RWE Renewables UK Dogger Bank South (West) Limited

RWE Renewables UK Dogger Bank South (East) Limited

Dogger Bank South Offshore Wind Farms

Preliminary Environmental Information Report

Chapter 20 – Flood Risk and Hydrology

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Glossary

Term	Definition
Aquifer	Geological strata that hold water.
Cable construction compound	Area set aside to facilitate construction of the onshore export cables. These will be located adjacent to the onshore export cable corridor, with access to the highway.
Coastal catchment	Land which drains directly to the coastal or estuarine waters, rather than through a river water body – not part of a river water body catchment.
Geomorphology	The study of landforms and the processes that shape them.
Groundwater	Water stored below the ground in rocks or other geological strata.
Horizontal directional drill (HDD)	HDD is a trenchless technique to bring the offshore cables ashore at the landfall and can be used for crossings other obstacles such as roads, railways and watercourses onshore.
Landfall compound	Compound at the landfall location within which HDD or other trenchless technique would take place.
Main River	Usually larger rivers and streams. The Environment Agency carries out maintenance, improvement or construction work on Main Rivers to manage flood risk.
Onshore Development Area	The Onshore Development Area for PEIR is the boundary within which all onshore infrastructure required for the Projects will be located including landfall, onshore export cable route, accesses, construction compounds and onshore substations. The Onshore Development Area is to be refined through the consultation and engineering review process.

Term	Definition
Onshore export cable corridor	This is the area which includes cable trenches, haul roads, spoil storage areas, and limits of deviation for micro-siting. For assessment purposes, the cable corridor does not include the onshore substations, Transition Joint Bays or temporary access routes; but includes construction compounds (purely for the cable route).
Ordinary Watercourse	Other rivers are called 'Ordinary Watercourses'. Lead local flood authorities, district councils and internal drainage boards carry out flood risk management work on Ordinary Watercourses.
Substation zones	Parcels of land within the Onshore Development Area where the onshore substation infrastructure (including the haul roads, temporary construction compounds and associated cable routeing) may be located.
Surface water flooding	Surface water flooding occurs when rainwater does not drain away through normal drainage systems or soak into the ground, but lies on or flows over the ground instead.
The Applicant	RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited as the owners of DBS West and DBS East respectively are the named undertakers that will have the benefit of the Development Consent Order. References in this document to obligations on, or commitments by, 'the Applicant' are given on behalf of RWE Renewables UK Dogger Bank South (West) Limited and RWE Renewables UK Dogger Bank South (East) Limited.
The Projects	DBS East and DBS West (collectively referred to as the Dogger Bank South offshore wind farms).

Acronyms

Term	Definition
AEP	Annual Exceedance Probability
CEA	Cumulative Effect Assessment
CIRIA	Construction Industry Research and Information Association
CoCP	Code of Construction Practice
DBS	Dogger Bank South
DCO	Development Consent Order
Defra	Department for Environment, Food and Rural Affairs
EIA	Environmental Impact Assessment
ES	Environmental Statement
FRA	Flood Risk Assessment
FWMA	Flood and Water Management Act 2010
HDD	Horizontal Directional Drilling
IDB	Internal Drainage Board
LLFA	Lead Local Flood Authority
NPPF	National Planning Policy Framework
NPS	National Policy Statement
PBDE	Polybrominated diphenyl ethers
PEIR	Preliminary Environmental Information Report
PPG	Pollution Prevention Guidance
RBD	River Basin District

Term	Definition
RBMP	River Basin Management Plan
RNAG	Reasons for Not Achieving Good
SPZ	Source Protection Zones
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage System
TJB	Transition Joint Bay
WER	Water Environment Regulations
WFD	Water Framework Directive

20 Flood Risk and Hydrology

20.1 Introduction

1. This chapter of the Preliminary Environmental Information Report (PEIR) considers the likely significant effects of the Projects on the hydrology, geomorphology and quality of surface waters, the quantity and quality of groundwaters, water resources and flood risk. The chapter provides an overview of the existing environment for the proposed Onshore Development Area, followed by an assessment of likely significant effects for the construction, operation, and decommissioning phases of the Projects.

2. The assessment should be read in conjunction with the following linked chapters:

- **Chapter 18 Terrestrial Ecology and Ornithology;** and
- **Chapter 19 Geology and Land Quality**.

3. Additional information to support the Flood Risk and Hydrology assessment include:

- **Appendix 20-1 Geomorphology baseline survey technical report**;
- **Appendix 20-2 Water Environment Regulations (WER) compliance assessment**; and
- **Appendix 20-3 Flood Risk Assessment (FRA)**.

20.2 Consultation

4. Consultation with regard to Flood Risk and Hydrology has been undertaken in line with the general process described in **Chapter 6 EIA Methodology**. The feedback received has been considered in preparing the PEIR. **Table 20-1** provides a summary of how the consultation responses received to date have influenced the approach that has been taken.

5. This chapter will be updated following consultation on PEIR in order to produce the final assessment that will be submitted with the Development Consent Order (DCO) application. Full details of the consultation process will also be presented in the Consultation Report alongside the DCO application.

Table 20-1 Consultation Responses

Comment	Project Response
Planning Inspectorate Scoping Responses 02/09/2022	
The Inspectorate considers that direct surface water disturbance during operation may be scoped out on the basis that operational activities will not directly disturb surface water bodies therefore significant effects are unlikely.	Direct disturbance of surface water bodies is scoped out for operational activities. Section 20.6.2 assesses the potential for supply of contaminants and changes to flows and flood risk during operation.
The Scoping Report (RWE Renewables, 2022) identifies flood risk as a matter to be assessed in the ES for all phases of the proposals, however in terms of coastal flood risk this is mentioned in section 3.3.4.2 the context of risks to the Proposed Development. Changes to coastal flood risk arising from impacts of the Proposed Development e.g., from interactions with existing defence infrastructure or works at possible landfall location, should be assessed within the ES and supporting Flood Risk Assessment (FRA).	Flood risk is summarised in section 20.5.5 and discussed in detail in **Appendix 20-3** (FRA). The FRA includes an assessment of coastal flood risk and the presence of defences at the possible landfall location. The FRA has been based on publicly available data related to flood risk at the present time. However, further information will be obtained from the Environment Agency and Local Authority, as appropriate, and included within the FRA to accompany the Environment Statement (ES) chapter.
No direct reference is made to the potential requirement for dewatering of groundwater, or the temporary or permanent alteration of surface water bodies, within the Scoping Report. The ES should provide a full description of any such activities and present an assessment of any resulting likely significant effects.	Impacts and effects on surface water bodies and groundwater are discussed in sections 20.6.1.1, 20.6.1.5 and 20.6.2.2.
Environment Agency Scoping Responses 02/09/2022	
Do you agree with the characterisation of the existing environment? Paragraph 626 – it does not appear to list all main rivers that are to be crossed, but perhaps this is due to the use of localised names. The Environment Agency would	The existing environment section has been updated and lists all Main Rivers and Internal Drainage Board (IDB) drains that would be crossed by the Onshore Development Area (section 20.5).

Comment	Project Response
be happy to check a route plan shapefile against a map of our main rivers. This would aid discussion around river crossings, available modelling data, our assets, as well as any proposed or ongoing projects in these areas.	
Have all the relevant data sources been identified within the Scoping Report? We note that the majority of data sources we previously mentioned have been picked up. In addition, we would like to flag to the applicant that the National Coastal Erosion Risk Mapping (https://data.gov.uk/dataset/7564fcf7-2dd2-4878-bfb9-11c5cf971cf9/national-coastal-erosion-risk-mapping-ncerm-national-2018-2021) may be of relevance to their assessment. LiDAR information may also be useful. As well as speaking to the lead local flood authority about surface water flooding, we also suggest speaking to them about groundwater flooding, as they may hold more detailed local information. The applicant should contact the Environment Agency to obtain any relevant flood risk modelling evidence that we hold. Please note that there may be gaps relating to the type and content of detailed modelling that may be available. You may need to commission additional modelling where relevant to your development, for example where you require a credible maximum climate change scenario.	Publicly available data sets, including flood extents and LiDAR data, have been used within **Appendix 20-3** (FRA) to consider all sources of flooding, in accordance with the National Planning Policy Framework (NPPF) and Planning Practice Guidance (PPG) for Flood Risk and Coastal Change. The FRA includes an assessment of the relevant climate change scenarios. Formal data requests, related to the availability of relevant flood risk information, will be submitted to the Environment Agency, East Riding of Yorkshire Council, as the Lead Local Flood Authority (LLFA), and Beverley and North Holderness Internal Drainage Board (IDB)for use within the FRA to accompany the ES. These data will be consulted alongside other key open source data. National Coastal Erosion Risk Mapping will be used in **Chapter 8 Marine Physical Environment** and referred to in this chapter, if appropriate.
Have all the potential impacts on flood risk and hydrology resulting from the Projects been identified in the Scoping Report?	Flood risk associated with trenched crossings (e.g. use temporary dams, culverts, capacity of pumps and flumes) have been assessed in section 20.6.1.1. Impacts associated with decommissioning are

Comment	Project Response
During construction, it is also worth noting that depending on how watercourses are going to be crossed, the temporary works could cause a localised increase in flood risk. The applicant should consider scoping this in. During operation and maintenance – any above ground structures could be subject to flooding at certain locations, therefore the flood risk to the project as well as from the project should be considered, and scoped in. During decommission – same comment as above for construction. Depending on how watercourses are going to be crossed, the temporary works could cause a localised increase in flood risk, so the applicant should consider scoping this in. There doesn't seem to be any consideration on flood/coastal risk at the possible landfall location. This needs to be scoped in.	assumed to be no worse than those considered for construction. Potential impacts on surface and groundwater flows and flood risk during operation are assessed in section 20.6.2.2. Flood risk, including at the possible landfall location, is assessed in **Appendix 20-3** (FRA) for all stages of the Projects comprising construction, operation and, where appropriate, decommissioning.
Do you agree with the impacts that have been scoped in (or scoped out) of further assessment? In addition to our comments above, due to the nature of flood risk in the catchment, consideration must also be given to residual flood risks, for example pump failure or breach. The applicant should also consider the role of existing flood defences. We would recommend a conversation with us once the cable corridor route been finalised to better understand how existing or future flood defences may affect the chosen option. This may include, for example, the removal of certain flood defences, or a change to the way flood risk is managed in parts of the interest area.	Flood risk, including the residual risk resulting from breaches or pump failures, is assessed in **Appendix 20-3** (FRA). To inform the development of the ES and accompanying FRA, formal data requests will be submitted to the Environment Agency, East Riding of Yorkshire Council, as the LLFA, and Beverley and North Holderness IDB to identify the location and standard of protection of flood defences, key areas of flood risk and any other concerns related to flood risk and drainage matters. The Flood Risk and Hydrology Expert Topic Group will continue to be consulted as the Projects progress. This will include consultation on all stages of the Projects from construction, operation through to decommissioning for all elements of the

Comment	Project Response
We would also like to see as part of any assessment more information on the potential interaction and impact on flood risk infrastructure. This should include: • How any option would interact around any existing flood risk infrastructure, for example cable crossings below flood defences or watercourses. • Interaction with any surface operations (e.g. ground investigations or construction activities) where this could affect access to inspect, maintain or operate flood risk infrastructure. This should also include more details on the construction technique, e.g. reception pits, compound locations and access requirements. We understand these details would become clearer once a refined corridor is identified. • Further details within a Construction Environmental Management Plan (or similar) looking at the interests of flood and coastal risk management, ensuring that existing flood infrastructure is not affected by any movement, damage, etc.... caused by the construction works or permanent structures associated with the development.	Projects from the landfall to the onshore substations. Construction details will be refined as the Projects progress and the ES chapter and accompanying FRA will be updated as required. A Construction Environmental Management Plan or similar will be in place for the Projects, which will include issues associated with flood risk.
Do you agree with the proposed approach to assessment? We are pleased to see that all sources of flood risk both to and from the project will be considered. For clarity, we would also expect tidal flood risk to be considered. Flood risk within the East Yorkshire catchment is complex, and therefore further discussion as this project progresses would be beneficial, to allow us to give more refined advice as more details become available.	The impact of flood risk from all sources to all elements of the Projects have been assessed in **Appendix 20-3** (FRA), in accordance with the requirements of both the NPPF and PPG for Flood Risk and Coastal Change. This assessment will be subject to refinement and update in both the ES chapter and accompanying FRA as additional information and data becomes available. It is anticipated that this will be informed by discussions within the Expert Topic Group, enabling further consultation with key

Comment	Project Response
We would advocate that consideration is given to an iterative and proportionate approach to EIA. We would anticipate being able to discuss this approach as the project progresses and refined details are available for comment. Will there be any storage of material in the floodplain during the project, if so the impacts of this on flood risk must be considered. What is the lifetime of this development?	stakeholders on flood risk and hydrology matters to be incorporated into the assessment. The exact location of temporary construction compounds, and other supporting facilities, within the Onshore Development Area will be refined as the Projects progress. As such, the ES and accompanying FRA will be updated to reflect this and assess any associated risks. The lifetime of the Projects is 30 years.
The Scoping Report indicates that impacts on surface water quality, groundwater quality and designated bathing waters are to be included in the Environmental Statement (ES). Storage of contaminants is included. These are the main areas of concern, especially during the construction phase. However, we note there is no mention of requirements of environmental permits for construction activities (for discharges of trade/sewage effluents or surface run-off from their activities). These will need to be considered when specific locations are decided on.	Potential impacts on surface and groundwater water quality, including the storage of contaminants, are assessed in sections 20.6.1.2, 20.6.1.4 and 20.6.2.1. Survey data on offshore contaminants is included **Chapter 8 Marine Physical Environment**. Potential impacts on bathing waters are assessed in **Appendix 20-2** (WER assessment). Permit requests will be submitted to the Environment Agency or relevant consenting authority post consent (once a contractor has been appointed).

20.3 Scope

20.3.1 Study Area

6. As part of the Humber River Basin Management Plan (RBMP) (Environment Agency, 2015) developed to comply with the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017, the Environment Agency has defined river water body catchments based on surface hydrological catchments with an area of greater than 5km^2.

7. The study area for Flood Risk and Hydrology has been defined based on these surface hydrological catchments. Catchments have been included within the study area if they are crossed by the Onshore Development Area, or they are hydrologically connected downstream. Catchments that are hydrologically connected upstream are not considered due to the lack of any mechanism for likely effects to propagate upstream. The Onshore Development Area, showing surface water catchments and Main Rivers, is shown in **Figure 20-1**.

8. When considering the potential impacts to groundwater, the study area is limited to those groundwater bodies that lie directly beneath the Onshore Development Area, which are shown in **Figure 20-2**.

20.3.2 Realistic Worst Case Scenario

20.3.2.1 General Approach

9. The realistic worst case design parameters for likely significant effects scoped into the Environmental Impact Assessment (EIA) for the Flood Risk and Hydrology assessment are summarised in **Table 20-2**. These are based on the project parameters described in **Chapter 5 Project Description**, which provides further details regarding specific activities and their durations.

10. In addition to the design parameters set out in **Table 20-2**, consideration is also given to the different development scenarios still under consideration and the possible phasing of the construction as set out in sections 20.3.2.2 to 20.3.2.5.

Table 20-2 Realistic Worst Case Design Parameters

	Parameter			
	DBS East or DBS West in isolation	**DBS East and DBS West concurrently**	**DBS East and DBS West sequentially**	**Notes and rationale**
Construction				
Landfall	Number of HDDs: 5 (4x power cables plus 1x spare) Indicative HDD depth: 20m HDD compound works area: 230 x 75m (for four HVAC) Transition joint bay size: 5 x 20m No. of transition joint bays: 4 Total construction land take for each transition joint bay: 10 x 30m Duration: 18 months	Number of HDDs: 9 (6x power cables, 1x fibre optic cable, 2x spare) Indicative HDD depth: 20m HDD compound area: 310 x 75m (for four HVAC, two HVDC) Transition joint bay size: 5 x 20m Number of transition joint bays: 6 Total construction land take for each transition joint bay: 10 x 30m Duration: 18 months.	Number of HDDs: 9 (6x power cables, 1x fibre optic cable, 2x spare) Indicative HDD depth: 20m HDD compound area: 310 x 75m (for four HVAC, two HVDC) Transition joint bay size: 5 x 20m Number of transition joint bays: 6 Total construction land take for each transition joint bay: 10 x 30m Duration: 42 months	Sequential construction is considered the worst case scenario on the basis of a combined longer duration.
Onshore export cable route	Working width: 50m (up to 125m at trenchless crossings) Corridor length: 39km Total onshore cable corridor works area: 4,504,535m^2 No. of trenches: Up to 5 (4x HVAC trefoils plus 1 contingency). Indicative cable burial depth: 1.6 to 2m Haul road width: 7m (increasing to 11m at passing places) Jointing bays: every 0.75 – 1.5km Jointing bay construction dimensions: 10 x 25m Jointing bay depth: 2.2m from existing ground level to bottom of joint bay Main construction compound: 100 x 100m Secondary construction compounds:75 x 75m No. of compounds (estimated): • Main compounds – 2 • Minor compounds – 15 (for routes to Substation Zone 1) • HDD compounds – 70	Working width: 100m (up to 250m at trenchless crossings) Corridor length: 39km Total onshore cable corridor works area (est.): 8,228,754m^2 No. of trenches: Up to 7 (4x HVAC trefoils, 2x HVDC plus 1 contingency) Indicative cable burial depth: 1.6m to 2m Haul road width: 7m (increasing to 11m at passing places) Jointing bays: every 0.75 – 1.5km Jointing bay construction dimensions: 10 x 25m Jointing bay depth: 2.2m from existing ground level to bottom of joint bay Main construction compound: 100 x 100m Secondary construction compounds: 75 x 75m No. of compounds (estimated): • Main compounds – 2 per project (4 in total) • Minor compounds – 30 • HDD compounds – 70 per project	Working width: 100m (up to 250m at trenchless crossings) Corridor length: 39km Total onshore cable corridor works area (est.): 8,228,754m^2 No. of trenches: Up to 7 (4x HVAC trefoils, 2x HVDC plus 1 contingency). Indicative cable burial depth: 1.6m to 2m Haul road width: 7m (increasing to 11m at passing places) Jointing bays: every 0.75 – 1.5km Jointing bay construction dimensions: 10 x 25m Jointing bay depth: 2.2m from existing ground level to bottom of joint bay Main construction compound: 100 x 100m Secondary construction compounds: 75 x 75m No. of compounds (estimated): • Main compounds – 2 per project (4 in total) • Minor compounds – 30 • HDD compounds – 70 per project	Sequential construction is considered the worst case scenario on the basis of a combined longer duration. Sequential construction would result in a longer duration of temporary watercourse crossings being in place along the onshore export cable corridor.

	Parameter			
	DBS East or DBS West in isolation	**DBS East and DBS West concurrently**	**DBS East and DBS West sequentially**	**Notes and rationale**
	• Substation compound: 1 Trenchless crossings physical parameters: • Maximum trenchless crossing depth: 20m • Trenchless crossing compound dimensions: 50x50m. • No. of trenchless crossing: 35 per cable identified in Outline Crossing Register. Actual number, including minor crossings, will be significantly higher. Duration: 33 months	• Substation compound: 1 per project Trenchless crossings physical parameters: • Maximum trenchless crossing depth: 20m • Trenchless crossing compound dimensions: 50x50m. • No. of trenchless crossing: 35 per cable identified in Outline Crossing Register. Actual number, including minor crossings, will be significantly higher. Duration: 33 months	• Substation compound: 1 per project Trenchless crossings physical parameters: • Maximum trenchless crossing depth: 20m • Trenchless crossing compound dimensions: 50x50m • No. of trenchless crossing: 35 per cable identified in Outline Crossing Register. Actual number, including minor crossings, will be significantly higher. Duration: 57 months.	
Onshore substations	Permanent area: 135,000 m2 (based on one HVAC substation) Total construction area: 180,000 m2 (based on one HVAC substation + temporary construction compound) Duration: 4 years	Permanent area: 199,416 m2 (based on one HVAC substation + one HVDC substation) Total construction area: 274,416 m2 (based on one HVAC substation + temporary construction compound, and one HVDC substation + temporary construction compound) Duration: 4 years	Permanent area: 199,416 m2 (based on one HVAC substation + one HVDC substation) Total construction area: 274,416 m2 (based on one HVAC substation + temporary construction compound, and one HVDC substation + temporary construction compound) Duration: 6 years	Sequential construction is considered the worst case scenario on the basis of a combined longer duration.
Operation				
Landfall	Permanent land take for the total number of TJBs: 400 m^2	Permanent Land take for the total number of TJBs: 600 m^2	Permanent Land take for the total number of TJBs: 600 m^2	Concurrent or sequential build would result in a greater area of permanent infrastructure per catchment in the landfall area.
Onshore export cable route	No. of trenches for all cables: 5 No. of link boxes: 229 Joint bay footprint (per box): 3 x 8m Number of joint bays: every 0.75 to 1.5km	No. of trenches for all cables: 7 No. of link boxes: 343 Joint bay footprint (per box): 3 x 8m Number of joint bays: every 0.75 to 1.5km	No. of trenches for all cables: 7 No. of link boxes: 343 Joint bay footprint (per box): 3 x 8m Number of joint bays: every 0.75 to 1.5km	Concurrent or sequential build would result in a greater area of permanent infrastructure per catchment along the cable corridor route.
Onshore substations	Permanent substation area: 135,000 m^2 (based on one HVAC substation)	Permanent substation area: 199,416 m^2 (based on one HVAC and one HVDC substation)	Permanent substation area: 199,416 m^2 (based on one HVAC and one HVDC substation)	Concurrent or sequential build would result in a greater area of

	Parameter			
	DBS East or DBS West in isolation	**DBS East and DBS West concurrently**	**DBS East and DBS West sequentially**	**Notes and rationale**
	Duration: 30 years	Duration: 30 years	Duration: 30 years	permanent infrastructure per catchment in the onshore substations area.
Decommissioning				
No final decision regarding the final decommissioning policy for the onshore project infrastructure, including landfall, onshore cable route and onshore substations has yet been made. It is also recognised that legislation and industry best practice change over time. However, it is likely that the onshore project equipment, including the cable, will be removed, reused or recycled wherever possible and the transition bays and cable ducts being left in place. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. It is anticipated that for the worst case scenario, the impacts will be no greater than those identified for the construction phase.				

20.3.2.2 Development Scenarios

11. There are currently two possible electrical solutions being considered for DBS West, HVAC or HVDC. Due to the distance of the array area offshore DBS East will be an HVDC project. Therefore, there are two possible electrical solutions for the Projects:

- One HVDC project and one HVAC project; or
- Two HVDC projects.

12. There are different parameters required for the onshore substations depending on which electrical solution is selected. Therefore, there are four possible development scenarios within the onshore substation zones that could be taken forward:

- Two HVDC substations in Substation Zone 4;
- One HVDC substation in Substation Zone 1 and one HVAC substation in Substation Zone 4;
- One HVDC substation in Substation Zone 4 and one HVAC substation in Substation Zone 1; or
- One HVDC substation in Substation Zone 1 and one HVDC substation in Substation Zone 4.

13. In order to ensure that a robust assessment has been undertaken, all development scenarios and options have been considered to ensure the realistic worst-case scenario for each topic has been assessed. Further details are provided in **Chapter 5 Project Description**.

20.3.2.3 Construction Scenarios

14. The following principles set out the framework for how the Projects may be constructed (relating to both onshore and offshore works):

- DBS East and DBS West may be constructed at the same time, or at different times;
- If built concurrently, both Projects could be constructed in five years;
- If built non-concurrently, either Project could be built first;
- If built non-concurrently, each Project would require a five year period of construction;
- If built non-concurrently, it is anticipated that there would be up to a two year lag between the start of construction for the first project and the start of construction for the second project; and

- Assuming a maximum construction period per Project of five years, and taking the above into account, the maximum construction period over which the construction of both Projects could take place is seven years.

15. All possible construction scenarios allow for the flexibility to build out the Projects usings a phased approach. This will allow the Projects to adapt to the National Grid Electricity Transmission Operator's development plans for onshore grid connection points. Under a phased approach the maximum timescales for individual elements of construction have been assessed.

16. In order to determine which construction scenario presents the realistic worst case for each receptor and impact, the assessment considers both maximum duration effects and maximum peak effects, in addition to each Project being developed in isolation, drawing out any differences between each of the two Projects.

17. The three construction scenarios considered by the Flood Risk and Hydrology assessment are therefore:

- Build DBS East or build DBS West in isolation;
- Build DBS East and DBS West concurrently – reflecting the maximum peak effects; and
- Build the Projects sequentially with a lag of up to two years – reflecting the maximum duration of effects.

18. Any differences between the Projects, or differences that could result from the manner in which the first and the second Projects are built (concurrent or sequential and the length of any gap) are identified and discussed where relevant in section 20.6. For each potential impact, only the worst case construction scenario for two Projects is presented, i.e. either concurrent or sequential. The justification for what constitutes the worst case is provided, where necessary, in section 20.6.

20.3.2.4 Operation Scenarios

19. Operation scenarios are described in detail in **Chapter 5 Project Description**. The assessment considers the following scenarios:

- Only DBS East in operation;
- Only DBS West in operation; and
- The two Projects operating concurrently, with or without a lag of two years between each Project commencing operation.

20. If the Projects are built out using a phased approach, there would also be a phased approach to starting the operational stage. The worst case scenario for the operational phase for the Projects have been assessed. See section 5.1.1 of **Chapter 5 Project Description** for further information on phasing scenarios for the Projects.

21. The operations lifetime of each Project is expected to be 30 years.

20.3.2.5 Decommissioning Scenarios

22. Decommissioning scenarios are described in **Chapter 5 Project Description**. Decommissioning arrangements will be agreed through the submission of a Decommissioning Programme prior to construction, however for the purpose of this assessment it is assumed that decommissioning of the Projects could be conducted separately, or at the same time.

20.3.3 Mitigation Embedded in the Design

23. This section outlines the embedded mitigation relevant to the Flood Risk and Hydrology assessment, which has been incorporated into the design of the Projects (**Table 20-3**). Where other mitigation measures are proposed, these are detailed in the impact assessment (section 20.6).

Table 20-3 Embedded Mitigation Measures

Parameter	Mitigation Measures Embedded into the Project Design
Cable crossings below watercourses	All Main Rivers will be crossed using trenchless techniques such as HDD to avoid direct interaction with these watercourses. The cable entry and exit pits will be at least 9m from the banks of the watercourse and the cable will be a maximum of 20m below the channel bed.
Temporary access across watercourses	Temporary bridges (Bailey bridges) or similar may be used as options to traverse Main Rivers where direct access is not readily available from both sides. Selection of cable crossing technique for all Ordinary Watercourses (including IDB drains) will be dependent on local site conditions and may include the use of temporary culverts.

20.4 Assessment Methodology

20.4.1 Policy, Legislation and Guidance

20.4.1.1 National Policy Statements

24. The assessment of potential impacts upon Flood Risk and Hydrology has been made with specific reference to the relevant National Policy Statements (NPS). These are the principal decision-making documents for Nationally Significant Infrastructure Projects (NSIPs). Those relevant to the Projects are:

- Overarching NPS for Energy (EN-1) (Department for Energy and Climate Change (DECC), 2011a);
- NPS for Electricity Networks Infrastructure (EN-5) (DECC 2011c);
- Draft Overarching NPS for Energy (EN-1) (DECC 2022a); and
- Draft NPS for Electricity Networks Infrastructure (EN-5) (DECC 2022b).

25. The specific assessment requirements for Flood Risk and Hydrology, as detailed in the NPS, are summarised in **Table 20-4** together with an indication of the section of this chapter where each is addressed.

26. EN-3 relates to offshore elements and is not included in the assessment for Flood Risk and Hydrology.

27. Following the consultation in 2021 on the draft energy NPS, a new consultation opened on the 30th March 2023 on revised drafts of the energy NPSs, including EN1, EN3 and EN5. Due to the timing of this consultation, and finalisation of this PEIR we have been unable to review and take these revised draft NPS into account within these documents. However, these will be reviewed and incorporated into the final ES where relevant.

Table 20-4 NPS Assessment Requirements

NPS Requirement	NPS Reference	PEIR section Reference
EN-1 NPS for Energy and Draft EN-1 NPS for Energy		
Where the development is subject to EIA (Environmental Impact Assessment) the applicant should ensure that the ES clearly sets out any effects on internationally, nationally, and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity. The applicant should provide environmental information proportionate to the infrastructure where EIA is not required to help the Secretary of State consider thoroughly the potential effects of a proposed project.	EN-1 - Section 5.3, paragraph 5.3.3 Draft EN-1 Section 5.4, paragraph 5.4.3, 5.4.4	Potential impacts on river channels, which provide physical habitats of importance for ecology, protected species and the conservation of biodiversity, are considered in section 20.6.1. Impacts on species and habitats are discussed in detail in **Chapter 18 Terrestrial Ecology and Ornithology**.
Development on land within or outside a SSSI, and which is likely to have an adverse effect on it (either individually or in combination with other developments), should not normally be permitted. The only exception is where the benefits (including need) of the development in the location proposed clearly outweigh both its likely impact on the features of the site that make it of special scientific interest, and any broader impacts on the national network of SSSIs. The Secretary of State should use requirements and/or planning obligations to mitigate the harmful aspects of the development and, where possible, to ensure the conservation and enhancement of the site's biodiversity or geological interest.	EN-1 Section 5.3, paragraph 5.3.11 Draft EN-1 Section 5.4, paragraph 5.3.10	Potential impacts to Sites of Special Scientific Interest (SSSI) impacts are considered in section 20.6.1. Impacts on SSSIs are discussed in detail in **Chapter 18 Terrestrial Ecology and Ornithology**.

NPS Requirement	NPS Reference	PEIR section Reference
A site-specific flood risk assessment should be provided for all energy projects in Flood Zones 2 and 3 in England or Zones B and C in Wales. In Flood Zone 1 in England or Zone A in Wales, an assessment should accompany all proposals involving: • Sites of 1 hectare or more • Land which has been identified by the EA or NRW as having critical drainage problems • Land identified (for example in a local authority strategic flood risk assessment) as being at increased flood risk in future • Land that may be subject to other sources of flooding (for example surface water) where the EA or NRW, Lead Local Flood Authority, Internal Drainage Board or other body have indicated that there may be drainage problems. This should identify and assess the risks of all forms of flooding to and from the project and demonstrate how these flood risks will be managed, taking climate change into account.	EN-1 Section 5.7, paragraph 5.7.4 Draft EN-1 Section 5.8, paragraph 5.8.6	Potential impacts on flood risk are considered in section 20.6.1, 20.6.2 and **Appendix 20-3** (FRA).
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. Where possible, applicants are encouraged to manage surface water during construction by treating surface water runoff from exposed topsoil prior to discharging and to limit the discharge of suspended	EN-1 Section 5.15, paragraph 5.15.2-3 Draft EN-1 Section 5.16, paragraphs 5.16.2 - 5.16.5	Potential impacts on water quality, the physical characteristics of surface watercourses and the quality and quantity of groundwater are considered in section 20.6.1, and **Appendix 20-2** (WER assessment).

NPS Requirement	NPS Reference	PEIR section Reference
solids e.g. from car parks or other areas of hard standing, during operation. Applicants are encouraged to consider protective measures to control the risk of pollution to groundwater beyond those outlined in Water Resource Management Plans- this could include, for example, the use of protective barriers. The ES should in particular describe: • 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 • 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) and also demonstrate how proposals minimise the use of water resources and water consumption in the first instance • 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		

NPS Requirement	NPS Reference	PEIR section Reference
• Any impacts of the proposed project on water bodies or protected areas (including shellfish protected areas) under the Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 and source protection zones (SPZs) around potable groundwater abstractions		
EN-5 NPS for Electricity Networks Infrastructure and Draft EN-5 for Electricity Networks Infrastructure		
Section 4.9 of EN-1 sets out the generic considerations that Applicants and the Secretary of State should take into account in order to ensure that electricity networks infrastructure is resilient to the effects of climate change. As climate change is likely to increase risks to the resilience of some of this infrastructure, from flooding for example, or in situations where it is located near the coast or an estuary or is underground, Applicants should in particular set out to what extent the proposed development is expected to be vulnerable, and, as appropriate, how it has been designed to be resilient to: • flooding, particularly for substations that are vital to the network; and especially in light of changes to groundwater levels resulting from climate change • the effects of wind and storms on overhead lines • higher average temperatures leading to increased transmission losses	EN-1 Section 2.6, paragraphs 2.6.1, 2.6.2 Draft EN-1 Section 2.6, paragraphs 2.6.1, 2.6.2	Flooding and the potential effects of climate change are considered in section 20.6.1, 20.6.2 and **Appendix 20-3** (FRA).

NPS Requirement	NPS Reference	PEIR section Reference
• earth movement or subsidence caused by flooding or drought (for underground cables) • coastal erosion – for the landfall of offshore transmission cables and their associated substations in the inshore and coastal locations respectively. Section 4.9 of EN-1 advises that the resilience of the project to the effects of climate change should be assessed in the Environmental Statement (ES) accompanying an application. For example, future increased risk of flooding would be covered in any flood risk assessment (see Section 5.8 in EN-1).		

20.4.1.2 Other

28. In addition to the NPS, there a number of pieces of legislation, policy and guidance applicable to the assessment of Flood Risk and Hydrology. These include:

20.4.1.2.1 The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017

29. The Water Framework Directive (WFD) (Council Directive 2000/60/EC) establishing a framework for community action in the field of water policy was adopted in 2000. The Water Environment (Water Framework Directive) (England and Wales) Regulations 2017 transposed the WFD into English and Welsh law. The WFD Regulations remain in force following the UK's withdrawal from the European Union under the Floods and Water (Amendment etc.) (EU Exit) Regulations 2019.

30. Under the Regulations, surface waters are designated as water bodies and are set objectives for achieving Good Ecological Status or Good Ecological Potential (in the case of heavily modified water bodies). The Environment Agency is required to produce RBMPs which describe the current state of the water environment within the River Basin District (RBD) and set out the objectives for protecting and improving it.

20.4.1.2.2 The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015

31. The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 set out the standards and thresholds used to determine the ecological and chemical status of water bodies. These are considered in terms of biological, hydromorphological, physico-chemical and chemical status for surface water bodies, and quantitative and chemical status for groundwater bodies.

20.4.1.2.3 The Conservation of Habitats and Species Regulations 2017

32. The 'Dutch Nitrogen Case' (Official Journal of the European Union, 2019) ruled that where an internationally important site (i.e., Special Protection Area, Special Area of Conservation and Ramsar Sites) is failing to achieve the required condition due to nutrient pollution, the potential for a new development to add to the nutrient load is "necessarily limited". This has informed the way in which the Conservation of Habitats and Species Regulations 2017 should apply to pollution related pressures and incidents.

33. Note that the further information on the Conservation of Habitats and Species Regulations 2017 is provided in **Chapter 18 Terrestrial Ecology and Ornithology**.

20.4.1.2.4 National Planning Policy Framework (2021) and Supporting Guidance (2022)

34. The NPPF sets out the UK Government planning policies for England and seeks to ensure that flood risk is considered at all stages of the planning and development process. Its policies aim to avoid inappropriate development in areas at highest risk of flooding, and to direct development away from these areas.

35. NPPF provides clarification that all strategic policies/plans should apply a sequential, risk-based approach to the location of development taking into account all sources of flood risk (e.g. fluvial, coastal, surface water, groundwater, reservoir and sewer flooding). It also provides guidance on how this is to be considered in the context of the location of site-specific development. Further guidance, on the application of the Sequential Test and Exception Test is provided in the supporting Planning Practice Guidance for Flood Risk and Coastal Change (Department for Levelling Up, Housing and Communities, 2022), which was updated on 25 August 2022.

36. In the recent update to the Planning Practice Guidance, it was extended to include clarification on the application of the Sequential Test for all sources of flood risk, not only fluvial and coastal/tidal flooding, as well as summarising an additional consideration with regard to the presence of flood risk management infrastructure.

20.4.1.2.5 Flood and Water Management Act 2010

37. The Flood and Water Management Act 2010 (FWMA) aims to improve the management of flood risk management and water resources by creating clear roles and responsibilities. It gave local authorities the new role of LLFA under which they take on the responsibility of managing flood risk on a local scale from surface water, groundwater and Ordinary Watercourses. The Environment Agency gained a strategic overview role of all flood risk. The FWMA provides opportunities for a comprehensive, risk-based approach on land use planning and flood risk management by local authorities and other key partners.

20.4.1.2.6 Humber RBD: RBMP (2022)

38. RBMPs provide a framework for the protection and enhancement of the benefits provided by the water environment in each RBD and are produced in order to implement the WFD. As water resources and land use are closely linked, RBMPs also inform decisions on land-use planning.

39. The third RBMP for the Humber RBD was finalised by the Department for the Environment, Food and Rural Affairs (Defra) and the Environment Agency in 2022. It provides a baseline classification of the water environment in the Humber RBD and highlights statutory objectives for protected areas such as waters used for drinking water, bathing, and designated sites. It lays out the actions needed to improve the water environment and achieve the objectives of the WFD.

20.4.2 Data and Information Sources

20.4.2.1 Site Specific Surveys

40. In order to provide site specific and up to date information on which to base the impact assessment, a geomorphology baseline survey was conducted in October 2022. The aim of the survey was to characterise the physical characteristics of the watercourses (Main Rivers, Ordinary Watercourses and WFD water bodies) within the Onshore Development Area. The survey included an assessment of channel form, flow conditions, floodplain characteristics, in-channel and riparian vegetation, and any evidence of channel modification. Summary findings are provided in section 20.5.2 and a detailed report can be found in **Appendix 20-1**.

20.4.2.2 Other Available Sources

41. Other sources that have been used to inform the assessment are listed in **Table 20-5.**

Table 20-5 Other Available Data and Information Sources

Data Set	Spatial coverage	Year	Notes
WFD water body status objectives and classification data	National	Updated May 2022	Environment Agency Catchment Data Explorer (https://environment.data.gov.uk/catchment-planning/)
Water quality data	National	Updated ~every 6 months	Environment Agency Water Quality Data Archive (https://environment.data.gov.uk/water-quality/view/landing)
Aquatic ecology data	National	Undated	Environment Agency Ecology and Fish Data Explorer (https://environment.data.gov.uk/ecology/explorer/)

Data Set	Spatial coverage	Year	Notes
Source Protection Zones (SPZs) Aquifer designation mapping Groundwater vulnerability mapping	National	Undated	Defra Magic (https://magic.defra.gov.uk/MagicMap.aspx)
Geological mapping	National	Undated	British Geological Survey (https://www.bgs.ac.uk/map-viewers/geology-of-britain-viewer/)
Licensed abstraction data	National	Abstractions dated individually	Environment Agency (available on request)
Statutory and non-statutory designated sites	National	Undated	Defra Magic (https://magic.defra.gov.uk/MagicMap.aspx)
Flood Map for Planning; Flood risk mapping (rivers and sea, surface water, reservoirs)	National	Undated	Environment Agency (https://flood-map-for-planning.service.gov.uk/; https://check-long-term-flood-risk.service.gov.uk/postcode)

20.4.3 Impact Assessment Methodology

42. **Chapter 6 EIA Methodology** provides a summary of the general impact assessment methodology applied. The following sections describe the methods used to assess the likely significant effects on Flood Risk and Hydrology.

20.4.3.1 Definitions

43. For each potential impact, the assessment identifies receptors sensitive to that impact and implements a systematic approach to understanding the impact pathways and the level of impacts (i.e. magnitude) on given receptors. The definitions of sensitivity and magnitude for the purpose of the Flood Risk and Hydrology assessment are provided in **Table 20-6** and **Table 20-7**.

Table 20-6 Definition of Sensitivity for a Flood Risk and Hydrology Receptor

Sensitivity	Definition
High	The receptor has no or very limited capacity to tolerate changes to hydrology, geomorphology, water quality or flood risk and has little potential for substitution. This includes water resources which support human health and/or the economic activity at a regional scale, or receptors with a high vulnerability to flooding. **Water resources** • Controlled waters with an unmodified, naturally diverse hydrological regime, a naturally diverse geomorphology with no barriers to the operation of natural processes, and good water quality; • Supports habitats or species that are highly sensitive to changes in surface hydrology, geomorphology or water quality; • Supports Principal Aquifer with public water supply abstractions by provision of recharge; • Site is within Inner or Outer SPZs. **Flood risk** • Highly Vulnerable Land Use, as defined by Annex 3 of NPPF (Department for Levelling Up, Housing and Communities, 2021); • Land with more than 100 residential properties (after Standards for Highways, 2020).
Medium	The receptor has limited capacity to tolerate changes to hydrology, geomorphology, water quality or flood risk. This includes water resources which support human health and/or economic activity at a local scale or receptors with a high vulnerability to flooding. **Water resources** • Controlled waters with hydrology that sustains natural variations, geomorphology that sustains natural processes, and water quality that is not contaminated to the extent that habitat quality is constrained; • Supports or contributes to habitats or species that are sensitive to changes in surface hydrology, geomorphology and/or water quality; • Supports Secondary A or Secondary B Aquifer with water supply abstractions; • Site is within a Catchment SPZ.

Sensitivity	Definition
	Flood risk • More Vulnerable Land Use, as defined by Annex 3 of NPPF (Department for Levelling Up, Housing and Communities, 2021); • Land with between 1 and 100 residential properties or more than 10 industrial premises (after Standards for Highways, 2020).
Low	The receptor has moderate capacity to tolerate changes to hydrology, geomorphology and, water quality or flood risk. This includes water resources that support human health and/or economic activity at a neighbourhood (multiple property) scale and receptors with a moderate vulnerability to flooding. **Water resources** • Controlled waters with hydrology that supports limited natural variations, geomorphology that supports limited natural processes, and water quality that may constrain some ecological communities; • Supports or contributes to habitats that are not sensitive to changes in surface hydrology, geomorphology or water quality; • Supports Secondary A or Secondary B Aquifer without abstractions. **Flood risk** • Less Vulnerable Land Use, as defined by Annex 3 of NPPF (Department for Levelling Up, Housing and Communities, 2021); • Land with 10 or fewer industrial properties (after Standards for Highways, 2020).

Sensitivity	Definition
Negligible	The receptor is generally tolerant of changes to hydrology, geomorphology, water quality or flood risk. This includes water resource that supports human health and/or economic activity at a single property scale and receptors with a low vulnerability to flooding. **Water resources** • Controlled waters with hydrology that does not support natural variations, geomorphology that does not support natural processes, and water quality that constrains ecological communities; • Aquatic or water-dependent habitats and/or species are tolerant to changes in hydrology, geomorphology or water quality; • Non-productive strata that does not support groundwater resources. **Flood risk** • Water Compatible Land Use as defined by Annex 3 of NPPF (Department for Levelling Up, Housing and Communities, 2021); • Land with limited constraints and a low probability of flooding of residential and industrial properties (after Standards for Highways, 2020).

Table 20-7 Definition of Magnitude of Impacts

Magnitude	Definition
High	Permanent/irreversible, or large-scale changes, over the whole receptor affecting usability, risk, or value. This causes fundamental changes to key features of the receptor's character or distinctiveness. **Water resources** • Permanent changes to geomorphology and/or hydrology that prevent natural processes operating; • Permanent and/or wide scale effects on water quality or availability; • Permanent loss or long-term degradation of a water supply source resulting in prosecution; • Permanent or wide scale degradation of habitat quality. • Deterioration in WFD surface water body status or prevention of achieving future status objectives;

Magnitude	Definition
	Deterioration in groundwater levels, flows or quality leading to a deterioration in WFD groundwater body status. **Watercourse crossings** • >10 trenched crossings per water body catchment • **Exposed ground** • >10% exposed ground during construction **Flood risk** • Permanent or major change to existing flood risk; • Reduction in on-site flood risk by raising ground level in conjunction with provision of compensation storage; • Increase in off-site flood risk due to raising ground levels without provision of compensation storage; • Failure to meet either sequential or exception test (if applicable).
Medium	Partial loss or noticeable change over the majority of the receptor, and/or discernible alteration to key features of the receptor's character or distinctiveness. Moderate permanent or long-term reversible change may result affecting usability, value, or risk, over the medium- term or local area. **Water resources** • Medium-term effects on water quality or availability; • Medium-term degradation of a water supply source, possibly resulting in prosecution; • Habitat change over the medium-term; • Potential temporary downgrading in the status of individual WFD elements, without affecting the ability of the surface water to achieve future objectives; • Medium-term deterioration in groundwater levels, flow or quality leading to potential temporary downgrading of WFD status. **Watercourse crossings** • 6 to <10 trenched crossings per water body catchment

Magnitude	Definition
	• **Exposed ground** • 6 to 10% exposed ground during construction **Flood risk** • Medium-term or moderate change to existing flood risk; • Possible failure of sequential or exception test (if applicable); • Reduction in off-site flood risk within the local area due to the provision of a managed drainage system.
Low	Discernible temporary change over a minority of the receptor, and/or with minimal effect on usability, risk or value. There may also be a potential discernible alteration to key features of the receptor's character or distinctiveness. **Water resources** • Short-term or local effects on water quality or availability; • Short-term degradation of a water supply source; • Habitat change over the short-term; • No change to WFD status. **Watercourse crossings** • 1 to <6 trenched crossings per water body catchment • **Exposed ground** • 1 to <6% exposed ground during construction **Flood risk** • Short-term temporary or minor change to existing flood risk; • Localised increase in on-site or off-site flood risk due to increase in impermeable area; • Passing of sequential and exception test.
Negligible	Temporary change, undiscernible over longer timescales, with no effect on usability, risk or value. This may result in light, or no, alteration to the characteristics or features of the receptor's character or distinctiveness. **Water resources** • Temporary impact on local water quality or availability; • Temporary or no degradation of a water supply source;

Magnitude	Definition
	• Very slight local changes to habitat that have no observable impact on dependent receptors. **Watercourse crossings** • No trenched crossings per water body catchment • **Exposed ground** • <1% exposed ground during construction **Flood risk** • Temporary or very minor change to existing flood risk; • Highly localised increase in on-site or off-site flood risk due to increase in impermeable area.

20.4.3.2 Significance of Effect

44. The assessment of significance of an effect is informed by the sensitivity of the receptor and the magnitude of the impact. The determination of significance is guided by the use of an impact significance matrix presented in **Chapter 6 EIA Methodology (Table 20-8)**. Definitions of each level of significance are provided in **Table 20-9**. For the purposes of this assessment, any effect that is of major or moderate significance is considered to be significant in EIA terms, whether this be adverse or beneficial. Any effect that has a significance of minor or negligible is not significant.

Table 20-8 Flood Risk and Hydrology Significance of Effect Matrix

		Adverse Magnitude				**Beneficial Magnitude**			
		High	**Medium**	**Low**	**Negligible**	**Negligible**	**Low**	**Medium**	**High**
Sensitivity	High	Major	Major	Moderate	Minor	Minor	Moderate	Major	Major
	Medium	Major	Moderate	Minor	Minor	Minor	Minor	Moderate	Major
	Low	Moderate	Minor	Minor	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Table 20-9 Definition of Effect Significance

Significance	Definition
Major	Very large or large change in receptor condition, which is likely to be important considerations at a regional or district level because they contribute to achieving national, regional or local objectives, or could result in exceedance of statutory objectives and / or breaches of legislation.
Moderate	Intermediate change in receptor condition, which is likely to be important considerations at a local level.
Minor	Small change in receptor condition, which may be raised as local issues but are unlikely to be important in the decision making process.
Negligible	No discernible change in receptor condition.
No change	No impact, therefore no change in receptor condition.

20.4.4 Cumulative Effect Assessment Methodology

45. The cumulative effect assessment (CEA) considers other plans and projects that may result in cumulation of effect with the Projects. **Chapter 6 EIA Methodology** provides details of the general framework and approach to the CEA that will be undertaken for the Projects.

46. The final assessment of cumulative effects will be undertaken during the later stages of the EIA, once further information is available on a number of projects such as the Outer Dowsing Offshore Wind Farm, Hornsea Project Four decision and the Sheringham Shoal and Dudgeon Extension Projects examination. However, for the purposes of the PEIR, it is possible to identify a number of projects and plans which are likely to feature in that assessment and consider the extent to which cumulative effects might arise. Section 20.7 presents the following preliminary information regarding cumulative effects:

- Screening for cumulative effects; and
- A preliminary short list of plans and projects considered for CEA, including a brief description as to how projects have been screened in and the initial tier level they have been assigned.

20.4.5 Assumptions and Limitations

47. This preliminary assessment is considered to be an interim stage in the EIA process. The results presented in the following sections are based on early design assumptions and initial assessments which will be refined and presented in the final ES to be submitted as part of the DCO application.

48. This assessment is based on a range of publicly available information and data sources (as listed in **Table 20-5**) and is largely desk-based. Although these data sets are considered robust, there is a level of uncertainty and assumptions associated with their use in this preliminary impact assessment. For example, the known characteristics of the drainage network and attributes and conditions specific to water bodies have been used as a proxy to assign value and sensitivity to the wider catchments and the Ordinary Watercourses within them. This is a precautionary approach that ensures value and sensitivity have not been under-assessed within this preliminary assessment.

20.5 Existing Environment

20.5.1 Surface Water Drainage

49. As discussed in section 20.3.1, this assessment is based on river water body catchments as defined by the Environment Agency. Water body catchments are shown in **Figure 20-1**. Receptors are those river water bodies that are crossed, or their catchments are crossed, by the Onshore Development Area, as well as and those that are downstream. Water body catchments are grouped within their respective operational catchments.

50. The majority of the Onshore Development Area falls within the catchment of the River Hull. This river system drains the eastern side of the Yorkshire Wolds and flows in a generally north-south direction to join the Humber Estuary at Hull. Within the possible landfall location there are several short watercourses that flow directly to the coast. Several of the Hull's tributaries rise very close to the coast and flow inland to join the main river.

51. The Onshore Development Area lies within three river catchments and crosses the following water bodies:

- Barmston Sea Drain operational catchment;
  - Barmston Sea Drain/Skipsea Drain to Confluence;
  - Coastal catchment;
- Upper Hull operational catchment;
  - Mickley Dike catchment;
  - Old How/Frodingham Beck to River Hull;
- Lower Hull operational catchment;
  - Catchwater Drain;
  - Foredyke Stream Upper;
  - Foredyke Stream Lower to Holderness Drain;
  - Holderness Drain Source to Foredyke Stream;
  - Beverley and Barmston Drain;
  - Hull from Arram Beck to Humber;
  - High Hunsley to Arram Area; and
  - High Hunsley to Woodmansey Area.

52. The Onshore Development Area crosses the following Main Rivers:

- Stream Dike;
- Monk Dike;
- Meaux and Routh East Drain;
- Holderness Drain;
- River Hull;
- Beverley and Barmston Drain; and
- Catchwater Drain.

53. The Onshore Development Area also crosses the following drains which are part of the Beverley and North Holderness IDB:

- Skipsea Drain;
- Dunnington Sewer;
- Arnold and Riston Drain;
- Turf Gutter;
- Turf Gutter and Eske River Side Drain;
- South Bullock Drain;
- Storkhill Drain;
- South Bullock (N. Branch - Diggins Arms); and
- South Bullock (S. Branch - Chalk Arm).

54. Planforms of watercourses within the Onshore Development Area are typically straight and are either artificial or have been resectioned, probably for land drainage and flood defence purposes (section 20.5.2; **Appendix 20-1**).

20.5.2 Geomorphology

55. The methodology and results of the geomorphological baseline survey undertaken in October 2022 are discussed in detail in **Appendix 20-1**.

56. Watercourses in the Onshore Development Area are typically of uniform depth and have trapezoidal cross sections with steep banks, indicative of artificial straightening. The majority of WFD water body catchment are also classified as artificial (section 20.5.3). Most channels are relatively narrow agricultural drains, except for the River Hull, which is 25-30m wide. Channels are typically incised below adjacent arable farmland. Most channels appear to be set within sediment deposition zones, with slow flows, low gradients and low velocities contributing to the settling out of fine sediments/silts. Fine sediment loads are likely sourced from adjacent agricultural fields and upstream in the wider catchment. Banks and channel margin areas are generally well-vegetated with rushes, sedges and reeds, as well as in-channel duckweed (*Lemna minor)* and Frogbit (*Hydrocharis morsus-ranae*). In some locations there are minor rock and wood bank protection structures.

20.5.3 Water Quality

57. A review of the Environment Agency's Catchment Data Explorer (Environment Agency, 2022) and water quality archive for surface water bodies gives an indication of water quality across the catchments of interest (**Table 20-10**). The ecological status (or ecological potential for artificial/heavily modified water bodies) is Moderate across the Onshore Development Area, and Fail for chemical status. Reasons for surface waters not achieving a Good (RNAG) status or potential are related to physical modifications (e.g. land drainage) and pollution from urban (e.g., sewage discharge, landfill leaching, septic tanks) and rural (e.g., poor nutrient management, riverbank erosion) sources. WFD groundwater quality is summarised in section 20.5.6.

58. Surface water bodies support Tophill Low Drinking Water Safeguard Zone (surface water) (SWSGZ6010). The Onshore Development Area crosses the safeguard zone for approximately 6km between Dunnington and Nunkeeling (**Figure 20-1a**). In July 2021 the water undertaker responsible for the safeguard zone was issued with a notice under regulation 28 (4) of the Water Supply (Water Quality) Regulations 2016 by the Drinking Water Inspectorate (DWI, 2021). Issues are related to *cryptosporidium*, taste and odour. The completion date for requirements of the notice is 30/06/2025.

Table 20-10 Water Quality in WFD Water Bodies (Rivers) (after Environment Agency 2022)

Water Body	Type and designation	Ecological status/potential and RNAG elements	Chemical status and RNAG elements
Beverley and Barmston Drain **GB104026067211**	River; artificial	Moderate Dissolved oxygen Phosphate Mitigation measures assessment	Fail PBDEs Mercury and its compounds
Catchwater Drain **GB104026066970**	River; artificial	Moderate Dissolved oxygen Phosphate Ammonia Invertebrates	Fail PBDEs Mercury and its compounds
Foredyke Stream Lower to Holderness Drain **GB104026066910**	River; artificial	Moderate Dissolved oxygen Phosphate Ammonia Fish Mitigation measures assessment	Fail PBDEs PFOS Mercury and its compounds
Foredyke Stream Upper **GB104026066890**	River; artificial	Moderate Phosphate Ammonia Invertebrates PBDEs Mitigation measures assessment	Fail PBDEs Mercury and its compounds

Water Body	Type and designation	Ecological status/potential and RNAG elements	Chemical status and RNAG elements
High Hunsley to Arram Area **GB104026066841**	River; artificial	Moderate Phosphate Ammonia Mitigation measures assessment	Fail PBDEs Mercury and its compounds Benzo(k)fluoranthene Benzo(g-h-i)perylene Benzo(b)fluoranthene
High Hunsley to Woodmansey Area **GB104026066820**	River; artificial	Moderate Fish	Fail PBDEs Mercury and its compounds
Holderness Drain Source to Foredyke Stream **GB104026066950**	River; artificial	Moderate Dissolved oxygen Phosphate Ammonia Mitigation measures	Fail PBDEs Mercury and its compounds
Hull from Arram Beck to Humber **GB104026067212**	River; heavily modified	Moderate Phosphate	Fail Tributyltin compounds PBDEs Mercury and its compounds Benzo(k)fluoranthene Benzo(g-h-i)perylene Benzo(b)fluoranthene

Water Body	**Type and designation**	**Ecological status/potential and RNAG elements**	**Chemical status and RNAG elements**
Mickley Dike Catchment **GB104026066990**	River; artificial	Moderate Dissolved oxygen Mitigation measures assessment	Fail PBDEs Mercury and its compounds
Old Howe/ Frodingham Beck to River Hull **GB104026067021**	River; heavily modified	Moderate Mitigation measures assessment	Fail PBDEs Mercury and its compounds
Barmston Sea Drain/ Skipsea Drain to Confluence **GB104026077770**	River; not designated artificial or heavily modified	Moderate Dissolved oxygen Phosphate Invertebrates Macrophytes and phytobenthos combined Ammonia	Fail PBDEs Mercury and its compounds

20.5.4 Abstractions And Discharges

59. Details of abstractions within the Onshore Development Area have been obtained from the Environment Agency. There are two active surface water abstraction licences within the Onshore Development Area both of which are for agricultural spray irrigation. The abstractions are located in surface water catchments of Holderness Drain Source to Foredyke Stream, and Beverley and Barmston Drain (**Figure 20-2**).

60. Maximum volumes of abstracted water are:

- Holderness Darin Source to Foredyke Stream
  - Maximum annual quantity (m^3):
    - 103,000
  - Maximum daily quantity (m^3):
    - 1,363
- Beverley and Barmston
  - Maximum daily quantity (m^3):
    - 25,003
  - Maximum daily quantity (m^3):
    - 1363

61. Some low risk water discharge and groundwater activities can be exempt from requiring a permit – most exceptions are for small sewage discharges. Environment Agency data show that two historical permit exceptions are located in the possible landfall location. These permit exemptions were replaced by general binding rules in 2015 (i.e. they are still active). Both discharges consist of biologically treated domestic effluent that must not exceed $2m^3$ per day.

20.5.5 Flood Risk

62. A summary of flood risk is provided in this section and a detailed FRA is provided in **Appendix 20-3**.

63. Large areas of the East Riding are defended against fluvial and coastal flooding. As such, much of the flood risk posed to the area is residual, as a result of flood events exceeding the standard of protection afforded by: The defence; defence or pumping failure; or flooding behind defences due to local runoff or groundwater (East Riding of Yorkshire Council 2019).

20.5.5.1 Flooding from Rivers and the Sea

64. Environment Agency mapping shows that most of the Onshore Study Area lies outside Flood Zones 2 and 3 (i.e. Flood Zone 1 (<0.1% Annual Exceedance Probability (AEP)) (**Figure 20-4**). Any land that is not mapped as Flood Zones 2 or 3 is part of Flood Zone 1, although this is not specifically mapped.

65. There are four main higher risk areas (Flood Zones 2 and 3) within the Onshore Development Area:

- In the possible landfall location, the coastline is in Flood Zone 3 (land that has a 1% or greater annual probability of river flooding, or a 0.5% or greater probability of flooding from the sea);
- Between Skipsea and Dunnington there are two narrow (~75-100m wide) areas in Flood Zones 2 and 3 associated with Skipsea Drain (West Branch) and Dunnington Sewer. Flood Zone 2 is defined as land that has a 0.1% to 1% annual probability of river flooding, or a 0.1% to 0.5% annual probability of flooding from the sea;
- At Catwick the Onshore Development Area crosses a ~200m wide area of floodplain in Flood Zone 3 (with some small peripheral areas in Flood Zone 2) associated with Stream Dike; and
- From the junction of the A1035 and A165, south of Leven, the Onshore Development Area crosses a wide swathe of floodplain (~9km) in Flood Zones 2 and 3. Most of this area is in Flood Zone 3, but there is a large area of land that occupies Flood Zone 2 between Routh in the north and Meaux in the south. To the west and south of Beverley, flood risk associated with Flood Zones 2 and 3 is limited and associated with several ordinary watercourses.

20.5.5.2 Surface Water Flood Risk

66. Given the low-lying topography of the Onshore Development Area, the risk of surface water flooding is high in many places. Surface water flood risk occurs as isolated areas of ponding and discrete flow pathways. For example, in the area west of Beverley, there are numerous narrow high risk (3.3% AEP) flow paths that drain towards Beverley. There are also several medium (1% AEP) to high risk flow paths in the area south of Beverley, in Substation Zones 1 and 4. Most of the narrow surface water flood risk pathways are associated with drains and hollows, but these connect to flatter areas in places to create more extensive areas of surface water flooding (but generally lower risk (1-0.1% AEP)) (e.g. immediately northeast of Beverley (close to North Bullock Dike).

20.5.6 Groundwater

20.5.6.1 Bedrock Geology and Bedrock Aquifers

67. Groundwater features are shown in **Figure 20-2** and **Figure 20-3**.

68. Bedrock geology across the Onshore Development Area is characterised by the White Chalk Subgroup. The subgroup is divided into two formations:

- The area from the coast to e ast of the A165 Beverley Road is characterised by rocks of the Rowe Chalk Formation; and
- The rest of the Onshore Development Area is characterised by rocks of the Flamborough Chalk Formation.

69. These rocks support a Principal aquifer across the entire Onshore Development Area (**Figure 20-3**). Principal aquifers provide significant quantities of drinking water and water for business needs. They may also support rivers, lakes and wetlands.

20.5.6.2 Superficial Geology and Superficial Aquifers

70. Superficial deposits are more varied but are dominated by till (diamicton). A wide belt of alluvium (sand, silt and clay), interspersed with more restricted pockets of glaciofluvial sand and gravel, runs north-south through the Onshore Development Area. Around the periphery of Beverley there are also Quaternary river terrace sediments and areas of head (head is poorly sorted, poorly stratified angular rock debris and/or clayey hillwash and soil creep, mantling a hillslope).

71. Superficial deposits support extensive Secondary (undifferentiated) aquifers (**Figure 20-3**). For these features it is not possible to apply either a Secondary A or B definition, because of the variable characteristics of the rock type, they have only a minor value. The Onshore Development Areas also crosses several Secondary A aquifers in the River Hull valley and other alluvial settings. Secondary A aquifers comprise permeable layers that can support local water supplies and may form an important source of base flow to rivers. Small Secondary B aquifers are also present near the coast in the Skipsea area. Secondary B aquifers are lower permeability layers which may yield limited amounts of groundwater due to localised features such as fissures, permeable horizons and weathering.

20.5.6.3 Groundwater Vulnerability

72. Groundwater vulnerability is medium across most of the Onshore Development Area (**Figure 20-3**). Medium-high vulnerability zones are crossed near Skipsea, near Catwick, and north-east of Beverley. Immediately north, west and south of Beverley the Onshore Development Area crosses a medium vulnerability area with an associated soluble rock risk.

20.5.6.4 Drinking Water Protected Areas, Source Protection Zones (SPZs)

73. A large part of the Onshore Development Area crosses Cottingham Drinking Water Safeguard Zone (GWSGZ0240). The Drinking Water Protected Area overlaps an SPZ (**Figure 20-3**). To the west of the junction between A1035 and A165 roads, near Leven, the Onshore Development Area crosses into Zone 3 (total catchment) of the SPZ. SPZ 3 is defined as the area around a supply source within which all the groundwater ends up at the abstraction point. Between Beverley and Bishop Burton, the Onshore Development Area crosses into Zone 2 (outer protection) of the SPZ. Zone 2 has a 400 day travel time of pollutant to source and has a 250 or 500m minimum radius around the source, depending on the amount of water taken. North of Cottingham the Onshore Development Area crosses into Zone I (inner protection) of the SPZ. SPZ I is the most sensitive, having a 50 day travel time of pollutant to source with a 50m default minimum radius. Note that the small red circles shown on **Figure 20-2** are induvial boreholes (SPZ1).

20.5.6.5 Groundwater Quality

74. The Onshore Development Area is underlain by a single groundwater body: Hull and East Riding Chalk (GB40401G700700) (**Figure 20-2**). Both quantitative and chemical classification elements are Poor. Reasons for not achieving good status (RNAG) classification elements are:

- General chemical test;
- Trend assessment;
- Chemical Drinking Water Protected Area;
- Chemical GWDTEs test;
- Quantitative saline intrusion; and
- Chemical saline intrusion.

75. Groundwater quality pressures are being caused by:

- Poor nutrient management;
- Atmospheric deposition;
- Private sewage treatment;
- Sewage discharge (continuous);
- Farm/site infrastructure; and
- Groundwater abstraction.

20.5.7 Designated Sites

76. The wider landfall area within which both potential landfall locations sit overlaps Withow Gap, Skipsea SSSI. The SSSI is an important site for the interpretation of Late Devensian (glacial) and Flandrian (post-glacial) environmental history in Holderness. The SSSI was last assessed in 2014 as in favourable (100%) condition. Designated sites are discussed and mapped in **Chapter 18 Terrestrial Ecology and Ornithology**,

77. West of the possible landfall location the Onshore Development Area crosses Skipsea Drain (West Branch) which flows through Skipsea Bail Mere SSSI (approximately 800m downstream of the Onshore Development Area). The SSSI is important for the interpretation of the vegetational history of the northern part of the Holderness coastal plain. The SSSI was last assessed in 2022 as in favourable (100%) condition.

78. West of Beverley the Onshore Development Area is close (~15m away) to Burton Bushes SSSI. The SSSI is characterised by oak woodland that is known to exceed 200 years in age, and evidence suggests that it is of natural origins. It is considered a good example of the woodland characteristic of Holderness Till soils. The SSSI was last assessed in 2010 as in favourable (100%) condition.

20.5.8 Receptor Sensitivity

79. Catchment receptor sensitivity is described in **Table 20-11**.

Table 20-11 Flood Risk and Hydrology Receptor Sensitivity

Catchment	Sensitivity	Justification
Barmston Sea Drain/ Skipsea Drain to Conf	Medium	Catchment supports Tophill Low Drinking Water Safe-guard Zone. River waterbody (not designated artificial or heavily modified) characterised by numerous straight planform reaches indicative of resectioning for land drainage and flood defence purposes. WFD ecological status is Moderate (with a Bad classification for ammonia) and Fail for chemical status. Skipsea Bail Mere SSSI is located ~800m downstream of the Onshore Development Area.
Coastal catchment	High	A narrow strip of land near the coast characterized by several short artificial drains. Sensitivity is high because the catchment includes Withow Gap, Skipsea SSSI.
Mickley Dike catchment	Medium	Catchment supports Tophill Low Drinking Water Safeguard Zone. Artificial river water body with a straight planform over most of its length. WFD ecological potential is Moderate (with a Poor classification for dissolved oxygen) and Fail for chemical status.
Old Howe/ Frodingham Beck to R Hull	Medium	Catchment supports Tophill Low Drinking Water Safeguard Zone. Heavily modified river water body with several long, straight planform sections reaches indicative of resectioning for land drainage and flood defence purposes. WFD ecological potential is Moderate (with a Poor classification for dissolved oxygen) and Fail for chemical status.
Catchwater Drain	Low	Artificial river water body with a straight planform over most of its length. WFD ecological potential is Moderate (with Bad classifications for ammonia and dissolved oxygen) and Fail for chemical status.
Foredyke Stream Upper	Low	Artificial river water body with several long, straight planform sections. WFD ecological potential is Moderate (with a Bad classification for ammonia) and Fail for chemical status.

Catchment	Sensitivity	Justification
Foredyke Stream Lower to Holderness Dr	Low	Artificial river water body with a straight planform over most of its length. WFD ecological potential is Moderate (with a Bad classification for fish and Poor classifications for ammonia, dissolved oxygen and phosphate) and Fail for chemical status.
Holderness Drain Source to Foredyke Stream	Low	Artificial river water body with a straight planform over most of its length. WFD ecological potential is Moderate (with a Bad classification for dissolved oxygen) and Fail for chemical status.
Beverley and Barmston Drain	Low	Artificial river water body with a straight planform over most of its length. WFD ecological potential is Moderate (with a Bad classifications for dissolved oxygen) and Fail for chemical status. Although Burton Bushes SSSI is adjacent to the Onshore Development Area, the site is designated for its oak woodland on till soils (not wet woodland). The woodland is not crossed by any watercourses and it is therefore unlikely there is a functional hydrological connection with the river water body.
Hull from Arram Beck to Humber	Medium	Heavily modified river water body with a low sinuosity meandering planform for much of its length. WFD ecological potential is Moderate; the majority of biological and physico-chemical quality elements are classed as High and Fail for chemical status.
High Hunsley to Arram Area	Low	Artificial river water body with a straight planform over most of its length. WFD ecological potential is Moderate (with a Poor classification for phosphate) and Fail for chemical status.
High Hunsley to Woodmansey Area	Low	Artificial river water body with several long, straight planform sections. WFD ecological potential is Moderate (with a Moderate classification for fish) and Fail for chemical status.
Hull and East Riding Chalk	High	Groundwater body that supports a Principal aquifer across the entire Onshore Development Area. Superficial deposits support a Secondary A aquifer. Groundwater vulnerability is mainly medium with some areas classed medium-high. The groundwater body also supports an SPZ and drinking water (groundwater) safeguard zone.

20.5.9 Future Trends

80. In the event that the Projects are not developed, an assessment of future conditions for Flood Risk and Hydrology has been carried out and is described within this section. The following description is based on a 'do nothing' scenario.

81. The review of the existing environment in this chapter demonstrates that surface water bodies in the study area support limited areas of high-quality natural habitats. Many of these water bodies have experienced physical modification for land drainage and flood risk management, affecting their geomorphology. Water quality is generally moderate but locally poor across the study area. Watercourses are adversely affected by diffuse pollution from agriculture and point source pollution (sewage). Some water bodies are affected by saline intrusion and surface water abstraction.

82. Ongoing measures to reduce existing pressures on geomorphology and water quality as part of the implementation of the WFD is likely to improve conditions over time.

83. The hydrology of the surface drainage network is expected to change with higher winter flows and lower summer flows with a greater number of storm-related flood flows (climate change is causing more extreme weather). This is likely to lead to changes in the hydrology of the river systems with increased geomorphological activity occurring as a result of storm events. Therefore, the drainage network is unlikely to remain stable over time and may revert to more natural river types in future, although there would be ongoing channel management (e.g. by IDBs).

84. Groundwater resources face pressure from diffuse pollution from agriculture (e.g. poor livestock and nutrient management). Ongoing initiatives are in place to reduce pressures on groundwater, including increased regulation of agricultural chemicals, in order to achieve compliance with the Water Environment Regulations (WER). This would suggest that groundwater quality and quantity is likely to improve in the future, although this would occur over long timescales.

85. In summary, water quality is likely to improve due to better contaminant management (due to the WER), however climate change impacts, such as more extreme weather (increased precipitation), are likely to impact catchment hydromorphology (higher flows, more geomorphic activity). Consequently, river channels may become more dynamic and flood risk may increase.

20.6 Assessment of Significance

20.6.1 Potential Effects During Construction

20.6.1.1 Impact 1 Direct Disturbance of Surface Water Bodies

86. Trenchless crossing techniques such as HDD have been embedded in the scheme design for Main Rivers (**Table 21.3**). The cables would be buried a maximum of 20 m deep at trenchless crossings. Although ground disturbance will occur at the entry and exit points (which could potentially be located on the floodplain), there would be no direct disturbance to the watercourses crossed using a trenchless technique. Therefore, there is no direct mechanism for impacts to occur to the geomorphology, hydrology and physical habitats of these watercourses.

87. Direct disturbance of Ordinary Watercourses will occur at trenched crossings. Trenched crossings will involve installing temporary dams (composed of sand bags, straw bales and ditching clay, or another suitable technique) upstream and downstream of the crossing point. The cable trench is then excavated in the dry area of riverbed between the two dams with the river flow maintained using a temporary pump or flume.

88. This installation technique would directly disturb the bed and banks of the watercourse and would result in the direct loss of natural geomorphological features and changes to their associated physical habitat niches. It may also result in increased geomorphological instability due to enhanced scour and increased sediment supply and changes to hydrology. These are, however, temporary impacts which would only occur whilst construction work is in progress, and the bed and banks would be reinstated to their original level, position, planform and profile.

89. In addition to the cable infrastructure itself, it may be necessary to install temporary structures to allow haul road access across watercourses where direct access is not readily available from both sides. This may potentially be required on watercourses which will be crossed using trenchless techniques.

90. Temporary crossings may comprise an appropriately sized culvert installed within the ditch with the haul road being installed over the top of the culvert. The culvert would be installed beneath the channel bed so as to avoid upstream impoundment and would be sized to accommodate reasonable 'worst-case' weather volumes and flows. These culverts may remain in place for the duration of the cable duct installation and subsequent cable pull. At larger crossings, or sensitive rivers, temporary bridges (e.g. Bailey bridges or similar) may be installed to allow continuation of the haul road.

91. Installation of temporary culverts across Ordinary Watercourses could potentially directly disturb the bed and banks of the watercourse and result in the direct loss of natural geomorphological features. They could also result in reduced flow and sediment conveyance, create upstream impoundment and affect the patterns of erosion and sedimentation. These impacts would be reversible once the temporary culverts have been removed and the bed and banks reinstated

92. Temporary bridges are unlikely to result in significant disturbance to the bed and banks of the channel, with any impacts limited to the footprint of the bridge abutments themselves.

93. For the purposes of this assessment, the magnitude of impact is assumed to be directly proportional to the total number of trenched watercourse crossings within each river water body catchment and the length of time over which temporary structures could be in place, as given in **Table 20-12.**

94. A five year construction window is assumed for each project with a two year lag for a sequential project to be completed. Therefore we could assume up to 6 years for the final cable pulls to be completed (through ducts installed during the first Project). This means that in the sequential scenario, temporary structures associated with the construction of a trenched crossing, such as the haul road, would be in place for a longer continuous period. This means that the total continuous period of disturbance would be greater in the sequential scenario, which is therefore considered to represent the worst-case.

Table 20-12 Magnitude of Impact for Trenched Watercourse Crossings

Magnitude of impact	Number of trenched crossings per water body catchment	
	Temporary crossings in place up to 33months (isolation or concurrent)	Temporary crossings in place up to 57 months (sequential)
No impact	0	0
Negligible	1-4	1
Low	5-9	2-4
Medium	10-14	5-9
High	>15	>10

20.6.1.1.1 Magnitude of Impact – DBS East or DBS West in Isolation

95. Either Project in isolation will cross the same number of Main Rivers and Ordinary Watercourses in each water body catchment. Numbers and types of crossings, and magnitude of impact based on the criteria set out in **Table 20-13**.

96. Magnitude of impact is negligible (1-4 trenched crossings) to low (5-9 trenched crossings) in all catchments except for Catchwater Drain, Beverley and Barmston Drain and High Hunsley to Woodmansey Area. In these catchments there would be up to 11, 28 and 13 trenched crossings (medium to high impact). The number of crossings in these catchments reflects the fact that they would be occupied by relatively large areas of the Onshore Development Area (e.g. Beverley and Barmston Drain is crossed by the Onshore Development Area in three different locations).

97. There would be no impacts in the catchments of Mickley Dike and the Hull from Arram Beck to Humber as there are no trenched crossings.

Table 20-13 Water Body Crossings in Surface Water Catchments

Catchment	Sensitivity	Trenchless crossings		Trenched crossings	Magnitude of impact	
		Main River	Ordinary Watercourse	Ordinary Watercourse	In place up to 33 months	In place up to 57 months
Barmston Sea Drain/Skipsea Drain to Conf	Medium	0	2	7	Low	Medium
Coastal catchment	High	0	0	3	Negligible	Low
Mickley Dike catchment	Medium	0	0	0	N/A	N/A
Old Howe/Frodingham Beck to R Hull	Medium	0	0	4	Negligible	Low
Catchwater Drain	Low	0	1	11	Medium	High
Foredyke Stream Upper	Low	1	0	4	Negligible	Low
Foredyke Stream Lower to Holderness Dr	Low	2	0	1	Negligible	Negligible

Catchment	Sensitivity	Trenchless crossings		Trenched crossings	Magnitude of impact	
		Main River	Ordinary Watercourse	Ordinary Watercourse	In place up to 33 months	In place up to 57 months
Holderness Drain Source to Foredyke Stream	Low	1	3	6	Low	Medium
Beverley and Barmston Drain	Low	1	5	28	High	High
Hull from Arram Beck to Humber	Medium	1	0	0	N/A	N/A
High Hunsley to Arram Area	Low	1	0	1	Negligible	Negligible
High Hunsley to Woodmansey Area	Low	0	2	13	Medium	High

20.6.1.1.2 Magnitude of Impact – DBS East and DBS West Together

98. Magnitude of impact for the worst case scenario (construction sequentially) is low or negligible in all catchments except for Barmston Sea Drain/Skipsea Drain to Confluence and Holderness Drain Source to Foredyke Stream (both medium impact), Catchwater Drain, High Hunsley to Woodmansey Area, and Beverley and Barmston Drain (all high impact). There would be no impacts in the catchments of Mickley Dike and the Hull from Arram Beck to Humber as there are no trenched crossings.

20.6.1.1.3 Sensitivity of Receptor

99. Receptor sensitivity is described in **Table 20-11**. Of the twelve surface water catchments crossed by the Onshore Development Area, sensitivity is high in three catchments, medium in three and low in six. High and medium sensitivity is related to the presence of designated sites (SSSIs); medium sensitivity is related to High WFD status for some biological and physico-chemical quality elements and the presence of Tophill Low Drinking Water Safeguard Zone.

20.6.1.1.4 Significance of Effect – DBS East or DBS West in Isolation

100. Significance of effect on each watercourse resulting from the direct disturbance of surface water bodies due to construction a Project in isolation is given in **Table 20-14**. Prior to mitigation, most effects are negligible to minor adverse, except for Beverley and Barmston Drain, which is moderate adverse.

20.6.1.1.5 Significance of Effect – DBS East and DBS West Together

101. Significance of effect on each watercourse resulting from direct disturbance of surface water bodies due to construction of the Projects sequentially is given in **Table 20-15**. Prior to mitigation, most effects are negligible to minor adverse. Effects are moderate adverse in the following catchments:

- Barmston Sea Drain/Skipsea Drain to Confluence catchment;
- coastal catchment;
- Catchwater Drain;
- Beverley and Barmston Drain;
- High Hunsley to Woodmansey Area.

20.6.1.1.6 Mitigation and Residual Significance of Effect – DBS East or DBS West in Isolation

102. HDD has been embedded into the scheme design for Main Rivers and there is no mechanism for direct impacts to occur to the geomorphology, hydrology and physical habitat of the watercourses. Therefore, no further mitigation is proposed at HDD locations.

103. Best practice mitigation measures at trenched crossings of Ordinary Watercourses will include:

- The amount of time that temporary dams are in place will be kept to a minimum;
- Prior to dewatering the area between the temporary dams, a fish rescue would be undertaken;
- Flumes or pumps would be adequately sized to ensure that flows downstream are maintained whilst minimising upstream impoundment;
- Scour protection would also be used to protect the river bed downstream of the dam from high energy flow at the outlets of flumes and pumps;
- Sympathetic reinstatement of channel bed and banks – this means keeping any coarse substrate separate and reinstating on the bed and recreating a natural profile when the banks are reinstated; and
- Vegetation would not be removed from the banks unless necessary to undertake the works, in which case removal would be restricted to the smallest practicable footprint.

104. Following the implementation of the mitigation measures, impacts on Ordinary Watercourses in which trenched crossings are proposed will be reduced. The resulting magnitude of impact and significance of effect on river water body catchments due to the construction of a Project in isolation are given in **Table 20-14**.

105. Mitigation measures listed above will reduce the magnitude of impact from high to medium in Beverley and Barmston Drain's catchment by minimising disturbance to channels (e.g. scour protection, not removing vegetation (bank disturbance) unless necessary), reducing significance of effect from moderate to minor adverse.

106. In catchments where magnitude of impact is low, mitigation measures will reduce impact to negligible, thereby reducing the significance of effect from minor adverse to negligible. In catchments where mitigation will reduce impacts to negligible, but sensitivity is medium, significance of effect will remain minor adverse.

107. In catchments where the magnitude of impact is negligible prior to mitigation, it is not expected that additional mitigation measures will further reduce the magnitude of impact. However, mitigation measures are an important and integral part of best practice construction methodology and will be adhered to for this Project to help ensure that direct channel disturbance is not increased.

108. All direct disturbance effects relating to construction of the Projects in isolation are deemed to be not significant.

Table 20-14 Effects Resulting from Direct Disturbance of Water Bodies During the Construction of a Project in Isolation

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Barmston Sea Drain /Skipsea Drain to Conf	Medium	Seven trenched crossings are required, resulting in impacts of low magnitude and minor adverse effects prior to mitigation. Mitigation will reduce magnitude of impact to negligible Residual effects remain minor adverse due to medium sensitivity. With mitigation in place, impacts on Skipsea Bail Mere SSSI, located ~800m downstream of the Onshore Development Area, are not anticipated.	Low	Minor adverse	Negligible	Minor adverse
Coastal catchment	High	Three trenched crossings are required, resulting in impacts of negligible magnitude and minor adverse effects prior to mitigation. Residual effects remain minor adverse because	Negligible	Minor adverse	Negligible	Minor adverse

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
		magnitude of impact is negligible prior to mitigation. With mitigation in place, impacts on Withow Gap, Skipsea SSSI are not anticipated.				
Mickley Dike catchment	Medium	There are no watercourse crossings in this catchment.	N/A	N/A	N/A	N/A
Old Howe/ Frodingham Beck to R Hull	Medium	Four trenched crossings are required, resulting in impacts of negligible magnitude and minor adverse effects prior to mitigation. Residual effects remain minor adverse because magnitude of impact is negligible prior to mitigation.	Negligible	Minor adverse	Negligible	Minor adverse
Catchwater Drain	Low	Eleven trenched crossings are required, resulting in impacts of medium magnitude and minor adverse effects prior to mitigation. Mitigation will	Medium	Minor adverse	Low	Minor adverse

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
		reduce magnitude of impact to low and significance of effect to negligible.				
Foredyke Stream Upper	Low	Four trenched crossings are required, resulting in impacts of negligible magnitude and negligible effects prior to mitigation. Residual effects remain negligible because magnitude of impact is negligible prior to mitigation.	Negligible	Negligible	Negligible	Negligible
Foredyke Stream Lower to Holderness Dr	Low	One trenched crossing is required, resulting in impacts of negligible magnitude and negligible effects impacts and effects. Residual effects remain negligible because magnitude of impact is negligible prior to mitigation.	Negligible	Negligible	Negligible	Negligible
Holderness Drain Source	Low	Six trenched crossings are required, resulting in impacts of low magnitude and minor adverse effects prior to	Low	Minor adverse	Negligible	Negligible

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
to Foredyke Stream		mitigation. Mitigation will reduce magnitude of impact and significance of effect to negligible.				
Beverley and Barmston Drain	Low	Up to 28 trenched crossings could be required. Mitigation measures will reduce magnitude of impact from high to medium, and significance of effect from moderate to minor adverse. With mitigation in place, impacts on Burton Bushes SSSI, which is adjacent to (outside) the Onshore Development Area, are not anticipated.	High	Moderate adverse	Medium	Minor adverse
Hull from Arram Beck to Humber	Medium	There are no trenched crossings in this catchment.	N/A	N/A	N/A	N/A
High Hunsley to Arram Area	Low	One trenched crossing is required, resulting in impacts of negligible magnitude and negligible effects prior	Negligible	Negligible	Negligible	Negligible

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
		to mitigation. Residual effects remain negligible because magnitude of impact is negligible prior to mitigation.				
High Hunsley to Woodmansey Area	Low	Up to thirteen trenched crossings are required, resulting in impacts of medium magnitude and minor adverse effects prior to mitigation. Mitigation will reduce magnitude of impact to low. Significance of effect will remain minor adverse.	Medium	Minor adverse	Low	Minor adverse

20.6.1.1.7 Mitigation and Residual Significance of Effect – DBS East and DBS West Together

109. The same mitigation (section 20.6.1.1.6) would be used for sequential construction of the Projects as described for construction in isolation. The resulting magnitude of impact and significance of effect are given in **Table 20-15**.

110. Mitigation measures will reduce the magnitude of impact from high to medium in the catchments of Beverley and Barmston Drain, Catchwater Drain and High Hunsley to Woodmansey Area. This will reduce significance of effect from moderate to minor adverse.

111. In catchments where magnitude of impact is low or medium, mitigation measures will reduce the magnitude of impact to negligible or low. This will reduce significance of effect from moderate adverse to minor adverse and minor adverse to negligible, except where sensitivity is medium (Old Howe/Frodingham Beck to R Hull catchment – significance of effect will remain minor adverse).

112. In catchments where the magnitude of impact is negligible prior to mitigation, it is not expected that additional mitigation measures will further reduce the magnitude of impact. However, mitigation measures are an important and integral part of best practice construction methodology and will be adhered to for this Project to help ensure that direct channel disturbance is not increased.

113. All effects are deemed to be not significant. Significance of effect on catchments through sequential project (worst case) scenario was concluded to be minor adverse as a consequence of direct disturbance during construction.

Table 20-15 Effects Resulting from Direct Disturbance of Water Bodies During the Construction of the Projects Sequentially

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Barmston Sea Drain/Skipsea Drain to Conf	Medium	Seven trenched crossings are required, resulting in impacts of medium magnitude and moderate adverse effects prior to mitigation. Mitigation will reduce magnitude of impact to low and significance of effect to minor adverse. With mitigation in place, impacts on Skipsea Bail Mere SSSI, located ~800m downstream of the Onshore Development Area, are not anticipated.	Medium	Moderate adverse	Low	Minor adverse
Coastal catchment	High	Three trenched crossings are required, resulting in impacts of low magnitude and moderate adverse effects prior to mitigation. Mitigation will reduce magnitude of impact to	Low	Moderate adverse	Negligible	Minor adverse

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
		negligible and effects to minor adverse. With mitigation in place, impacts on Withow Gap, Skipsea SSSI are not anticipated.				
Mickley Dike catchment	Medium	There are no watercourse crossings in this catchment.	N/A	N/A	N/A	N/A
Old Howe/ Frodingham Beck to R Hull	Medium	Four trenched crossings are required, resulting in impacts of low magnitude and minor adverse effects prior to mitigation. Mitigation will reduce magnitude of impact to negligible and residual effects are minor adverse.	Low	Minor adverse	Negligible	Minor adverse
Catchwater Drain	Low	Eleven trenched crossings are required, resulting in impacts of high magnitude and moderate adverse effects prior to mitigation. Mitigation	High	Moderate adverse	Medium	Minor adverse

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
		will reduce magnitude of impact to medium and significance of effect to minor adverse.				
Foredyke Stream Upper	Low	Four trenched crossings are required, resulting in impacts of low magnitude and minor adverse effects prior to mitigation. Mitigation will reduce magnitude of impact to low and significance of effect to negligible.	Low	Minor adverse	Negligible	Negligible
Foredyke Stream Lower to Holderness Dr	Low	One trenched crossing is required, resulting in impacts of negligible magnitude and negligible effects prior to mitigation. Residual effects remain negligible because magnitude of impact is negligible prior to mitigation.	Negligible	Negligible	Negligible	Negligible

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Holderness Drain Source to Foredyke Stream	Low	Six trenched crossings are required, resulting in impacts of medium magnitude and minor adverse effects prior to mitigation. Mitigation will reduce magnitude of impact to low and significance of effect to minor adverse.	Medium	Minor adverse	Low	Minor adverse
Beverley and Barmston Drain	Low	Up to 28 trenched crossings could be required. Mitigation measures will reduce magnitude of impact from high to medium, and effects from moderate to minor adverse. With mitigation in place, impacts on Burton Bushes SSSI, which is adjacent to (outside) the Onshore Development Area, are not anticipated.	High	Moderate adverse	Medium	Minor adverse

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Hull from Arram Beck to Humber	Medium	There are no watercourse crossings in this catchment.	N/A	N/A	N/A	N/A
High Hunsley to Arram Area	Low	One trenched crossing is required, resulting in impacts of negligible magnitude and negligible effects prior to mitigation. Residual effects remain negligible because magnitude of impact is negligible prior to mitigation.	Negligible	Negligible	Negligible	Negligible
High Hunsley to Woodmansey Area	Low	Up to 13 trenched crossings are required in this catchment, resulting in impacts of high magnitude and moderate adverse effects prior to mitigation. Mitigation will reduce magnitude of impact to low and significance of effect to minor adverse.	High	Moderate adverse	Medium	Minor adverse

20.6.1.2 Impact 2 Increased Sediment Supply

114. Construction of the landfall, onshore export cable corridor, temporary haul roads and onshore substations will involve earthworks (e.g. some piling, earthworks and the tracking of large construction machinery). This will create areas of bare ground by removing vegetation cover and topsoil and will increase the potential for the erosion of soil particulates. This could result in an increase in the supply of fine sediment (e.g., clays, silts and fine sands) to surface water bodies (including land drainage channels) through surface runoff and the erosion of exposed soils.

115. Increased sediment supply can affect the geomorphology of water bodies by increasing the turbidity of the water column and, where energy is sufficiently low, encouraging increased deposition of fine sediment on the bed of the channel. Increased sediment loads could therefore smother existing bed habitats, reduce light penetration and reduce dissolved oxygen concentrations, adversely affecting the biota of the water body including macrophytes, aquatic invertebrates and fish. This has the overall effect of reducing the quality of in-channel habitats.

116. In addition to the potential sources of sediment considered, temporary bridges may be used to maintain haul road access across water bodies. These crossings would provide a mechanism by which sediment could be produced close to the water bodies which they cross. Disturbed ground associated with trenched crossings also has the potential to increase sediment supply.

117. **Table 20-16** shows the criteria used to assess the magnitude of impact associated with increased sediment supply resulting from exposed land in a water body catchment. Sequential construction of the Projects is considered the worst case scenario for increased sediment supply, due to the longer duration of disturbance than if the Projects are built concurrently or in isolation. Areas of disturbed ground have been estimated from the area of Onshore Development Area in each water body catchment for all scenarios. This is because the final location of construction compounds is not yet known and the Onshore Development Area represents the worst case scenario. Areas will be updated in the ES.

Table 20-16 Magnitude of Impact Resulting from Exposed Land in a Water Body Catchment

Magnitude of impact	Area of exposed ground per catchment during construction (%)
Negligible	≤1
Low	1 – <6
Medium	6 – <10
High	>10

20.6.1.2.1 Magnitude of Impact – DBS East or DBS West in Isolation

118. The area of each water body catchment occupied by the Onshore Development Area is considered the worst case for all construction scenarios (i.e. build in isolation, concurrently or sequentially). This is because the final location of construction compounds is not yet known. Areas of disturbed ground per catchment and magnitude of impact for the construction of DBS East or DBS West in isolation will presented in the ES.

20.6.1.2.2 Magnitude of Impact – DBS East and DBS West Together

119. If the Projects are built together (sequentially) areas of exposed land per catchment would range from 0.02 (Mickley Dike Catchment) to 3.45km^2 (Beverley and Barmston Drain). Proportions of each catchment affected range from 0.1 to 6.2%. Magnitude of impact is low in all catchments except Catchwater Drain (medium).

Table 20-17 Worst Case (Sequential Scenario) Estimated Maximum Area of Disturbed Ground in each Catchment Receptor

Water body catchment	Estimated total area of disturbed ground during construction	
	km^2	%
Foredyke Stream Upper	0.77	3.9
Foredyke Stream Lower to Holderness Dr	0.73	3.2
Old Howe/ Frodingham Beck to R Hull	0.89	3.5
Beverley and Barmston Drain	3.45	3.3
Hull from Arram Beck to Humber	0.03	0.1
Barmston Sea Drain / Skipsea Drain to Conf	1.38	3.6
High Hunsley to Woodmansey Area	0.66	4.3
High Hunsley to Arram Area	1.08	2.6
Holderness Drain Source to Foredyke Stream	1.36	3.1
Catchwater Drain	1.39	6.2
Mickley Dike Catchment	0.02	0.1
Coastal catchment	0.04	2.3

20.6.1.2.3 Sensitivity of Receptor

120. Receptor sensitivity is described in **Table 20-11**. Of the twelve surface water catchments crossed by the Onshore Development Area, sensitivity is high three catchments, medium in three and low in six. High and medium sensitivity is related to the presence of designated sites (SSSIs); medium sensitivity is related to High WFD status for some biological and physico-chemical quality elements and the presence of Tophill Low Drinking Water Safeguard Zone.

20.6.1.2.4 Significance of Effect – DBS East or DBS West in Isolation

121. Significance of effect for the construction of DBS East or DBS West in isolation will be presented in the ES.

20.6.1.2.5 Significance of Effect – DBS East and DBS West Together

122. Prior to mitigation, effects are considered to be of minor adverse in all surface water bodies except for the coastal catchment, which is moderate adverse due to the presence of a SSSI (high sensitivity). The significance of the effect on each water body resulting from increased sediment supply due to the construction of the Projects sequentially is assessed in **Table 20-18**.

20.6.1.2.6 Mitigation and Residual Significance of Effect – DBS East or DBS West in Isolation

123. Residual significance of effect for the construction of DBS East or DBS West in isolation will be presented in the ES.

20.6.1.2.7 Mitigation and Residual Significance of Effect – DBS East and DBS West Together

124. Construction activities will adhere to industry good practice measures as detailed in the Environment Agency's PPG notes (PPG1, PPG5, PPG8 and PPG21). Although the Environment Agency's PPG notes have been revoked in England, they have been updated as Guidance for Pollution Prevention (GPP notes) for use in Scotland and Northern Ireland (NetRegs, 2022). Updates are included in the measures listed below. Construction Industry Research and Information Association (CIRIA) best practice (Control of water pollution from construction sites: Guidance for consultants and contractors (C532) (2001)) will also be adhered to. Mitigation is especially relevant for the coastal catchment (moderate significance of effect), but the following measures will be applied to all catchments to ensure best practice is followed and any potential impacts are minimised.

125. Specific measures within will include:

- Limiting the extent of open excavations along the onshore export cable corridor to short sections at any one time (work fronts). Topsoil would be stripped from the entire width of the onshore export cable corridor for the length of the work front, then stored and capped to minimise erosion from wind and rain;
- Temporary works areas (e.g., construction compounds and trenchless crossing areas) within the Onshore Development Area may comprise hardstanding of permeable material, such as gravel aggregate or alternatively matting/timber or similar, underlain by geotextile or another suitable material to a minimum of 50% of the exposed area. This would minimise the area of open ground.
- Only removing vegetation from the area that needs to be exposed in the near future;
- Seeding or covering stockpiles;
- Using geotextile silt fencing at the toe of the slope, to reduce the movement of silt – this should be installed before soil stripping has begun and vehicles start tracking over the site;
- On-site retention of sediment to be maximised by routing all drainage through the site drainage system;
- Include measures to intercept sediment runoff at source in the drainage system using suitable filters to remove sediment from water discharged to the surface drainage network;
- Plant and wheel washing is carried out in a designated area of hard standing at least 10m from any watercourse or surface water drain, rock outcrop (hard rock at surface) or karstic sinkhole;
- Traffic movements would be restricted to minimise surface disturbance;
- Collect run-off in lagoons and allow suspended solids to settle before disposal;
- Divert clean water away from the area of construction work in order to minimise the volume of contaminated water; and
- Buffer strips of vegetation will be retained where possible to prevent runoff.

126. Mitigation measures will reduce the magnitude of impact by limiting the opportunity for soil erosion. Impacts will reduce from low to negligible in all catchments except for the Catchwater Drain, which will reduce from medium to low (**Table 20-18)**. Residual effects will reduce from minor adverse to negligible where sensitivity is low. Effects will remain minor adverse where either sensitivity is medium or where magnitude of impact prior to mitigation is medium.

127. All effects relating to increased sediment supply for sequential construction of the Projects are deemed to be not significant.

Table 20-18 Effects Resulting from Increased Sediment Supply to Water Bodies Resulting from Construction of the Projects Sequentially

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Coastal catchment	High	Although only 0.0.044km^2 of the catchment could be disturbed by construction, the catchment is small (disturbance could affect 2.3% of the catchment area) and sensitivity high due the presence of Withow Gap, Skipsea SSSI. Mitigation will reduce magnitude of impact from low to negligible, and significance of effect from moderate to minor adverse. With mitigation in place, impacts on Withow Gap, Skipsea SSSI are not anticipated.	Low	Moderate adverse	Negligible	**Minor** adverse

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Barmston Sea Drain/Skipsea Drain to Conf	Medium	$1.38km^2$ (6.2%) of the catchment could be disturbed by construction activities. Mitigation will reduce magnitude of impact from low to negligible, and residual significance of effect is minor adverse. With mitigation in place, impacts on Skipsea Bail Mere SSSI, located ~800m downstream of the Onshore Development Area, are not anticipated.	Low	Minor adverse	Negligible	**Minor** adverse
Mickley Dike catchment	Medium	$0.02km^2$ (0.1%) of the catchment could be disturbed by construction activities. Although best practice mitigation measures will be in place, magnitude of impact will remain negligible and residual significance of effect is minor adverse.	Negligible	Minor adverse	Negligible	**Minor** adverse

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Old Howe/ Frodingham Beck to R Hull	Medium	0.89km^2 (3.5%) of the catchment could be disturbed by construction activities. Mitigation will reduce magnitude of impact from low to negligible, and residual significance of effect is minor adverse.	Low	Minor adverse	Negligible	**Minor** adverse
Catchwater Drain	Low	1.39km^2 (3.5%) of the catchment could be disturbed by construction activities. Mitigation will reduce magnitude of impact from medium to low, and residual significance of effect is minor adverse.	Medium	Minor adverse	Low	**Minor** adverse
Foredyke Stream Upper	Low	0.77km^2 (3.9%) of the catchment could be disturbed by construction activities. Mitigation will reduce magnitude of impact from low to negligible, and significance of effect from minor adverse to negligible.	Low	Minor adverse	Negligible	**Negligible**

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Foredyke Stream Lower to Holderness Dr	Low	0.73km^2 (3.2%) of the catchment could be disturbed by construction activities. Mitigation will reduce magnitude of impact from low to negligible, and significance of effect from minor adverse to negligible.	Low	Minor adverse	Negligible	**Negligible**
Holderness Drain Source to Foredyke Stream	Low	1.36km^2 (3.1%) of the catchment could be disturbed by construction activities. Mitigation will reduce magnitude of impact from low to negligible, and significance of effect from minor adverse to negligible.	Low	Minor adverse	Negligible	**Negligible**

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Beverley and Barmston Drain	Low	$3.45km^2$ (3.3%) of the catchment could be disturbed by construction activities. Mitigation will reduce magnitude of impact from low to negligible, and significance of effect from minor adverse to negligible. With mitigation in place, impacts on Burton Bushes SSSI, adjacent to the Onshore Development Area, are not anticipated.	Low	Minor adverse	Negligible	**Negligible**
Hull from Arram Beck to Humber	Medium	$0.03km^2$ (0.1%) of the catchment could be disturbed by construction activities. Although best practice mitigation measures will be in place, magnitude of impact will remain negligible and residual significance of effect is minor adverse.	Negligible	Minor adverse	Negligible	**Minor** adverse

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
High Hunsley to Arram Area	Low	1.08km^2 (2.6%) of the catchment could be disturbed by construction activities. Mitigation will reduce magnitude of impact from low to negligible, and significance of effect from minor adverse to negligible.	Low	Minor adverse	Negligible	**Negligible**
High Hunsley to Woodmansey Area	Low	0.66km^2 (4.3%) of the catchment could be disturbed by construction activities. Mitigation will reduce magnitude of impact from low to negligible, and significance of effect from minor adverse to negligible.	Low	Minor adverse	Negligible	**Negligible**

20.6.1.3 Impact 3 Accidental Release of Contaminants to Surface and Groundwaters

128. During construction, there is potential for the accidental release of lubricants, fuels and oils from construction machinery. This can occur because of spillages, leakage from vehicle storage areas and direct release from construction machinery working directly in or adjacent to water bodies, including land drainage channels. Bentonite, which is an inert clay-based material used at the drillhead during the installation of trenchless crossings, can breakout during use and cause smothering of habitats, although it is inert and not a pollutant. There is also potential for accidental leakages of foul water from welfare facilities, and construction materials including concrete and inert drilling fluids. These can enter surface waters and connected groundwaters through run-off, especially following rainfall.

129. The length of trenchless drills (HDD) is likely to vary depending on the obstacle being crossed. Longer crossings have a greater potential to interact with the underlying chalk aquifer.

130. A significant leakage or spillage has the potential to cause adverse effects to water quality if contaminants enter the surface drainage network and can adversely affect the ecology of the water bodies, in particular fish and invertebrate species (**Chapter 18 Terrestrial Ecology and Ornithology**).

131. Construction activities, including excavations for cable trenching, could result in the remobilisation of contaminants that are already present in the soil. This could include in situ contaminated land and nutrients such as nitrogen and phosphorus from nitrogen-rich arable soils. Nutrients could also be supplied through discharges of foul water from temporary welfare facilities in construction compounds. The supply of nutrients to surface waters could result in adverse effects on water quality (including, in extreme cases, eutrophication) and aquatic plant, invertebrate and fish communities supported by surface waters.

132. Construction activities such as excavation, piling and underground trenchless crossing techniques which disturb the ground can also introduce contaminants (including nutrients) into underlying groundwater bodies, particularly shallow aquifers. Therefore, these activities could adversely affect the quality of the underlying groundwater and any licensed or unlicensed abstractions associated with it.

20.6.1.3.1 Magnitude of Impact – DBS East or DBS West in Isolation

133. The area of each catchment disturbed by construction is used as a proxy for the area of land that could be affected by the accidental release of contaminants. The area of each water body catchment occupied by the Onshore Development Area is considered the worst case for all construction scenarios (i.e. build in isolation, concurrently or sequentially). This is because the final location of construction compounds is not yet known. Areas of disturbed ground per catchment and magnitude of impact for the construction of DBS East or DBS West in isolation will be presented in the ES.

20.6.1.3.2 Magnitude of Impact – DBS East and DBS West Together

134. Magnitude of impact is based on the area of ground in each catchment that could be disturbed by construction activities (**Table 20-17**) and therefore potentially exposed to contaminants. Although worst case parameters are the same for concurrent and sequential scenarios, the longer duration of a sequential scenario means ground would be exposed for longer and therefore construction machinery (and associated fuels and oils) would be operational over a longer period (Magnitude of impact is low in all catchments except Catchwater Drain (medium).

20.6.1.3.3 Sensitivity of Receptor

135. Receptor sensitivity is described in **Table 20-11**. Of the twelve surface water catchments crossed by the Onshore Development Area, sensitivity is high in three catchments, medium in three and low in six. High and medium sensitivity is related to the presence of designated sites (SSSIs); medium sensitivity is related to High WFD status for some biological and physico-chemical quality elements and the presence of Tophill Low Drinking Water Safeguard Zone.

136. Groundwater sensitivity is high due to the presence of a Principal aquifer, SPZ and drinking water (groundwater) safeguard zone.

20.6.1.3.4 Significance of Effect – DBS East or DBS West in Isolation

137. Significance of effect for the construction of DBS East or DBS West in isolation will be presented in the ES.

20.6.1.3.5 Significance of Effect – DBS East and DBS West Together

138. Prior to mitigation, effects are considered to be of minor adverse in all surface water bodies except for the coastal catchment, which is moderate adverse due to the presence of a SSSI (high sensitivity). The significance of the effect on each water body resulting from the accidental release of contaminants due to construction of the Projects sequentially is given in **Table 20-19**.

20.6.1.3.6 Mitigation and Residual Significance of Effect – DBS East or DBS West in Isolation

139. Residual significance of effect for the construction of DBS East or DBS West in isolation will be presented in the ES.

20.6.1.3.7 Mitigation and Residual Significance of Effect – DBS East and DBS West Together

140. The specific measures relevant to the prevention of contaminant supply to water bodies will prevent the immediate discharge of contaminated water and sediment from the onshore export cable corridor into the surface drainage network are described below. This is especially the case for the coastal catchment (moderate significance of effect), but the following measures will be applied to all catchments to ensure best practice is followed and any potential impacts are minimised:

- Locating concrete and cement mixing and washing areas at least 10m away from the nearest water body. These areas will incorporate settlement and recirculation systems to allow water to be re-used. All washing out of equipment would take place in a contained area and the water collected for disposal off-site;
- Storing all fuels, oils, lubricants and other chemicals in impermeable bunds with at least 110% of the stored capacity, with any damaged containers being removed from site. Refuelling would take place in a dedicated impermeable area, using a bunded bowser, located at least 10m away from the nearest water body;
- Ensuring that spill kits are available on site at all times as well as sand bags and stop logs for deployment on the outlets from the site drainage system in case of emergency spillages;

- Foul drainage (e.g., from construction welfare facilities) will be collected through mains connection to an existing mains sewer (if such a connection is available) or collected in a septic tank located within the DCO order limits and transported off site for disposal at a licensed facility with appropriate treatment capacity within its existing permit;
- During construction, the onshore cable installation will be designed such that it will be bounded by parallel drainage channels (one on each side) to intercept drainage within the working width. Additional drainage channels will be installed to intercept water from the cable trench. This will be discharged at a controlled rate into local ditches or drains via temporary interceptor drains. Depending upon the precise location, water from the channels will be infiltrated or discharged into the existing drainage network;
- Construction drainage will be developed and implemented to minimise water within the cable trench and ensure ongoing drainage of surrounding land. If water enters the trenches during installation from surface runoff of groundwater seepage, this will be pumped via settling tanks, sediment basins or mobile treatment facilities to remove sediment, before being discharged into local ditches or drains via temporary interceptor drains. Existing land drains will be reinstated following construction;
- Potential contaminants will be stored under cover to prevent rainwater carrying pollutants away;
- Potential contaminants will be stored in a safe place away from vehicles, to prevent collisions;
- Buffer strips of vegetation will be retained adjacent to water bodies where possible, to intercept any contaminated runoff; and
- To protect groundwater bodies, excavation will be shallow, except where below road or rail infrastructure and water bodies, where it may be deeper.

141. Residual effects are assessed in **Table 20-19.**

142. Mitigation measures will reduce the magnitude of impact by limiting the potential for any accidental spills and ensuring an appropriate response if such a spill was to occur. Impacts will reduce from low to negligible in all catchments except for the Catchwater Drain, which will reduce from medium to low. Residual effects will reduce from minor adverse to negligible where sensitivity is low. Effects will remain minor adverse where either sensitivity is medium or where magnitude of impact prior to mitigation is medium.

143. All effects relating to the accidental release of contaminants to surface and groundwaters for sequential construction of the Projects are deemed to be not significant.

Table 20-19 Effects Associated with the Accidental Release of Contaminants to Surface and Groundwaters Resulting from Construction of the Projects Sequentially

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Coastal catchment	High	HDD would take place at the landfall, with the drilling rig, drilling fluid and fuels and oils associated with construction machinery. In addition, a temporary works compound would be required with fuel storage. The presence of these activities increases the likelihood of a contamination event occurring in the areas affected by onshore construction activities. With mitigation in place magnitude of impact will reduce from low to negligible, and significance of effect from moderate to minor adverse in the coastal catchment. If the landfall is located in Landfall Zone 8, construction activities as described for the coastal catchment would also apply to the Barmston Sea Drain/Skipsea Drain to Confluence catchment. With mitigation in place magnitude of impact would reduce to negligible and residual effects would be minor adverse.	Low	Moderate adverse	Negligible	**Minor** adverse
Barmston Sea Drain/ Skipsea Drain to Conf	Medium		Low	Minor adverse	Negligible	**Minor** adverse
Mickley Dike catchment	Medium	Approximately 0.10% of Mickley Dike's catchment would be affected by construction of the onshore export cable corridor, which could result in the accidental release of contaminants to the surface drainage network. With mitigation in place, magnitude of impact would reduce from low to negligible, and residual significance of effect would be minor adverse.	Low	Minor adverse	Negligible	**Minor** adverse
Old Howe/ Frodingham Beck to R Hull	Medium	Approximately 3.5% of the Old Howe/Frodingham Beck to R Hull catchment would be affected by construction of the onshore export cable corridor, which could result in the accidental release of contaminants to the surface drainage network. With mitigation in place, magnitude of impact would reduce from low to negligible, and residual significance of effect would be minor adverse.	Low	Minor adverse	Negligible	**Minor** adverse
Catchwater Drain	Low	Approximately 6.2% of Catchwater Drain's catchment would be affected by construction of the onshore export cable corridor, which could result in the accidental release of contaminants to the surface drainage network. With mitigation in place, magnitude of impact would reduce from medium to low, and residual significance of effect would be minor adverse.	Medium	Minor adverse	Low	**Minor** adverse
Foredyke Stream Upper	Low	Approximately 3.9% of the Foredyke Stream Upper catchment would be affected by construction of the onshore export cable corridor, which could result in the accidental release of contaminants to the surface drainage network. With mitigation in place, magnitude of impact would reduce from low to negligible, and significance of effect would reduce from minor adverse to negligible.	Low	Minor adverse	Negligible	**Negligible**
Foredyke Stream Lower to Holderness Drain	Low	Approximately 3.2% of the catchment would be affected by construction of the onshore export cable corridor, which could result in the accidental release of contaminants to the surface drainage network. With mitigation in place, magnitude of impact would reduce from low to negligible, and significance of effect would reduce from minor adverse to negligible	Low	Minor adverse	Negligible	**Negligible**
Holderness Drain Source	Low	Approximately 3.1% of the catchment would be affected by construction of the onshore export cable corridor, which could result in the accidental release of contaminants to the surface drainage network. With mitigation in place, magnitude of impact would reduce	Low	Minor adverse	Negligible	**Negligible**

River water body catchment	Sensitivity	Assessment	Magnitude of impact		Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
to Foredyke Stream		from low to negligible, and significance of effect would reduce from minor adverse to negligible.					
Beverley and Barmston Drain	Low	Approximately 3.3% of the catchment would be affected by construction of the onshore export cable corridor, which could result in the accidental release of contaminants to the surface drainage network. With mitigation in place, magnitude of impact would reduce from low to negligible, and significance of effect would reduce from minor adverse to negligible.	Low	Minor adverse	Negligible	**Negligible**	
Hull from Arram Beck to Humber	Medium	Approximately 0.1% of the catchment would be affected by construction of the onshore export cable corridor, which could result in the accidental release of contaminants to the surface drainage network. With mitigation in place, magnitude of impact would reduce from low to negligible, and residual significance of effect would be minor adverse.	Low	Minor adverse	Negligible	**Minor** adverse	
High Hunsley to Arram Area	Low	Approximately 2.6% of the catchment would be affected by construction of the onshore export cable corridor, which could result in the accidental release of contaminants to the surface drainage network. With mitigation in place, magnitude of impact would reduce from low to negligible, and significance of effect would reduce from minor adverse to negligible.	Low	Minor adverse	Negligible	**Negligible**	
High Hunsley to Woodmansey Area	Low	Approximately 4.3% of the catchment would be affected by construction of the onshore export cable corridor and onshore substations, which could result in the accidental release of contaminants to the surface drainage network. With mitigation in place, magnitude of impact would reduce from low to negligible, and significance of effect would reduce from minor adverse to negligible.	Low	Minor adverse	Negligible	**Negligible**	
Hull and East Riding Chalk	High	Approximately 0.7% of the groundwater body would be affected by construction activities, which could result in the accidental release of contaminants to the surface drainage network. Although best practice mitigation would be in place, residual effects would remain negligible because magnitude of impact is negligible prior to mitigation.	Negligible	Minor adverse	Negligible	**Minor** adverse	

20.6.1.4 Impact 4 Changes to Surface and Groundwater Flows and Flood Risk

144. Initial site preparation activities and construction works would alter surface drainage patterns and surface flows by changing the distribution of surface drainage within the Onshore Development Area. Infiltration would be reduced, and surface runoff increased, by a reduction in the proportion of impermeable surfaces in a drainage catchment caused by the compaction of soil by construction vehicles and the development of surface infrastructure. This is directly related to the area of construction and can alter site runoff characteristics; the greater the area of construction, the greater the potential impact on surface and groundwater flows (including land drainage channels).

145. Temporary changes to surface flows because of trenched crossings of Ordinary Watercourses may also occur, particularly if the capacity of any pumps or flumes are exceeded. Any changes in surface flows can alter and/or increase flood risk in the proposed Onshore Development Area.

146. Subsurface flow patterns can be altered because of changes to infiltration rates, surface flows and the installation of impermeable subsurface infrastructure. Therefore, the construction of the onshore infrastructure associated with the Projects has the potential to generate increased surface water flows. This could result in increased discharge within watercourses and associated bed and bank scour, as well as in-wash of increased volumes of fine sediment related to the additional surface runoff. This could adversely affect hydrology and geomorphology of the surface drainage network.

147. Note that the potential flood risk implications of the project will be assessed in a separate FRA that will accompany the PEIR (**Appendix 20-3**).

20.6.1.4.1 Magnitude of Impact – DBS East or DBS West in Isolation

148. The proportion of each catchment disturbed by construction is used as a proxy for the area of land that could experience changes in land use, and therefore changes to infiltration rates, runoff rates and flood risk. The area of each water body catchment occupied by the Onshore Development Area is considered the worst case for all construction scenarios (i.e. build in isolation, concurrently or sequentially). This is because the final location of construction compounds is not yet known. Areas of disturbed ground per catchment and magnitude of impact for the construction of DBS East or DBS West in isolation will be presented in the ES.

20.6.1.4.2 Magnitude of Impact – DBS East and DBS West Together

149. Magnitude of impact is based on the area of ground in each catchment that could be disturbed by construction activities (**Table 20-17**) and therefore alter surface and subsurface flows and flood risk. Construction of the Projects sequentially is likely to lead to a greater magnitude of impact than a concurrent construction scenario due to the longer duration of work and thus greater potential for ground conditions to change (e.g. soils becoming compacted) and affect infiltration and flows. Magnitude of impact is low in all surface water catchments except Catchwater Drain (medium). Impact is negligible in the Hull and East Riding Chalk groundwater catchment.

20.6.1.4.3 Sensitivity of Receptor

150. Receptor sensitivity is described in **Table 20-11**. Of the twelve surface water catchments crossed by the Onshore Development Area, sensitivity is high three catchments, medium in three and low in six. High and medium sensitivity is related to the presence of designated sites (SSSIs); medium sensitivity is related to High WFD status for some biological and physico-chemical quality elements and the presence of Tophill Low Drinking Water Safeguard Zone. Sensitivity of the Hull and East Riding Chalk groundwater body is high due to the presence of a principal aquifer and SPZ.

20.6.1.4.4 Significance of Effect – DBS East or DBS West in Isolation

151. Significance of effect for the construction of DBS East or DBS West in isolation will be presented in the ES.

20.6.1.4.5 Significance of Effect – DBS East and DBS West Together

152. Prior to mitigation, effects are considered to be of minor adverse in all surface water bodies except for the coastal catchment, which is moderate adverse due to the presence of a SSSI (high sensitivity). The significance of the effect on each water body resulting from changes to surface and groundwater flows and flood risk due to construction of the Projects concurrently is given in **Table 20-20**. Effects are minor adverse in all catchments except the coastal catchment, which is moderate adverse due to its high sensitivity (SSSI).

20.6.1.4.6 Mitigation and Residual Significance of Effect – DBS East and DBS West in Isolation

153. Residual significance of effect for the construction of DBS East and DBS West in isolation will be presented in the ES

20.6.1.4.7 Mitigation and Residual Significance of Effect – DBS East and DBS West Together

154. The specific measures relevant to changes to surface and groundwater flows and flood risk described below. Mitigation is especially relevant for the coastal catchment (moderate significance of effect), but the following measures will be applied to all catchments to ensure best practice is followed and any potential impacts are minimised:

155. Changes in surface water runoff resulting from the increase in impermeable area following construction of the onshore export cable corridor, and particularly the onshore substations, would be attenuated and discharged at a controlled rate, in consultation with the LLFA (East Riding of Yorkshire Council) and the Environment Agency, and potentially Anglian Water (if a connection to their drainage infrastructure is required during construction of the onshore substation). An Operational Surface Water and Drainage Plan will be developed in consultation with the relevant regulators and approved by the relevant planning authority.

156. As described above for watercourse crossings, the Applicant will appoint a land drainage consultant to develop pre-and post-construction drainage plans. Land drainage systems will be maintained during construction and land drainage would be reinstated following completion of construction works during the reinstatement phase. An outline Code of Construction Practice (CoCP) and Soil Management Plan (SMP) will be submitted with the DCO and the DCO will contain a requirement to submit a final CoCP and SMP prior to commencement of construction.

157. During construction, the onshore cable installation would be designed such that it will be bounded by parallel drainage channels (one on each side) to intercept drainage within the working width. Additional drainage channels would be installed to intercept water from the cable trench. This would be discharged at a controlled rate into local ditches or drains via temporary interceptor drains. Depending upon the precise location, water from the channels would be infiltrated or discharged into the existing drainage network.

158. Construction drainage would be developed and implemented to minimise water within the cable trench and ensure ongoing drainage of surrounding land. If water enters the trenches during installation from surface runoff of groundwater seepage, this would be pumped via settling tanks, sediment basins or mobile treatment facilities to remove sediment, before being discharged into local ditches or drains via temporary interceptor drains. Existing land drains would be reinstated following construction.

159. As described for watercourse crossings, temporary culverts will be adequately sized to avoid impounding flows.

160. Residual effects are assessed in **Table 20-20**.

161. These measures will reduce the magnitude of impact. Impacts will reduce from low to negligible in all catchments except for the Catchwater Drain, which will reduce from medium to low. Residual effects will reduce from minor adverse to negligible where sensitivity is low. Effects will remain minor adverse where either sensitivity is medium or where magnitude of impact prior to mitigation is medium.

162. All effects relating to changes to surface and groundwater flows and flood risk for sequential construction of the Projects are deemed to be not significant.

Table 20-20 Impacts and Effects Associated with Changes to Surface and Groundwater Flows and Flood Risk Resulting from Construction of the Projects Sequentially

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Coastal catchment	High	Only a relatively small proportion of each catchment would be directly affected by construction activities, which could affect surface and groundwater flows. Across entire catchments, these activities would not lead to a significant change in surface water drainage or flood risk. Although each catchment except the Hull from Arram Beck to Humber will have trenched crossings, which could affect flows through the capacity of pumps or flumes, with mitigation in place, impacts are for all catchments would reduce to from medium to low (Catchwater Drain) or low to negligible, and effects would be either minor adverse or negligible.	Low	Moderate adverse	Negligible	**Minor** adverse
Barmston Sea Drain/Skipsea Drain to Conf	Medium		Low	Minor adverse	Negligible	**Minor** adverse
Mickley Dike catchment	Medium		Low	Minor adverse	Negligible	**Minor** adverse
Old Howe/Frodingham Beck to R Hull	Medium		Low	Minor adverse	Negligible	**Minor** adverse
Catchwater Drain	Low		Medium	Minor adverse	Low	**Minor** adverse
Foredyke Stream Upper	Low		Low	Minor adverse	Negligible	**Negligible**
Foredyke Stream Lower to Holderness Drain	Low		Low	Minor adverse	Negligible	**Negligible**
Holderness Drain Source to Foredyke Stream	Low		Low	Minor adverse	Negligible	**Negligible**
Hull from Arram Beck to Humber	Medium		Low	Minor adverse	Negligible	**Minor** adverse
High Hunsley to Arram Area	Low		Low	Minor adverse	Negligible	**Negligible**
High Hunsley to Woodmansey Area	Low		Low	Minor adverse	Negligible	**Negligible**
Beverley and Barmston Drain	Low	Approximately 3.3% of the catchment would be affected by construction of the onshore export cable corridor, which could lead to changes in surface and groundwater flows. Although there could be up to 16 trenched crossings in this catchment, which could affect flows through the capacity of pumps or flumes, with mitigation in place, magnitude of impact would reduce from low to negligible, and significance of effect minor adverse to negligible.	Low	Minor adverse	Negligible	**Negligible**

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Hull and East Riding Chalk	High	A very low proportion (0.7%) of the total area of the groundwater body catchment would be affected by construction of the Projects. This is likely to have a minimal impact on subsurface flows and the potential to cause flood risk. Although best practice mitigation would be in place, magnitude of impact prior to mitigation is negligible, which means residual significance of effect would remain minor adverse.	Negligible	Minor adverse	Negligible	**Minor** adverse

20.6.2 Potential Effects During Operation

20.6.2.1 Impact 1 Accidental Release of Contaminants to Surface and Groundwater

163. Operational activities at the possible landfall location, along the onshore export cable corridor and at the onshore substations will include planned and unplanned maintenance. This could lead to a supply of fine sediment, fuels, oils and lubricants from the road network and other impermeable surfaces, which could affect water quality and geomorphology of water bodies in the surface water drainage network. This in turn could impact upon aquatic ecology.

164. Contaminants may leak into surface waters during operation through surface runoff or accidental spillage or leakage of fuel oils or lubricants from vehicles during operational activities, which could impact upon surface water quality and that of connected groundwaters (including aquifers which support potable water supplies, particularly in SPZ1). This could have subsequent impacts upon aquatic ecology and the use of water resources for licensed and unlicensed abstractions.

165. In addition, welfare facilities at the onshore substations could increase the supply of nutrients such as nitrogen and phosphorus to the drainage system, either as direct discharges from the site or as increased loadings to the sewage treatment network and associated treated effluent discharges. The supply of additional nutrients to surface waters could result in adverse effects on water quality (including, in extreme cases, eutrophication) and aquatic plant, invertebrate and fish communities supported by surface waters.

20.6.2.1.1 Magnitude of Impact – DBS East or DBS West in Isolation

166. The area of installed infrastructure (above ground or buried) can be used as a proxy to indicate the extent of required maintenance activities in each catchment for the different build scenarios (**Table 20-21**). These figures are based on the area of permanent land take for the landfall, transition joint bays, onshore export cable trenches, joint bays and onshore substations.

167. If either Project is built in isolation, catchment areas occupied by permanent infrastructure are very small, with a maximum of 0.172km^2 for surface water catchments, and 0.399km^2 for the groundwater catchment. These areas equate to very small proportions of each catchment ($\leq$0.177% for all catchments except for High Hunsley to Woodmansey Area (1.00%)). For a worst case scenario, it is assumed that a HVAC air insulated substation (AIS) will be built in onshore Substation Zone 1 (i.e. the High Hunsley to Woodmansey Area catchment). However, if the HVAC AIS is built in Substation Zone 4, the percentage figure would fall to less than 1% because the onshore substation would very likely be located partially within Beverley and Barmston Drain's catchment.

Table 20-21 Areas and Percentages of Permanent Infrastructure in Each Surface and Groundwater Catchment for Different Build Scenarios

Catchment	Isolation		Concurrent / Sequential	
	Area of permanent infrastructure		Area of permanent infrastructure	
	km^2	%	km^2	%
Beverley and Barmston Drain	0.172	0.164	0.209	0.199
Catchwater Drain	0.040	0.177	0.079	0.354
Foredyke Stream Lower to Holderness Drain	0.017	0.074	0.033	0.147
Foredyke Stream Upper	0.027	0.137	0.054	0.274
High Hunsley to Arram Area	0.028	0.067	0.055	0.135
High Hunsley to Woodmansey Area	0.153	1.003	0.170	1.119

Catchment	Isolation		Concurrent / Sequential	
	Area of permanent infrastructure		Area of permanent infrastructure	
	km²	%	km²	%
Holderness Drain Source to Foredyke Stream	0.038	0.087	0.076	0.173
Hull from Arram Beck to Humber	0.001	0.003	0.002	0.006
Mickley Dike Catchment	0.002	0.014	0.005	0.029
Old Howe/ Frodingham Beck to River Hull	0.030	0.117	0.059	0.234
Barmston Sea Drain/ Skipsea Drain to Confluence	0.027	0.069	0.052	0.133
Coastal catchment	0.004	0.073	0.006	0.109
Hull and East Riding Chalk	0.399	0.020	0.727	0.037

168. If either Project is built in isolation, magnitude of impact in each catchment receptor resulting from operational activities at the landfall and along the onshore export cable corridor are negligible prior to mitigation, due to the relatively infrequent and highly localised nature of likely operation and maintenance activities, which in turn are unlikely to generate large volumes or contaminants that could have a discernible alteration to the water quality of receptors.

169. In the event of a cable failure, it is likely that the affected stretch of cable (500-1,000m section) would be pulled out of the duct and replaced. To do this the joint bays, which are below ground at either end of that stretch of cable, would be exposed to get access to those bays, and then backfilled after the works are complete. This activity would be highly localised and may not be required during the operational life of the cable infrastructure.

170. The High Hunsley to Woodmansey Area catchment is the exception. Magnitude of impact is likely to be low as the catchment is likely to contain the onshore substation, and therefore the potential for oil leakage from transformers. This area will also require more frequent maintenance and foul water drainage, and also represents a larger area of impermeable above-ground infrastructure with the potential to cause an increase in surface water runoff. This can translate to a greater potential for contaminants to be released into the surface water system.

20.6.2.1.2 Magnitude of Impact – DBS East and DBS West Together

171. Building the Projects together (concurrently or sequentially) would result in the same area of permanent infrastructure in each catchment for each scenario. Catchment areas occupied by permanent infrastructure are very small, with a maximum of 0.209km^2 for surface water catchments, and 0.727km^2 for the groundwater catchment. These areas equate to very small proportions of each catchment ($\leq$0.354% for all catchments except for the High Hunsley to Woodmansey Area catchment (1.119%)). For a worst case scenario, it is assumed that a HVAC air insulated substation (AIS) will be built in onshore Substation Zone 1 (i.e. the High Hunsley to Woodmansey Area catchment). However, if the HVAC AIS is built in Substation Zone 4, the percentage figure would fall to less than 1% because the onshore substation would very likely be located partially within Beverley and Barmston Drain's catchment.

172. Magnitudes of impact in each receptor, prior to mitigation, are negligible due to the relatively infrequent nature of likely operation and maintenance activities, which in turn are unlikely to generate large volumes or contaminants that could have a discernible alteration to the water quality of receptors.

173. The High Hunsley to Woodmansey Area catchment is the exception. Magnitude of impact is likely to be low as the catchment is likely to contain the onshore substation, and therefore the potential for oil leakage from transformers. This area will also require more frequent maintenance and foul water drainage, and also represents a larger area of impermeable above-ground infrastructure with the potential to cause an increase in surface water runoff. This can translate to a greater potential for contaminants to be released into the surface water system.

20.6.2.1.3 Sensitivity of Receptor

174. Receptor sensitivity is described in **Table 20-11**. Of the twelve surface water catchments crossed by the Onshore Development Area, sensitivity is high in three catchments, medium in three and low in six. High and medium sensitivity is related to the presence of designated sites (SSSIs); medium sensitivity is related to High WFD status for some biological and physico-chemical quality elements and the presence of Tophill Low Drinking Water Safeguard Zone.

20.6.2.1.4 Significance of Effect – DBS East or DBS West in Isolation

175. Prior to mitigation, the significance of effect of the potential accidental release of contaminants into water bodies resulting from the operation of a single Project in isolation is negligible or minor adverse across all receptors (**Table 20-22**).

20.6.2.1.5 Significance of Effect – DBS East and DBS West Together

176. Prior to mitigation, the significance of effect of the potential supply of contaminants into water bodies resulting from the operation of the Projects together is negligible (**Table 20-23**) or minor adverse across all receptors. This is discussed in **Table 20-23**.

20.6.2.1.6 Mitigation and Residual Significance of Effect – DBS East or DBS West in Isolation

177. Operational drainage at the onshore substation would be developed according to the principles of the sustainable drainage system (SuDS) discharge hierarchy and is secured through CoCP. The aim will be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable: i) into the ground (infiltration); ii) to a surface water body; iii) to a surface water sewer, highway drain or another drainage system; or iv) to a combined sewer. This will include attenuation and hydrocarbon interceptors to prevent the accidental release of contaminants (including oils and fine sediment).

178. Foul waters from welfare facilities will either be discharged through a mains connection to an existing mains sewer (if such a connection is available) or collected in a septic tank located within the DCO order limits and transported off site for disposal at a licensed facility with appropriate treatment capacity within its existing permit. The operational use of the onshore substation site is likely to be limited to a low number of workers visiting per week, and as such additional nutrient loadings are likely to be very low.

179. All fuels, oils, lubricants and other chemicals used at the onshore substation would be stored in an impermeable bund with at least 110% of the stored capacity. Damaged containers will be removed from site and all refuelling would take place in a dedicated impermeable area, using a bunded bowser. Biodegradable oils will be used where possible.

180. Spill kits would be available on site at all times. Sand bags or stop logs will also be available for deployment on the outlets from the site drainage system in case of emergency.

181. Given the sporadic nature of maintenance activities along the onshore export cable corridor and the predicted lack of impact, no permanent mitigation is proposed beyond that suggested for the onshore substations. Any excavations along the onshore export cable corridor route would employ best-practice measures to manage runoff and the supply of sediment and contaminants from construction sites (sections 20.6.1.2.6 and 20.6.1.4.6).

182. Permanent mitigation at the substation and best practice mitigation related to localised and infrequent maintenance along the onshore export cable corridor means that significance of effect is negligible in all catchments. For catchments with high or medium sensitivity and negligible magnitude of impact, residual significance of effect has been set to negligible instead of minor adverse. This is because mitigation measures will prevent the accidental release of contaminants to surface and groundwater and associated protected areas. These measures will minimise the likelihood of an accidental release and put in place procedures for an effective response to any pollution event. As a result, effects greater than negligible are considered very unlikely.

183. All operational effects relating to the accidental release of contaminants to surface and groundwaters for construction of the Projects in isolation are deemed to be not significant.

20.6.2.1.7 Mitigation and Residual Significance of Effect – DBS East and DBS West Together

184. If the Projects are built together (concurrently or sequentially) the same mitigation would be used as described for a Project in isolation (section 20.6.2.1.6). Permanent mitigation at the substation and best practice mitigation related to localised and infrequent maintenance along the onshore export cable corridor means that significance of effect is negligible in all catchments. For catchments with high or medium sensitivity and negligible magnitude of impact, residual significance of effect has been set to negligible instead of minor adverse. This is because mitigation measures will prevent the accidental release of contaminants to surface and groundwater and associated protected areas. These measures will minimise the likelihood of an accidental release and put in place procedures for an effective response to any pollution event. As a result, effects greater than negligible are considered very unlikely.

185. All operational effects relating to the accidental release of contaminants to surface and groundwaters for construction of the Projects in together are deemed to be not significant.

Table 20-22 Effects Associated with the Accidental Release of Contaminants due to the Operation of a Project in Isolation

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Barmston Sea Drain/Skipsea Drain to Conf	Medium	Permanent infrastructure would have a limited spatial extent within each catchment. Infrequent maintenance activities would be necessary during the operational life of the Project. However, the mechanism for contaminants to enter the surface water drainage system, as a result of the operation of the Project, is limited and best practice mitigation would minimise the likelihood of an accidental release and put in place procedures for an effective response to any pollution event.	Negligible	Minor adverse	Negligible	**Negligible**
Coastal catchment	High		Negligible	Minor adverse	Negligible	**Negligible**
Mickley Dike catchment	Medium		Negligible	Minor adverse	Negligible	**Negligible**
Old Howe/Frodingham Beck to R Hull	Medium		Negligible	Minor adverse	Negligible	**Negligible**
Catchwater Drain	Low		Negligible	Negligible	Negligible	**Negligible**
Foredyke Stream Upper	Low		Negligible	Negligible	Negligible	**Negligible**
Foredyke Stream Lower to Holderness Dr	Low		Negligible	Negligible	Negligible	**Negligible**
Holderness Drain Source to Foredyke Stream	Low		Negligible	Negligible	Negligible	**Negligible**
Beverley and Barmston Drain	Low		Negligible	Negligible	Negligible	**Negligible**
Hull from Arram Beck to Humber	Medium		Negligible	Minor adverse	Negligible	**Negligible**
High Hunsley to Arram Area	Low		Negligible	Negligible	Negligible	**Negligible**
High Hunsley to Woodmansey Area	Low	The High Hunsley to Woodmansey Area may contain all or part of the onshore substations. This forms a small proportion of the overall catchment, and although some routine maintenance would be required throughout the operational life of the Project, mitigation measures will be in place to control any potential accidental release of oils from the transformer, foul drainage and surface water drainage.	Low	Minor adverse	Negligible	**Negligible**

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Hull and East Riding Chalk	High	Only 0.002% of the groundwater body will be impacted by the Onshore Development Area. Infrequent planned and unplanned maintenance activities would be necessary during the operational life of the Project. Mitigation measures will control potential for accidental release of foul drainage and surface water drainage from the substation.	Negligible	Minor adverse	Negligible	**Negligible**

Table 20-23 Effects Associated with the Accidental Release of Contaminants due to the Operation of the Projects Together

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Barmston Sea Drain/Skipsea Drain to Conf	Medium	Permanent infrastructure would have a limited spatial extent within each catchment. Infrequent maintenance activities would be necessary during the operational life of the Projects. However, the mechanism for contaminants to enter the surface water drainage system as a result of the operation of the Projects is limited and best practice mitigation would minimise the likelihood of an accidental release and put in place procedures for an effective response to any pollution event.	Negligible	Minor adverse	Negligible	**Negligible**
Coastal catchment	High		Negligible	Minor adverse	Negligible	**Negligible**
Mickley Dike catchment	Medium		Negligible	Minor adverse	Negligible	**Negligible**
Old Howe/Frodingham Beck to R Hull	Medium		Negligible	Minor adverse	Negligible	**Negligible**
Catchwater Drain	Low		Negligible	Negligible	Negligible	**Negligible**
Foredyke Stream Upper	Low		Negligible	Negligible	Negligible	**Negligible**
Foredyke Stream Lower to Holderness Dr	Low		Negligible	Negligible	Negligible	**Negligible**
Holderness Drain Source to Foredyke Stream	Low		Negligible	Negligible	Negligible	**Negligible**
Beverley and Barmston Drain	Low		Negligible	Negligible	Negligible	**Negligible**
Hull from Arram Beck to Humber	Medium		Negligible	Minor adverse	Negligible	**Negligible**
High Hunsley to Arram Area	Low		Negligible	Negligible	Negligible	**Negligible**
High Hunsley to Woodmansey Area	Low	The High Hunsley to Woodmansey Area catchment may contain all or part of the onshore substations. This forms a small proportion of the overall catchment, and although some routine maintenance would be required throughout the operational life of the Projects, however, mitigation measures will be in place to control any potential accidental release of oils from the transformer, foul drainage and surface water drainage.	Low	Minor adverse	Negligible	**Negligible**

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Hull and East Riding Chalk	High	Only 0.002% of the groundwater body will be impacted by the Onshore Development Area. Infrequent planned and unplanned maintenance activities would be necessary during the operational life of the Projects. Mitigation measures will control potential for accidental release of foul drainage and surface water drainage from the substations.	Negligible	Minor adverse	Negligible	**Negligible**

20.6.2.2 Impact 2 Changes to Surface and Groundwater Flows and Flood Risk

186. Permanent above ground infrastructure, including the onshore substations and any new permanent access tracks, would result in permanent changes to land use. Permeable surface treatments will be used where possible at the onshore substations.

187. The presence of the buried cable ducting along the onshore export cable corridor may impact upon subsurface flow corridors as it will introduce an impermeable barrier which may change subsurface flow patterns; forcing water to move upwards towards the surface, or downwards away from the surface. Buried cable ducting may also impact upon the level of recharge and distribution of groundwater within the aquifers underlying the Onshore Development Area (including shallow aquifers and deeper Principal aquifers). However, the relatively shallow depth of the cable infrastructure (1.6 to 2m (locally up to 20m deep at trenchless crossings)) means that any impacts are likely to be highly localised and confined to shallow near-surface groundwater bodies,

188. An increase in the impermeable area in a catchment would result in a reduced rate of infiltration and therefore a potential increase in surface runoff in watercourses, including land drainage channels. Changes in surface water runoff and subsurface flows could be sufficient to impact upon the hydrology of the surface water system, by increasing surface water volumes, and may result in permanent changes to geomorphology by increasing rates of bed and bank erosion, encouraging geomorphological adjustment. Geomorphological changes may also impact upon in-channel habitat conditions for aquatic organisms. Impacts on geomorphology and in-channel habitats are likely to be particularly marked if drainage from a large area is discharged at a discrete location within the existing surface drainage network.

189. Furthermore, the ground disturbance during installation of the cable trench is likely to change the transmissivity of the ground which overlays the cable infrastructure after reinstatement and may therefore become a preferential corridor for subsurface water flow.

190. Changes to the proportion of groundwater contained in surface waters could potentially alter water chemistry and impact upon the quality of water-dependent habitats.

20.6.2.2.1 Magnitude of Impact – DBS East or DBS West in Isolation

191. The scale of potential impact upon catchment receptors if either Project is built in isolation is proportional to the area of permanent infrastructure in each catchment during operation, as described (**Table 20-21**). Magnitude of impact in each receptor is discussed in **Table 20-24**, but has been assessed as being negligible in all catchments except in High Hunsley to Woodmansey Area, where it is low. This is because all or part of the onshore substation, and associated permanent infrastructure, could be located in this catchment. Permanent infrastructure could alter surface flow patterns. For all other catchments, impacts are anticipated to be negligible due to the very small proportion of the catchment containing operational above or below ground infrastructure, and therefore a lack of mechanism for impact during operation.

20.6.2.2.2 Magnitude of Impact – DBS East and DBS West Together

192. The scale of potential impact upon a catchment is proportional to the area of permanent infrastructure in each catchment during operation (**Table 20-21**). This has been estimated based on the area of onshore export cable trenches, transition joint bays and onshore substations (**Table 20-21**) and is a greater area for the Projects together (concurrently or sequentially) than in isolation.

193. Magnitude of impact in each receptor is discussed in **Table 20-25**, but has been assessed as being negligible in all catchments except in High Hunsley to Woodmansey Area, where it is low. This is because all or part of the onshore substations, and associated permanent infrastructure, could be located in this catchment. Permanent infrastructure could alter surface flow patterns. For all other catchments, impacts are anticipated to be negligible due to the very small proportion of the catchment containing operational above or below ground infrastructure, and therefore a lack of mechanism for impact during operation.

20.6.2.2.3 Sensitivity of Receptor

194. Receptor sensitivity is described in **Table 20-11**. Of the twelve surface water catchments crossed by the Onshore Development Area, sensitivity is high three catchments, medium in three and low in six. High and medium sensitivity is related to the presence of designated sites (SSSIs); medium sensitivity is related to High WFD status for some biological and physico-chemical quality elements and the presence of Tophill Low Drinking Water Safeguard Zone.

20.6.2.2.4 Significance of Effect – DBS East or DBS West in Isolation

195. Significance of effect for each catchment receptor as a result of the operation of either Project in isolation is given in **Table 20-24**, and is assessed as negligible or minor adverse for all receptors.

20.6.2.2.5 Significance of Effect – DBS East and DBS West Together

196. Significance of effect for each catchment receptor as a result of the operation of the Projects in together (concurrent or sequentially) is given in **Table 20-25**, and is assessed as negligible or minor adverse for all receptors.

20.6.2.2.6 Mitigation and Residual Significance of Effect – DBS East or DBS in Isolation

197. Surface water drainage at the onshore substation would be designed to meet the requirements of the NPPF and NPS EN-5, with runoff limited, where feasible, through the use of infiltration techniques which can be accommodated within the DCO Order limits. The drainage would be developed according to the principles of the SuDS discharge hierarchy. Generally, the aim will be to discharge surface water runoff as high up the following hierarchy of drainage options as reasonably practicable: i) into the ground (infiltration); ii) to a surface water body; iii) to a surface water sewer, highway drain or another drainage system; or iv) to a combined sewer. This will include attenuation and hydrocarbon interceptors to prevent the accidental release of contaminants (including oils and fine sediment). No mitigation is proposed specifically along the onshore export cable corridor.

198. Following the implementation of mitigation measures at the onshore substation, the potential for increased surface water runoff and flood risk during the operational phase of a Project in isolation would be reduced in the High Hunsley to Woodmansey Area catchment. This means significance of effect would be negligible.

199. For surface water bodies associated with the onshore export cable corridor, no mitigation measures are proposed, and the effects will remain of either negligible or minor adverse.

200. All operational effects relating changes to surface and groundwater flows and flood risk for construction of the Projects in isolation are deemed to be not significant.

20.6.2.2.7 Mitigation and Residual Significance of Effect – DBS East and DBS in Together

201. If the Projects are built together (concurrently or sequentially) the same mitigation would be used as described for a Project in isolation (section 20.6.2.2.6). Following the implementation of mitigation measures at the onshore substations, the potential for increased surface water runoff and flood risk during the operational phase of a Project in isolation would be reduced in the High Hunsley to Woodmansey Area catchment. This means significance of effect would be negligible.

202. For surface water bodies associated with the onshore export cable corridor, no mitigation measures are proposed, and the effects will remain of either negligible or minor adverse.

203. All operational effects relating changes to surface and groundwater flows and flood risk for construction of the Projects together are deemed to be not significant.

Table 20-24 Effects Associated with Surface and Groundwater Flows and Flood Risk Associated with the Operation of a Project in Isolation

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Barmston Sea Drain/Skipsea Drain to Conf	Medium	As a result of the limited spatial extent of permanent impermeable development across the Onshore Development Area, effects are considered to be of negligible or minor adverse magnitude in all catchments. No operational mitigation measures are proposed for the cable corridor and associated infrastructure therefore the magnitude of effect will remain negligible or minor adverse.	Negligible	Minor adverse	Negligible	**Minor** adverse
Coastal catchment	High		Negligible	Minor adverse	Negligible	**Minor** adverse
Mickley Dike catchment	Medium		Negligible	Minor adverse	Negligible	**Minor** adverse
Old Howe/ Frodingham Beck to R Hull	Medium		Negligible	Minor adverse	Negligible	**Minor** adverse
Catchwater Drain	Low		Negligible	Negligible	Negligible	**Negligible**
Foredyke Stream Upper	Low		Negligible	Negligible	Negligible	**Negligible**
Foredyke Stream Lower to Holderness Dr	Low		Negligible	Negligible	Negligible	**Negligible**
Holderness Drain Source to Foredyke Stream	Low		Negligible	Negligible	Negligible	**Negligible**
Beverley and Barmston Drain	Low		Negligible	Negligible	Negligible	**Negligible**
Hull from Arram Beck to Humber	Medium		Negligible	Minor adverse	Negligible	**Minor** adverse
High Hunsley to Arram Area	Low		Negligible	Negligible	Negligible	**Negligible**
High Hunsley to Woodmansey Area	Low	A small proportion of the High Hunsley to Woodmansey Area catchment could potentially be impacted by changes to surface water runoff, groundwater flows and flood risk resulting from the permanent presence of the onshore substation. However, mitigation measures implemented to ensure that runoff rates remain at their greenfield rates would reduce the magnitude to negligible.	Low	Minor adverse	Negligible	**Negligible**

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Hull and East Riding Chalk	High	It is expected that subsurface (groundwater) flows would pass above or below the ducting along the cable corridor and would not change significantly. As a result, although there will be some minor changes in the distribution of flows, there is unlikely to be a significant perturbation/change in overall flow directions and quantities. Furthermore, the size and shallow depth of the impermeable subsurface barrier created by cable ducting and foundations for the onshore substation, in comparison to the size of the groundwater bodies which underlie the Onshore Development Area, is very small. The impermeable area comprises is 0.02% of the overall area of the groundwater body. This would result in an effect upon infiltration rates, groundwater lows, sub-surface flow corridors and alterations in the distribution of groundwater of negligible magnitude.	Negligible	Minor adverse	Negligible	**Minor** adverse

Table 20-25 Effects Associated with Surface and Groundwater Flows and Flood Risk Associated with the Operation of the Projects Together (Concurrent or Sequential)

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
Barmston Sea Drain/ Skipsea Drain to Conf	Medium	As a result of the limited spatial extent of permanent impermeable development across the Onshore Development Area, effects are considered to be of negligible or minor adverse magnitude in all catchments. No operational mitigation measures are proposed for the cable corridor and associated infrastructure therefore the magnitude of effect will remain negligible or minor adverse.	Negligible	Minor adverse	Negligible	**Minor** adverse
Coastal catchment	High		Negligible	Minor adverse	Negligible	**Minor** adverse
Mickley Dike catchment	Medium		Negligible	Minor adverse	Negligible	**Minor** adverse
Old Howe/ Frodingham Beck to R Hull	Medium		Negligible	Minor adverse	Negligible	**Minor** adverse
Catchwater Drain	Low		Negligible	Negligible	Negligible	**Negligible**
Foredyke Stream Upper	Low		Negligible	Negligible	Negligible	**Negligible**
Foredyke Stream Lower to Holderness Dr	Low		Negligible	Negligible	Negligible	**Negligible**
Holderness Drain Source to Foredyke Stream	Low		Negligible	Negligible	Negligible	**Negligible**
Beverley and Barmston Drain	Low		Negligible	Negligible	Negligible	**Negligible**
Hull from Arram Beck to Humber	Medium		Negligible	Minor adverse	Negligible	**Minor** adverse
High Hunsley to Arram Area	Low		Negligible	Negligible	Negligible	**Negligible**

River water body catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect prior to mitigation	Magnitude of impact following mitigation	Residual significance of effect following mitigation
High Hunsley to Woodmansey Area	Low	A small proportion of the High Hunsley to Woodmansey Area catchment could potentially be impacted by changes to surface water runoff, groundwater flows and flood risk resulting from the permanent presence of the onshore substations. However, mitigation measures implemented to ensure that runoff rates remain at their greenfield rates would reduce the magnitude to negligible.	Low	Minor adverse	Negligible	**Negligible**
Hull and East Riding Chalk	High	It is expected that groundwater flows would pass above or below the ducting along the offshore export cable corridor, and flows would not change significantly. Although there will be some minor changes in the distribution of flows, there is unlikely to be a significant change in overall flow directions and quantities. Furthermore, the size and shallow depth of the impermeable infrastructure, in comparison to the size of the groundwater bodies which underlie the Onshore Development Area, is very small. The impermeable area comprises is 0.02% of the overall area of the groundwater body. Effects upon infiltration rates, groundwater lows, sub-surface flow corridors and alterations in the distribution of groundwater would be of negligible magnitude.	Negligible	Minor adverse	Negligible	**Negligible**

20.6.3 Potential Effects During Decommissioning

204. No final decision regarding the final decommissioning policy for the onshore project infrastructure including the landfall, onshore export cable route and onshore substations has yet been made. It is also recognised that legislation and industry best practice change over time. However, it is anticipated that the onshore electrical cables will be left in-situ with ends cut, sealed and buried to minimise environmental effects associated with removal.

205. The detail and scope of the decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator. It is anticipated that for the worst case scenario, the impacts and effects will be no greater than those identified for the construction phase (section 20.6.1).

20.7 Preliminary Assessment of Cumulative Effects

206. As detailed in Section 20.4.4, this section presents a preliminary assessment of cumulative effects in relation to Flood Risk and Hydrology. The final CEA will be undertaken within the ES chapter.

20.7.1 Initial Screening for Cumulative Effects

207. **Table 20-26** details the potential cumulative effects that may occur between the Projects and other plans, projects and activities. Only potential impacts assessed in Section 20.6 where the potential for cumulative effects has been identified (minor, moderate or major) will be taken forward to the final CEA (i.e. those assessed as 'no impact' are not taken forward as there is no potential for them to contribute to a cumulative impact).

Table 20-26 Potential Cumulative Effects

Impact	Potential for Cumulative Effects	Data Confidence	Rationale
Construction			
Impact 1: Direct disturbance of surface water bodies	Yes	Low Confidence will be increased in the ES	Impacts to surface water bodies could act cumulatively with other projects if these cause direct disturbance to the same water body catchments.
Impact 2: Increased sediment supply	Yes	Low Confidence will be increased in the ES	Other projects being constructed within the same water body catchments may lead to an increase in sediment supply to the surface water drainage system which could act cumulatively.
Impact 3: Accidental release of contaminants to surface and groundwaters	Yes	Low Confidence will be increased in the ES	Other projects being constructed within the same water body catchments may act cumulatively to reduce surface and groundwater quality if they cause contaminants to be released into the surface water drainage system.
Impact 4: Changes to surface and groundwater flows and flood risk	Yes	Low Confidence will be increased in the ES	Other projects being constructed within the same water body catchments could increase the area of impermeable ground and alter surface and subsurface flow patterns. This could increase flood risk.

Impact	Potential for Cumulative Effects	Data Confidence	Rationale
Operation & Maintenance			
Impact 1: Accidental release of contaminants to surface and groundwaters	Yes	Low Confidence will be increased in the ES	All new developments are likely to have operational or maintenance requirements which may require regular access by machinery, therefore increasing the likelihood of contaminants being released and acting cumulatively. However, operational activities associated with the project will be largely confined to the onshore substation site and as such could only result in cumulative impacts in the catchments which contain the onshore substation (Holland Brook and Tenpenny Brook)
Impact 2: Changes to surface and groundwater flows and flood risk	Yes	Low Confidence will be increased in the ES	As a result of the limited spatial extent of permanent impermeable in the onshore project area, the effect is considered to be limited and highly localised and therefore unlikely to act cumulatively with other projects. However, the greater area of impermeable ground at the substation could result in cumulative impacts with other projects in the same catchments (Holland Brook, Tenpenny Brook).
Decommissioning			
Decommissioning strategies have not yet been finalised; however, the cumulative impacts are expected to be the same as those of the initial construction phase.			

20.7.2 Plans/Projects Considered for Cumulative Impacts

208. A high-level list of plans/projects that may result in cumulative effects with the Projects is detailed in **Table 20-27**. For Flood Risk and Hydrology, surface hydrological catchments crossed by the onshore development area have been used to determine the initial list of projects considered for the CEA.

209. Plans / projects have been assigned a tier level between 1 and 7, based on the most recent guidance (see **Chapter 6 EIA Methodology**). For the final CEA at ES, this high-level list will be reviewed and screened to ensure all relevant plans / projects are considered in the final assessment. All listed plans / projects will be re-examined at ES to ensure each assigned tier remains accurate at the time of writing.

210. In addition to other offshore wind farms, the classes of projects that could potentially be considered for the cumulative assessment of infrastructure and other users includes:

- Other energy generation projects (e.g. solar farms, Scotland England Green Link 2, new national grid substation)
- Infrastructure development (e.g. road improvements)
- Building developments (e.g. recycling centre)

211. With respect to these activities, the cumulative assessment considers them to be part of the baseline conditions for the surrounding area. As such, it is not expected that the Projects will contribute to cumulative effects with the existing activities in the above list, and therefore these have been have not been the subject of further assessment.

Table 20-27 High-Level List of Plans/Projects Screened For Further Assessment in the Final CEA

Tier	Plan / Project	Distance to Onshore Development Area (km)
2	Dogger Bank A & B Offshore Wind Farm	Crosses onshore export cable corridor
3	A164 and Jock Lodge Junction Improvement Scheme	Crosses onshore export cable corridor
3	Solar Farm – Land south of Creyke Beck Substation, 4875 Park Lane, Cottingham	Within Onshore Development Area
3	Solar Farm – Land east and west of West of Tickton Bridge Plantation, Main Road, Routh	Adjacent to the Onshore Development Area
4	Hornsea Project Four Offshore Wind Farm	Adjacent to onshore export cable corridor
4	Scotland England Green Link 2	3.5
4	Solar Farm – Land north east and west of Carr Plantation, Ferry Road, Wawne	1.5
4	Household Recycling Centre – Land north west of Ings Road Picnic Site, Molescroft	Within Onshore Development Area
6	Solar Farm – Robson & Co, White Hall, Shepard Lane, Woodmansey	Within Onshore Development Area
7	New National Grid Substation (Birkill Wood)	Within Onshore Development Area
7	North Humber to High Marnham	Within Onshore Development Area
7	Creyke Beck Substation Extension	400m from Onshore Development Area

20.8 Potential Monitoring Requirements

212. Monitoring requirements will be described in the In-Principal Monitoring Plan (IPMP) submitted alongside the DCO application and further developed and agreed with stakeholders prior to construction based on the IPMP and taking account of the final detailed design of the Projects.

213. Construction work has the potential to disturb soils and release contaminants (section 20.6.1). As there is a designated site (SSSI) and drinking water resources (Principal aquifer, SPZs, surface water and groundwater protection zones), within the Onshore Development Area, water quality monitoring may be required. Parameters would be agreed with the Environment Agency but may include a range of metals, PAHs (polycyclic aromatic hydrocarbons), PCBs (polychlorinated biphenyls), VOCs (volatile organic compounds), petroleum hydrocarbons and general inorganics (pH, BOD (biochemical oxygen demand), dissolved oxygen, suspended and dissolved solids).

214. If monitoring is required, details would be formalised in a water quality monitoring protocol which would be secured under the DCO.

20.9 Interactions

215. The effects identified and assessed in this chapter have the potential to interact with each other. The areas of potential interaction between effects are presented in **Table 20-28**. This provides a screening tool for which effects have the potential to interact.

216. **Table 20-29** provides an assessment for each receptor (or receptor group) as related to these impacts. Effects are assessed relative to each development phase to see if multiple effects could increase the significance of the effect upon a receptor. Following this a lifetime assessment is undertaken which considers the potential for effect to affect receptors across all development phases.

Table 20-28 Interactions Between Impacts - Screening

Potential Interactions between Impacts				
Construction	Impact 1: Direct disturbance of surface water bodies	Impact 2: Increased sediment supply	Impact 3 Accidental release of contaminants	Impact 4: Changes to surface water runoff and flood risk
Impact 1: Direct disturbance of surface water bodies		Yes	Yes	Yes
Impact 2: Increased sediment supply	Yes		Yes	Yes
Impact 3: Accidental release of contaminants	Yes	Yes		No
Impact 4: Changes to surface water runoff and flood risk	Yes	Yes	No	
Operation	Impact 1: Accidental release of contaminants		Impact 2: Changes to surface water runoff and flood risk	
Impact 1: Accidental release of contaminants			No	
Impact 2: Changes to surface water runoff and flood risk	No			
Decommissioning	Impact 1: Direct disturbance of surface water bodies	Impact 2: Increased sediment supply	Impact 3: Accidental release of contaminants	Impact 4: Changes to surface water runoff and flood risk
Impact 1: Direct disturbance of surface water bodies		Yes	Yes	Yes
Impact 2: Increased sediment supply	Yes		Yes	Yes
Impact 3: Accidental release of contaminants	Yes	Yes		No
Impact 4: Changes to surface water runoff and flood risk	Yes	Yes	No	

Table 20-29 Interaction Between Impacts - Phase and Lifetime Assessment

Receptor	**Highest Significance Level following mitigation**				
	Construction	Operation	Decommissioning	Phase Assessment	Lifetime Assessment
Surface watercourses	Minor adverse	Negligible	Minor adverse	No greater than individually assessed impact The proposed mitigation will minimise the potential for the direct disturbance of watercourses, the direct (from in-channel works) and indirect (from activities in the vicinity of the channel) supply of fine sediment and contaminants, and changes to surface hydrology and flow patterns during the construction phase. There would be no direct disturbance during operation, and further measures would be in place to prevent the accidental release of contaminants or changes to flow patterns during operation. It is therefore considered there would be no pathway for interaction to exacerbate the potential impacts associated with these activities during or between any of the project phases.	No greater than individually assessed impact The greatest magnitude of effect would occur during the construction of trenched watercourse crossings. Once this disturbance impact has ceased all further impact during construction and operation will be small scale, highly localised and episodic. It is therefore considered that over the project lifetime these impacts would not combine to increase the significance level of any impacts identified in this assessment.
Groundwater	Negligible	Negligible	Minor adverse	No greater than individually assessed impact The proposed mitigation will minimise the potential for the introduction of contaminants to groundwater during construction. The inert nature of the cables will prevent contamination during operation. Furthermore, the small scale and relative shallowness of the permanent infrastructure means that impacts on groundwater flows during operation are minimal. It is therefore considered there would be no pathway for interaction to exacerbate the potential impacts associated with these activities during or between any of the project phases.	The greatest magnitude of effect will occur as a result of subsurface excavations during the construction phase. Once this disturbance impact has ceased, any further impact would be small scale, highly localised and episodic. It is therefore considered that over the project lifetime these impacts would not combine to increase the significance level of any impacts identified in this assessment.

20.10 Inter-relationships

217. For Flood Risk and Hydrology potential inter-relationships between other topics assessed within this PEIR including Geology and Land Quality, and Ecology. A summary of the potential inter-relationships between these topics is provided in **Table 20-30**

Table 20-30 Flood Risk and Hydrology Inter-relationships

Topic and description	Related chapter	Where addressed in this chapter	Rationale
Construction			
Impact 1: Direct disturbance of surface water bodies Impact 2: Increased sediment supply Impact 3 Accidental release of contaminants Impact 4: Changes to surface water runoff and flood risk	**Chapter 19 Geology and Land Quality**	Section 20.6.1	Potential changes to ground conditions (including chemical quality and physical properties such as transmissivity) during construction could affect the quality and quantity of groundwater and hydrologically connected surface water receptors.
Impact 1: Direct disturbance of surface water bodies	**Chapter 18 Terrestrial Ecology and Ornithology**	Section 20.6.1	Potential changes to the hydrology, geomorphology and water quality during construction could impact upon water-dependent biological communities.
Operation			
Impact 1: Accidental release of contaminants	**Chapter 19 Geology and Land Quality**	Section 20.6.2	Potential changes to ground conditions (including chemical quality and transmissivity) during operation could affect the quality and quantity of groundwater and hydrologically-connected surface water receptors.

Topic and description	Related chapter	Where addressed in this chapter	Rationale
Impact 2: Changes to surface water runoff and flood risk	**Chapter 18 Terrestrial Ecology and Ornithology**	Section 20.6.2	Potential changes to the hydrology, geomorphology and water quality could impact upon water-dependent biological communities.
Decommissioning			
Impacts associated with the decommissioning phase would be no greater than those identified for the construction phase.			

20.11 Summary

218. This chapter has provided a characterisation of the existing environment for Flood Risk and Hydrology based on both existing data (e.g. national flood risk and WER classification datasets) and site-specific survey data (e.g. a geomorphological walkover survey).

219. The assessment has established that surface and groundwater receptors could be affected as a result of direct disturbance, the supply of fine sediment and contaminants, and changes to flow patterns during the construction and decommissioning phases. Residual effects on all receptors during these phases would be either negligible or minor adverse.

220. The assessment has also established that surface and groundwater receptors could be affected by the accidental release of contaminants and changes to flow patterns during the operational phase. However, given the passive or sporadic nature of operational activities, the resulting residual impacts will be negligible or minor adverse.

221. A summary of the results of this assessment is provided in (**Table 20-31**). This summarises the worst-case scenario for all receptors and impacts, as determined in section 20.6. In all cases this relates to the Projects being built sequentially or concurrently.

Table 20-31 Summary of Potential Likely Significant Effects on Flood Risk and Hydrology for Sequential (Impact 1) or Concurrent (Impacts 2-4) Scenarios

Potential Impact	Receptor	Sensitivity	Magnitude of Impact	Pre-mitigation Effect	Mitigation Measures Proposed	Residual Effect
Construction						
Impact 1: Direct disturbance of surface water bodies	Surface water bodies	Low to high	Negligible to high	No impact to moderate adverse	HDD main rivers Best practice for trenched crossings (section 20.6.1.1.6)	**Negligible** to **minor** adverse
Impact 2: Increased sediment supply	Surface water bodies	Low to high	Low to medium	Minor to moderate adverse	Best practice for sediment control (section 20.6.1.2.6)	**Negligible** to **minor** adverse
Impact 3: Accidental release of contaminants	Surface and groundwater bodies	Low to high	Low to medium	Minor to moderate adverse	Best practice for use and control of fuels, oils and lubricants (section 20.6.1.4.6)	**Negligible** to **minor** adverse

Potential Impact	Receptor	Sensitivity	Magnitude of Impact	Pre-mitigation Effect	Mitigation Measures Proposed	Residual Effect
Impact 4: Changes to surface water runoff and flood risk	Surface and groundwater bodies	Low to high	Low to medium	Minor to moderate adverse	Construction drainage plans, SuDS and other best practice for runoff control (section 20.6.1.5.6)	**Negligible** to **minor** adverse
Operation						
Impact 1: Accidental release of contaminants	Surface and groundwater bodies	Low to high	Negligible to low	Negligible to minor adverse	SuDS, spill kits and best practice for any excavations (section 20.6.2.1.6)	**Negligible**

Potential Impact	Receptor	Sensitivity	Magnitude of Impact	Pre-mitigation Effect	Mitigation Measures Proposed	Residual Effect
Impact 2: Changes to surface water runoff and flood risk	Surface and groundwater bodies	Low to high	Negligible to low	Negligible to minor adverse	SuDS at the onshore substation; no permanent mitigation along the onshore export cable corridor	**Negligible** to **minor** adverse
Decommissioning						
Impacts associated with the decommissioning phase would be no greater than those identified for the construction phase.						

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