposed Development.

Source-Pathway-Receptor Approach

12.3.10 The impact assessment is based on a source-pathway-receptor approach. For an impact on the water environment to exist the following is required:

- an impact source (such as the release of polluting chemicals, particulate matter, or biological materials that cause harm or discomfort to humans or other living organisms, or the loss or damage to all or part of a water body);

- a receptor that is sensitive to that impact (i.e. water bodies and the services they support); and
- a pathway or pathways by which the two are linked.

12.3.11 The first stage in applying the source-pathway-receptor model is to identify the potential causes or 'sources' of impact from a development. The sources have been identified through a review of the details of the Proposed Development, including the size and nature of the development, potential construction methodologies and timescales. The next step in the model is to undertake a review of the potential receptors, that is, the water environment receptors that have the potential to be affected. Water bodies including their attributes have been identified through desk study and site surveys. The last stage of the model is, therefore, to determine if there is a viable exposure pathway or a 'mechanism' linking the source to the receptor. This has been undertaken in the context of local conditions relative to the water receptors within the study area, such as topography, geology, climatic conditions and the nature of the impact (e.g. the mobility of a liquid pollutant or the proximity to works that may physically impact a water body).

12.3.12 The assessment of the likely significant effects is qualitative, and considers construction, operational and decommissioning phases, as well as cumulative effects with other developments. This assessment has considered the risk of pollution to surface water bodies directly and indirectly from construction activities, particularly in relation to those water features which are within or close to the Proposed Development Site. The risk of pollution from urban runoff and the increased demand on water resources has also been considered so that appropriate measures (e.g. SuDS, proprietary treatment devices, and water conservation measures) can be incorporated into the design of the Proposed Development.

12.3.13 Some specific assessments have been undertaken to support this impact assessment process. These are described in more detail in the following sections.

Assessment of Surface Water Runoff for the Operational Phase

12.3.14 During operation, surface water runoff from the Proposed Development may contain pollutants derived from urban surfaces (e.g. inert particulates, litter, hydrocarbons, metals, nutrients and de-icing salts). This mixture of pollutants is collectively known as 'urban diffuse pollutants,' and although each pollutant may itself not be present in harmful concentrations, the combined effects over the long term can cause chronic adverse impacts. Changes in impermeable surfaced area within the Proposed Development Site may lead to increases in the rate and quantities of these pollutants from the Site to receiving watercourses. An assessment is therefore needed to determine the potential risk to the receiving watercourses and to inform the development of suitable treatment measures.

12.3.15 The appropriateness of the surface water drainage measures in terms of providing adequate treatment of diffuse pollutants has been assessed with reference to the Simple Index Assessment method described in the SuDS Manual (CIRIA, 2015). The Simple Index Approach follows three steps:

- Step 1 – Determine suitable pollution hazard indices for the land use(s);

- Step 2 – Select SuDS with a total pollution mitigation index that equals or exceeds the pollution hazard index (for three key types of pollutants - total suspended solids, heavy metals and hydrocarbons). Only 50% efficiency should be applied to second, third etc. treatment train components; and
- Step 3 – If the discharge is to a water body protected for drinking water, consider a more precautionary approach.

12.3.16 The SuDS Manual only provides a limited number of land use types so these have been chosen as the most suitable for the components of the Proposed Development. Where more than one pollution hazard category applies to a component of the Proposed Development, the worst pollution hazard has been selected. For areas where there is a greater risk of a chemical spillage, a process specific risk assessment may be required, for example, within to inform the Environmental Permit application. Engagement will be undertaken with the Environment Agency regarding the approach to assessment.

Water Framework Directive Assessment

12.3.17 Proposed developments having the potential to impact on current or predicted WFD status are required to assess their compliance against the objectives defined for potentially affected water bodies. The Environment Agency considers whether proposals for new developments have the potential to:

- cause a deterioration of a water body from its current status or potential; and/ or
- prevent future attainment of Good status (or potential where not already achieved).

12.3.18 The guidance on WFD assessments used to inform this assessment includes:

- Environment Agency Advice Note - Water Framework Directive Risk Assessment: How to assess the risk of your activity' (Environment Agency, 2016b); and
- The Planning Inspectorate Advice Note 18: The Water Framework Directive' (PINS, 2017).

12.3.19 The aim of screening is to identify the Proposed Development components that could affect WFD status and 'screen out' aspects of the Proposed Development that do not require further consideration. Where required, a scoping stage is undertaken in which WFD receptors that are potentially at risk and how the risk will be assessed is identified and finally, if required, Stage 3 involves a full impact assessment, and potentially, consideration of the criteria in Article 4.7 of the Directive. Article 4.7 sets out the conditions that must be met to justify derogation of the Directive.

12.3.20 A WFD screening of the Proposed Development is included in **Appendix 12**B: Water Framework Directive Screening Assessment (PEI Report Volume II). Further assessment will be undertaken at the ES stage, as required.

Flood Risk Assessment

12.3.21 A Site-wide FRA is provided in **Appendix 12A:** Flood Risk Assessment (PEI Report Volume II) which assesses the current and future risk of flooding from all sources

including tidal, fluvial, surface water, groundwater, artificial sources and drainage infrastructure. The flood risk baseline is also summarised in Section 12.4 of this chapter.

Cooling Water System Discharge Assessment

12.3.22 The Proposed PCC Site will require a source of cooling water for heat rejection purposes. A number of options are technically feasible to achieve the required cooling including options for direct/ hybrid cooling of the CCGT and/ or the CCP. Technical assessments have been undertaken in order to identify preferred cooling options for the Proposed Development and at this stage, two water sources are under consideration; the Stainforth and Keadby Canal (Canal Water Abstraction Option) or the River Trent (River Water Abstraction Option - see **Figure 3.2** in PEI Report Volume III).

12.3.23 The Applicant is proposing to re-use existing assets and pipework for Keadby 1 Power Station for the discharge of treated effluent to the River Trent. A **Water Discharge Corridor** is included in the Proposed Development Site, comprising the existing easement of the existing cooling water corridor north-east from Keadby 1 Power Station connecting with the River Trent. Interconnecting pipework would extend from Proposed PCC Site to connect to this infrastructure.

12.3.24 At this early stage in the design and development process, there are limitations to the level of detail available regarding the cooling water system (CWS) and associated abstraction and discharge options, including potential discharge into the River Trent.

12.3.25 It is proposed that a qualitative appraisal of the CWS discharge to the estuarine River Trent will be undertaken in the ES and that this will consider both potential thermal impacts and chemical pollutants.

Classification of Effect and Significance Criteria for EIA Assessment

12.3.26 The classification and significance of effects has been determined using the principles of the guidance and the criteria set out in DMRB LA113 (Highways England 2019) adapted to take account of hydromorphology and navigation. Although these assessment criteria were primarily developed for road infrastructure projects, they are suitable for any development project and provide a robust and well tested method for assessing the likely significance of effects. The methodology also considers advice set out in Department for Transport (DfT) TAG Unit A3, Environmental Impact Appraisal (DfT 2019).

12.3.27 Approaches to mitigating potential significant effects during construction and operational phases have been described with reference to good practice guidance and design.

12.3.28 Following the DMRB LA 113 (Highways England, 2019) guidance, the importance of the receptor (Table 12.2) and the magnitude of impact (Table 12.3) are determined and then used to determine the overall classification of effects (see Table 12.4). Where significant adverse effects are predicted, options for mitigation have been considered and proposed where reasonably practicable. The residual effects of the Proposed Development with identified mitigation in place have then been assessed.

12.3.29 Whilst other disciplines may consider 'receptor sensitivity', 'receptor importance' is considered here. This is because when considering the water environment, the availability of dilution means that there can be a difference in the sensitivity and importance of a water body. For example, a small drainage ditch of low conservation value and biodiversity with limited other socio-economic attributes, is very sensitive to impacts, whereas an important regional scale watercourse, that may have conservation interest of international and national significance and support a wider range of important socio-economic uses, is less sensitive by virtue of its ability to assimilate discharges and physical effects. Irrespective of importance, all controlled waters in England are protected by law from being polluted.

12.3.30 The magnitude of impact will be determined based on the criteria in Table 12.3 taking into account the likelihood of the effect occurring. The likelihood of an impact occurring is based on a scale of certain, likely or unlikely. Likelihood has been considered in the case of water resources only, as likelihood is inherently included within the flood risk assessment.

Table 12.2: Evaluating the Importance for Surface Water, Flood Risk, and Water Resources

Importance	Surface Water[1]	Morphology[2]	Flood Risk	Navigation
Very High	Watercourse having a WFD classification shown in a RBMP and Q95≥1.0m^3/s. Sites protected/designated under a EC or UK legislation (SAC, SPA, SSSI, Ramsar, salmonid water) / Species protected by EC legislation Ecology and Nature Conservation.	Unmodified, near to or pristine conditions, with well-developed and diverse geomorphic forms and processes characteristic of river type.	Essential infrastructure or highly vulnerable development	Corridor is a navigation route of principal importance
High	Watercourse having a WFD classification shown in a RBMP and Q95<1.0m^3/s. Species protected under EC or UK legislation Ecology and Nature Conservation.	Conforms closely to natural, unaltered state and would often exhibit well-developed and diverse geomorphic forms and processes characteristic of river type, with abundant bank side vegetation. Deviates from natural conditions due to direct and/or indirect channel, floodplain, and/or catchment development pressures.	More vulnerable development	Corridor is a navigation route of high importance
Medium	Watercourses not having a WFD classification shown in a RBMP and Q95 >0.001m^3/s.	Shows signs of previous alteration and / or minor flow regulation but still retains some natural features or may be recovering towards conditions indicative of the higher category.	Less vulnerable development	Corridor is a navigation route of medium importance (e.g. intermittently used by a small number of craft)

Importance	Surface Water[1]	Morphology[2]	Flood Risk	Navigation
Low	Watercourses not having a WFD classification shown in a RBMP and Q95 <0.001m^3/s.	Substantially modified by past land use, previous engineering works or flow regulation and likely to possess an artificial cross-section (e.g. trapezoidal) and would probably be deficient in bedforms and bankside vegetation. Could be realigned or channelised with hard bank protection, or culverted and enclosed. May be significantly impounded or abstracted for water resources use. Could be impacted by navigation, with associated high degree of flow regulation and bank protection, and probable strategic need for maintenance dredging. Artificial and minor drains and ditches would fall into this category.	Water compatible development	Corridor is rarely used for navigation or is non-navigable
Note 1: Professional judgement is applied when assigning an importance category to all water features. All controlled waters are protected from pollution under the Environmental Permitting (England and Wales) Regulations 2016 and the Water Resources Act 1991 (as amended), and future WFD targets also need to be considered.				
Note 2: Based on the water body 'Reach Conservation Status' presently being adopted for the High Speed 2 project (developed originally by Atkins) and developed from EA conservation status guidance (Ref 12-32, Ref 12-33) as DMRB guidance does not currently provide any importance criteria for morphology.				

Table 12.3: Evaluating Magnitude for Surface Water, Flood Risk, and Water Resources

Impact	Criteria	Description and Examples
Major Adverse	Results in a loss of attribute and/ or quality and integrity of the attribute	Loss or extensive change to a fishery. Loss of regionally important public water supply. Loss or extensive change to a designated Nature Conservation Site. Reduction in water body WFD classification. Increase in peak flood level (>100mm)[5] Major disruptions to navigation or risks posed to navigable craft.
Moderate Adverse	Results in effect on integrity of attribute, or loss of part of attribute	Partial loss in productivity of a fishery. Degradation of regionally important public water supply or loss of major commercial/industrial/agricultural supplies. Contribution to reduction in water body WFD classification. Increase in peak flood level (>50mm). Delays to navigation as a result of a reduction in navigable channel extent.
Minor Adverse	Results in some measurable change in attribute's quality or vulnerability	Minor effects of water supplies. Increase in peak flood level (>10mm). Minor reductions to wetted width of the channel and at the edge of what is navigable.
Negligible	Results in effect on attribute, but of insufficient magnitude to affect the use or integrity	No risk identified to surface water quality or hydromorphology or navigation. Negligible change in peak flood level (≤+/- 10mm).
Minor Beneficial	Results in some beneficial impact on attribute or a reduced risk of negative effect occurring	Contribution to minor improvement in water quality, but insufficient to raise WFD classification. Creation of flood storage and decrease in peak flood level (>10mm). Removal of an in channel structure at edge of or outwith of the navigable channel, which may lead to small improvements to travel times.

[5] All references to peak flood level in this table are for a 1% annual probability event, including climate change.

Impact	Criteria	Description and Examples
Moderate beneficial	Results in moderate improvement of attribute quality	Contribution to improvement in waterbody WFD classification. Creation of flood storage and decrease in peak flood level (>50mm). Removal of in channel structure increasing width of navigable channel leading to a reduction of travel times.
Major beneficial	Results in major improvement of attribute quality	Removal of existing polluting discharge, or removing the likelihood of polluting discharges occurring to a watercourse. Improvement in water body WFD classiciation. Creation of flood storage and decrease in peak flood level (>100mm). Removal of an in channel structure leading to a significant reduction in collision risk to vessels.

Classification and Significance of Effect

12.3.31 Once the magnitude of impact and the receptor importance have been defined, the classification and significance of the potential effect can be derived by combining both assessments in a simple matrix as shown in Table 12.4. Effects classed as moderate or greater are considered significant in EIA terms (i.e. shaded cells). Where there is a range of effects (e.g. large/ very large) professional judgement has been used to determine the residual effect.

Table 12.4: Classification and Significance of Effect

Magnitude of Impact	Importance of Attribute			
	Very High	**High**	**Medium**	**Low**
Major	Very Large	Large / Very Large	Moderate / Large	Slight / Moderate
Moderate	Large / Very Large	Moderate / Large	Moderate	Slight
Minor	Moderate / Large	Slight / Moderate	Slight	Neutral / Slight
Negligible	Slight	Neutral	Neutral / Slight	Neutral / Slight
No change	Neutral	Neutral	Neutral	Neutral
Note: adapted from DMRB LA104 (Highways England, 2019)				

Rochdale Envelope

12.3.32 The assessment contained herein makes use of the 'Rochdale Envelope' approach under the Planning Act (2008) (HMSO, 2008). The approach is employed where the nature of the Proposed Development means that some details of the whole project have not been confirmed when the application is submitted, and flexibility is sought to address the uncertainty.

12.3.33 Key principles in the context of the DCO application process are given in the PINS Advice Note Nine: Using the Rochdale Envelope (PINS, 2018). This includes the need to outline timescales associated with the flexibility sought, and that the assessment should establish those parameters likely to result in the maximum adverse effect (the reasonable worst-case scenario) and be undertaken accordingly to determine significant effects from the Proposed Development and to allow for the identification of necessary mitigation.

12.3.34 The following are the reasonable worst-case scenario assumptions (maximum parameters) for the purposes of the Water Environment assessment:

- Cooling water will be required for heat rejection from the combined cycle gas turbine (CCGT) and carbon capture and compression plant (CCP). There are two options under consideration to support this process, both in terms of the cooling technology and abstraction/ discharge. The preferred solution is hybrid cooling of both the CCGT and CCP using water abstracted from the Stainforth and Keadby Canal (**Canal Water Abstraction Option**). In the event that it is not possible to abstract sufficient volumes of water from the canal, an alternative option would be to utilise the existing Keadby 1 Power Station cooling water abstraction infrastructure from the River Trent for the Proposed Development (River Water Abstraction Option). It is anticipated that this infrastructure is in a suitable condition for re-use with some refurbishment and additions (e.g. new pumps), although the existing River Trent water intake would be subject to modification. It is anticipated that cooling would be achieved through the use of hybrid wet/ dry cooling towers using make up water that is either abstracted from the River Trent or from the Stainforth and Keadby Canal, supplemented with extra pre-cooling by dry fin-fan coolers when necessary (e.g. in summer months when the hybrid cooling towers will not provide enough standalone cooling). As a worst-case scenario, the assessment considers both options to abstract from the River Trent or from Stainforth and Keadby Canal.
- As a worst case, it has been assumed that open-cut methods will be required for installation of any pipework across minor watercourses and drains associated with the Water Connection Corridors and electrical connection to 132kV Northern Powergrid substation option, if selected. In such cases, it is assumed that flow would be temporarily over-pumped, diverted around or flumed through the working area and the watercourse fully reinstated, on completion of works.

General Assumptions

12.3.35 The assessment has been undertaken using available data and Proposed Development design details at the time of writing in September 2020. It is also based on understanding of flow pathways as observed during the site walkover.

Assumptions have been made regarding flow pathways for culverted sections of watercourses, based on Ordnance Survey mapping. Understanding of flow pathways is described for each watercourse in the baseline (Section 12.4).

12.3.36 For the purposes of the assessment, it is assumed that a similar intake structure and layout as currently being constructed for the Keadby 2 Power Station canal intake will be used for the Proposed Development. As the existing screen[6] installation is designed for 442 litres per second (L/s) and the maximum estimated hybrid cooling water demand for the Proposed Development is approximately 308 L/s[7], it is expected that the overall dimensions of the new inlet will be no larger than the Keadby 2 Power Station installation. Consultation is ongoing with the Environment Agency and CRT to define the parameters of any abstraction/ discharge, including the volume of water that could be abstracted or discharged per annum, and frequency/ rate.

12.3.37 It is assumed that wastewater from the cooling process will be discharged to the River Trent following treatment at a rate compliant with the discharge limits set by the Environment Agency within the Environmental Permit.

12.3.38 It is assumed that installation works will require use of a cofferdam in close proximity to the intake structure in the River Trent and/ or proposed intake structure location in the Stainforth and Keadby Canal. Water would be pumped out after any necessary fish rescue and at a suitable rate and way as to avoid any significant disturbance or scour of the river or canal bed. It is assumed that no dredging would be required.

12.3.39 Water supply for use on site for all activities with the exception of cooling water and process water (i.e. make-up to the steam/water cycle of the Proposed PCC Site) will be supplied by Anglian Water.

12.3.40 For the purposes of this assessment it has been assumed that all foul water from welfare facilities will be directed to the nearest wastewater treatment works (WwTW), and that given the relatively small volumes involved, that they will have adequate capacity to do so within current permit standards. This will be confirmed through ongoing consultation with Anglian Water.

12.3.41 In terms of site drainage, the assessment assumes that prior to discharge to the River Trent, effluent treatment facilities will be provided on site for treatment of contaminants in the cooling tower blowdown, direct contact cooler (DCC) blowdown, demineralisation plant and condensate polishing plant regeneration wastewater, Heat Recovery Steam Generator (HRSG) boiler blowdown and reject water (brine) from the desalination process.

12.3.42 At this preliminary stage, it is assumed that bypass oil water separators and storage tanks will be provided for surface water runoff to any chosen SuDS (e.g. retention pond) situated upstream of the main outfall from the Proposed Development Site. It is also assumed that penstocks would be provided to isolate any accidental spillages.

[6] Aqseptence Group is a supplier of specialized filtration and separation products, including screens to minimise risks to ecological taxa as part of Cooling Water Systems.

[7] This estimate is informed by preliminary design and options appraisal work commissioned by the Applicant. It will be refined further as the EIA progresses.

A fire water drainage philosophy will be developed to ensure that should an incident occur, contaminated fire water would not enter the surface water drainage system or process water system, but rather be retained on-Site for a period and be disposed of safely. Further details on the proposed SuDS will be provided in an outline drainage strategy to accompany the Application. An initial Conceptual Drainage Strategy is provided within (Section 5 – 6) of **Appendix 12A**: Flood Risk Assessment (PEI Report Volume II).

12.3.43 It is assumed that water discharged from the Proposed Development Site will be limited to the greenfield runoff rate, and that water storage (i.e. the retention pond illustrated on **Figure 4.1** in PEI Report Volume III) is appropriately sized to accommodate the 1% Annual Exceedance Probability (AEP) event with 40% allowance for climate change.

12.3.44 Any crossings of watercourses to facilitate either construction access (e.g. to temporary laydown areas) or permanent access, including emergency egress for the Proposed Development will seek to minimise the length of bank affected and impacts to these watercourses.

12.3.45 Assumptions and limitations relating to flood risk are outlined in **Appendix 12A:** Flood Risk Assessment (PEI Report Volume II).

12.3.46 Due to the proposed low volumes associated with the cooling water discharge and the minimal anticipated thermal uplift, a qualitative assessment of potential impacts to the River Trent is proposed. This takes into account the previous cooling water assessments undertaken for Keadby 1 Power Station and Keadby 2 Power Station operating simultaneously, described in Section 12.6 in addition to the expectation that the Keadby 1 Power Station and the Proposed Development are unlikely to discharge cooling water return to the river concurrently.

12.3.47 As there is not a scenario whereby The Proposed Development and Keadby 1 Power Station and Keadby 2 Power Station would be operational together, (the Proposed Development is being designed to re-used some of Keadby 1 Power Station's infrastructure) the findings from the combined assessment for Keadby 1 Power Station and Keadby 2 Power Station will help to inform this qualitative assessment. The approach and methodology for this assessment will be discussed with relevant stakeholders as the EIA process progresses.

12.3.48 As a contractor has not yet been appointed, construction method statements are not available at this time, and therefore reasonable assumptions have been made that all works will take place using best practice. Such measures will be set out in the Framework Construction Environmental Management Plan (CEMP) to be submitted with the application for Development Consent.

12.3.49 No water quality monitoring has been undertaken specifically to inform this assessment. Background water quality has been determined from the nearest data available of the Environment Agency's Water Quality Archive website (Environment Agency, 2020b) and other assessments produced to inform the design of Proposed Development. Such assessments including preliminary water supply and wastewater discharge feasibility assessments.

12.3.50 The understanding of drainage arrangements assessed herein is based work undertaken by the Applicant to inform the design of the Proposed Development[8]. The drainage strategy is subject to further development, in consultation with the Environment Agency and LLFA, and will be presented and assessed at the full impact assessment stage. An indicative assessment is provided herein.

12.3.51 Any required cofferdam is estimated to extend to a maximum of 25m into the Trent around the existing abstraction point on the western bank of the River Trent. This is a preliminary, estimated extent; the maximum required area for a cofferdam in order to ensure a safe and dry working area – if required - will be refined further as the EIA progresses.

12.3.52 If the Canal Water Abstraction Option is selected, a smaller cofferdam would be expected in the Stainforth and Keadby Canal (likely extending approximately 15m from the canal bank). Cofferdam installation or removal would be timed to minimise ecological impacts from the structure (e.g. relating to fish migration in the River Trent), as described in **Chapter 11**: Biodiversity and Nature Conservation.

12.3.53 The expected treatment performance of different SuDS options is based on advice reported in CIRIA C753 - The SuDS Manual (CIRIA, 2015) using the Simple Index Approach. Professional judgement has been used when deciding the example land use used, and what treatment a particular option may provide, taking into account the design of the SuDS feature and whether it is considered to be 'optimum' or 'sub-optimum' for the Proposed Development.

12.4 Baseline Conditions

12.4.1 The relevant baseline physical characteristics of the study area and the water features present are described in this section and with reference to **Figure 12-1:** Surface Waterbodies and their attributes (PEI Report Volume III).

Land Use, Topography and Rainfall

12.4.2 The Proposed Development Site and a 1km study area surrounding this lies within the extensive floodplain of the River Trent within the Isle of Axholme. Land is generally low lying at elevations below 10m Above Ordnance Datum (mAOD) and with very shallow gradients. Beyond the area associated with the current (operational) Keadby 1 Power Station, land use is almost entirely arable farming, used mainly to grow wheat and sugar beets. The land is particularly fertile due to its history of annual flooding from the Trent and peat soil.

12.4.3 The Water Connection Corridor eastwards from the Proposed Development Site towards the village of Keadby, and the Proposed Development Site construction and operational access route extends to the south-west, crossing numerous watercourses including the Sheffield and South Yorkshire Navigation – Stainforth and Keadby Canal (herein referred to as 'the Stainforth and Keadby Canal'), North Soak Drain and South Soak Drain.

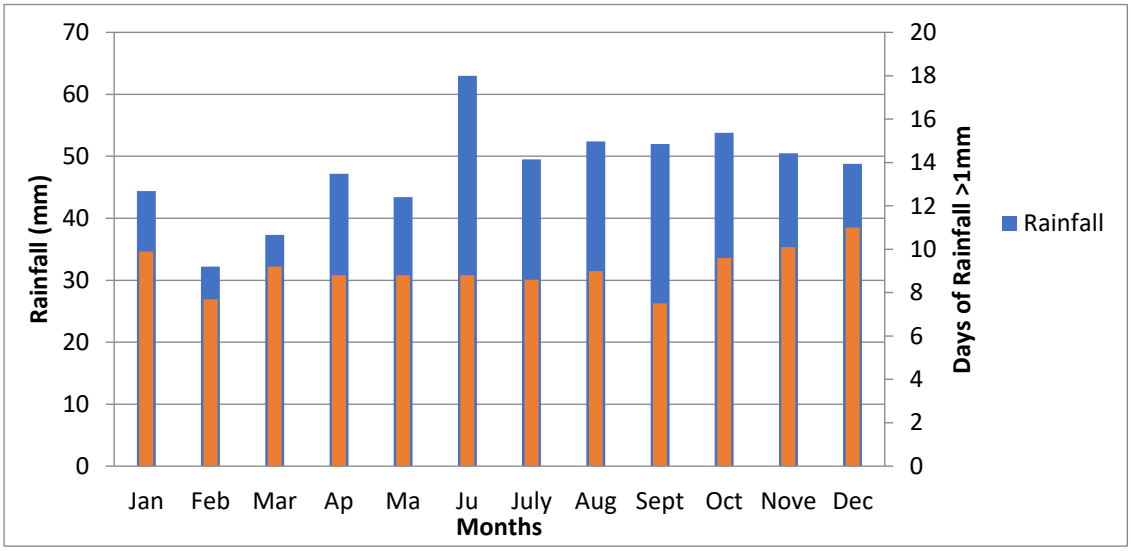
[8] As the EIA progresses, further details of this will be provided.

12.4.4 The study area has a complex surface water hydrology and a long history of land drainage. The Proposed Development Site and land north of the Stainforth and Keadby Canal is within the IoAaNNWLMB area.

12.4.5 The nearest weather station on the Met Office website with historical data is located at Robin Hood Doncaster Sheffield Airport, approximately 21km south-west of the Proposed Development Site, at NGR SK 65933 98500. Based on the average climate data (for the period 1981 to 2010) for this weather station, the study area experiences an average of 574mm of rainfall per year, with it raining more than 1mm on around 109 days per year. This is a relatively low level of rainfall when compared to the average for England.

12.4.6 Plate 12.1 illustrates this data to show how the average rainfall varies throughout the year, with the wettest period being in the mid to late summer to autumn, and driest in late winter to early spring. Average monthly rainfall is generally less than 60mm throughout the year, except in July when it rises to 63mm. February is the driest month with an average of approximately 32mm between 1981 and 2010.

Plate 12.1 Robin Hood Doncaster Sheffield Airport Weather Station - Average rainfall per month (1981-2010) and average days per month with >1mm of rainfall (1981-2010)



Groundwater, Geological Features and Soils

12.4.7 **Chapter 13:** Geology, Hydrogeology and Land Contamination (PEI Report Volume I) describes the geology and groundwater at the Proposed Development Site, summarised here.

12.4.8 The British Geological Society (BGS) Geoindex viewer (BGS, 2020) indicates that the entire study area is underlain by bedrock of the Mercia Mudstone Group. Above this, superficial deposits consist mainly of Warp (sand and silt) with Alluvium (clay, sand,

silt, and gravel) along the course and immediate margins of the River Trent. Warp is artificially induced alluvium that was created when agricultural warping[9] was practiced.

12.4.9 According to the MAGIC online map (DEFRA, 2020) the bedrock beneath the Proposed Development Site is classed as a Secondary B aquifer ('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 former non-aquifers') whilst the superficial deposits across the Proposed Development Site are classed as a Secondary A aquifer ('permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers').

12.4.10 Levels within the historical borehole records (BGS, 2020) indicate generally shallow groundwater levels within the superficial geology of between 0.9m and 3.0m below ground level (bgl). Occasionally, deeper groundwater strikes were recorded between 5.4m and 6.9m bgl. There is insufficient information to conclude at this stage whether these levels are representative of true groundwater levels across the wider area.

12.4.11 According to the Environment Agency's online Catchment Data Explorer website (Environment Agency, 2020a) groundwater beneath the Proposed Development Site and north of the Stainforth and Keadby Canal is designated under the WFD as waterbody GB40402G990300 (Lower Trent Erewash - Secondary Combined) of the Humber RBMP. This groundwater body has a surface area of approximately 1924km^2 and is currently at Poor Overall Status due to the Chemical Dependent Surface Water Body Status parameter. To the south of the Stainforth and Keadby Canal, the WFD groundwater body is the 'Idle Torne - Secondary Mudrocks' (GB40402G992200). This waterbody is a Good overall status.

12.4.12 Information obtained from Cranfield Soil and AgriFood Institute (CSAI) Soilscapes website (CSAI, 2020) describes the soils on the Proposed Development Site to be loamy and clayey soils of coastal flats with naturally high groundwater[10]. Land within this soil type is described as generally draining to local groundwater and mostly drained. Shallow groundwater and marginal ditches to most fields mean that the water resource is vulnerable to pollution from nutrients, pesticides and wastes that may be applied to the land.

12.4.13 According to the Landmark Information Group Envirocheck report (Landmark, 2020), Natural England reports the Agricultural Land Classification (ALC) to be Grade 2 for the majority of the Proposed Development Site. This is classed as soil of 'very good quality'. This land is further described as having only minor limitations which affect crop yield, cultivations or harvesting. It can support a wide range of agricultural and horticultural crops but there can be some reduced flexibility on land within the grade, which causes difficulty in the production of more demanding crops e.g. winter harvested vegetables and arable root crops. In areas of the Proposed Development

[9] Warping is the process of allowing turbid river water to flood agricultural land to deposit a layer of sediment to improve fertility before the water was allowed to drain away.

[10] Soilscape identification description number 21

Site south of the Stainforth and Keadby Canal, some parts are classified as Grade 1 (excellent quality). Further information is provided in **Chapter 3**: The Site and its Surroundings (PEI Report Volume III).

Water Features

12.4.14 A Site Walkover was undertaken on 31 July 2020 in sunny, dry conditions. Using observations taken on this visit, data from OS mapping and the Environment Agency Catchment Data Explorer website (Environment Agency, 2020a) the surface waterbodies listed in Table 12.5.5 were identified within the study area. **Figure 12-1** (PEI Report Volume III) illustrates the location and WFD status of these waterbodies.

Table 12.5: Summary of Waterbodies in the Study Area including WFD status

Waterbody	Type of Waterbody	WFD designation or associated WFD waterbody (where applicable)
River Trent	Transitional Waterbody (main river)	Humber Upper (GB530402609203)
Paupers Drain (includes Warping Drain and Eastoft Moors Drain)	Watercourse (ordinary) – maintained by IoAaNNWLMB	Paupers Drain Catchment (trib of Trent) (GB104028064300)
North Soak Drain (and South Soak Drain)	Watercourse (main river)	North Soak Drain Catchment (trib of Torne/Three Rivers) (GB104028064350)
Hatfield Waste Drain	Watercourse (main river)	Hatfield Waste Drain Catchment (trib of Torne/Three Rivers) (GB104028064330)
Torne/Three Rivers (includes South Engine Drain and Folly Drain)	Watercourse (main river)	Torne/Three Rivers from Mother Drain to Trent (GB104028064340)
Eastoft Moors Drain	Watercourse (ordinary) – maintained by IoAaNNWLMB	Tributary of Humber Upper (GB530402609203)
Sewer Drain	Watercourse (ordinary) - maintained by IoAaNNWLMB	Tributary of Humber Upper (GB530402609203)
Keadby Boundary Drain	Watercourse (ordinary) - maintained by IoAaNNWLMB	Tributary of Paupers Drain Catchment (trib of Trent) (GB104028064300)
South Moors Drain	Watercourse (ordinary) - maintained by IoAaNNWLMB	Tributary of Paupers Drain Catchment (trib of Trent) (GB104028064300)

Waterbody	Type of Waterbody	WFD designation or associated WFD waterbody (where applicable)
North and South Cross Moors Road Drain	Watercourse (ordinary) - maintained by IoAaNNWLMB	Tributary of Paupers Drain Catchment (trib of Trent) (GB104028064300)
Sheffield and South Yorkshire Navigation – Stainforth and Keadby Canal	Watercourse (Canal)	Sheffield and South Yorkshire Navigation (New Junction and Stainforth and Keadby) (GB70410281)
Ubiquitous unnamed drainage ditches (including those named in Appendix 11C PEA Report as drains D1-D7)	Watercourse (ordinary) – generally maintained by IoAaNNWLMB	Tributaries of the various WFD waterbodies listed above
Five small ponds west of the River Trent (four immediately east of Keadby Boundary Drain, one south of Boskeydyke Farm)	Stillwater	Situated within the Paupers Drain Catchment (trib of Trent) (GB104028064300)
One small pond east of the River Trent within the study area, off Neap House Road	Stillwater	Situated within the Humber Upper (GB530402609203) catchment
Idle Torn – Secondary Mudrocks	Groundwater	WFD designation (GB40402G992200)
Lower Trent Erewash – Secondary Combined	Groundwater	WFD designation (GB40402G990300)

Surface Waterbodies

12.4.15 The Environment Agency's Catchment Data Explorer website (Environment Agency, 2020a) confirms that the transitional waterbodies in the study area (i.e. River Trent) are contained within the:

- the Humber River Basin District;
- Humber Transitional and Coastal (TraC) Management Catchment; and
- Humber Estuary TraC Operational Catchment.

12.4.16 The fluvial waterbodies are contained within:

- the Humber River Basin District;
- Trent Lower and Erewash, and Idle and Torne Management Catchments; and
- Trent and Trib, and Isle of Axholme Operational Catchments.

12.4.17 There are six WFD designated surface water bodies within the study area, described briefly in Table 12.6. Although these are the WFD reporting reaches, WFD principles and objectives apply to all tributaries of these watercourses. The WFD waterbodies include one transitional waterbody (Humber Upper transitional waterbody), four rivers (Paupers Drain Catchment (trib of Trent), North Soak Drain Catchment (trib of Torne/Three Rivers), Hatfield Waste Drain Catchment (trib of Torne/ Three Rivers) and Torne/ Three Rivers from Mother Drain to Trent) and one canal (Sheffield and South Yorkshire Navigation (New Junction and Stainforth and Keadby)). **Figure 12-1** (PEI Report Volume III) illustrates these waterbodies.

Table 12.6: WFD Surface Waterbodies in the Study Area

Waterbody	Ecological Status / Potential	Chemical Status	Overall Target Objective	Hydromorphological Designation	Designated Reach
Humber Upper (GB530402609203)	Moderate Ecological Potential	Good	Moderate (2015)	Heavily Modified	This section of the River Trent is designated from Owston Ferry to the south (approximately 13km upstream of Keadby) to its confluence with the River Ouse approximately 14.5km downstream of Keadby.
Site Observations: The Humber Upper waterbody (River Trent) was observed during the site visit from the western bank adjacent to Keadby Power Station, where it flows from the south to the north. Embankments line the river here for flood protection. At this point the waterbody is tidal and has a width of approximately 140m. The river is used for navigation with a wharf at Keadby and the nearest jetty approximately 600m upstream on the east bank near Gunners Wharf. Further details regarding hydrodynamics, tides and sediments are provided later in the baseline. Adjacent to Keadby village, there are two existing discharge points into the River Trent from Keadby Power Station (SE 83536 11647 and SE 83655 12226), with trash screens and bollards to prevent collision from passing boats. The tide was low enough during the site visit to expose intertidal muddy sediments at the channel margins surrounded by vegetation that appeared typical of a salt marsh. The river adjacent to Keadby is situated in the Humber Estuary SSSI, Humber Estuary SAC and Humber Estuary Ramsar Site.					
Paupers Drain Catchment (trib of Trent) (GB104028064300)	Bad Ecological Potential	Good	Moderate (2015)	Artificial	Unusually, this waterbody consists of two separate designated watercourses, Warping Drain and Paupers Drain which both flow west to east between Crowle and the River Trent, totalling approximately 13km length and draining an area of around 32.0km^2.
Site Observations: Warping drain was observed from the B1392 at SE 83592 12125 where it crosses beneath the road. The watercourse is single thread and approximately 7m wide here and perfectly straight. There was no flow observed due to the tidal lock upstream of the River Trent. The watercourse was extremely turbid and so depth could not be ascertained. There was an algal bloom upstream of the tidal lock indicative of nutrient enrichment. The channel is incised with banks rising relatively steeply away from the channel bed. The banks and riparian zone was densely vegetated as would be expected in summer and provided a buffer strip to the arable fields beyond. The drain is a designated local wildlife site (LWS) as it supports a population of whorled water-milfoil (*Myriophyllum verticillatum*). The site is also designated for its wet reed beds with a large population of common reed (*Phragmites australis*).					
North Soak Drain Catchment (trib of Torne/Three Rivers) (GB104028064350)	Moderate Ecological Potential	Good	Moderate (2015)	Artificial	This artificial drain is designated between Thorne and Keadby, where it meets Torne/ Three Rivers shortly upstream of the River Trent. It is 26.4km in length and drains a catchment area of 55.6km^2

Waterbody	Ecological Status / Potential	Chemical Status	Overall Target Objective	Hydromorphological Designation	Designated Reach
Site Observations: North and South Soak Drains were observed during the site visit at SE 82505 11545 and SE 82487 11450, respectively. Both were approximately 8m wide and are straight, artificial drainage channels with steep banks, and are located either side of the Stainforth and Keadby Canal. Both were extremely turbid with phytoplankton such that depth could not be ascertained although is expected to be several metres. There were clumps of algae on the surface and they appeared nutrient enriched. Fine sediment accumulations were apparent at channel margins in some locations. South Soak Drain is located approximately 3m lower in elevation than the adjacent canal, and the drain supports rich aquatic, emergent and marginal flora. The drain is a designated LWS for its swamp habitat which is dominated by common reed.					
Hatfield Waste Drain Catchment (trib of Torne/Three Rivers) (GB104028064330)	Poor Ecological Potential	Good	Good (2027)	Artificial	The designated reach consists of two branches, one rising at Old Cantley and the other near Tunnel Pits Farm. The two arms meet near the A18 at Bolton Grange and flow east to meet the Torne/ Three Rivers at Pilfrey Bridge. The designated watercourse is 36.4km in length and drains a catchment of 120.2km^2.
Site Observations: This watercourse was not visited as part of the Water Environment walkover. **Appendix 11C**: Preliminary Ecological Appraisal (PEA) Report presented in Volume II of this PEI Report) indicates that this is a designated LWS for a rich aquatic, emergent and marginal flora with a surrounding mosaic of neutral grassland and common reed swamp.					
Torne/ Three Rivers from Mother Drain to Trent (GB104028064340)	Moderate Ecological Potential	Good	Good (2027)	Artificial	This watercourse includes the River Torne, South Engine Drain and Folly Drain. In total, it is designated from the northeast of Rossington and flows generally north-west to meet the River Trent at Keadby. In places the drains move apart and flow parallel to each other. Their combined total length is 50.6km, and they drain a catchment of 85.3km^2.
Site Observations: Torne/ Three Rivers from Mother Drain to Trent was not visited during the Water Environment walkover due to being upstream of the Proposed Development, and so should not be impacted. Three Rivers is a LWS designated for its three parallel canalised watercourses which support a rich aquatic, emergent and marginal flora. Similarly, the River Torne LWS is designated for supporting a rich aquatic, emergent and marginal flora. It is also designated for its surrounding neutral grassland, purple moor grass and rush pasture and marsh.					
Sheffield and South Yorkshire Navigation (New Junction and Stainforth and Keadby) (GB70410281)	Good Ecological Potential	Good	Good (2015)	Artificial	The designated reach is 43.8km in length, extending from an offtake from the River Don in the centre of Doncaster to the south-west, to the River Trent immediately southeast of the Keadby 1 Power Station.
Site Observations: This watercourse was visited between the road crossing at SE 82494 11484 and the lock gates between the canal and River Trent at SE 83444 11423. The canal by its nature is artificial and so very straight. At this point it is a wide waterbody at approximately 30m width. There are four sets of lock gates separating the canal from the River Trent, managed by CRT. The canal appeared to be around 1.5m deep with the water being very clear at the time of the site visit. There was an abundance of submerged, floating and emergent macrophytes, and numerous fish were seen in the channel. The canal is used for navigation and water sports, and the towpath is popular for recreation. There is an existing abstraction point from the canal for Keadby 1 Power Station at SE 82997 11468, and a new abstraction point for Keadby 2 Power Station was being constructed behind a cofferdam during the site visit at SE 82769 11499. The Stainforth and Keadby Corridor LWS is designated for a rich aquatic flora throughout its length. The canal is also designated for its mosaic of associated bankside habitats.					

12.4.18 Within the catchments of the WFD waterbodies outlined in Table 12.5, there are also a number of named watercourses shown on Ordnance Survey mapping, and these are described in Table 12.7 based on the Proposed Development Site visit and walkover details also described in **Appendix 11C:** Preliminary Ecological Appraisal (PEA) Report (PEI Report Volume II).

Table 12.7: Other named watercourses in the study area that are not defined WFD water bodies

Waterbody	Tributary of	Watercourse Description	Site Observations
Sewer Drain	River Trent	This drain flows as two connected parallel channels which are also parallel to the Warping Drain, approximately 30m and 330m to the north of Warping Drain between Keadby windfarm and the River Trent. Further upstream of the windfarm it is known as Old Sewer. Its approximate combined length is 3.5km.	This watercourse was not visited during the site visit as it is upstream of the Proposed Development and will not be impacted.
Keadby Boundary Drain/ Drain D3 as described in **Appendix 11C**: PEA Report (PEI Report Volume II).	Warping Drain	This drain is orientated north-south between North Pilfrey Farm to the south (adjacent to Stainforth and Keadby Canal) and north to Warping Drain. Its approximate length is 1.4km.	Field drain approximately 1m wide with spring water depth approximately 20cm deep. The channel was dominated by silt. Banks support semi-improved grassland and dense scrub. Common reed was the dominant plant species within the channel. Connected to the rest of the drains associated with Keadby Common
South Moors Drain	Warping Drain	This drain is orientated north-south between the Stainforth and Keadby Canal between Ealand Warpings and North Pilfrey Farm to the south, extending north to Bonnyhale Moor Road. It is approximately 1.1km in length.	This watercourse was not visited during the site visit as it is upstream of the Proposed Development and will not be impacted.
North and South Cross Moors Road Drain	Warping Drain	This drain is orientated north-south between the Stainforth and Keadby Canal between Ealand Warpings to the south, extending north to Bonnyhale Moor Road. It is approximately 1.2km in length.	This watercourse was not visited during the site visit as it is upstream of the Proposed Development and will not be impacted.
Drain D1 as described in **Appendix 11C**: PEA Report (PEI Report Volume II)	Unnamed drainage ditch upstream of River Trent	This drain flows along the northern boundary of Keadby Common between Keadby Boundary Drain and Keadby 1 Power Station. It is	Field drain which is designated as a LWS. The drain is over-deepened and is subject to periodic dredging. The channel

Waterbody	Tributary of	Watercourse Description	Site Observations
		approximately 1.5km in length.	width is approximately 2m. Water depth is variable, but the average is around 50cm. The substrate within the drain is equal part clay to silt. Supports a moderately diverse flora.
Drain D2 as described in **Appendix 11C**: PEA Report (PEIR Volume II)	Unnamed drainage ditch upstream of River Trent	This drain runs along the southern boundary to Keadby Common adjacent to the laydown area for Keadby 2 Power Station. It is approximately 900m in length.	Field drain approximately 2m wide and 50cm deep at time of spring survey for the PEA. The channel was dominated by silt and the water surface was dominated by algae. Banks support semi-improved grassland and dense scrub. Common reed was dominant in the channel by July, except where overhung by scrub. Connected to other drains associated with Keadby Common.
Drain D4 as described in **Appendix 11C**: PEA Report (PEI Report Volume II)	Unnamed drainage ditch upstream of River Trent	This drain runs through the centre of Keadby Common and is approximately 380m long.	Field drain with water approximately 10cm deep and approximately 1m wide. The channel was dominated by silt. Banks support improved grassland. Common reed, reed canary-grass and reed sweet-grass are all abundant. Connected to the rest of the drains associated with Keadby Common.
Drain D5 as **Appendix 11C**: PEA Report (PEI Report Volume II)	Unnamed drainage ditch upstream of River Trent	This drain runs along the eastern boundary to Keadby Common adjacent to the existing 400kV National Grid substation.	Field drain with water depth in spring of approximately 10cm. Channel 1m wide. The channel was dominated by silt. Banks support improved grassland. Reed canary-grass dominates the channel Connected to the rest of the drains associated with Keadby Common.
Drain D6 as described in **Appendix 11C**: PEA Report (PEI Report Volume II)	River Trent	This drain runs along the eastern side of the field south of Trent Road. It is therefore within the Proposed Development Site but distant from the land required for construction of the Proposed Development.	Field drain with water depth approximately 50cm and 2m wide. Banks supported rank semi improved grassland and a hedgerow. Common reed present.

Waterbody	Tributary of	Watercourse Description	Site Observations
Drain D7a, b, c, as described in **Appendix 11C**: PEA Report (PEI Report Volume II)	Unnamed drainage ditch upstream of River Trent	Three arable field drains which are culverted under the existing access road.	Incised, straight watercourses of approximately 1m width.

12.4.19 In addition to the watercourses described in Tables 12-6 and 12-7, there are numerous small drains and ditches across the wider 1km study area. These are predominantly related to drainage of agricultural land. In general, they are artificial, straight, embanked watercourses that are likely to be nutrient enriched due to runoff of fertilisers and other farming products. They are generally expected to have minimal biodiversity value with many likely to be ephemeral (i.e. flowing for only part of the year or only after storms), with few geomorphic bedforms (e.g. riffles and pools).

12.4.20 There are five small ponds west of the River Trent in the study area. The largest is south of Boskeydyke Farm (SE 83703 12940) and is approximately 2.0km^2. There are four immediately east of Keadby Boundary Drain, at SE 81311 12482, SE 81199 12003, SE 81373 11953 and SE 81275 12021. These are offline ponds, not obviously connected to other watercourses in the study area. There is also a small pond to the east of the River Trent at SE 84410 12362, but this is not considered further as it is upstream of the Proposed Development.

River Trent – Tidal Cycle

12.4.21 Preliminary Water Supply and Discharge assessment undertaken by the Applicant for the Proposed Development indicates that the estuary of the River Trent is characterised by a semi-diurnal tide (i.e. a cycle which has two high and two low tides a day). There is approximately 24 hours 50 minutes between two tidal crests (for example, high– low –high–low–high) and so one tidal cycle (that is, high–low–high) has a period of approximately 12 hours 25 minutes. In this regime, the two high tide levels are commonly unequal.

12.4.22 A complete tidal cycle from high tide to low tide to high tide comprises two distinct elements – the flood tide (the incoming tide when water levels are rising) and the ebb tide (the outgoing tide when water levels are falling).

12.4.23 There are two key variations in tides which occur over a 29-day cycle (i.e. spring and neap tides), with two spring and two neap tides occurring over this period. During neap tides, the tidal range is significantly reduced compared with that experienced during spring tides (that is, high tide levels are lower and low tide levels are higher). The maximum spring and neap tides occur approximately 1.5 days after new/ full Moon or first/ last quarter. These two variations have a significant influence on the range of impact on water quality and suspended sediment.

12.4.24 The tides experienced in the River Trent estuary have very pronounced spring and neap tides. In addition, the tidal cycle seen in the River Trent estuary is not perfectly symmetrical (i.e. flood and ebb portions of the cycle are of unequal lengths). This is due to frictional resistance between oncoming and reflected tidal waves within the irregular coastline of the Humber estuary. In the River Trent, the time between ebb slack and flood slack is approximately three hours, while the difference between flood slack and ebb slack is approximately nine hours. This gives rise to a very rapid rise

in tide level followed by a slow decline in the tide level. These times are subject to natural variation, particularly due to weather and flow within the River Trent itself.

12.4.25 Adjacent to the operational Keadby 1 Power Station, the typical mean tidal range is 4.7m (i.e. -0.4 mAOD to +4.3 mAOD) with a maximum astronomical tide range of 7.62m (i.e. - 0.81 mAOD to +5.81 mAOD).

12.4.26 The tidal limit of the River Trent is 70km upstream of the Proposed Development area at Cromwell Weir, shortly downstream of Newark-on-Trent.

River Trent - Hydrology

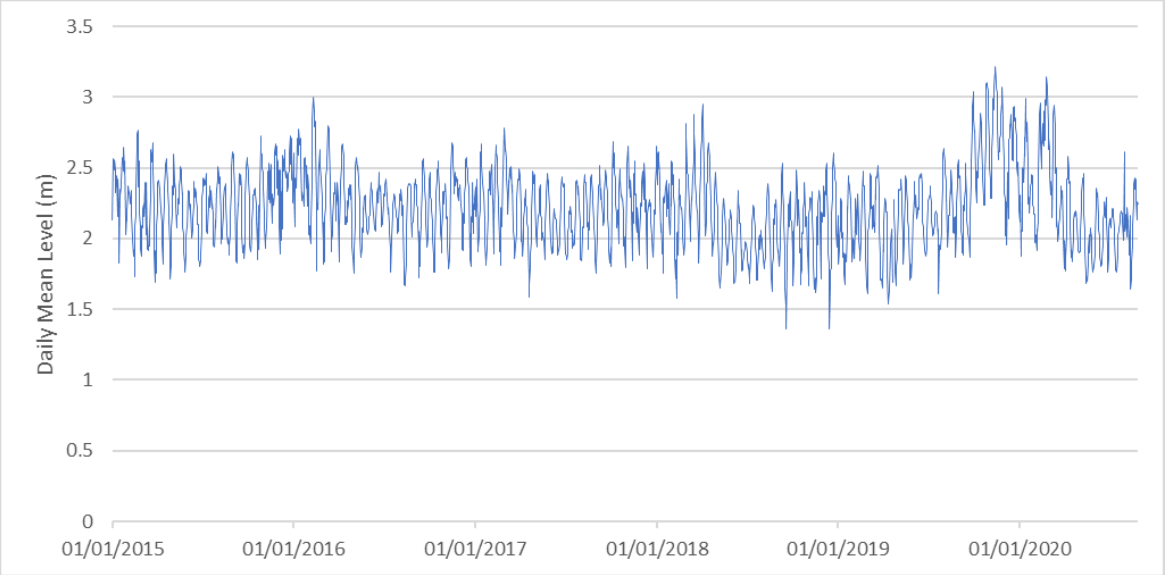
12.4.1 The area draining to the River Trent at Keadby comprises almost the whole of the Trent basin. The Trent's channel is entrained between primary flood defences at Keadby, with land on both sides of the river being very low-lying marsh at approximately 2mAOD. Over the last 170 years, the artificial component of total freshwater flows has increased due to the import of water for public supply from the Severn basin with subsequent discharge to the Trent catchment. At low flows, it is reported that the artificial component can make up half of the total flow (National Rivers Authority (now Environment Agency), 1994).

12.4.2 The long-term average mean daily flow from the Trent to the Humber Estuary was 7,590 million litres per day (Ml/d) for the period 1969-92, mean summer flow (April-September) was 5,290Ml/d and mean winter flow was 9,910Ml/d. The flow which is exceeded for 95% of the time (Q95) was 2,340Ml/d for the same period (National Rivers Authority (now Environment Agency), 1994).

12.4.3 The Environment Agency has provided mean daily level data for the Keadby gauge at SE 08354 01131. The data for 2015-2020 is shown in Plate 12.2. This indicates that highest levels (and hence flows) in this period have been recorded in the winter and spring of 2019-2020, peaking at a mean daily level of 3.2m on 14/11/19.

12.4.4 The UK Government's river levels website indicates that at the same Keadby gauging station, the typical water level range is 0.61m to 6.60m. The highest level on record was 7.23m recorded on 5/12/2013.

Plate 12.2: Mean Daily Level (m) for the River Trent at the Environment Agency's Keadby gauge.



12.4.5 No other river levels are available for watercourses in the study area on the National River Flow Archive website (CEH, 2020) or the UK Government river levels website. The Environment Agency also provided no further level of flow data for watercourses in the study area.

River Trent – Sedimentology

12.4.6 A review of available sampling analysis for neighbouring Marine Licence applications (MLA), as advocated by the International Maritime Organisation (IMO) sampling guidelines, has been undertaken.

12.4.7 The sediment characteristics of The River Trent adjacent to the Proposed Development Site have been considered as part of preliminary water supply and wastewater discharge feasibility assessments for the Proposed Development. Initial findings suggest that the suspended solid concentration and particle size distribution varies considerably from hour to hour, from season to season, and climatically as a result of tidal conditions, floodwater, degree of saline mixing, turbulence due to river traffic and dredging activities.

12.4.8 The results of particle size analysis undertaken at the Keadby 1 Power Station cooling water intake (John Brown Engineering Ltd, 1996) are shown in Table 12.8 below:

Table 12.8: River Trent Water Particle Size (<10µm)

Particle Size	Minimum Concentration (%)	Maximum Concentration (%)	Mean Concentration (%)
<10 µm	42	90	59

12.4.9 Analysis of the dredged material removed annually from between the Keadby 1 Power Station intake and outfall locations identified the dredged material as silty clay (i.e. 31.3 - 62.5 µm particle size) with a specific gravity of 2.7 (CEFAS, 2017a). Analysis of the dredged material was undertaken in 2017 for trace metals, organotins (tributyltin, dibutyltin) and polyaromatic hydrocarbons (PAH) (CEFAS, 2017b). ~~(Cefas, 2017). T~~race metal results show slightly elevated levels of determinands cadmium, chromium, nickel, lead and zinc. These determinands were found to be above Cefas Action Level 1[11] however, in the context of the River Trent, they are not unusual (noting that sample results were reported to be 'within the expected range for the River Trent and Humber Estuary and therefore are not a cause for concern' (Cefas/ MMO, 2017).

12.4.10 The results for organotins showed that the levels were below limits of detection. However, the PAH results did show elevated levels for a number of determinands above Cefas Action Level 1. Cefas and the MMO noted that whilst PAH levels above Action Level 1 required further investigation, it was noted that levels had dropped since previous sampling in 2014. Under conditions associated with the extant marine dredging licence (MLA/2017/00312) consenting dredging at the Keadby Power Station intake in the River Trent), periodic sampling and analysis is required. Any additional results will therefore be reviewed as the EIA progresses.

12.4.11 Limited sample analysis of the River Trent at a point approximately 3.8km upstream of the intake was carried out in 1996 and 1997. The results from the two sets of sample analysis identified that the mean particle size varied from between 10 µm - 50 µm, indicating the variability of particle size distribution and the large quantity of fines in the sediment bed and wash load.

Surface Water Quality

12.4.12 The Humber Upper Transitional WFD waterbody is at Good Chemical Status under the WFD Cycle 2 classifications (2016) with all priority substances, priority hazardous substances and other pollutants being at Good status or higher.

12.4.13 The Paupers Drain Catchment WFD waterbody, the North Soak Drain Catchment WFD waterbody and the Hatfield Waste Drain WFD waterbody are all at Good Chemical Status under the WFD Cycle 2 classifications (2016), and do not require assessment for priority substances, priority hazardous substances and other pollutants.

12.4.14 The Torne/ Three Rivers from Mother Drain to Trent is at Good Chemical Status, with priority substances and priority hazardous substances at Good status, with other pollutants not requiring assessment.

[11] Cefas action levels are non-statutory, but provide a method used to help determine the suitability of material prior to disposal to sea. Whilst it is focused on informing a decision on licensing of disposal activities, Action Levels can also be used to help inform wider considerations of potential environmental (marine) risk. Generally, material at/ below Action Level 1 is suitable for disposal to sea; material at/ above Action Level 2 may not be suitable for disposal to sea without prior treatment.

12.4.15 The Sheffield and South Yorkshire Navigation (New Junction and Stainforth and Keadby) is at Good Chemical Status, with priority substances, priority hazardous substances and other pollutants not requiring assessment.

River Trent Water Quality at Keadby

12.4.16 Preliminary water supply and wastewater discharge assessments summarise water quality collected close to the study area. This is considered further in **Appendix 12B:** Water Framework Directive Screening Assessment (Annex C): Baseline Surface Water Quality Data (PEI Report Volume II).

12.4.17 The data indicates that the River Trent at Keadby is circum-neutral with high electrical conductivity as would be expected for a transitional water. It is a very turbid river with an average total suspended particulate matter of >300mg/L based on values of 406mg/L, 1,875mg/L and 3,347mg/L during three sampling programmes for this determinand. Based on the data in **Appendix 12B (Annex C)** dissolved oxygen (mg/L) falls within the WFD Good classification based on 5th percentile and High classification based on the mean.

12.4.18 Pollutants including Biochemical Oxygen Demand (BOD) and ammonia are present at low concentrations, likely due to the significant dilution provided due to the scale of the River Trent. Nitrate concentrations are high (mean 35mg/L) likely reflecting the agricultural land use of the surrounding catchment, with use of fertilisers which run off to watercourses draining to the River Trent.

12.4.19 Certain metals such as copper and zinc are elevated, and may surpass WFD environmental quality standards (EQS). Such metals may be derived from road runoff to watercourses across the catchment, including the Stainforth and Keadby Canal, which is then directed towards the River Trent.

Sheffield and South Yorkshire Navigation (New Junction and Stainforth and Keadby Canal) – Water Quality

12.4.20 Preliminary water supply and wastewater discharge study assessments undertaken CEFAS, 2017asummarise water quality monitoring data for the Stainforth and Keadby Canal undertaken by the Applicant and it's appointed contractor for the Keadby 2 construction project (Siemens). This is presented in **Appendix 12B (Annex C):** Baseline Surface Water Quality Data (PEI Report Volume II).

12.4.21 The data indicates that pH is weakly alkaline, and the watercourse has moderate electrical conductivity. Turbidity is low, reflecting conditions noted on the site visit where the water was very clear. Nitrate and orthophosphate concentrations are very high as would be expected given the surrounding agricultural land uses. Several metals are elevated (e.g. dissolved copper), which may be driven from runoff from the road and railway crossings noted above.

Keadby Warping Drain – Water Quality

12.4.22 Water quality data has been obtained from the Environment Agency's Water Quality Archive (Environment Agency, 2020Environment Agency, 2020b) for Keadby Warping Drain. Ten samples were taken between 2016 and 2018 and data is summarised in **Appendix 12B (Annex C):** Baseline Surface Water Quality Data (PEI Report Volume

II) which indicates slightly alkaline conditions, with an average pH of 7.9, fallings within the WFD High classification based on the ten samples.

12.4.23 A 10th percentile dissolved oxygen saturation of 20.2% falls within Poor classification (<45%). Available data suggests that the waterbody is extremely vulnerable to large fluctuations of dissolved oxygen which may be the result of nutrient rich water with an abundance of macrophytes. Ammonia levels are classified as Good which suggests pollution from organics such as a sewage materials are unlikely to be having a detrimental impact on the waterbody. Nitrate and orthophosphate values are somewhat elevated and indicate potential pressure from the surrounding agricultural land uses through use of fertilisers and other products which may runoff to the watercourse.

Keadby Pumping Station Drain – Water Quality

12.4.24 Water quality data has been obtained from the Environment Agency's Water Quality Archive (Environment Agency, 2020Environment Agency, 2020b) for Keadby Pumping Station Drain. Fourteen samples were taken between 2018 and 2020 and data is summarised in **Appendix 12B (Annex C):** Baseline Surface Water Quality Data (PEI Report Volume II). The data indicates the Keadby Pumping Station Drain is very slightly alkaline in nature with an average pH of 7.8 and falls within the WFD High classification based on the 14 samples considered.

12.4.25 A 10th percentile dissolved oxygen saturation of 48.5% falls within Moderate classification, with available data suggesting that the waterbody is vulnerable to large fluctuations of dissolved oxygen and may be the result of nutrient rich water with an abundance of macrophytes.

12.4.26 Ammonia levels are classified as Moderate (<1.1mg/L) which suggests pollution from organics could be having a detrimental impact on the waterbody. However, BOD, falls within the Good WFD classification, suggesting the slightly elevated ammonia levels are not from sewage materials. Nitrate and orthophosphate values are somewhat elevated and potentially indicate pressure from surrounding agricultural land uses through use of fertilisers and other products which may runoff to the watercourse.

Ecology Overview

12.4.27 Full details regarding aquatic ecology within the study area are provided in **Chapter 11:** Biodiversity and Nature (PEI Report Volume I). This includes details on:

- fish surveys;
- macroinvertebrate surveys;
- macrophyte surveys;
- sites of ecological importance;
- other ecologically designated sites;
- LWS within 1km of the Proposed Development Site; and
- other designations.

12.4.28 This is also supported by **Appendix 11C:** Preliminary Ecological Appraisal (PEA) including **Annex 11D:** Descriptions of Relevant Watercourses and Assessment of their Suitability for Riparian Mammals, Fish and Aquatic Invertebrates (PEI Report Volume II).

Water availability

12.4.29 The location of Keady Power Station is on the boundary of two of the Environment Agency's Catchment Abstraction Management Strategy (CAMS) areas: the Lower Trent & Erewash (LT&E) CAMS; and the Idle & Torne (I&T) CAMS. The LT&E CAMS covers 174km of the River Trent (and tributaries) from its confluence with the River Dove until its confluence with the River Humber at Trent Falls (this includes the section passing the Keadby Power Station). I&T CAMS includes the Stainforth and Keadby Canal and the Torne which join the River Trent at Keadby.

12.4.30 The Environment Agency has undertaken a water resource assessment of the two catchment areas. The approach is illustrated in the CAMS documents (Ref. 12-67; Ref. 12-68). The assessment indicates that the Environment Agency considers the area around Keadby Power Station (within the LT&E CAMS) as having water available for licensing at all but the lowest flows (i.e. Q95) where it is 'Restricted for Licensing'. This restriction does not necessarily mean that an abstraction licence will not be issued but it is likely that any new abstraction licence would be subject to a Hands Off Flow (HOF) condition at which abstraction is prohibited (Environment Agency, 2013).

12.4.31 With regards to the I&T CAMS assessment, this has identified that there is no water available for abstraction at any flowrate in the vicinity of Keadby Power Station. Additionally, the Stainforth and Keadby Canal and the River Torne are categorised as a High Hydrological Regime, thus potentially placing severe restrictions on any abstraction licence.

12.4.32 As both CAMS were published in 2013 and as there are no Environment Agency assessment points close to Keadby Power Station on the River Trent, this may not represent the current situation.

12.4.33 Preliminary Water Supply and Wastewater Discharge Study assessments undertaken to inform the design of the Proposed Development indicate that the Environment Agency has assessed water reliability and expect that the water resources (in the LT&E CAMS) in the region of the Keadby Power Station will be available at least 70% of the time. But from the I&T CAMS the availability is expected to be less than 30%.

12.4.34 The Canal and River Trust's Code of Practice (CRT, 2020) states that applications will be considered for the purchase of untreated water which is surplus to the Trust's navigational requirements. This includes for cooling and/ or heating of waterside developments but would be subject to water availability and with no guarantee on either the quality of water or the continuity of supply. Additionally, where maintenance of the canal is required, abstraction may have to cease for the duration of the works.

12.4.35 Abstractions from the canal taking greater than 20m³ per day of water will also be subject to an abstraction licence from the Environment Agency. This would be applied for, and usually held, by the CRT.

Water Resources

12.4.36 The following provides information on water activity permits (i.e. discharges), water abstractions and past pollution incidents based on information requested from the Environment Agency, and the Landmark Information Group Envirocheck report (Envirocheck, 2020Landmark, 2020).

Water Activity Permits

12.4.37 There are 13 active water permits (i.e. formerly discharge consents) within 1km of the Proposed Development. These are listed in Table 12.9 and shown in **Figure 12-1** (PEI Report Volume III).

Table 12.9: Water Activity Permits within the Study Area

Label on Fig 12.1	Licence	NGR	Issued Date	Discharge Type	Receiving Water
Environment Agency Data:					
D1	T/83/21614/O (Woodcarr Avenue Storm Overflow)	SE 83370 11090	22/06/1992	Storm Tank/ combined sewer overflow (CSO) on Sewerage Network (water company)	Three Rivers
D2	WQ/72/137 (Canal Side, Keadby)	SE 83200 11300	21/08/1975	Undefined or Other	Three Rivers
D3	EPRLB3392RP (Keadby Power Station)	SE 82607 11512 and SE 82334 11595	17/05/2019	Sub-station/ Electricity/ Gas/ Air Conditioning Supply	North Soak Drain
D4	3/28/83/0806 (Keadby 400kv substation)	SE 82300 11800	22/01/1968	Undefined or Other	North Soak Drain
D5	WQ/72/1350 (Keadby Sanitary Station)	SE 83100 12100	23/08/1977	Undefined or Other	Warping Drain
D6	T/84/45997/T (Keadby substation)	SE 82340 12160	12/09/2004	Sub-station/ Electricity/ Gas/ Air Conditioning Supply	Keadby Boundary Drain
D7 / D8	T749 (Vazon Swing Bridge House)	SE 82500 11400	12/10/1960	WwTW (not water co) (not STP at a private premises)	South Soak Drain
Landmark Envirocheck Data:					
D9	Am6773 (Keadby Power Station)	SE 83661 12227, SE 82764 11755, SE 83001 11477, SE 82978 11592, SE 83017 11721 and SE 82596 11766	09/10/1995	Sub-station/ Electricity/ Gas/ Air Conditioning Supply, Trade Effluent Discharge – Site Drainage	River Trent, Unnamed Drainage Ditch, Stainforth and Keadby Canal

Label on Fig 12.1	Licence	NGR	Issued Date	Discharge Type	Receiving Water
D10	T/84/45990/R (Gunness STW)	SE 83924 12359	11/08/2004	WwTW/ Sewage Treatment Works (Water Company)	River Trent
D11	WQ/72/1296/1 (Chemical Vessel Services Ltd)	SE 83397 11286	14/07/1977	Sewage Effluent	Groundwater
D12	T83/45559/R (Althorpe Sewage Treatment Works)	SE 83564 11268	24/09/2009	Sewage Discharges – Final/ Treated Effluent	River Trent
D13	T/83/21614/O	SE 83564 11268	22/06/1992	Public Sewage: Storm Sewage Overflow	Three Rivers

12.4.38 The consented discharges are for a range of uses including CSO on the sewerage network, final/ treated sewage effluent discharges, and discharges from Keadby Power Station including process water and runoff.

Abstractions

12.4.39 Data provided by the Environment Agency and derived from the Envirocheck report indicates that there are 16 licensed water abstractions within 1km of the Proposed Development Site, which are presented in Table 12.10 and **Figure 12.1** (PEI Report Volume III).

Table 12.10: Abstraction Licenses within the Study Area

Fig 12.1 Ref	Licence Holder	Abstraction Licence	Use	Source Description	National Grid Reference
Environment Agency:					
A1	Canal and River Trust	03/28/83/0171 (Surface Water - Canal)	Boiler Feed	Production Of Energy - Electricity	SE 8279 1149
A2	R Smith & Son	03/28/83/0245 (Surface Water - River)	Spray Irrigation - Direct	Agriculture - General Agriculture	SE 8190 1040
A3	R Smith & Son	03/28/83/0245 (Surface Water – River)	Spray Irrigation - Direct	Agriculture - General Agriculture	SE 8256 1004
A4	M & J AGRICULTURE	03/28/83/0246 (Surface Water – River)	Spray Irrigation - Direct	Agriculture - General Agriculture	SE 8190 1040
A5	KEADBY GENERATION LTD	03/28/85/0007 (Tidal Waters)	Non-Evaporative Cooling	Production of Energy - Electricity	SE 8354 1164

Fig 12.1 Ref	Licence Holder	Abstraction Licence	Use	Source Description	National Grid Reference
A6	KEADBY GENERATION LTD	03/28/85/0007 (Tidal Waters)	Boiler Feed	Production of Energy -Electricity	SE 8354 1164
A7	Canal and River Trust	MD/028/0083/014 (Surface Water – Canal)	Evaporative Cooling	Production of Energy - Mechanical Non Electrical	SE 82790 11478
A8	Siemens Public Limited Company	MD/028/0083/040 (Groundwater)	Dewatering	Industrial, Commercial and Public Services - Other Industrial/Commercial /Public Services	SE 82653 11642
A9	Siemens Public Limited Company	MD/028/0083/040 (Groundwater)	Dewatering	Industrial, Commercial and Public Services - Other Industrial/Commercial /Public Services	SE 82619 11656
A10	Siemens Public Limited Company	MD/028/0083/040 (Groundwater)	Dewatering	Industrial, Commercial and Public Services - Other Industrial/Commercial /Public Services	SE 82420 11710
A11	ER Woodhouse	MD/028/0084/002/R01 (Surface Water – River)	Spray Irrigation - Direct	Agriculture - General Agriculture	SE 82260 12480
A12	RJ & AE GODFREY	MD/028/0084/005 (Surface Water – River)	Spray Irrigation - Direct	Agriculture - General Agriculture	SE 83171 12204
Landmark Envirocheck Data					
A13	Mr W Foster-Thornton	03/28/85/0007 (Surface Water - River)	General agriculture: spray irrigation - direct	Agriculture - General Agriculture	SE 81780 12230
A14	J A Chapman Farms	03/28/83/0094 (Surface Water - River)	General agriculture: spray irrigation - direct	Agriculture - General Agriculture	SE 81800 11400
A15	Holly Hall Farms Ltd	03/28/85/0006/1 (Tidal Waters)	Spray irrigation	Agriculture - General Agriculture	SE 83700 11795
A16	T F Belton Limited	03/28/85/0010 (Tidal Water)	General agriculture: spray irrigation - direct	Agriculture - General Agriculture	SE 83700 11795

12.4.40 Three of the abstractions are from groundwater, and these are all for dewatering relating to the Keadby 2 Power Station (under construction). There are four abstractions from tidal waters, both for use in the operational Keadby 1 Power Station to the west of the River Trent, and for agricultural spray irrigation to the east of the River Trent. There are two abstractions from the Stainforth and Keadby Canal for process water relating to the operational Keadby 1 Power Station and (under construction) Keadby 2 Power Station. The remaining seven licenses are from rivers and are for agricultural use (direct spray irrigation).

12.4.41 Details on private water supplies have been requested from North Lincolnshire Council but have not been received to date and so will be presented and assessed as part of the full impact assessment stage, if provided.

Water Pollution Incidents

12.4.42 In response to the submitted data request, the Environment Agency has stated that there have been no Category 3 or above pollution incidents in the area of interest within the last 5 years.

Flood Risk

12.4.43 For information relating to existing flood risk in the study area from all sources taking into account the information presented in please refer to **Appendix 12A:** Flood Risk Assessment (PEI Report Volume II).

12.4.44 The Environment Agency's 'Flood Map for Planning' (Environment Agency, 2020Ref.Environment Agency, 2020c) identifies areas subject to fluvial/ tidal flood risk. The Flood Zone definitions for the flood zones used on the Flood Map for Planning, are defined in Table 12.11 below.

Table 12.11: Flood Zone Definitions (source Table 1 of the PPG Ref 12-4)

Flood Zone	Definition	Probability of Flooding
Flood Zone 1	Land that has a low probability of flooding (less than 1 in 1,000 annual probability of river or sea flooding (<0.1%))	Low
Flood Zone 2	Land that has a medium probability of flooding (between 1 in 100 and 1 in 1,000 annual probability of river flooding (0.1-1%), or between 1 in 200 and 1 in 1,000 annual probability of sea flooding (0.1-0.5%)	Medium
Flood Zone 3a	Land that has a high probability of flooding (1 in 100 year or greater annual probability of river flooding (>1%), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5%)	High
Flood Zone 3b (Functional Floodplain)	Land where water has to flow or be stored in times of flood based on flood modelling of a 5% AEP event (1 in 20 chance of flooding in any one year) or greater, or land purposely designed to be flooded in an extreme flood event (0.1% AEP).	Very High

Tidal Sources

12.4.45 The River Trent is considered tidal from the Humber Estuary to Keadby Bridge, just upstream of the Proposed Development Site. The Environment Agency's 'Flood Map for Planning' Environment Agency, 2020cillustrates that the entire Proposed Development Site and surrounding environs (other than a small, slightly elevated area between Keadby Common in the east, Keadby Boundary Drain in the west, and the canal to the south, and around Crowle) is within the Environment Agency's indicative Flood Zone 3. Flood Zone 3 is land assessed as having a 1 in 100 or greater annual probability of river flooding (>1% Annual Exceedance Probability or AEP), or a 1 in 200 or greater annual probability of flooding from the sea (>0.5% AEP) in any year. However, land north of the canal benefits from flood defences (embankments) along the River Trent.

Tidal Flood Defences

12.4.46 In accordance with the NPPF (MHCLG, 2019), the requirements are to ensure any proposed developments are built to withstand tidal flooding up to a 1% AEP (1 in 100 chance) event taking into account the potential impacts of climate change.

12.4.47 There are existing tidal flood defences located approximately adjacent along the banks of the River Trent, and specifically, within the Water Connection Corridor for the Proposed Development Site. The SFRA (North and North East Lincolnshire Council, 2011North and North East Lincolnshire Council, 2011c) states that the tidal defences are 6m to 6.3m AOD and have been built to provide a 1 in 200-year level of protection. According to the additional information provided by the Environment Agency, the tidal defences protecting the area around the Proposed Development Site consist of concrete floodwalls and are in 'fair' to 'good' condition' - further details are provided in **Appendix 12A:** Flood Risk Assessment (PEI Report Volume II). The Environment Agency inspects these defences routinely to identify potential defects. The residual risk of flooding in the event of a defence breach scenario has been considered by the assessment (refer to Section 12.6).

Tidal Flooding – Summary

12.4.48 Based on the information provided by the Environment Agency, it has been determined that during the existing scenario the Proposed Development Site is at a 'low' risk of flooding from tidal sources with the defences in place or resulting from overtopping of the defences during events that exceed a 0.5% AEP (1 in 200 chance) of flooding. If the defences were to fail and breach during the existing scenario, the Proposed Development Site would be at a 'high' risk of flooding during either the 0.5% or 0.1% AEP (1 in 1000 chance) events.

12.4.49 During a future scenario resulting from climate change up to 2055, The Proposed Development Site is potentially at a 'high' residual risk of flooding as a result of overtopping during events that exceed a 0.5% AEP (1 in 200 chance) of flooding, or in the event that the defences were to breach during either the 0.5% or 0.1% AEP (1 in 1000 chance) events.

Fluvial Flooding

12.4.50 The Flood Map for Planning (Environment Agency, 2020c2020) illustrates that the Proposed Development Site is wholly located within Flood Zone 3 (high risk) defined as land having a >1%/ 0.5% AEP (greater than a 1 in 100/ 1 in 200 chance in any year) of river or sea flooding. However, this map does not differentiate between the tidal/ fluvial sources of risk and the tidal defences are not taken into account.

12.4.51 Further data provided by the Environment Agency on fluvial flooding is provided in **Appendix 12A:** FRA (PEI Report Volume II) (Environment Agency, 2020c).

12.4.52 Based on the information provided by the Environment Agency, it has been determined that the Proposed Development Site is at a 'low' risk of flooding from fluvial sources with the defences in place or resulting from overtopping of the defences during events that exceed a 0.5% AEP (1 in 200 chance) on the River Trent.

Groundwater Flood Risk

12.4.53 Groundwater flooding can occur when groundwater levels rise above ground surface levels. The underlying geology has a major influence on where this type of flooding takes place; it is most likely to occur in low-lying areas underlain by permeable rocks (aquifers).

12.4.54 Based on the information provided in Appendix 12A: Flood Risk Assessment (PEI Report Volume II), the Proposed Development Site is considered to be at low risk of flooding from groundwater sources.

Pluvial (Surface Water) Flooding

12.4.55 Surface water flooding is caused by overland flow that results from rainfall that fails to drain into the ground through infiltration, instead travelling over the ground surface. This can be exacerbated where the permeability of the ground is low due to the type of soil (such as clayey soils) and geology or land use including urban developments with impermeable surfaces.

12.4.56 The Environment Agency 'Risk of Flooding from Surface Water' maps (Environment Agency, 2020, Environment Agency, 2020d) indicate areas at risk from surface water flooding when rainwater does not drain away through the normal drainage systems or soak into the ground, but instead lies on or flows over the ground. The mapping indicates that the Proposed Development Site is generally not at risk from surface water flooding, classifying the majority of the land to be at 'very low' risk of flooding from surface water. Existing Drainage Infrastructure – Flood Risk

12.4.57 Extensive site drainage systems exists at the Proposed Development Site within Keadby 1 Power Station and Keadby 2 Power Station area. Information supplied by the Environment Agency confirms that the Keadby 2 Power Station drainage system compromises three subsystems:

- surface water system;
- oily-waste system; and
- condensate polishing plant wastewater system.

12.4.58 Construction of these drainage systems as part of Keadby 2 Power Station is currently ongoing.

12.4.59 Further data is provided in **Appendix 12A**: Flood Risk Assessment (PEI Report Volume II).

12.4.60 Based on available data presented in **Appendix 12A**: Flood Risk Assessment (PEI Report Volume II), the risk to the Proposed Development Site from overland flow of surface water generated adjacent to, or from waterbodies located within, is considered to be 'low' to 'very low'.

Artificial Waterbodies – Flood Risk

12.4.61 The Proposed Development Site is not considered at risk from reservoir flooding (Environment Agency, 2020d). The Stainforth and Keadby Canal is directly adjacent to the Proposed Development Site, but given the flat, shallow gradients, the risk of flooding is also considered likely to be low from this source. The risk of flooding to the Proposed Development Site from all artificial waterbodies is therefore considered to be low.

Future Baseline

Construction (2022)

12.4.62 The future baseline has been determined qualitatively by considering the likelihood of changes in the attributes that are considered when deciding the importance of water bodies in the study area.

12.4.63 Generally, there is an improving trend in water quality and the environmental health of waterways in the UK. In terms of water quality impacts, the future baseline assumes that all WFD water bodies achieve their planned target status by 2027.

12.4.64 It is likely that through the action of new legislative requirements and ever more stringent planning policy and regulation, the health of the water environment will continue to improve post-2027, although there are significant challenges such as adapting to a changing climate and pressures of population growth that are noted as difficult to forecast with certainty.

12.4.65 Under the WFD, relevant water bodies have the following future objectives:

- the Humber Upper waterbody has an objective of achieving Moderate Ecological Potential by 2015;
- Paupers Drain Catchment has an objective of Moderate Ecological Potential by 2015;
- North Soak Drain Catchment has a target of Moderate Ecological Potential by 2015;
- Hatfield Waste Drain Catchment has a target of Good Ecological Potential by 2027;
- Torne/ Three Rivers has a target of Good Ecological Potential by 2027;

- Sheffield and South Yorkshire Navigation (New Junction and Stainforth and Keadby) has a target of Good Ecological Potential by 2015;
- The Lower Trent Erewash - Secondary Combined groundwater body has an objective of Good by 2027; and
- The Idle Torne - Secondary Mudrocks groundwater body has an objective of Good by 2015.

12.4.66 Where waterbodies are currently at this overall status, there must be no deterioration from this, and there are also objectives for individual elements of the WFD classification that are to be achieved (e.g. biological quality elements, physico-chemical parameters). It is assumed that these objectives will be achieved.

12.4.67 The assessment of the importance of waterbodies takes into account a large range of attributes and does not focus solely on water quality. This assessment takes into account other attributes such as scale, nature conservation designations, fish habitat type, the presence of protected species, social and economic uses. For some of these attributes, it is unlikely that they will change in the future (e.g. waterbody size, whether a river is likely to support cyprinid or salmonid fish populations, the presence of a designated nature conservation site or bathing water).

Operation (2025)

12.4.68 The same future baseline conditions expected during construction will apply to the operation phase (i.e. all WFD targets are met, improving water quality, no change in the presence and status of designated sites).

Importance of Receptors

12.4.69 The initial importance of the local water resource receptors within the study area is described in Table 12.12. Importance is based on the criteria outlined above in Table 12.2. The importance will be reviewed to confirm that there are no required changes prior to the final ES.

Table 12.12: Importance of Identified Receptors

Watercourse	Importance Descriptions
River Trent (Humber Upper WFD waterbody)	The River Trent is considered a **Very High importance** receptor for **water quality** on the basis of its scale, being WFD designated and supporting and range of internationally, nationally and locally protected nature conservation sites (e.g. Humber Estuary SSSI, Humber Estuary SAC and Humber Estuary Ramsar). It is also important for the dilution and dispersion of treated/ untreated sewerage/ trade/ process wastewater, which at the same time influence water quality and present a risk of chemical spillages. The **morphology** is considered **Low importance** due to the heavily modified nature of the channel, particularly along the banks. The channel is considered **High importance** for **navigation**.

Watercourse	Importance Descriptions
Paupers Drain Catchment (trib of Trent) WFD waterbody	Paupers Drain (including Warping Drain) is considered a **High importance** receptor for **water quality** on the basis of being WFD designated and an estimated Q95 flow rate of <1 m^3/s. It also supports locally protected nature conservation sites (LWS). The **morphology** of the waterbody is considered **Low importance** as an artificial, heavily modified waterbody, with flow controlled by a tidal lock.
North Soak Drain Catchment (trib of Torne/Three Rivers) WFD waterbody	North Soak Drain Catchment (including South Soak Drain) is considered a **High importance** receptor for **water quality** on the basis of being WFD designated and an estimated Q95 flow rate of <1 m^3/s. It also supports locally protected nature conservation sites (LWS). The **morphology** of the waterbody is considered **Low importance** as an artificial, heavily modified waterbody.
Hatfield Waste Drain Catchment (trib of Torne/Three Rivers) WFD waterbody	Hatfield Waste Drain is considered a **High importance** receptor for **water quality** on the basis of being WFD designated and an estimated Q95 flow rate of <1m^3/s. It also supports locally protected nature conservation sites (LWS). The **morphology** of the waterbody is considered **Low importance** as an artificial, heavily modified waterbody.
Torne/Three Rivers from Mother Drain to Trent WFD waterbody	Torne/Three Rivers is considered a **High importance** receptor for **water quality** on the basis of being WFD designated and an estimated Q95 flow rate of <1m^3/s. It also supports locally protected nature conservation sites (LWS). The **morphology** of the waterbody is considered **Low importance** as an artificial, heavily modified waterbody.
Sheffield and South Yorkshire Navigation (New Junction and Stainforth and Keadby) WFD waterbody	Sheffield and South Yorkshire Navigation is considered a **High importance** receptor for **water quality** on the basis of its scale, being WFD designated and supporting a locally protected nature conservation site. It is also important for water supply with current abstractions to Keadby 1 Power Station, and another under construction to Keadby 2 Power Station. The **morphology** is considered **Low importance** due to being an artificial channel. The watercourse is considered **High importance** for **navigation**.
Sewer Drain	Sewer Drain is considered a **Medium importance** receptor for **water quality** on the basis of not having a WFD classification but is estimated to have a Q95 >0.001m^3/s. It is likely to be suffering from nutrient enrichment given the surrounding agricultural land use.

Watercourse	Importance Descriptions
	It is considered a **Low importance** receptor for **morphology** on the basis of being an artificial watercourse (i.e. straight ditch with steep banks) with deficiency of bedforms.
Keadby Boundary Drain / Drain D3	Keadby Boundary Drain is considered a **Medium importance** receptor for **water quality** on the basis of not having a WFD classification but is estimated to have a Q95 >0.001m^3/s. It is likely to be suffering from nutrient enrichment given the surrounding agricultural land use. It is considered a **Low importance** receptor for **morphology** on the basis of being an artificial watercourse (i.e. straight ditch with steep banks) with deficiency of bedforms.
South Moors Drain	South Moors Drain is considered a **Medium importance** receptor for **water quality** on the basis of not having a WFD classification but is estimated to have a Q95 >0.001m^3/s. It is likely to be suffering from nutrient enrichment given the surrounding agricultural land use. It is considered a **Low importance** receptor for **morphology** on the basis of being an artificial watercourse (i.e. straight ditch with steep banks) with deficiency of bedforms.
North and South Cross Moors Road Drain	North and South Cross Moors Road Drain is considered a **Medium importance** receptor for **water quality** on the basis of not having a WFD classification but is estimated to have a Q95 >0.001m^3/s. It is likely to be suffering from nutrient enrichment given the surrounding agricultural land use. It is considered a **Low importance** receptor for **morphology** on the basis of being an artificial watercourse (i.e. straight ditch with steep banks) with deficiency of bedforms.
Drain D1/ Drain D2 and Drain 6	Drain D1, Drain 2 and Drain 6 are considered **Medium importance** receptors for **water quality** on the basis of not having a WFD classification but being estimated to have a Q95 >0.001m^3/s. These drains are likely to be suffering from nutrient enrichment given the surrounding agricultural land use. These drains are considered **Low importance** receptors for **morphology** on the basis of being artificial watercourses (i.e. straight ditches with steep banks) with deficiency of bedforms.
Drain D4/ Drain 5/ Drain D7 a, b,c	Drain D4, Drain 5 and Drains 7a, b, and c are considered **Low importance** receptors for **water quality** on the basis of not having a WFD classification and an estimated Q95 <0.001 m^3/s. These drains are likely to be suffering from nutrient enrichment given the surrounding agricultural land use. The drains are considered **Low importance** receptors for **morphology** on the basis of being artificial watercourses (i.e.

Watercourse	Importance Descriptions
	straight ditches with steep banks) with deficiency of bedforms.
Other unnamed drains	Other unnamed drains are small in scale and artificially straight and incised. They are not WFD designated and considered likely ephemeral, and so are considered **Low importance** receptors for **water quality**, and **Low importance** receptors for **morphology**.
Small Ponds near Boskeydyke Farm and Keadby Common	**Low importance** for **water quality and morphology** as they are not designated and have minimal social or economic use.

Floodplain Sensitivity for Impact Assessment

12.4.70 For the construction assessment, the key receptor in terms of all forms of flood risk relates to construction workers present at the Proposed Development Site, who are considered to be of Very High sensitivity.

12.4.71 For the operation assessment, the importance is based on understanding of the receptors present within areas at risk of flooding and the existing risk of flooding from all sources. This can include both operatives at the Proposed Development Site, or members of the public (where relevant) who are also classified as being of Very High sensitivity.

12.4.72 As noted previously, the Proposed Development Site is potentially at a 'high' residual risk of flooding as a result of overtopping during events that exceed a 0.5% AEP (1 in 200 chance) of flooding, or in the event that the defences were to breach during either the 0.5% or 0.1% AEP (1 in 1000 chance) events. Given this, the sensitivity of the floodplain for impact assessment purposes is considered 'Very High'.

12.4.73 In terms of fluvial flood risk, the entire Proposed Development Site is within Flood Zone 3. However, the flood defences are sufficient to prevent overtopping during events with a 0.5% annual probability, the overall sensitivity to fluvial flooding is therefore considered 'Low'.

12.4.74 The criteria described in Table 12.2 do not provide examples of sensitivity for other forms of flood risk and so the sensitivity is based on the existing baseline risk described earlier in this chapter. For the purpose of this impact assessment the sensitivity of non-fluvial forms of flood risk is as follows:

- flooding from surface water – mainly Very Low to Low Sensitivity, with localised areas of Medium Sensitivity (refer to Figure 12-3 Surface Water Flood Risk);
- flooding from artificial sources – Low Sensitivity;
- flooding from groundwater – Low Sensitivity; and
- flooding from existing drainage infrastructure – Low to Very Low Sensitivity.

12.5 Development Design and Impact Avoidance

12.5.1 The following impact avoidance measures have either been incorporated into the design (i.e. embedded mitigation) or are standard construction or operational practices. These measures have, therefore, been taken into account during the impact assessment.

Construction

12.5.2 For the purposes of this assessment, it is assumed that the measures set out below would be required of any contractors undertaking construction work in relation to the Proposed Development

Surface Water

12.5.3 During construction, accidental water pollution may occur directly from spillages of polluting substances into waterbodies, or indirectly by being conveyed in runoff from hard standing, other sealed surfaces or from construction machinery. Fine sediment may also be disturbed in waterbodies directly or also wash off working areas and hard standing (including approach roads) into waterbodies indirectly via existing drainage systems or overland. This sediment may potentially contain contaminants that could be harmful to the aquatic environment. Plans to avoid, prevent and reduce adverse effects on the water environment and deal with any accidental pollution would be included within the CEMP prepared by the Contractor, prior to commencement of construction. An Outline CEMP will be provided with the DCO Application.

12.5.4 The CEMP will be reviewed and updated to ensure all relevant potential impacts and effects are considered and addressed as far as reasonably practicable, taking into account available good practice. The principles of the mitigation measures set out below are the minimum standards that the Contractor will implement, acknowledging that for some issues, there are multiple ways to address. Methods to deal with pollutant risk will be reviewed and adapted as construction works progress in response to different activities, weather conditions, and work locations.

12.5.5 It is envisaged that the final CEMP will contain a Water Management Plan (WMP) as a technical appendix which would provide relevant details regarding mitigation to be implemented to protect the water environment from adverse impacts during construction, including, but not limited to the general mitigation measures outlined below.

Good Practice Guidance

12.5.6 The construction of the Proposed Development would be in accordance with good practice guidance. A series of Guidance for Pollution Prevention (GPP) is in development, which provides updated good practice guidance to the UK. While this is not regulatory guidance in England where the UK government website outlines regulatory requirements, it remains a useful resource for best practice. The following relevant GPP have been released to date on the NetRegs website (Northern Ireland Environment Agency and Scottish Environment Protection Agency, 2020; NetRegs, 2020) and should be identified as good practice:

- GPP 2: Above ground oil storage tanks;
- GPP 4: Treatment and disposal of wastewater where there is no connection to the public foul sewer;
- GPP 5: Works and maintenance in or near water;
- GPP 8: Safe storage and disposal of used oils;
- GPP 13: Vehicle washing and cleaning;
- GPP 19: Vehicles: Service and Repair;
- GPP 20: Dewatering underground ducts and chambers;
- GPP 21: Pollution Incident Response Planning;
- GPP22: Dealing with spills; and
- GPP26: Safe storage – drums and intermediate bulk containers.

12.5.7 Where new GPP are yet to be published, previous Pollution Prevention Guidance (PPG) documents continue to provide useful advice on the management of construction to avoid, minimise and reduce environmental impacts, although they should not be relied upon to provide accurate details of the current legal and regulatory requirements and processes. Construction phase operations would be carried out in accordance with guidance contained within the PPG (also available at NetRegs), including:

- PPG1: General guide to the prevention of pollution;
- PPG3: Use and design of oil separators in surface water drainage systems;
- PPG6: Working at construction and demolition sites;
- PPG7: Safe storage – the safe operation of refuelling facilities; and
- PPG18: Managing fire water and major spillages.

12.5.8 Additional good practice guidance for mitigation to protect the water environment can be found in a range of CIRIA documents and British Standards Institute documents described in Section 12.3. A full list will be provided in the Framework CEMP to accompany the DCO Application.

Management of Construction Site Runoff

12.5.9 The measures outlined below, which will be included in the CEMP, will be required for the management of fine sediment in surface water runoff as a result of the construction activities:

- Reasonably practicable measures will be taken to prevent the deposition of fine sediment or other material in, and the pollution by sediment of, any existing waterbody during construction taking into account relevant industry guidelines including CIRIA report 'C532: Control of water pollution from construction sites' (CIRIA, 2001). This may typically include use and maintenance of temporary lagoons, tanks, seeding/ covering of earth stockpiles, earth bunds, straw bales

and sandbag walls, other proprietary measures, fabric silt fences or silt screens and consideration of the type of plant used.

- A temporary drainage system will be developed to prevent runoff contaminated with fine particulates from entering surface water drains without treatment. This will cover all land drains and waterbodies within the Proposed Development Site that could be affected, taking measures to adequately protects using e.g. drain covers, sand bags, earth bunds, geotextile silt fences, straw bales, or proprietary treatment. Any discharge to waterbodies (directly or indirectly) will only be made with the consent of the Environment Agency (or Anglian Water, if to the public foul sewer) and with any agreed treatment measures implemented.
- Where reasonably practicable, earth moving works will seek to avoid periods of very wet weather, to minimise the risk of generating runoff contaminated with fine particulates. Where this is not reasonably practicable, mitigation measures will be implemented to control fine sediment laden runoff.
- To protect waterbodies from fine sediment runoff, topsoil/ subsoil will be stored a minimum of 20m from watercourses on flat lying land (and further where any ground is sloping. Where this is not reasonably practicable and material is to be stockpiled for longer than two weeks, material will either be covered with geotextile mats or seeded to promote vegetation growth, with runoff from the stockpile prevented from draining to any watercourses, without prior treatment.
- Appropriately sized runoff storage areas for the settlement of fine particulates in runoff will be provided. It is anticipated that treated water may be pumped under a temporary Water Activity Permit from the Environment Agency or agreed with Anglian Water to an existing WwTW.
- Mud deposits will be controlled, as far as reasonably practicable, at entry and exit points to the Proposed Development Site using wheel washing facilities and/ or road sweepers operating during earthworks activities or other times as considered necessary.
- Equipment and plant will be washed out and cleaned in designated areas within the Proposed Development Site compound where runoff can be isolated for treatment before discharge to under appropriate consent and/ or agreement with Environment Agency, IoAaNNWLMB and/ or Anglian Water, or otherwise removed from the Proposed Development Site for appropriate disposal at a licensed waste facility.
- Debris and other material will be prevented from entering surface water drainage, through maintenance of a clean and tidy site, provision of clearly labelled waste receptacles, grid covers and the presence of site security fencing.
- The CEMP will include details of necessary water quality monitoring including visual observations, in situ testing using handheld water quality probes and periodic sampling for laboratory analysis.

Management of Spillage Risk

12.5.10 The measures outlined below will be implemented to manage the risk of accidental spillages and potential conveyance to nearby waterbodies via surface runoff or land

drains. The measures relating to the control of spillages and leaks will be included in the CEMP and adopted during the construction works:

- Any liquid fuel will be stored and used in accordance with the Control of Substances Hazardous to Health Regulations 2002 (HMSO, 2002), and the Control of Pollution (Oil Storage) (England) Regulations 2001 (HMSO, 2001);
- Particular care will be taken with the delivery and use of concrete and cement as it is highly corrosive and alkaline;
- Fuel and other potentially polluting chemicals will either be in self bunded leak proof containers or stored in a secure impermeable and bunded area (minimum capacity of 110% of the capacity of the containers);
- Any plant, machinery or vehicles will be regularly inspected and maintained to ensure they are in good working order and clean for use in a sensitive environment. This maintenance is to take place off site if possible or only at designated areas within the Proposed Development Site compound. Only construction equipment and vehicles free of all oil/ fuel leaks will be permitted on site. Drip trays will be placed below static mechanical plant;
- All washing down of vehicles and equipment will take place in designated areas and wash water will be prevented from passing untreated into watercourses;
- All refuelling, oiling and greasing will take place above drip trays or on an impermeable surface which provides protection to underground strata and watercourses, and away from drains as far as reasonably practicable. Vehicles will not be left unattended during refuelling;
- As far as reasonably practicable, only biodegradable hydraulic oils will be used in equipment working in or over watercourses;
- All fixed plant used on the Proposed Development Site will be self-bunded;
- Mobile plant is to be in good working order with drip trays installed beneath oil tanks/ engines/ gearboxes and hydraulics, which would be checked and emptied regularly;
- Plans to deal with accidental pollution would be included within the CEMP prior to commencement of construction and any necessary equipment (e.g. spillage kits) would be held on site and all site personnel would be trained in their use. The Environment Agency would be informed immediately in the unlikely event of a suspected pollution incident;
- The Proposed Development Site will be secure to prevent any vandalism that could lead to a pollution incident;
- Construction waste/ debris will be prevented from entering any surface water drainage or water body;
- Suitable facilities for concrete wash water (e.g. geotextile wrapped sealed skip, container or earth bunded area) will be adequately contained, prevented from entering any drain, and removed from the Proposed Development Site for appropriate disposal at a suitably permitted waste facility.

Use of Cofferdam at the Abstraction Points

12.5.11 As described in **Chapter 5**: Construction Management and Programme, the Proposed Development will require use of cofferdam(s) in close proximity to the intake and outfall structures. Intake structures may be in the Stainforth and Keadby Canal (preferred cooling water option) or in the River Trent. Use of cofferdam(s) is necessary in order to create a dry working environment which is safe for contractors to operate within.

12.5.12 Installation of any cofferdam in the Stainforth and Keadby Canal would require permission from the Environment Agency and CRT. Any cofferdam within the River Trent would require a Marine Licence from the MMO which may be 'Deemed' within the DCO (the preferred option) or 'standalone'. Maintaining a dry working area for any in-channel working using a cofferdam will reduce the overall channel disturbance and potential for mobilising fine sediment (and any contamination) into the water column and estuary/ canal.

12.5.13 Any works would be undertaken with due regard to the Eels (England and Wales) Regulations 2009 (HMSO, 2009), which may require installation of an eel screen. A fish rescue would be required from the cofferdam before pumping out of water. All works would be undertaken in accordance with a Fish Management Plan, as described in **Chapter 11**: Biodiversity and Nature Conservation (PEI Report Volume I).

12.5.14 All cofferdam(s) would be designed to minimise changes to the estuary or canal bed and bank erosion and toe scour by extending the minimum distance into the channel. Dewatering within the cofferdam(s) area will be undertaken once any fine sediment has settled out such that it is consistent with the turbidity of the flowing River Trent and following any necessary fish rescue. The rate and location of the discharge will be controlled and carefully chosen to avoid further erosion of any nearby soft sediments.

12.5.15 Whilst in-situ, the cofferdam(s) will be regularly inspected and maintenance undertaken, where required, and any water entering the cofferdam(s) area via seepage will be disposed of appropriately (i.e. by pumping back into the waterbody).

Other connections/ works

12.5.16 It is assumed that any pipelines required beneath minor watercourses (e.g. small drains of 1-2m width) will be constructed using open cut methods. In such cases, it is assumed that flow may be temporarily over-pumped, diverted around or flumed through the working area and the watercourse fully reinstated following completion of works.

12.5.17 Measures to reduce the potential adverse impacts considered would include:

- implementation of a temporary site drainage system;
- undertaking works in the typically drier periods of the year, where reasonably practicable;
- completing a pre-works survey to record waterbody form and condition prior to works commencing;

- any required pump intakes would be appropriately screened to prevent fish being drawn into the pipe/ pump;
- no plant would track through any channel where works are undertaken and would be confined to the banks;
- crossings would be perpendicular to the channel where reasonably practicable;
- measures to control effects relating to bed substrate would also be developed including careful storage of sediment layers to enable typical pre-construction habitats and hydromorphological processes to quickly re-establish following the works.

Management of Flood Risk

12.5.18 The Contractor will monitor weather forecasts on a daily basis and plan works accordingly. For example, works in the channel of any watercourse will be avoided or halted where there to be a risk of high flows or even flooding. In addition, the Contractor will sign up to Environment Agency flood warning alerts and describe in the Emergency Response Plan the actions to be taken in the event of a possible flood event to ensure all workers, the construction site and third-party land, property and people are adequately protected from flooding.

12.5.19 If water is encountered during below ground construction, suitable de-watering methods will be used. Any significant groundwater dewatering required will be undertaken in line with the requirements of the Environment Agency (under Water Resources Act 1991 as amended (HMSO, 1991)) and Environmental Permitting Regulations (HMSO, 2016).

12.5.20 Safe egress and exits are to be maintained at all times when working in excavations. When working in excavations a banksman is to be present at all times.

12.5.21 Further details regarding the management of flood risk are available within **Appendix 12A:** FRA (PEI Report Volume II) and **Appendix 12A (Section 5 – 6):** Conceptual Drainage Strategy (PEI Report Volume II).

Operation

12.5.22 A number of embedded mitigation features are being incorporated into the design of the Proposed Development design in order to avoid, minimise and reduce potential adverse impacts on water features, water resources and flood risk, and these are described in the following sections.

Surface Water Drainage

12.5.23 It is proposed that a suitable surface water drainage network and management system will be provided for the Proposed Development that will provide appropriate interception, conveyance, treatment, and attenuation of surface water runoff. Further details are provided in the Conceptual Drainage Strategy is provided in **Appendix 12A (Section 5 – 6)** (PEI Report Volume II).

12.5.24 Due to the nature of the Proposed Development, it is likely that a range of different diffuse pollutant types may be present in surface water runoff, with concentrations

varying depending on many factors. This risk will be mitigated by providing suitable treatment measures and ensuring their maintenance.

12.5.25 The detailed drainage strategy will be developed in consultation with the Environment Agency, the LLFA (North Lincolnshire Council), the IDB (IoAaNNWLMB) and other statutory agencies. The proposed drainage system is to include the use of bypass oil water separators and SuDS where reasonably practicable, to attenuate surface water flows due to increases in the impermeable area as a result of the Proposed Development. SuDS would also provide treatment of runoff to ensure potential adverse effects on water quality are avoided/ minimised, as far as reasonably practicable. SuDS and the treatment train will be selected and assessed with reference to the SuDS Manual (CIRIA, 2015a) and the Simple Index Approach contained therein, or as otherwise agreed through consultation with the Environment Agency.

12.5.26 The maintenance required for SuDS and drainage networks will be based on standard guidance and practice. Requirements for maintenance and management of vegetated drainage systems (e.g. ponds) are described in The SuDS Manual (CIRIA, 2015a) and DMRB CG 532 (Highways England, 2020a). Furthermore, it is expected that silt / oil alarms will be fitted on all interceptors and attenuation storage facilities to alert operators when they require emptying.

Process Water Treatment

12.5.27 At this stage in the design process, preliminary water supply and wastewater discharge assessments have outlined what process waste waters may be generated by the Proposed Development and how these may be treated with the application of Best Available Techniques (BAT). These assessments indicate that wastewater contaminants will be generated from the following activities:

- cooling tower blowdown - blowdown from the power plant and carbon capture cooling towers are likely to contain total dissolved solids (TDS), with some suspended solids plus trace chemical and organics resulting from water treatment chemical addition. The composition of the cooling tower blowdown will be limited by the number of cycles of concentration that the water undergoes. It is proposed that this will be discharged via a dedicated pipeline connection to the existing infrastructure used by Keadby 1 Power Station to the River Trent. All discharges would be in accordance with an Environmental Permit required for the operation of the Proposed Development.
- Direct Contact Cooler (DCC) Blowdown - DCC blowdown wastewater will be treated within the power island and CCP plant area. A number of Treatment processes are under consideration to enable the treated water to be recovered for cooling water make-up or discharged to the River Trent.
- Demin Plant and Condensate Polishing Plant Regeneration - The wastewater from the demineralisation plant and possible steam condensate polishing plant will be treated prior to discharge to the River Trent.
- Heat Recovery Steam Generator Boiler Blowdown - The HRSG boiler blowdown is likely to be treated prior to recovery for cooling water make-up or discharge to the River Trent.

- Water Treatment Works (WTW) Residuals - The quantity and quality of the wastewater discharge from the WTW is highly dependent upon the salinity of the source and the required level of desalination. Further assessment is proposed, to determine any treatment required.

River Trent Outfall

12.5.28 In order to ensure safe system operation and not compromise performance of the Proposed Development, the outfall to the River Trent must take precautions to prevent aquatic life entering the system. Environment Agency guidance documents identify that the most vulnerable eels at outfalls are glass eels, elvers and yellow eels up to 30cm. It is proposed that the discharge from the outfall is kept in excess of the burst velocity of the yellow eels to prevent entry. By adopting suitable diameter pipes, this could be achieved by gravity (subject to a combined study of the Keadby 2 & 3 systems). If this is not possible then a pumped discharge system may have to be considered.

Canal Intake

12.5.29 For the purposes of the study, it is assumed that a similar intake structure and layout as currently being constructed for the Keadby 2 canal intake will be used for the Proposed Development. As the existing Aqseptence screen installation is designed for 442L/s, and the maximum hybrid cooling water demand for The Proposed Development is 308L/s, it is expected that the overall dimensions of the new inlet will be no larger than the Keadby 2 installation.

Management of Hazardous Substances on Site

12.5.30 The operational phase of the Proposed Development would require storage, transport, handling and use of potentially polluting substances (e.g. chemicals, and wastes). Throughout its lifetime, the facility would be regulated by the Environment Agency through an Environmental Permit, which would include conditions relating to handling, storage and use of hazardous substances, including emergency procedures in line with the use of Best Available Techniques (BAT). These measures would be in place to prevent pollution during plant operation in accordance with the permit. An application to for an Environmental Permit to include the operation of the Proposed Development would be submitted to the Environment Agency for determination and which will describe the relevant measures proposed.

12.5.31 Areas at most risk of frequent spills will be isolated through the use of bunds (or other physical barriers) to prevent spread of spills across the Proposed Development Site and towards watercourses, and then would be disposed of appropriately. Penstocks, booms or absorbent systems will also be used to ensure accidental fuel/ chemical spills and fire control do not enter the surface water network.

12.5.32 A number of the impact avoidance measures employed during the construction phase would remain for the operational phases of the Proposed Development (where relevant), and would be implemented through the Proposed Development Site Environmental Management System (EMS), for example:

- an Incident and Emergency Response Plan to deal with incidents, including accidental pollution and all necessary equipment (e.g. spillage kits) would be held on-site and all relevant site personnel would be trained in their use, for example the plan would incorporate details on how to appropriately deal with accidental spillages to ensure they are not drained to any surface water system;
- containment measures would be implemented, including bunding or double-skinned tanks for fuels and oils; all chemicals would be stored in accordance with their COSHH guidelines; and
- any relevant measures incorporated within the drainage system design to prevent material entering local waterbodies would be described. It is currently envisaged that this may include penstocks on surface and foul water drainage systems to provide final containment of any major chemical spillage, and upstream at the Proposed Development Site outfall to the River Trent, and to any discharge upstream of sewers into which site foul waste is discharged. An Outline Drainage Strategy will accompany the DCO Application.

12.5.33 including:

- HS(G)191 Emergency planning for major accidents. Control of Major Accident Hazards Regulations 1999 (HSE, 1999);
- HS(G)71 Chemical warehousing: the storage of packaged dangerous substances (HSE, 1992); and
- BS 5908: Fire and explosion precautions at premises handling flammable gases, liquids and dusts. Code of practice for precautions against fire and explosion in chemical plants, chemical storage and similar premises (BSI, 1990).

12.5.34 All products are to be labelled with their hazard ratings so that the user is aware of any potential risks to the environment. Provided they follow the label instructions, the risks are well controlled. Only well trained, certificated and staff experienced in the use of the various chemical products will be allowed access.

12.5.35 In the event of any hazardous spillage, following containment, the material would be treated to render it safe e.g. using neutralising agents. Following treatment, clean up would be undertaken and effluent disposed of off-site or to sewer if practical and agreed with the sewerage undertaker. Should any spillage occur the Environment Agency would immediately be informed, or Anglian Water should it impact the foul water system.

Flood Risk during Operation

12.5.36 Mitigation measures required to protect the Proposed Development from the residual risk of flooding in the event that the existing tidal defences fail in the vicinity of the Proposed Development Site, or in the event of heavy rainfall that could result in surface water flooding at the Proposed Development Site if the design capacity of the drainage network is exceeded.

12.5.37 A number of flood resistance/ resilience measures are included in **Appendix 12A**: Flood Risk Assessment for consideration at the detailed design stage of the Proposed Development (refer to Appendix 12A in PEI Report Volume II).

12.5.38 In order to protect against the residual risk of breach and the future risk from defence overtopping, the critical equipment and infrastructure will be raised above the predicted water levels on site in a 0.5% AEP +35yr climate event and the predicted level from a breach.

12.5.39 Further detail on additional measures is provided in Section 6 of **Appendix 12A**: Flood Risk Assessment (PEI Report Volume II).

Decommissioning

12.5.40 The Proposed Development would be subject to decommissioning under the conditions of the Environmental Permit including conditions relating to chemical/ polluting material handling, storage and use and emergency procedures in line with BAT. A detailed Decommissioning Environmental Management Plan (DEMP) would be prepared to identify required measures to prevent pollution during this phase of the Proposed Development, based on the detailed decommissioning plan.

12.5.41 The impact avoidance measures for decommissioning would be similar to those identified above for the construction phase. As above, measures would be in place to prevent pollution in accordance with the permit.

12.6 Likely Impacts and Effects

12.6.1 The Proposed Development has the potential to cause adverse effects to the water environment during construction, operation and decommissioning phases. Water resources described in Section 12.4 have therefore been assessed for the likelihood of actual effects occurring as a result of these phases of the Proposed Development (taking into account the mitigation measures as detailed in **Section 12.5)**.

Construction Phase

Surface Water Quality – Suspended Fine Sediments

12.6.2 Taking into consideration the source-pathway-receptor approach, construction of any cofferdam(s) (in the River Trent and/ or Stainforth and Keadby Canal (the receptors) would cause some mobilisation of fine sediments during installation and removal, and this may mobilise some fine sediment into the water column (the pathway). However, the volume of sediment will be relatively small and localised. In the case of the River Trent, background data shows that concentrations of TSS are often quite high. Once any cofferdam has been installed, any fine sediment that has been mobilised will quickly dissipate through settling or dispersion and is unlikely to create a plume that may propagate into the wider waterbody. The purpose of the cofferdam is to allow a dry working area to be created, which in itself is a measure designed partly to reduce adverse impacts on water quality.

12.6.3 The cofferdam(s) will be designed to minimise changes in riverbed and bank erosion and toe scour, and hence minimise sediment mobilisation. It is currently envisaged that these would follow the line of the shore and not protrude significantly into the channel (i.e. up to circa 25m for the Trent and up to circa 15m for the Stainforth and Keadby Canal), taking into account similar works within these watercourses for the purposes of Keadby Power Station. These indicative extents of cofferdam area would

ensure a safe and dry working area and would be refined further as the design of the Proposed Development progresses.

12.6.4 Before the installation of the cofferdam in the River Trent, the sediments will be sampled for chemical analysis. This will be required to inform an application for a deemed marine licence for works to the estuary bed as this will require information on the chemical composition of the sediments that might be mobilised. The CRT and Environment Agency would also be consulted regarding sampling requirements for the Stainforth and Keadby canal prior to works.

12.6.5 The preferred approach for the Proposed Development wastewater discharge is to re-use the existing Keadby Power Station outfall to the River Trent. To ensure that eels cannot pass into the network, it is proposed that any refurbishment works at the discharge outfall would be designed to ensure compliance with the Eels Regulations and that the system could be achieved by gravity (subject to confirmation through ongoing design). Should tis not be reasonably practicable, a pumped discharge system may be considered.

12.6.6 With the embedded mitigation measures (described in Section 12.5) in place, it is considered that there would be negligible impact to the River Trent from any cofferdam installation, given the scale of the watercourse and that preparatory dredging is not proposed. The tidal nature of the estuary here would quickly disperse any mobilised sediments. Given that the River Trent is a very high importance receptor this negligible impact would result in a **slight adverse effect (not significant).**

12.6.7 Construction of the abstraction point behind a cofferdam in the Stainforth and Keadby Canal would have a minor adverse magnitude impact given that there is less ability to quickly disperse any sediment in this waterbody given the low flow. This minor adverse impact would be very localised and temporary in nature. It will be necessary to consider appropriate cofferdam installation and design in order to ensure no impact to the canal liner at the abstraction point, and this may include bolstering the liner with clay. Given appropriate cofferdam design, the overall impact is considered to be minor adverse on the high importance Stainforth and Keadby Canal. This would result in a **slight adverse effect (not significant).**

12.6.8 With regard to the open-cut crossings of smaller freshwater watercourses and drains (i.e. in the order of 1-2m width), taking into account the embedded mitigation measures described in section 12.5 and using a source-pathway-receptor approach, the direct works to the channel could mobilise sediments (source). The pathway is direct mobilisation into the watercourse which could then also propagate downstream, and the receptor is the drain in which the work is undertaken and potentially downstream waterbodies. The watercourses which may require new crossings either for pipelines within the Proposed PCC Site, or for the Water Connection Corridors and access routes are drains D1 (medium importance), D2 (medium importance), D4 (low importance), D5 (low importance), D6 (medium importance), D7 (low importance) and several unnamed drains (low importance) between Keadby Power Station and Warping Drain.

12.6.9 Given the very localised and temporary nature of the works for any open-cut crossings of drains, as well as restoration required, the magnitude of impact is considered minor, and largely mitigated through the measures outlined in Section 12.5. For the medium

importance drains D1, D2 and D6 this would give a **slight adverse effect (not significant)**. For the low importance drains D4, D5, D7 and other unnamed drains this would give a **neutral effect (not significant).** Given the embedded mitigation measures, **no adverse effect** is anticipated to downstream waterbodies.

12.6.10 It is assumed that the existing water connection corridor crossing of Warping Drain (high importance) will be maintained and therefore will not require a new crossing, and that the existing access route crossings of the North and South Soak Drain (high importance) and Stainforth and Keadby Canal (high importance) will be maintained and do not require new crossings. However, there will be construction work in close proximity to these watercourses which could result in runoff of fine sediment towards them. Given the embedded mitigation measures described in section 12.5, any adverse impact is expected to be minor, resulting in a **slight adverse (not significant)** effect to these waterbodies, with no adverse effect on downstream waterbodies from this source i.e. the Torne/Three Rivers waterbody or the River Trent.

Surface Water Quality – Chemical Spillages

12.6.11 Leaks and spillages of polluting substances during construction could potentially pollute nearby surface watercourses if their use or removal is not carefully controlled (source) and spillages enter existing flow pathways or waterbodies directly (pathway). Like excessive fine sediment in construction site runoff, the risk is greatest where works occur close to and within waterbodies (the receptor). However, to ensure legislative compliance, storage, handling and disposal of such substances will need to be in place prior to and during construction via the CEMP.

12.6.12 Upgrade works are proposed to be undertaken directly within the River Trent at the Water Discharge location (and potentially at the river water abstraction point, should this option be selected). Given the scale of the waterbody with significant dilution potential, and given the majority of works would be undertaken behind a cofferdam with mitigation measures implemented (described in Section 12.5), including water quality monitoring, there would be a negligible impact on the very high importance River Trent. This would give a short-term **slight adverse effect (not significant)**.

12.6.13 The Stainforth and Keadby Canal is a high importance waterbody that would be worked within directly for the potential Canal Water Abstraction Option. Any impact relating to chemical spillages would be negligible given the implementation of best practice measures (see Section 12.5) and the use of a cofferdam to isolate the majority of the works, causing a **neutral effect (not significant).**

12.6.14 There would also be work in close proximity to (but not directly within) other high importance waterbodies, namely Warping Drain, North and South Soak Drains and Hatfield Waste Drain where the existing temporary bridge may be replaced and works to upgrade the existing junction at the A18 into the Proposed Development Site may be undertaken. For the bridge replacement works, it is envisaged that works would involve removal of the existing bridge and delivery and placement of a new bridge (pre-fabricated off-Site) during a weekend. Given the implementation of mitigation measures to be within the CEMP, any impact from chemical spillages would be negligible, giving a **neutral effect (not significant).**

12.6.15 The medium importance drains D1, D2 and D6 are expected to be directly worked on for watercourse crossings, although non-open cut approaches will be considered, wherever reasonably practicable given that, open-cut works carry a greater risk of chemical spillages directly into the channel. This would be a temporary minor adverse impact, giving a **slight effect (not significant).**

12.6.16 Direct works will be undertaken to the low importance drains D2, D4, D5, D7 and several unnamed drains and ditches. The temporary minor adverse impact to these watercourses would give rise to a **neutral effect (not significant)**.

12.6.17 Given the embedded mitigation to deal with chemical spillages there is expected to be no impact to downstream waterbodies (e.g. River Torne/Three Rivers), or the isolated ponds within the Proposed Development Site boundary which are not directly impacted.

Morphological Effects to Waterbodies relating to the use of a Cofferdam

12.6.18 The installation of a cofferdam will result in the localised loss of habitat on the bed of the River Trent and/ or Stainforth and Keadby Canal beneath its footprint and may cause some scour. However, any cofferdam(s) will be designed to minimise changes in riverbed and bank erosion. Given the dynamic nature of the River Trent, which also contains significant TSS the estuary bed would be expected to make a rapid recovery, although recovery is likely to be somewhat slower in the canal which is a less dynamic environment, but where the footprint of impact is expected to be less.

12.6.19 Using the source-pathway-receptor approach, impacts on morphology would be negligible for the River Trent due to the localised and temporary nature of the impact in a dynamic environment. As such, there is expected to be a **neutral effect (not significant)** on an asset of low importance (for morphology) with regard to the cofferdam use within the River Trent. The impact on the Stainforth and Keadby Canal would be minor adverse given the slower probable recovery of the bed, giving a **slight adverse effect (not significant)** on this low importance (for morphology) receptor.

Morphological Effects to Waterbodies: Crossings for the Connection Corridors

12.6.20 The watercourses which may require new crossings relating to connection corridors and access routes are drains D1 (medium importance), D2 (medium importance), D4 (low importance), D5 (low importance), D6 (medium importance), D7 (low importance) and several unnamed drains (low importance) between Keadby Power Station and Warping Drain. Non-intrusive crossing methodologies will be considered, where reasonably practicable, although it is assumed that open-cut methods will also be required.

12.6.21 Where open-cut approaches are used, the pipe/ cables will be buried at sufficient depth to prevent exposure and the flow over-pumped or flumed during the works to minimise the risk of water pollution being carried downstream. However, there will unavoidably be short term, temporary adverse impacts on the watercourse and riparian habitats, and the hydrological and sediment regimes during construction. These impacts would be very localised and short in duration, with the channels reinstated. Overall, physical works to watercourses would give a localised, temporary minor adverse impact against hydromorphological status. All of these watercourses

are of low morphological importance, due to mainly being artificial straight channels, lacking significant geomorphic and bedform features. This results in a **neutral effect (not significant)** due to the short-term nature of the work which would have limited impact at the scale of the wider waterbody.

Potential Flood Risk – Tidal and Fluvial Sources During Construction

12.6.22 Taking into account implementation of standard construction methods and mitigation as described in the Section 12.5, which would be included in the CEMP, flood risk during construction would be effectively managed (for example by monitoring weather forecasts and Environment Agency flood warnings, by undertaking works close to watercourses during periods of dry weather, by ensuring an adequate temporary drainage system is in place and maintained throughout the construction phase and avoiding stockpiling material on floodplains). A Flood Emergency Response Plan will define access and egress routes from the Proposed Development Site and will ensure that flood warnings are received from the Environment Agency's 'Floodline Warnings Direct' service to inform if there is a risk of flooding from a tidal storm surge type event which could result in overtopping or breach of defences. At least one designated Flood Warden will be present on site who is familiar with the risks and remains vigilant to news reports, Environment Agency flood warnings and water levels in the River Trent.

12.6.23 Given these measures, the magnitude of flooding from these sources on very high importance construction workers, on site and further downstream, is considered to be negligible resulting in a **slight adverse effect (not significant).**

Potential Flood Risk – Surface Water Sources During Construction

12.6.24 The Proposed Development Site would in general be at very low to low risk from surface water flooding, although in some areas associated with watercourses there are areas of medium risk as outlined in the baseline and FRA (PEI Report Volume III: Appendix 12A). However, during the works, existing surface flow paths may be disrupted and altered due to site clearance, earthworks, and excavation work. The exposure and compaction of bare ground and the construction of new embankments and impermeable surfaces may increase the rates and volume of runoff and increase the risk from surface water flooding. However, with the implementation of standard construction methods and mitigation measures (see Section 12.5), this risk can be effectively managed. As such, the magnitude of flooding from these sources on very high importance construction workers is considered to be negligible resulting in a **slight effect (not significant).**

Potential Flood Risk – Groundwater Sources During Construction

12.6.25 The Proposed Development Site is considered to be at low risk of flooding from groundwater sources. Excavation of any cuttings has the potential to liberate groundwater in some areas, and open excavations in some locations may also be more prone to becoming inundated by groundwater. With the implementation of the measures outlined in the CEMP and WMP (presented in Section 12.5), a negligible magnitude of impact is predicted resulting in a **slight effect (not significant)** on very high importance construction workers.

Potential Flood Risk – Drainage Infrastructure and Artificial Sources During Construction

12.6.26 The Proposed Development is at low to very low risk of flooding from existing drainage infrastructure. With the implementation of the measures outlined in the CEMP and other flood risk mitigation as outlined in section 12.5, flooding from these sources is considered to be negligible given the implementation of standard good practice construction techniques resulting in a **slight effect (not significant).**

12.6.27 Environment Agency mapping and the FRA (PEI Report Volume III – **Appendix 12A**) indicates that the Proposed Development Site is not at risk of flooding from reservoirs (no effect), and at low risk from artificial waterbodies given proximity to the Stainforth and Keadby Canal. As such, the risk of flooding from artificial sources (canal) is considered to have a **slight effect (not significant)** on very high importance construction workers.

Operation Phase

Potential Pollution of Surface Watercourses: Surface Water Routine Runoff and Accidental Spillages

12.6.28 Throughout its lifetime, the Proposed Development would be regulated by the Environment Agency through an Environmental Permit, which would include conditions relating to handling, storage and use of materials, including emergency procedures in line with the use of Best Available Techniques (BAT). These measures would be in place to prevent pollution during plant operation in accordance with the permit.

12.6.29 The Conceptual Drainage Strategy (PEI Report Volume II **Appendix 12B**: Flood Risk Assessment) proposes to include SuDS in line with North Lincolnshire Council's SuDS and Flood Risk Guidance Document (North Lincolnshire Council, 2017). This will enable attenuation of surface water flows due to increases in the impermeable area as a result of the Proposed Development. SuDS would also provide treatment of runoff to ensure potential adverse effects on water quality are avoided. An appropriate SuDS treatment train will be selected as the Proposed Development designs are advanced and considering the SuDS Manual (CIRIA, 2015).

12.6.30 Using the source-pathway-receptor approach, the source of pollution would be potential contaminants on impermeable surfaces (e.g. metal from vehicles on roads) which are transferred by the pathway of surface water runoff to the River Trent (the receptor). It has been assumed for the purposes of assessment that a storage pond would be the most likely form of SuDS attenuation for surface water runoff (indicated on **Figure 4.1** in PEI Report Volume III), after passing through an oil interceptor (with collected oil intermittently removed and disposed of off-site). Additional treatment may be provided upstream of the pond if required. Water from the pond would then be discharged, subject to agreement of relevant authorizing body.

12.6.31 The SuDS Manual's Simple Index Approach (CIRIA, 2015) has been applied to assess the suitability of an assumed attenuation pond for surface water runoff and spillages (from non-process areas). The High Pollution Hazard Index has been adopted to assess runoff from the Proposed Development, as this is described in the

SuDS Manual as, *"Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites, trunk roads and motorways"*. It is thus deemed the most appropriate hazard index available for the Proposed Development.

12.6.32 Table 12.15 shows the pollutant hazard index score for different pollutants for the High Pollution Hazard Level, as outlined in the SuDS Manual (CIRIA, 2015).

Table 12.13: Pollution Hazard Indices and the Total Pollutant Index for each Pollutant

Proposed Development land use	SuDS	Mitigation		
		Total Suspended Solids	Metals	Hydrocarbons
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites, trunk roads and motorways	Pond	0.7	0.7	0.5
	Pollution Hazard Index	0.8	0.8	0.9
	Total Mitigation Index	**0.7**	**0.7**	**0.5**

12.6.33 Table 12.15 also shows the treatment potential of a pond when compared against the pollution hazard index. To achieve a pass, the total mitigation index must meet or surpass the pollution hazard index. Currently, the mitigation index fails to meet the pollution hazard index in all cases and so additional treatment would be required.

12.6.34 Appropriate additional treatment would therefore be provided upstream of any SuDS, considering a preference for creating a treatment train consisting of numerous SuDS components (e.g. filter drains, swales, wetlands). An indicative treatment performance is shown in Table 12.16 for a treatment train consisting of a wetland, which feeds into a pond prior to discharging to the River Trent. In this instance, the mitigation index equals or exceeds the pollution hazard index for TSS, metals and hydrocarbons, and so the treatment train would pass the assessment. Additional consideration of SuDS techniques would be considered at the detailed design stage

and design principles confirmed through consultation with the Environment Agency, LLFA and IDB.

Table 12.14: Indicative Mitigation Index using additional SuDS (wetland)

Proposed Development land use	SuDS train	Mitigation		
		Total Suspended Solids	Metals	Hydrocarbons
Sites with heavy pollution (e.g. haulage yards, lorry parks, highly frequented lorry approaches to industrial estates, waste sites), sites where chemicals and fuels (other than domestic fuel oil) are to be delivered, handled, stored, used or manufactured; industrial sites, trunk roads and motorways	1.Wetland	0.8	0.8	0.8
	2. Pond (50% due to second component of treatment train	0.35	0.35	0.25
	Pollution Hazard Index	0.8	0.8	0.9
	Total Mitigation Index	**1.15**	**1.15**	**1.05**

12.6.35 The Outline Drainage Strategy will aim to ensure that suitable treatment is provided prior to discharge to any watercourse in order to not adversely impact water quality of receiving waterbodies.

12.6.36 Taking into account the design and impact avoidance measures, a negligible impact is predicted to the River Trent at Keadby from surface water drainage. Given that this is a very high importance receptor, this would result in a **slight effect (not significant)**.

Potential Impacts on water quality of the River Trent from Operational discharges

12.6.37 Cooling water from the Proposed Development Site (the source in the source-pathway-receptor approach) will discharge (the pathway) to the River Trent (the receptor) under an environmental permit. It is anticipated that the volume of discharge from the Proposed Development will be less than 1m^3/s and is likely to require discharge intermittently, in combination with the 0.016 m^3/s proposed to be discharged from Keadby 2 Power Station. As such it is considered that the Proposed Development will be operating well within the parameters of what was determined to be not significant for Keadby 1 Power Station, where the existing permit (EPR/YP3133LL) allows a maximum daily discharge of 15m^3/s (average of 24-hour

period). Further assessment will be undertaken within the ES in parallel with preparation of the Environmental Permit application when the quantity of the proposed discharge will be confirmed. On the basis of available data at this time, it is considered that there will be negligible impact on temperature status of the River Trent, and the discharge would not prevent a barrier to migratory routes for fish. For the very high importance River Trent, this negligible impact would give a **slight effect (not significant)**. Engagement with the relevant stakeholders – principally the Environment Agency and MMO – will be undertaken to confirm the approach to assessment within the Environmental Permit application.

12.6.38 There is further potential for physico-chemical water quality impacts at the River Trent outfall, as discharged water is likely to include that from:

- Cooling Tower Blowdown – effluent from which may have elevated TDS concentrations, suspended solids concentrations, plus trace chemical and organics resulting from water treatment chemical addition. Chlorine is also likely to be elevated but will be treated through careful management of biocide addition during normal operation, and by timing shock chlorination dosing to align with plant shutdown operations to allow natural chlorine decay during outage periods;
- Direct Contact Cooler Blowdown – effluent from which may include high concentrations of ammonia, dissolved carbon dioxide and other trace chemicals. Treatment options are being developed which may include air and thermal stripping of wastewater to achieve a preliminary 5 mg/L ammonia content;
- Demin Plant and Condensate Polishing Plant Regeneration - effluent will be high in salt content, with a TDS concentration typically in the region of 30,000 ppm. It is assumed at this stage that these wastewaters will be neutralised in a treatment pond and discharged to the River Trent.
- Heat Recovery Steam Generator Boiler Blowdown - effluent is likely to be low in TDS but contaminated with a range of trace chemical additives. Limited treatment of this wastewater will be required before discharge to the River Trent via the existing outfall. Options also considered include recovery of this wastewater for cooling water make-up.
- Water Treatment Works (WTW) Residuals - effluent quantity and quality of the wastewater discharge from the WTW is highly dependent upon the salinity of the source and the required level of desalination. It is proposed to recover the wash water from the media filtration processes, along with sludge processing return liquors, to minimise waste discharge from the Proposed Development Site and to minimise water abstraction rates. The required WTW will vary depending on the cooling water option that is finally selected.

12.6.39 The Humber Upper (River Trent) WFD waterbody currently has Good Physico-Chemical Status and Chemical Status is Failing. The Proposed Development must not lead to deterioration of this status or prevent future improvement. It will need to be demonstrated that the discharged effluent from the Proposed Development meets the required standards for a range of water quality indicators in order to obtain a Water Activity Permit (i.e. a consent from the Environment Agency to discharge).

12.6.40 An on-site effluent treatment plant would be provided following Best Available Techniques (BAT) for treatment of effluent derived from the above processes. This is

then expected to discharge to a retention pond upstream of the River Trent outfall. Water sampling facilities are to be provided for manual sampling of water prior to discharge. The frequency of testing and parameters will be agreed with the permitting authority. In situ continuous monitoring of flow, temperature, conductivity and pH measurement shall also be undertaken, where appropriate as informed by consultation as part of the EIA process.

12.6.41 Given the requirements for the effluent from the Proposed Development to meet conditions of an environmental permit, it is considered that there is limited potential for pollution from the outfall, especially given the large capacity for dilution and dispersal offered by the Trent waterbody. As such, a negligible impact is predicted at this stage, with no changes likely to impact on WFD classifications for the larger waterbody. Given that the outfall is to a very high importance receptor, this results in a **slight effect (not significant).**

Surface Water Ponds: Water Quality

12.6.42 It is considered that there would be limited potential for adverse impacts resulting from receiving 'unclean' water or accidental spillages during operation on any existing 'natural' ponds (i.e. excluding new ponds that may be constructed as part of the Proposed Development for drainage purposes). This is based on all routine runoff during operation being directed to the River Trent, and not to the surface water ponds in the area. There are no ponds within the Proposed Development Site boundary, but five within the wider study area west of the River Trent, and these will receive no impact.

Physical Effects to Waterbodies: Loss of Sections of Existing Drains

12.6.43 Drains D2 and D4 fall under, or close to, the footprint of the Proposed PCC Site, and so they are likely to be lost, culverted or realigned. D2 is a field drain approximately 2m wide and 50cm deep, and D4 is approximately 1m wide and 10cm deep (depths noted at time of the spring survey for the PEA (Appendix 11C of PEI Report Volume II). Both channels are dominated by silt and are largely overgrown with macrophytes in the summer. They lack hydromorphic bedform features (e.g. riffles, pools, localised meanders) and are not known to be of any significant biodiversity, social, or economic value.

12.6.44 Assuming a worst-case scenario, it is assumed that D4 will be wholly lost (approximately 400m length) and D2 may be partially culverted or diverted. Drainage of the PCC Site area will instead be via the proposed drainage system for the Proposed Development (see Section 12.5). Consent would need to be obtained through consultation with the IoAaNNWLMB, and consultation will therefore be undertaken to agree any relevant mitigation measures required.

12.6.45 Permanent loss of sections of D4 and addition of culverts or diversions of D4 or D2 will unavoidably cause loss of bed and bank habitats, however, hydrologic continuity would be maintained. To some extent, the loss of these sections of low-quality habitat will be compensated by the use of SuDS in the Proposed Development drainage strategy which is expected to incorporate an attenuation pond or wetland and thereby create new habitat. Given the low quality of the D2 and D4 drain habitat and potential new habitat creation, the magnitude of the impact is considered minor adverse. For

D2 which is considered a medium importance receptor (with an estimated Q95 above 0.001m^3/s) this results in a **slight adverse effect (not significant)**. For D4, which is considered a low importance receptor (with an estimated Q95 below 0.001m^3/s), this results in a **slight adverse effect (not significant)**. This assessment will be revisited within the ES following engagement with the IoAaNNWLMB.

Demand for Water

12.6.46 An abstraction license has been granted to Keadby 2 Power Station to abstract water from the Stainforth and Keadby canal. However, there will be insufficient capacity within the new Keadby 2 abstraction licence (MD/028/0083/0014) to support a combined abstraction for Keadby 2 Power Station and the Proposed Development, but there may be potential for an additional new abstraction of raw water to be made available for use by The Proposed Development.

12.6.47 Keadby Power Station currently holds two abstraction licences, the aforementioned license for the canal as well as a licence for the River Trent. It is anticipated that The Proposed Development would potentially be able to adopt an existing licence for water abstraction. However, if these licences are insufficient, then a new licence would be required, or the water requirement may be achieved through licence trading. This would follow the same approach as applying for a new licence.

12.6.48 Based on initial discussions with regulators, it appears that water will be available for abstraction from the River Trent. However, it is likely that water abstraction from the I&T CAMS area (i.e. Stainforth and Keadby Canal) would be limited to trading with existing licence holders. It is also likely that any abstraction licence, would be subject to a number of conditions including Hands Off Flows or Levels.

12.6.49 Given that there is sufficient water supply available from the River Trent and also potentially from the Stainforth and Keadby Canal (through suitable trading arrangements or HOF/level conditions), and that any abstraction would be licensed by the Environment Agency, a negligible impact is predicted on water availability from these sources. This gives a **slight adverse effect (not significant)** on the River Trent due to it being a very high importance receptor, and a neutral effect **(not significant)** on the Stainforth and Keadby Canal as a high importance receptor. Consultation is ongoing with the Environment Agency and CRT with regard to abstraction arrangements, which will be further assessed within the ES.

Foul Water Discharge

12.6.50 Sewage and sanitary waste from the Proposed Development will be sent off-site via pipeline connecting to a local Anglian Water treatment plant, details of which would be subject to agreement with Anglian Water to confirm capacity. For the purposes of this assessment, it has been assumed that Anglian Water will treat foul water prior to discharge to any waterbodies in accordance with requirements to not cause deterioration or prevent improvement under the WFD. Further consultation with Anglian Water and development of a suitable detailed foul drainage strategy will be undertaken as the Proposed Development is progressed. The impact of foul water discharges is considered to be a **neutral (not significant)** effect.

Flooding from Tidal Sources during Operation

12.6.51 As described in section 12.5, a range of mitigation measures are proposed (set out within **Appendix 12A** of PEI Report Volume II) to mitigate flood risk and ensure the occupiers of the Proposed Development Site are safe and critical equipment can continue to function at the Proposed Development Site in the event of such inundation. This would include a Flood Emergency Response Plan, and allocation of a place of safe refuge.

12.6.52 All runoff from the Proposed Development Site is to discharge to the River Trent following SuDS attenuation and this discharge would be restricted to the greenfield runoff rate. As such, the risk of tidal flooding should not be exacerbated by the Proposed Development.

12.6.53 Tidal flooding is considered of Very High Importance due to the nature of the development as essential infrastructure. Given that the Proposed Development is expected to have negligible impact on flood levels on or off site through implementation of a Drainage Strategy, then a **slight effect (not significant)** is anticipated on tidal flooding (based on the classification approach in table 12.4). While there is a high residual risk of flooding to the Proposed Development Site, appropriate mitigation measures have been outlined to manage this risk.

Flooding from Fluvial Sources during Operation

12.6.54 As described above (tidal flooding) all runoff from the Proposed Development Site is to discharge to the River Trent following SuDS attenuation and this discharge would be restricted to the greenfield runoff rate. As such, the risk of fluvial flooding should not be exacerbated by the Proposed Development. Given the low risk of fluvial flooding and implementation of the proposed drainage strategy (**Appendix 12A** of PEI Report Volume II), it is considered that the Proposed Development would result in a negligible impact on fluvial flooding on and off site during operation, resulting in a long-term **neutral effect (not significant)** on fluvial flooding.

Flooding from Surface Water Sources during Operation

12.6.55 The risk of surface water flooding within the Proposed Development Site from elsewhere or generated within the Proposed Development Site is considered to be 'low to very low', with some small and isolated patches of medium risk. Extensive drainage infrastructure already exists across the Proposed Development Site due to the Keadby 1 Power Station and Keadby 2 Power Station.

12.6.56 Given the implementation of the proposed drainage strategy, surface water from the Proposed Development will be carefully managed, treated and directed to the River Trent outfall at controlled rates. It is therefore considered that the Proposed Development would have a negligible impact, resulting in a **neutral effect (not significant)** on surface water flood risk.

Flooding from Ground Water Sources during Operation

12.6.57 On the basis of the embedded mitigation measures outlined in section 12.5, the magnitude of impact from groundwater flooding during operation is considered negligible, with a resultant neutral (not significant) effect.

Flooding from Artificial Sources during Operation

12.6.58 The Proposed Development Site is not considered at risk from reservoir flooding. The Stainforth and Keadby Canal is adjacent to the Proposed Development Site, but given the shallow gradients, the risk of flooding is also likely to be low (see PEIR Volume III **Appendix 12A**). As such, the risk of flooding from these sources is considered negligible, giving a Neutral (not significant) effect.

12.6.59 Taking into account appropriate design measures previously described, the magnitude of impact is considered to be minor adverse, and a **slight effect (not significant)** is anticipated as a worst-case scenario.

Decommissioning Phase

12.6.60 At the end of its operating life, all above-ground equipment associated with the Proposed Development will be decommissioned and removed from the Proposed Development Site. There is therefore opportunity to restore the banks of watercourses where infrastructure is removed. It is assumed that all underground infrastructure will remain in-situ, however, all connection and access points will be sealed or grouted to ensure disconnection.

12.6.61 On this basis, decommissioning impacts are expected to be limited to waterbodies in close proximity to the Proposed Development Site (i.e. River Trent, Stainforth and Keadby Canal, North Soak Drain and Drains D1, D2, D4, D5 and D6), and will be similar to the impacts reported for the construction phase, but with fewer earthworks, excavations and tunnel arisings to manage.

12.6.62 A detailed Decommissioning Environmental Management Plan will be prepared to identify required measures to prevent pollution during this phase of the development, based on the detailed decommissioning plan.

12.6.63 There is likely to be a no change to the water quality of the River Trent waterbody following decommissioning of the Proposed Development given that the proposed abstraction/ discharge has not been identified to cause any significant adverse effect. There may be minor local benefits at the abstraction and discharge points, but there is expected to be no change at the waterbody scale, giving a **neutral effect**.

12.7 Mitigation, Monitoring and Enhancement Measures

12.7.1 A number of legislative and best practice measures which would be followed during the construction, opening and operation and decommissioning of the Proposed Development are detailed in **section 12.5 and section 12.6**. The design and impact avoidance measures have been taken into account in the assessment and no additional mitigation requirements have been identified.

12.7.2 Requirements for water quality monitoring will be explained in the CEMP. These would be further developed by the Principal Contractor in consultation with the Environment Agency (due to works potentially impacting flow in a main river and WFD waterbodies), the LLFA and/ or IDB (due to works potentially impacting flow in ordinary watercourses), and the MMO (due to works impacting the Humber Estuary) for works affecting, or for temporary discharges to, waterbodies during the construction period.

12.8 Limitations or Difficulties

12.8.1 This assessment has been undertaken using available data and Proposed Development design details. However, at this early concept design stage, details of the Proposed Development remain uncertain or under development, e.g. the location of the abstraction and the detailed design of drainage arrangements. For this reason, as described in Section 12.3, reasonable worst-case assumptions have been used following the Rochdale Envelope approach. As such the assessment provided herein should be considered provisional, and where additional detail becomes available, will be re-evaluated within the ES to accompany the DCO Application In deriving reasonable worst-case assumptions e.g. regarding cofferdam design and dimensions, works undertaken previously (including recently for Keadby 2 Power Station) have been used as the basis for assessment.

12.9 Summary of Likely Residual Effects and Conclusions

12.9.1 A summary of residual effects on water resources and flood risk and their significance is provided in Table 12.17.

Table 12.15: Summary of Residual Impacts and Effects

Description of Effect	Importance of Receptor (sensitivity for Flood Risk)	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation and Monitoring	Residual Effect Significance
Construction					
Surface Water Quality – suspended fine sediments	River Trent – Very High; Stainforth and Keadby Canal – High; Warping Drain – High; North and South Soak Drain – High; Drain D1, D2, D6 – Medium; Drains D4, D5, D7 and unnamed drains – Low.	River Trent – Negligible; Stainforth and Keadby Canal – Minor Adverse; Warping Drain – Minor Adverse; North and South Soak Drain – Minor Adverse; Drains D1, D2, D4, D5, D6, D7 – Minor Adverse.	Slight Adverse (not significant) effects predicted for: River Trent Stainforth and Keadby Canal Warping Drain North and South Soak Drain Drain D1, D2, D6 Neutral (not significant) effect for Drains D4, D5, D7 and unnamed drains	Further to the implementation of the CEMP and WMP (embedded mitigation), water quality monitoring pre-construction and during construction will be undertaken. Careful management of any required drilling techniques for pipeline installation across watercourses as far as reasonably practicable.	Slight Adverse (not significant) effects for: River Trent Stainforth and Keadby Canal Warping Drain North and South Soak Drain Drain D1, D2, D6 Neutral (not significant) effects for Drains D4, D5, D7 and unnamed drains
Surface Water Quality – chemical spillages	River Trent – Very High; Stainforth and Keadby Canal – High; Warping Drain – High;	River Trent – Negligible; Stainforth and Keadby Canal – Negligible; Warping Drain – Negligible Adverse;	River Trent – Slight Adverse (not significant); Stainforth and Keadby Canal – Neutral (not significant);	Further to the implementation of the CEMP and WMP (embedded mitigation), water quality monitoring pre-construction and	Slight Adverse (not significant) effects for: River Trent Warping Drain

Description of Effect	Importance of Receptor (sensitivity for Flood Risk)	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation and Monitoring	Residual Effect Significance
	North and South Soak Drain – High; Drain D1, D2, D6 – Medium; Drains D4, D5, D7 and unnamed drains – Low.	North and South Soak Drain – Negligible; Drains D1, D2, D4, D5, D6, D7 – Minor Adverse.	Warping Drain – Slight Adverse (not significant); North and South Soak Drain – Slight Adverse (not significant); Drain D1, D2, D6 – Slight Adverse (not significant); Drains D4, D5, D7 and unnamed drains – Neutral (not significant).	during construction will be undertaken.	North and South Soak Drain Drain D1, D2, D6 Neutral (not significant) effects for: Stainforth and Keadby Canal Drains D4, D5, D7 and unnamed drains
Morphological effects relating to installation of a cofferdam at the abstraction point	River Trent – Low (for morphology); Stainforth and Keadby Canal – Low (for morphology).	River Trent – Negligible; Stainforth and Keadby Canal – Minor Adverse.	Neutral (not significant) effects for: River Trent Slight Adverse (not significant) effects for: Stainforth and Keadby Canal	N/A Monitoring, as required, during cofferdam works.	Neutral (not significant) effects for: River Trent Slight Adverse (not significant) effects for: Stainforth and Keadby Canal

Description of Effect	Importance of Receptor (sensitivity for Flood Risk)	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation and Monitoring	Residual Effect Significance
Morphological effects relating to watercourse crossings	Drain D1, D2, D4, D5, D6, D7 and unnamed drains – Low (for morphology).	Drain D1, D2, D4, D5, D6, D7 and unnamed drains – Minor Adverse	Drain D1, D2, D4, D5, D6, D7 – Neutral (not significant)	Further to the implementation of the CEMP and WMP (embedded mitigation), including, water should be over-pumped through the works; works should be undertaken in drier periods of the year, as far as reasonably practicable; pump intakes should be appropriately screened to prevent fish being drawn into the pipe/ pump; and drainage and planting to be reinstated following completion of works.	Drain D1, D2, D4, D5, D6, D7 – Neutral (not significant)
Flooding from tidal and fluvial sources during construction	Flood Risk - High (construction workers)	Negligible	Slight adverse (not significant)	Implementation of temporary site drainage system as described in CEMP and WMP	Slight adverse (not significant)

Description of Effect	Importance of Receptor (sensitivity for Flood Risk)	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation and Monitoring	Residual Effect Significance
				(embedded mitigation); Flood Emergency Response Plan; Safe access and egress routes	
Flooding from surface water sources during construction	Flood Risk - High (construction workers)	Negligible	Slight adverse (not significant)	Implementation of temporary site drainage system as described in CEMP and WMP (embedded mitigation).	Slight adverse (not significant)
Flooding from groundwater sources during construction	Flood Risk - High (construction workers)	Negligible	Slight adverse (not significant)	Implementation of temporary site drainage system as described in CEMP and WMP (embedded mitigation).	Slight adverse (not significant)
Flooding from drainage artificial sources and drainage infrastructure during construction	Flood Risk - High (construction workers)	Negligible	Slight adverse (not significant)	None proposed.	Slight adverse (not significant)

Description of Effect	Importance of Receptor (sensitivity for Flood Risk)	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation and Monitoring	Residual Effect Significance
Operation					
Potential Pollution of Surface Watercourses: Routine Runoff and Accidental Spillages	River Trent - Very High	River Trent - Negligible	River Trent - Slight adverse (not significant)	Implementation of Drainage Strategy during detailed design (embedded mitigation).	River Trent - Slight adverse (not significant)
Potential Impacts on water quality of the River Trent from operational discharges	River Trent -Very High	River Trent - Negligible	River Trent - Slight adverse (not significant)	Implementation of Drainage Strategy during detailed design (embedded mitigation).	River Trent - Slight adverse (not significant)
Surface Water Ponds: Water Quality	Ponds - Low	Ponds - No change	Ponds - Neutral	Refer to **Chapter 8**: Air Quality (PEI Report Volume I) for effects relating to atmospheric deposition.	Ponds - Neutral
Physical Effects to Waterbodies: Loss of Sections of Existing Drains	Drain D2 – Medium; Drain D4 – Low.	Drain D2 – Moderate Adverse; Drain D4 – Moderate Adverse.	Drain D2 – Moderate Adverse (significant); Drain D4 – Slight Adverse (not significant).	Clarification on treatment of existing drains within detailed design. Explore habitat creation opportunities, including use of SuDS.	Drain D2 – Slight Adverse (not significant); Drain D4 – Slight Adverse (not significant).

Description of Effect	Importance of Receptor (sensitivity for Flood Risk)	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation and Monitoring	Residual Effect Significance
Demand for Water Abstraction	River Trent - Very High; Stainforth and Keadby Canal - High	River Trent: Negligible; Stainforth and Keadby Canal: Negligible.	River Trent – Slight Adverse (not significant); Stainforth and Keadby Canal – Neutral (not significant).	Further engagement to be undertaken with Environment Agency and CRT on abstraction options, including licensing and trading.	River Trent – Slight Adverse (not significant); Stainforth and Keadby Canal – Neutral (not significant).
Demand for Foul Water	Unknown waterbody (depends on treatment works used)	Minor adverse	Neutral (not significant)	Consultation to be undertaken with Anglian Water.	Neutral (not significant)
Flooding from tidal sources during operation	Flood Risk: Very High	Negligible	Slight Adverse (not significant)	Implementation of the drainage strategy (embedded mitigation)	Slight Adverse (not significant)
Flooding from fluvial sources during operation	Flood Risk: Low	Negligible	Neutral (not significant)	Implementation of the drainage strategy (embedded mitigation)	Neutral (not significant)
Flooding from surface water sources during operation	Flood Risk: Low to Very Low, isolated patches Medium	Negligible	Neutral (not significant)	Implementation of the drainage strategy (embedded mitigation)	Neutral (not significant)

Description of Effect	Importance of Receptor (sensitivity for Flood Risk)	Magnitude of Impact	Initial Classification of Effect (with embedded mitigation)	Additional Mitigation and Monitoring	Residual Effect Significance
Flooding from groundwater sources during operation	Flood Risk: Low	Negligible	Neutral (not significant)	Implementation of the drainage strategy (embedded mitigation) Consideration of BS British Standard 8102 Code of Practice for Protection of Below Ground Structures Against Water From the Ground.	Neutral (not significant)
Flooding from drainage infrastructure and artificial waterbodies during operation	Flood Risk: Low	Minor	Slight (not significant)	Implementation of the drainage strategy (embedded mitigation)	Slight (not significant)

12.10 References

AECOM (2020), Cooling Water Study, Revision 1.0, 60625943-PE-RP-004

Bing (2020) Online Ordnance Survey Maps. (Online) Available at: https://www.bing.com/maps.

British Geological Society's (BGS, 2020) Online Mapping Viewer 'GeoIndex'. (Online) Available at: http://mapapps2.bgs.ac.uk/geoindex/home.html.

British Standards Institute (BSI, 2009) BS6031:2009 Code of Practice for Earth Works.

BSI (1990) BS 5908 – Code of practice for fire precautions in the chemical and allied industries, British Standards Institution.

BSI (2009) 8102 Code of Practice for Protection of Below Ground Structures Against Water From the Ground.

BSI (2013) BS8582 Code of Practice for Surface Water Management of Development Sites.

Canal & River Trust (CRT, 2020). Code of Practice for Works Affecting the Canal & River Trust.

CEFAS (2017a) Assessment of 10 year licence application from Scottish & Southern Energy for maintenance dredging at Keadby power station, Lincolnshire, Reference Number: MLA/2017/00312.

CEFAS (2017b). MLA/2017/00312 – Advice to inform Keadby Power Station Intake and Outfall Dredging. (Online) Available via the MMO Public Register: https://marinelicensing.marinemanagement.org.uk/mmofox5/fox/live/MMO_PUBLIC_REGISTER/

Centre for Ecology and Hydrology (CEH, 2020). National River Flow Archive. (Online) Available at: http://nrfa.ceh.ac.uk/.

CIRIA (2001) C532 – Control of water pollution from construction sites – Guidance for consultants and contractors.

CIRIA (2004) C609 – Sustainable Drainage Systems, hydraulic, structural and water quality advice.

CIRIA (2006) C648 – Control of water pollution from linear construction projects, technical guidance.

CIRIA (2010) C688 – Flood resilience and resistance for critical infrastructure.

CIRIA (2015a) C753 – The SuDS Manual.

CIRIA (2015c) C744 – Coastal and marine environmental site guide (second edition).

CIRIA (2015d) C741 – Environmental good practice on site guide (fourth edition).

Cranfield Soil and AgriFood Institute (CSAI, 2020) Soilscapes viewer (website accessed September 2020) http://www.landis.org.uk/soilscapes/.

Cranfield University (2020). 'Soilscapes'. (Online) Available at: http://www.landis.org.uk/soilscapes.

DECC (2011b) NPS for Fossil Fuel Electricity Generating Infrastructure (EN-2).

DECC (2011c) National Policy Statement for Gas Supply Infrastructure and Gas and Oil Pipeline (EN-4).

DEFRA (2011a) UK Marine Policy Statement.

DEFRA (2011b) Future Water: The Government's Water Strategy for England.

DEFRA (2014) The East Inshore and East Offshore Marine Plans.

DEFRA (2018) 25 Year Environment Plan.

DEFRA (2020). Multi-Agency Geographic Information for the Countryside (MAGIC). (Online) Available at: http://www.magic.gov.uk/.

DEFRA and Environment Agency (2018) Humber River Basin Management Plan (Online). Available at: https://www.gov.uk/government/publications/humber-river-basin-district-river-basin-management-plan [Accessed November 2020].

DEFRA. (2015) Sustainable Drainage Systems: non-statutory technical standards.

DEFRA/Environment Agency (2005) FRA Guidance for new Developments FD2320.

Department for Communities and Local Government (2012) National Planning Policy Framework. London. The Stationery Office.

Department for Energy and Climate Change (DECC), now Department for Business, Energy and Industrial Strategy (2011a) The Overarching NPS for Energy (EN-1).

Department for Transport (DfT, 2019) TAG unit A3 Environmental Impact Appraisal. (Online) Available at: https://www.gov.uk/government/publications/webtag-tag-unit-a3-environmental-impact-appraisal-december-2015;

Environment Agency (2001). Pollution Prevention Guidance. Available at: https://www.gov.uk/government/collections/pollution-prevention-guidance-ppg Accessed September 2020.12-44 Northern Ireland Environment Agency and Scottish Environment Protection Agency, 2020Environment Agency. 2001. Guidelines on Pollution Prevention Guidance. Available at: https://www.gov.uk/government/collections/pollution-prevention-guidance-ppghttps://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/ Accessed September 2020;

Environment Agency (2005). Screening for Intake and Outfalls: a best practice guide

Environment Agency (2013) February 2013, Lower Trent & Erewash Abstraction Licensing Strategy.

Environment Agency (2016) Discharges to surface water and groundwater: environmental permits. (Online) Available at: https://www.gov.uk/guidance/discharges-to-surface-water-and-groundwater-environmental-permits.

Environment Agency (2016b) Water Framework Directive Risk Assessment – How to assess the risk of your activity'. Available at https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/522426/LIT_10445.pdf

Environment Agency (2020) Ecology and Fish Data Explorer. Available at https://environment.data.gov.uk/ecology-fish/

Environment Agency (2020a) Environment Agency Catchment Data Explorer website. (Online) Available at: http://environment.data.gov.uk/catchment-planning/.

Environment Agency (2020b) Environment Agency Water Quality Archive website (Online) Available at: https://environment.data.gov.uk/water-quality/view/landing.

Environment Agency (2020c). Flood Risk Maps for Planning. (Online) Available at: https://flood-map-for-planning.service.gov.uk/.

Environment Agency (2020d) Flood Warning Information website, available at: https://flood-warning-information.service.gov.uk/long-term-flood-risk/ Accessed September 2020.

ERM (2016) Keadby 2 Power Station Environmental Statement.

Health and Safety Executive (1992) HS(G)71 Chemical warehousing: the storage of packaged dangerous substances, HSE.

Highways England (2019) Design Manual for Roads and Bridges LA104 Environmental Assessment and Monitoring.

Highways England (2019) Design Manual for Roads and Bridges LA113 Road Drainage and the Water Environment.

Highways England (2020a) Design Manual for Roads and Bridges CD 532, Vegetated Drainage Systems for Highway Runoff.

Highways England (2020b) Design Manual for Roads and Bridges CG501, Design of Highway Drainage Systems.

HMSO (1975) Salmon and Freshwater Fisheries Act 1975.

HMSO (1990) Environmental Protection Act 1990.

HMSO (1991) Land Drainage Act 1991.

HMSO (1991) Water Resources Act 1991.

HMSO (1995) Environment Act 1995.

HMSO (2001) Control of Pollution (Oil Storage) (England) Regulations 2001.

HMSO (2002) Control of Substances Hazardous to Human Health (COSHH) Regulations 2002.

HMSO (2008) Planning Act 2008.

HMSO (2009) Eels (England and Wales) Regulation 2009.

HMSO (2009) Flood Risk (England and Wales) Regulations 2009.

HMSO (2009) Groundwater (England and Wales) Regulations 2009.

HMSO (2009) Marine and Coastal Access Act 2009.

HMSO (2010a) Floods and Water Management Act 2010.

HMSO (2010b) The Building Regulations 2010.

HMSO (2013) Bathing Water Regulations 2013.

HMSO (2014) The Water Act 2014.

HMSO (2015) Control of Major Accident Hazards (COMAH) Regulations 2015.

HMSO (2015) Environmental Damage (Prevention and Remediation) Regulations 2015.

HMSO (2016) Environmental Permitting (England and Wales) Regulations 2016.

HMSO (2017) Water Environment (Water Framework Directive) (England Wales) Regulations 2017.

HSE (1999) HS(G)191 Emergency planning for major accidents. Control of Major Accident Hazards Regulations.

HSE (2020) Health and Safety Executive, Technical Measures Document, Emergency response / spill control website, (http://www.hse.gov.uk/comah/sragtech/techmeasspill.htm), accessed January 2020.

John Brown Engineering Ltd. (1996). Report on the River Trent water suspended solids.

Keadby 2-CCGT Water Specification, Sched Pt 4 Att 004,SSE Engineering Centre.

Landmark (2020) Envirocheck Report: Reference 242986885_1_1.

Met Office (2020). Climate averages data. (Online) Available at: http://www.metoffice.gov.uk/public/weather/forecast.

MHCLG (2014a) National Planning Practice Guidance. London, The Stationery Office.

MHCLG (2014b) Flood Risk and Coastal Change NPPG, London, The Stationary Office.

Ministry of Housing, Communities and Local Government (MHCLG) (2019) National Planning Policy Framework.

National Rivers Authority (1994) Humber Estuary: Catchment Management Plan Consultation Report.

NetRegs (2010) Environmental Guidance for your Business in Northern Ireland and Scotland. Available at: https://www.netregs.org.uk/environmental-topics/pollution-prevention-guidelines-ppgs-and-replacement-series/guidance-for-pollution-prevention-gpps-full-list/ Accessed September 2020.

North and North East Lincolnshire Council (2011c) Strategic Flood Risk Assessment.

North Lincolnshire Council (2011a) Core Strategy: 11 – Environment and Resources.

North Lincolnshire Council (2011b) North Lincolnshire Preliminary Flood Risk Assessment.

North Lincolnshire Council (2016) Local Flood Risk Management Strategy.

North Lincolnshire Council (2017) SuDS and Flood Risk Guidance Document.

North Lincolnshire Council (2020) North Lincolnshire Local Plan Preferred Options February 2020.

The Planning Inspectorate (2017) Advice Note 18: The Water Framework Directive. Available at https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2017/06/advice_note_18.pdf

The Planning Inspectorate (2018) Advice Note Nine: Using the Rochdale Envelope.

UK Government Flood Information Service: River Trent at Keadby. Available at https://flood-warning-information.service.gov.uk/station/2144