NORTH FALLS

Offshore Wind Farm

PRELIMINARY ENVIRONMENTAL INFORMATION REPORT

Chapter 21 Water Resources and Flood Risk

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Glossary of Acronyms

AONB	Area of Outstanding Natural Beauty
BEIS	Department for Business, Energy & Industrial Strategy
BOD	Biochemical oxygen demand
CEA	Cumulative Effects Assessment
CIRIA	Construction Industry Research and Information Association
CoCP	Code of Construction Practice
DCO	Development Consent Order
DECC	Department of Energy & Climate Change
Defra	Department for Environment, Food & Rural Affairs
EIA	Environmental Impact Assessment
ES	Environmental Statement
ETG	Expert Topic Group
FRA	Flood Risk Assessment
FWMA	The Flood and Water Management Act
GEP	Good Ecological Potential
GES	Good Ecological Status
GPP	Guidance for Pollution Prevention
HDD	Horizontal Directional Drilling
LLFA	Lead Local Flood Authority
LNR	Local Nature Reserve
NNR	National Nature Reserve
NPPF	National Planning Policy Framework
NPS	National Policy Statement
OCoCP	Outline Code of Construction Practice
PAH	Polycyclic aromatic hydrocarbons
PBDE	Polybrominated diphenyl ethers
PCB	Polychlorinated biphenyls
PEIR	Preliminary Environmental Information Report
PFRA	Preliminary Flood Risk Assessment
PPG	Pollution Prevention Guidance
RBD	River Basin District

RBMP	River Basin Management Plan
RNAG	Reasons for Not Achieving Good
SAC	Special Area of Conservation
SFRA	Strategic Flood Risk Assessment
SMP	Soil Management Plan
SPA	Special Protection Area
SPZ	Source Protection Zones
SSSI	Site of Special Scientific Interest
SuDS	Sustainable Drainage System
UKBAP	UK Biodiversity Action Plan
VOC	Volatile organic compounds
WFD	Water Framework Directive

Glossary of Terminology

Aquifer	Geological strata that hold water
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
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
Main River	Usually larger rivers and streams. The Environment Agency carries out maintenance, improvement or construction work on Main Rivers to manage flood risk
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
Onshore scoping area	The boundary in which all onshore infrastructure required for the Project will be located, as considered within the North Falls EIA Scoping Report.
Onshore project area	The boundary in which all onshore infrastructure required for the Project will be located (i.e. landfall; onshore cable route, accesses, construction compounds; onshore substation and National Grid substation extension), as considered within the PEIR.
The Applicant	North Falls Offshore Wind Farm Limited (NFOW).
The Project Or 'North Falls'	North Falls Offshore Wind Farm, including all onshore and offshore infrastructure.
Landfall search area	Locations being considered for the landfall, comprising the Essex coast between Clacton-on-Sea and Frinton-on-Sea.
Landfall compound	Compound at landfall within which HDD or other trenchless technique would take place
Horizontal directional drill (HDD)	Trenchless technique to bring the offshore cables ashore at the landfall. The technique will also be used for installation of the onshore export cables at sensitive areas of the onshore cable route.
Onshore cable corridor(s)	Onshore corridor(s) within which the onshore export cables and associated infrastructure will be located. A final onshore cable route for which consent will be sought will be selected from within these corridor(s).
Onshore substation	A compound containing electrical equipment required to transform and stabilise electricity generated by the Project so that it can be connected to the National Grid.
Onshore substation zone	Area within which the onshore substation will be located.

21 Water Resources and Flood Risk

21.1 Introduction

1. This chapter of the Preliminary Environmental Information Report (PEIR) considers the likely significant effects of North Falls offshore wind farm (hereafter 'North Falls' or 'the Project') on water resources and flood risk. The chapter provides an overview of the existing environment for the onshore project area, followed by an assessment of likely significant effects for the construction, operation, and decommissioning phases of the Project.
2. This chapter has been written by Royal HaskoningDHV, with the assessment undertaken with specific reference to the relevant legislation and guidance, of which the primary sources are the National Policy Statements (NPS). Details of these and the methodology used for the Environmental Impact Assessment (EIA) and Cumulative Effects Assessment (CEA) are presented in Section 21.4 and Section 21.8.
3. The assessment should be read in conjunction with following linked chapters (Volume I):
   - Chapter 19 Ground Conditions and Contamination; and
   - Chapter 23 Onshore Ecology
4. Additional information to support the water resources and flood risk assessment includes:
   - Appendix 21.1 Geomorphological Baseline Survey (Volume III);
   - Appendix 21.2 Water Framework Directive (WFD) Compliance Assessment (Volume III); and
   - Appendix 21.3 Flood Risk Assessment (FRA) (Volume III).

21.2 Consultation

5. Consultation regarding water resources and flood risk has been undertaken in line with the general process described in Chapter 6 EIA Methodology (Volume I). The key elements to date have included scoping and the ongoing technical consultation. The feedback received has been considered in preparing the PEIR.
6. Table 21.1 provides a summary of how the consultation responses received to date have influenced the approach that has been taken.
7. This chapter will be updated following the consultation on the PEIR in order to produce the final assessment, which will be presented in an Environmental Statement (ES) 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 as part of the DCO application.

Table 21.1 Consultation responses

Consultee	Date/Document	Summary of Comment	Response / where addressed in the PEIR
Anglian Water	27/07/2021 Scoping Opinion	Anglian Water works with developers including those constructing projects under the 2008 Planning Act to ensure requests for alteration of sewers, wastewater and water supply infrastructure is planned to be undertaken with the minimum of disruption to the project and customers. The ES should include reference to Anglian Water's existing sewerage infrastructure.	Details of potable and raw water mains, and sewerage infrastructure, are given in Section 21.5.5. Consultation with Anglian Water will take place through an Expert Topic Group.
		Anglian Water recommends the use of Sustainable Drainage Systems (SuDS) for the onshore works. The risk of sewer flooding and any required mitigation within the public sewerage network should form part of a Flood Risk Assessment and Surface Water and Foul Drainage Strategy.	A Construction Surface Water and Drainage Plan will be developed as part of the Code of Construction Practice (CoCP) in consultation with the relevant regulators and approved by the relevant planning authority. An Outline CoCP (OCoCP) will be included as part of the DCO application. All potential sources of flooding are assessed in Appendix 21.3 (Volume III).
Anglian Water	12/08/2021 Scoping Opinion	We welcome that Anglian Water (Table 1.4) will be invited to attend relevant Expert Topic Groups and would suggest this would be the Onshore Water Resources and Flood Risk group. We would expect that the Environmental Statement would include reference to existing sewerage infrastructure managed by Anglian Water and, if necessary, water supply infrastructure near Colchester. Maps of Anglian Water's assets are available to view at the following address: http://www.digdat.co.uk/	Existing water supply and sewerage infrastructure has been outlined in Section 21.5.5. Further consultation with Anglian Water on existing infrastructure will take place through an Expert Topic Group.
Anglian Water	12/08/2021 Scoping Opinion	We note that the Scoping Report identifies the potential impacts from construction (para 424 et al) including excavation activities as well the potential pathways for contamination. At para 491 the Report summaries the position for utilities and that no detailed data has been sought. No reference is made to sewage or water supply data and so we would urge the applicant to consider the impact on utilities early in cable route	Existing water supply and sewerage infrastructure has been outlined in Section 21.5.5. Further consultation with Anglian Water on existing infrastructure will take place through an Expert Topic Group.

Consultee	Date/Document	Summary of Comment	Response / where addressed in the PEIR
		and design work to minimise impacts and to reduce to a minimum the carbon cost of diversions.	
Anglian Water	12/08/2021 Scoping Opinion	No reference is made to the need for upgraded and additional sewerage infrastructure or water supply for construction or operation. It is recommended that the Environmental statement should include reference to identified impacts on the sewerage network and sewage treatment.	Potential sewage impacts are discussed in Section 21.6.2.1. Any potential impacts would be associated with the onshore substation only. However, the onshore substation is likely to be unmanned, with no, or at most minimal, welfare facilities on site. As a result, it is very unlikely that welfare facilities 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.
Affinity Water	29/07/2021 Scoping Opinion	Concern will only be at the point of landfall and associated development in terms of connections to existing grid infrastructure; in those instances, Affinity Water will want to ensure there are no potential contamination issues.	At this stage North Falls Offshore Wind Limited (NFOW) do not anticipate making any connections into existing infrastructure (with the possible exception of the onshore substation). However, consultation will take place with Affinity Water throughout the development process.
Environment Agency	16/08/2021 Scoping Opinion	Consider whether EIA should address the potential for saline intrusion with HDD at the landfall, and the potential for localised changes to groundwater flow in terms of barriers e.g., excavations proximal to shallow groundwater abstractions. Local wildlife sites and water features surveys will be included in EIA approach.	Saline intrusion is listed as one of the reasons for the Holland Brook WFD water body failing to achieve good ecological potential. Although best practice to minimise the risks associated with saline intrusion will be agreed with the Environment Agency, water quality monitoring (conductivity) may be required in the watercourses surrounding the landfall during the construction phase to ensure that there are no adverse impacts on existing freshwater resources. If construction monitoring is required during the construction phase, details would be formalised in a water quality monitoring protocol which would be secured under the DCO.

Consultee	Date/Document	Summary of Comment	Response / where addressed in the PEIR
			Details of Essex Wildlife Trust nature reserves and other local wildlife sites that could be affected by the Project have been included in Section 21.5.8.
		The onshore aspects of the report should consider flood risk and the requirement for environmental (flood risk activity) permits.	Flood risk and climate change are being considered explicitly within the EIA, through an FRA and in Chapter 33 Climate Change (Volume I).
		Consideration of local wildlife sites is required, and method, geology and best practice associated with potential HDD drilling (bentonite) contamination.	Details of Essex Wildlife Trust nature reserves and other local wildlife sites that could be affected by the Project have been included in Section 21.5.8. Consultation will take place with the Environment Agency to discuss any recent incidents where bentonite breakout from HDD operations has resulted in effects on statutory designated sites.
Essex County Council	20/08/2021 Scoping Opinion	Drainage strategy to manage surface runoff from larger storm events.	Drainage strategies and flood risk will be addressed in Appendix 21.3 (FRA) (Volume III) and in a Surface Water and Drainage Plan, for both construction and operational phases.
		All information associated with surface water drainage should be included as part of the forthcoming DCO submission. The project details with reference to surface water drainage and any potential drainage elements are yet to be established and therefore we recommend all information associated with surface water drainage should be included as part of any major planning application and it should be in accordance with SUDS Design Guide.	A Construction Surface Water and Drainage Plan will be developed as part of the CoCP in consultation with the relevant regulators and approved by the relevant planning authority.

Consultee	Date/Document	Summary of Comment	Response / where addressed in the PEIR
Planning Inspectorate	26/08/2021 Scoping Opinion	Direct disturbance to surface water bodies to remain scoped out during operation.	Two operational impacts are assessed: supply of contaminants (including fine sediment) and changes to surface and groundwater flows and flood risk.
		Scoping report focused primarily on inland effects on surface water bodies, with little reference to coastal flooding	All potential sources of flooding are assessed in Appendix 21.3 (FRA) (Volume III).
		Information should be provided regarding the location, scale, and dimensions of any proposed watercourse crossings/in-stream structures, as well as the nature of any associated construction works (e.g., dewatering, trenching, and HDD). The ES should consider the potential of such works to negatively impact the ecological status of watercourses under the WFD and the results of the WFD assessment should be reported in the ES and/or associated technical appendix.	When a methodology for trenched watercourse crossings is available, it will be incorporated into the worst case scenario for the direct disturbance to surface water bodies (Table 21.2). An initial worst case assessment has been made of potential ecological impacts based on possible trenched crossing methods, and this will be updated in the ES and WFD assessment when final details are known.
		There is potential for indirect effects to below ground heritage assets arising from flood risk and drainage impacts. The ES should set out the method for defining the sensitivity of both heritage and ecological receptors to flood risk and drainage impacts where significant effects are likely to occur.	The sensitivity of heritage receptors is defined in Chapter 25 Onshore Archaeology and Cultural Heritage (Volume I). There are no known heritage assets/buried archaeology in the onshore search area that could be affected by flood risk and drainage impacts. Water resources and flood risk receptor sensitivity (Table 21.6) refers to habitats and species.
		The ES should present the results of the most recent FRA and should take into account the latest EA guidance on climate change, including climate change allowances (currently UKCP18). Effort should be made to agree the relevant baseline with the EA and relevant consultation bodies, including the Lead Local Flood Authority (LLFA) (Essex County Council).	All potential sources of flooding will be assessed in an FRA that will accompany the ES as part of the DCO application. Consultation with the Environment Agency and the LLFA (Essex County Council) will take place through an Expert Topic Group.

Consultee	Date/Document	Summary of Comment	Response / where addressed in the PEIR
		The ES should provide information in relation to the Applicant's proposed drainage strategy, including the details of any proposals to implement Sustainable Drainage Systems (SuDS). The ES should explain how the proposed drainage strategy will interact with any relevant biodiversity and cultural heritage objectives.	A Construction Surface Water and Drainage Plan will be developed as part of the CoCP in consultation with the relevant regulators and approved by the relevant planning authority.
		The ES should provide information on existing abstractions and discharges within the baseline and assess the effects of the Proposed Development on any identified abstraction sources or discharges, where significant effects are likely to occur. The ES should also refer to the relevant Strategic Flood Risk Assessment(s) (SFRAs) and lead local flood authority (LLFA) Flood Risk Management Strategies.	Details of licensed abstractions and discharges have been added to Section 21.5.4. Local (SFRA) documents are referred to in Section 21.4.1.
		Paragraph 501 of Section 3.4 (land use) states that permanent infrastructure and hardstanding at the onshore substation, plus the presence of buried cables, has the potential to permanently impact upon land drainage. It states that impacts on drainage are considered further in Section 3.3.3; however, limited further information is provided on this matter. The ES should provide information in relation to the Applicant's proposed drainage strategy, including the details of any proposals to implement Sustainable Drainage Systems (SuDS). The ES should explain how the proposed drainage strategy will interact with any relevant biodiversity and cultural heritage objectives.	The presence of permanent infrastructure has been assessed in Section 21.6.2, and further detail on land drainage is provided in Chapter 22 Land Use and Agriculture (Volume I). A Construction Surface Water and Drainage Plan will be developed as part of the CoCP in consultation with the relevant regulators and improved by the relevant planning authority. This will include measures relating to any interactions with relevant biodiversity and cultural heritage.
Environment Agency	29/06/2021 ETG Meeting 1	An initial meeting held with Essex County Council and the Environment Agency to discuss: • The scope of the water resources and Flood Risk assessment;	The sensitivity of surface groundwater resources from HDD is assessed in Section 21.6. An assessment of the potential effects of bentonite break-put on qualifying features of the Holland Haven Marshes

Consultee	Date/Document	Summary of Comment	Response / where addressed in the PEIR
		• Data collection; • Impacts to be assessed and the assessment methodology; and • Proposed DCO documents. It was noted that the Environment Agency receive a lot of applications with respect to Horizontal Directional Drilling (HDD) techniques and that the Environment Agency would seek more information around local groundwater abstractions / sensitivity of sites (more needed at coast) when considering risks from HDD, although as the project will not be going through chalk the sensitivity may be lower. The Environment Agency noted that some issues have been identified with HDD on other projects, resulting in pollution of estuaries from bentonite which prevented SSSI features from functioning (an example was provided - the Deben - where damage had been observed). Noted that all parties need to work together to address best approach for mitigating HDD risk. The Environment Agency will look at the geology as standard when assessing HDD risk and also ask for a drilling mud pressure monitoring plan (or similar) and mud breakout contingency strategy to manage mud loss incidents should they occur.	Site of Special Scientific Interest (SSSI) is provided in Chapter 23 Onshore Ecology (Volume I).

21.3 Scope

21.3.1 Study area

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

9. The study area for water resources and flood risk has been defined based on these surface hydrological catchments. Catchments have been included within the study area if they are crossed by the onshore project 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 study area, showing surface water catchments and Main Rivers, is shown in Figure 21.1 (Volume II).

10. When considering the potential impacts to groundwater, the study area is limited to those groundwater bodies that lie directly beneath the onshore project area, which are shown in Figure 21.2 (Volume II).

21.3.2 Realistic worst case scenario

11. The final design of the Project will be confirmed through detailed engineering design studies that will be undertaken post-consent. In order to provide a precautionary but robust impact assessment at this stage of the development process, realistic worst case scenarios have been defined in terms of the potential effects that may arise. This approach to EIA, referred to as the Rochdale Envelope, is common practice for developments of this nature, as set out in Planning Inspectorate Advice Note Nine (2018). The Rochdale Envelope for a project outlines the realistic worst case scenario for each individual impact, so that it can be safely assumed that all other scenarios within the design envelope will have less impact. Further details are provided in Chapter 6 EIA Methodology (Volume I).

12. The realistic worst case scenarios for the likely significant effects scoped into the EIA for the water resources and flood risk assessment are summarised in Table 21.2. These are based on North Falls parameters described in Chapter 5 Project Description (Volume I), which provides further details regarding specific activities and their durations.

Table 21.2 Realistic worst case scenarios

Potential impact	Parameter	Notes
Construction		
Impact 1: Direct disturbance of surface water bodies	Onshore cable corridor Trenchless methods (e.g., HDD) to be used at most watercourse crossings (either Main River or Ordinary Watercourse). Detailed methods for trenched watercourse crossings are not yet known. They may include: • Temporary dam and divert or fluming for minor watercourses, ducts installed below the channel bed. • Where the cable corridor crosses an open ditch or drain, and access for the haul road is required, an appropriately sized culvert may be installed inside the channel bed to avoid upstream impoundment. This would remain in place for the duration that the haul road is required. • Width of open cut trenching working width = 60m • Length of onshore cable corridor = 24km • Maximum burial depth = 2m • Cable trench dimensions = 3.75 x 2m (width x depth) • Minimum cable burial depth = 0.9m • Number of joint bays = 80 -192 (approximately every 500m) buried below ground • Haul road width = 6m	Direct disturbance of surface water bodies will only occur due if temporary damming and diversion / fluming of Ordinary Watercourses is used where the onshore cable corridor and haul road crosses them. These parameters represent the worst-case scenario of the onshore cable corridor.

Potential impact	Parameter	Notes
Impact 2: Increased sediment supply Impact 3: Supply of contaminants to surface and groundwater Impact 4: Changes to surface and groundwater flows and flood risk	Landfall • Number of transition joint bays = Up to 4 • Landfall temporary working area = 100 x 200m Onshore cable corridor(s) • Number of export cables = Up to 4 • Working corridor width (inc. haul road) = 60m open cut; 82m at shallow HDD crossings; 122m at deeper HDD crossings • Number of cable construction compounds (est.) = 7 • Cable construction compound dimensions = 150 x 150m (general cable construction compounds); 100 x 100m (small cable construction compounds). • Trenchless crossing compound dimensions = 80 x 120m (major crossings) and 40 x 120m (minor crossings). • Total onshore cable length = 24km • Maximum burial depth = 2m • Cable trench dimensions = 3.75 x 2m (width x depth) • Minimum cable burial depth = 0.9m • Indicative HDD drive depth = 5-20m (at least 1.5m below hard bed level) • Number of joint bays = 80 -192 (approximately every 500m) buried below ground • Haul road width = 6m Onshore substation	These parameters represent the maximum footprint of disturbance and activities within the onshore project area that could lead to the potential disturbance of sediment, contamination and alteration of surface and groundwater flows and flood risk.

Potential impact	Parameter	Notes
	• Permanent substation footprint = 267m x 300m • Construction compound dimensions = 150 x 250m	
Operation		
Supply of contaminants to surface and groundwater	Onshore cable corridor(s) • Joint bays would require periodic access by technicians for inspection and testing during operation and maintenance. • Joint bay frequency = approximately every 500m	These parameters represent the worst-case scenario for maintenance requirements. The use of vehicles for maintenance activities is the main potential source of contaminants to surface and groundwater.

Potential impact	Parameter	Notes
	Onshore substation Details of activities at the substation are not yet known but could include: • Hazardous materials/substances = transformer oil: filled during construction, only topped up in the event of a leak. • Oily water sump will be present to provide secondary containment in the event of an oil spillage from transformers.	
Changes to surface and groundwater flows and flood risk	Onshore cable corridor(s) • Number of export cables = Up to 4 • Total onshore cable length = 24km • Indicative external cable diameter = 200mm • Maximum burial depth = 2m • Minimum burial depth = 0.9m • Number of joint bays = approximately every 500m • Joint bay dimensions = 13 x 5m (length x width) Onshore substation • Permanent substation footprint = 267 x 300m • Foundations = concrete raft type – some piling may be required	These parameters represent the worst-case scenario for impermeable ground and potential sources of disruption to surface and groundwater flows.
Decommissioning		
No final decision has yet been made regarding the final decommissioning policy for the onshore project infrastructure including landfall, onshore cable corridor and onshore substation. 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 where possible with 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 purposes of a worst case scenario, the impacts will be no greater than those identified for the construction phase.		

21.3.3 Summary of mitigation embedded in the design

13. This section outlines the embedded mitigation relevant to the water resources and flood risk assessment, which has been incorporated into the design of North Falls (Table 21.3). Measures outlined below will be secured in the CoCP.

Table 21.3 Embedded mitigation measures

Parameter	Mitigation measures embedded into North Falls design
Watercourse crossings (construction phase)	
Cable crossings beneath watercourses	All Main Rivers (see Figure 21.1, Volume II) will be crossed using trenchless techniques such as HDD to avoid direct interaction with these watercourses. Most Ordinary Watercourses will also be crossed using trenchless techniques.
Temporary access across watercourses	Temporary bridges may be used as options to traverse Main Rivers where direct access is not readily available from both sides. Culverts will not be used to cross Main Rivers. Selection of a crossing technique for Ordinary Watercourses not crossed using trenchless techniques will be dependent on local site conditions and may include the use of temporary culverts. Temporary culverts will be adequately sized to avoid impounding flows (including allowing for increased winter flows as a result of climate change).

Trenched crossings	Best practice measures at trenched crossings include:
	• Either temporary dams or flumes are used to divert water during trenched installation;
	• Where temporary dams are used:
	  ○ 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;
	• The amount of time that temporary dams or flumes are in place will be kept to a minimum;
	• 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; and
	• Sympathetic reinstatement of channel and banks.

Agricultural drainage	The Applicant will appoint a land drainage consultant to develop pre-and post-construction drainage plans. Additionally, land drainage systems will be maintained during construction and land drainage would be reinstated following completion of construction works during the reinstatement phase. An OCoCP will be submitted with the DCO application and this will include outline soil management measures and outline the mitigation measures and best practice techniques, which contractors would be obliged to comply with. The DCO will contain a requirement to submit a final CoCP and Soil Management Plan (SMP) (which must be in accordance with the OCoCP) prior to commencement of construction.
Exposed land (construction and operational maintenance phases)	
Sediment supply to watercourses	Construction activities will adhere to industry good practice measures as detailed in the Environment Agency's Pollution Prevention Guidance (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

Parameter	Mitigation measures embedded into North Falls design
	Association (CIRIA) best practice (Control of water pollution from construction sites: Guidance for consultants and contractors (C532) (2001)) will also be adhered to. Specific measures will potentially include: • Minimising the amount of time stripped ground and soil stockpiles are exposed; • 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 10mfrom any watercourse or surface water drain, rock outcrop (hard rock at surface) or karstic sinkhole; • Traffic movements would be restricted to minimise surface disturbance; • Divert clean water away from the area of construction work in order to minimise the volume of contaminated water; and • Routing the cable to avoid water resources and flood risk receptors where possible. In locations where large areas of exposed ground lie adjacent to watercourses, buffer strips of vegetation will be retained where possible to prevent runoff. • Other embedded best practice measures include: • Limiting the extent of open excavations along the onshore cable corridor to short sections of adequate length to carry out excavation and installation and there is no need for tracking over the trench sections at any one time (work fronts); and • Temporary works areas (e.g., construction compounds and trenchless crossing areas) within the onshore project 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.
Supply of contaminants (construction and operational maintenance phases)	
	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 cable corridor(s) into the surface drainage network, and include: • Situating 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;

Parameter	Mitigation measures embedded into North Falls design
	• 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; • Construction drainage will be developed and implemented to minimise water within the cable trench and ensure ongoing drainage of surrounding land. Water filling the trenches would be appropriately treated to ensure no adverse effects on the local watercourses. Existing agricultural drainage would be reinstated to include the replacement of any drains that were damaged during the construction process; • Potential contaminants will be stored under cover to prevent rainwater carrying pollutants away; and • Potential contaminants will be stored in a safe place away from vehicles, to prevent collisions. In addition, buffer strips of vegetation will be retained adjacent to water bodies where possible, to intercept any contaminated runoff. To protect groundwater bodies, excavation will be shallow, except where below road or rail infrastructure and water bodies, where it may be deeper.
Changes to surface and groundwater flows and flood risk (construction and operational maintenance phases)	
Surface water runoff	• Changes in surface water runoff resulting from the increase in impermeable area following construction of the onshore cable corridor(s), and particularly the onshore substation, would be attenuated and discharged at a controlled rate, in consultation with the LLFA (Essex County 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. • 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 OCoCP including outline soil management measures 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. • Construction drainage would be developed and implemented to minimise water within the cable trench and ensure ongoing drainage of surrounding land. Water filling the trenches would be appropriately treated to ensure no adverse effects on the local watercourses. Existing agricultural drainage would be reinstated to include the replacement of any drains that were damaged during the construction process; • As described for watercourse crossings, temporary culverts will be adequately sized to avoid impounding flows.
Groundwater quality and abstractions for public water supply (construction and operational maintenance phases)	
Cable routing	• The onshore cable corridor has been developed to avoid interaction with Groundwater Source Protection Zone 1, and therefore minimise the potential for impact on abstractions for public water supply.

Parameter	Mitigation measures embedded into North Falls design
	• Ground investigations and a hydrogeological risk assessment meeting the requirements of The Environment Agency's Approach to Groundwater Protection (Environment Agency, 2018), will be undertaken at each major HDD crossing location. • A written scheme dealing with contamination of any land and groundwater will be submitted and approved by the relevant planning authority before construction activities commence.

21.4 Assessment methodology

21.4.1 Legislation, guidance and policy

21.4.1.1 National Policy Statements

14. The assessment of likely significant effects upon water resources and flood risk 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 Project are:

- Overarching NPS for Energy (EN-1) (Department of Energy and Climate Change (DECC) 2011a);
- NPS for Renewable Energy Infrastructure (EN-3) (DECC 2011b);
- NPS for Electricity Networks Infrastructure (EN-5) (DECC 2011c);
- Draft Overarching NPS for Energy (EN-1) (Department for Business, Energy and Industrial Strategy (BEIS) 2021a);
- Draft NPS for Renewable Energy Infrastructure (EN-3) (BEIS 2021b); and
- Draft NPS for Electricity Networks Infrastructure (EN-5) (BEIS 2021c).

15. The UK Government announced a review of the existing NPSs within its December 2020 Energy White Paper (HM Government, 2020) and issued a draft version of Overarching NPS for Energy EN-1, NPS for Renewable Energy Infrastructure EN-3 and NPS for Electricity Networks Infrastructure EN-5 for consultation on 6th September 2021 (BEIS 2021a; BEIS 2021b; BEIS 2021c). At the time of writing this PEIR chapter, final versions of the revised NPSs are not available.

16. The specific assessment requirements for water resources and flood risk as detailed in the NPS, are summarised in Table 21.4 together with an indication of the section of the PEIR chapter where each is addressed.

Table 21.4 NPS assessment requirements

NPS Requirement	NPS Reference	ES Reference
Overarching NPS for Energy (EN-1)		
‘Where the development is subject to EIA [Environmental Impact Assessment] the applicant should ensure that the ES [Environmental Statement] 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.’	Section 5.3, paragraph 5.3.3	Potential impacts on river channels, which provide physical habitats of importance for ecology, protected species and the conservation of biodiversity, are considered in Section 21.6.
‘Where a proposed development on land within or outside an SSSI [Site of Special Scientific Interest] is likely to have an adverse effect on a SSSI (either individually or in combination with other developments), development	Section 5.3, paragraph 5.3.11	Potential SSSI impacts are considered in Section 21.6.

NPS Requirement	NPS Reference	ES Reference
consent should not normally be granted. Where an adverse effect, after mitigation, on the site's notified special interest features is likely, an exception should only be made where the benefits (including need) of the development at this site clearly outweigh both the impacts that it is likely to have on the features of the site that make it of special scientific interest and any broader impacts on the national network of SSSIs.'		
'Applications for energy projects of 1 hectare or greater in Flood Zone 1 in England or Zone A in Wales and all proposals for energy projects located in Flood Zones 2 and 3 in England or Zones B and C in Wales should be accompanied by a flood risk assessment (FRA). An FRA will also be required where an energy project less than 1 hectare may be subject to sources of flooding other than rivers and the sea (for example surface water), or where the EA, 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.'	Section 5.7, paragraph 5.7.4	Potential impacts on flood risk are considered in Section 21.6.and Appendix 21.3 (FRA) (Volume III).
'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. 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); • Existing physical characteristics of the water environment (including quantity and dynamics of flow) affected by the proposed project and any impact of physical modifications to these characteristics; and • Any impacts of the proposed project on water bodies or protected areas under the Water Framework Directive and source protection zones (SPZs) around potable groundwater abstractions.'	Section 5.15, paragraph 5.15.2-3	Potential impacts on water quality, the physical characteristics of surface watercourses and the quality and quantity of groundwater are considered in Section 21.6. Potential impacts on WFD compliance are considered separately in Appendix 21.2 (Volume III).
NPS for Renewable Energy Infrastructure (EN-3)		
A review of NPS EN-3 (2011b) did not identify requirements relating to water resources and flood risk and are therefore not considered relevant to this chapter.		

NPS Requirement	NPS Reference	ES Reference
NPS for Energy Networks Infrastructure (EN-5)		
'Section 4.8 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. 'Section 4.8 of EN-1 advises that the resilience of the project to 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 5.7 in EN-1)'	Section 2.6, paragraphs 2.6.1, 2.6.2	Flooding and the potential effects of climate change are considered in Section 21.6.and an FRA is provided in Appendix 21.3 (Volume III).
Draft NPS for Energy (EN-1)		
A review of draft NPS EN-1 (2021a) did not identify requirements relating to water resources and flood risk and are therefore not considered relevant to this chapter.		
Draft NPS for Renewable Energy Infrastructure (EN-3)		
A review of draft NPS EN-3 (2021b) did not identify requirements relating to water resources and flood risk and are therefore not considered relevant to this chapter.		
Draft NPS for Electricity Networks Infrastructure (EN-5)		
A review of draft NPS EN-5 (2021c) did not identify requirements relating to water resources and flood risk and are therefore not considered relevant to this chapter.		

21.4.1.2 Other legislation, policy and guidance

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

17. 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 national law in the UK. 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.

18. Under the Regulations, surface waters are designated as water bodies and are set objectives for achieving Good Ecological Status (GES) or Good Ecological Potential (GEP) (in the case of heavily modified water bodies). The Environment Agency is required to produce River Basin Management Plans (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.

21.4.1.2.2 The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2017

19. The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2017 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.

21.4.1.2.3 The Conservation of Habitats and Species Regulations 2017

20. The 'Dutch Nitrogen Case' (Official Journal of the European Union, 2019) ruled that where an internationally important site (i.e., Special Protection Area (SPA), Special Area of Conservation (SAC) 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 (as amended) should apply to pollution related pressures and incidents.

21. Note that the further information on the Conservation of Habitats and Species Regulations 2017 is provided in Chapter 23 Onshore Ecology (Volume I).

21.4.1.2.4 National Planning Policy Framework (2021) and Supporting Guidance

22. The National Planning Policy Framework (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.

23. 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 (Ministry of Housing, Communities and Local Government, 2021), which was updated on 25th August 2022.

24. In the recent update to the Planning Practice Guidance the guidance 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.

21.4.1.2.5 Flood and Water Management Act (2010)

25. The Flood and Water Management Act (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.

21.4.1.2.6 Anglian River Basin District: River Basin Management Plan (2015)

26. 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.

27. The second RBMP for the Anglian RBD was finalised by the Department for the Environment, Food and Rural Affairs (Defra) and the Environment Agency in December 2015 and was published in 2016. It provides a baseline classification of the water environment in the Anglian 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.

21.4.1.2.7 Essex County Council Preliminary Flood Risk Assessment (PFRA)

28. Essex County Council produced a Preliminary FRA in January 2011 which provides a high level overview of flooding from local sources in Essex. Flood risk data and records of historic flooding were collected from several local and national sources to develop a clear understanding of the flood risk across Essex. Information relating to 1342 flood events, caused by flooding from surface water, groundwater, Ordinary Watercourses, canals and small impounded reservoirs, was collected and analysed to develop a better understanding of flood risk in the area.

21.4.1.2.8 Local Flood Risk Management Strategy

29. Essex Local Flood Risk Management Strategy was produced by Essex County Council in 2018. The strategy sets out the council's aims and actions to reduce the impact of local flooding to communities. Local flooding in Essex as defined in the strategy means the risk of flooding from artificial drainage systems, small watercourses and rainfall-runoff from land.

21.4.2 Data sources

21.4.2.1 Site specific

30. In order to provide site specific and up to date information on which to base the impact assessment, a geomorphological baseline survey was conducted between 22nd and 24th August 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 project 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 21.5.2 and a detailed report can be found in Appendix 21.1 (Volume III).

21.4.2.2 Other available sources

31. The sources of information presented in Table 21.5 were consulted to inform the water resources and flood risk assessment.

Table 21.5 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/)
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)

21.4.3 Impact assessment methodology

32. Chapter 6 EIA Methodology (Volume I) explains the general impact assessment methodology applied to North Falls. The following sections describe the methods used to assess the likely significant effects on water resources and flood risk. More detailed methodologies specific to the WFD can be found in Appendix 21.2 (Volume III).

33. As described in Section 21.3.1, the study area has been defined based on surface hydrological catchments that could potentially interact with the Project. For the purposes of this assessment, each catchment has been defined as a

single receptor, containing multiple Main Rivers and Ordinary Watercourses, and assigned a single sensitivity which reflects the most sensitive watercourse within that receptor. For clarity, the sensitivity of each water body is defined once, with a justification, in Table 21.10, and is referred to throughout the impact assessment in Section 21.6.

21.4.3.1 Definitions

34. For each potential impact, the assessment identifies receptors within the study area which are 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. Definitions of sensitivity and magnitude for the purpose of this assessment are provided in Table 21.6 and Table 21.7.

21.4.3.1.1 Sensitivity

35. For each receptor, the assessment identifies a level of sensitivity (as defined in Table 21.6). This is then used systematically to understand the impact pathways and the level of impacts on given receptors which considers both magnitude (as defined in Table 21.7 and sensitivity of receptor to determine the effects of the Project on each receptor.

36. Timescales in the tables below for impact duration are defined based on the RBMP cycle. Therefore, short-term is less than one year, medium-term is one to six years (i.e., one RBMP cycle) and long-term is greater than six years (i.e., more than one RBMP cycle).

Table 21.6 Definition of sensitivity for a water resources and flood risk 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. 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 Source Protection Zones. 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	Receptor has limited capacity to tolerate changes to hydrology, geomorphology, water quality or flood risk. Water resources which support human health and/or economic activity at a local scale. Receptors with a high vulnerability to flooding. Water resources

Sensitivity	Definition
	• 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 Source Protection Zone. 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	Receptor has moderate capacity to tolerate changes to hydrology, geomorphology and, water quality or flood risk. Water resources that support human health and/or economic activity at a neighbourhood (multiple property) scale. 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).
Negligible	Receptor is generally tolerant of changes to hydrology, geomorphology, water quality or flood risk. Water resource that supports human health and/or economic activity at a single property scale. 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).

21.4.3.1.2 Magnitude

37. In addition to the magnitude of impact definitions outlined in Table 21.7, three specific measures of magnitude are used for assessing water resources and flood risk:

- First, for construction impacts related to the direct disturbance of surface water bodies, magnitude of impact is defined in terms of the number of trenched crossings per water body catchment;
- Second, for construction impacts related to increased sediment supply, magnitude of impact is defined in terms of the estimated total area of disturbed ground per water body catchment. The area of disturbed ground is also used to assess the magnitude of the supply of contaminants from construction; and
- Third, the total area of buried/permanent infrastructure per water body catchment is used to estimate the potential for changes in surface runoff and flood risk due to an increased area of impermeable surfaces.

Table 21.7 Definition of magnitude for a water resources and flood risk receptor

Magnitude	Definition
High	Permanent/irreversible, or large-scale changes, over the whole receptor affecting usability, risk, or value. 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. • Deterioration in groundwater levels, flows or quality leading to a deterioration in WFD groundwater body status. 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 affecting usability, value, or risk, over the medium- term or local area. Water resources • Medium-term effects on water quality or availability.

<table>
<tr><th>Magnitude</th><th>Definition</th></tr>
<tr><td></td><td>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.
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.</td></tr>
<tr><td>Low</td><td>Discernible temporary change over a minority of the receptor, and/or with minimal effect on usability, risk or value. Also 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.
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.</td></tr>
<tr><td>Negligible</td><td>Temporary change, undiscernible over longer timescales, with no effect on usability, risk or value. Slight, 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.
Very slight local changes to habitat that have no observable impact on dependent receptors.
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.</td></tr>
</table>

21.4.3.2 Significance of effect

38. The assessment of significance of an effect is a function of the sensitivity of the receptor and the magnitude of the impact (see Chapter 6 EIA Methodology (Volume I) for further details). The determination of significance is guided by the

use of a significance of effect matrix, as shown in Table 21.8. Definitions of each level of significance are provided in Table 21.9.

39. Likely significant effects identified within the assessment as major or moderate are regarded within this chapter as significant. Appropriate mitigation has been identified, where possible, in consultation with the regulatory authorities and relevant stakeholders. The aim of mitigation measures is to avoid or reduce the overall significance of effect to determine a residual effect upon a given receptor.

Table 21.8 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	Negligible	Negligible	Negligible	Minor	Minor	Moderate
	Negligible	Minor	Negligible	Negligible	Negligible	Negligible	Negligible	Negligible	Minor

Table 21.9 Definition of effect significance

Significance	Definition
Major	Very large or large change in receptor condition, both adverse or beneficial, which are 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 are 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 effect, therefore no change in receptor condition

40. Note that for the purposes of the EIA, major and moderate impacts are deemed to be significant. In addition, whilst minor impacts are not significant in their own right, it is important to distinguish these from other non-significant impacts as they may contribute to significant impacts cumulatively or through interactions.

21.4.4 Cumulative effects assessment methodology

41. The cumulative effects assessment (CEA) considers other plans, projects and activities that may interact cumulatively with North Falls. Chapter 6 EIA Methodology (Volume I) provides further details of the general framework and approach to the CEA.

42. For water resources and flood risk, these activities include the potential crossing of cable routes associated with other offshore wind farms. Concurrent activities involving large scale excavation, such as major infrastructure projects, taking

place within the same surface water catchments as the Project would also require consideration.

21.4.5 Transboundary effects assessment methodology

43. The transboundary assessment considers the potential for transboundary effects to occur on water resources and flood risk as a result of North Falls. Chapter 6 EIA Methodology (Volume I) provides further details of the general framework and approach to the assessment of transboundary effects. For water resources and flood risk, no potential for transboundary effects have been identified and therefore do not need to be considered for this chapter.

21.4.6 Assumptions and limitations

44. This assessment is based on a range of publicly available information and data sources (as listed out in Table 21.5) and is largely desk-based. Although these data sets are considered robust, there is a degree of uncertainty and assumptions associated with their use in this 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 assessment.

21.5 Existing environment

21.5.1 Surface water drainage

45. As discussed in Section 21.3.1, this assessment is based on river water body catchments as defined by the Environment Agency. Receptors are those river water bodies that are crossed, or their catchments are crossed, by the onshore project area, as well as and those that are downstream. Water body catchments are grouped within their respective operational catchments.

46. The onshore infrastructure associated with the Project lies within two operational catchments:

- Colne Essex operational catchment
    a. Holland Brook:
    b. Tenpenny Brook
- Stour operational catchment
    c. Wrabness Brook
    d. Coastal catchment associated with Hamford Water

21.5.1.1 Holland Brook catchment

47. The brook (Main River) rises near Little Bromley and flows in a south-easterly direction to Holland Haven where it meets the sea. It is a largely rural catchment and is fed by numerous tributaries. These include Tendring Brook, Weeley Brook and Kirby Brook (all Main River).

48. In the lower reaches of the catchment, the Main River flows through Holland Haven Marshes SSSI, which Natural England state is an area of neutral

grassland in favourable condition, reclaimed estuarine saltmarsh and freshwater marsh with an extensive ditch system (Natural England, 2022a). The SSSI extends upstream on Holland Brook as far as Hunter's Bridge. The main tributary watercourse in the SSSI is Kirby Brook, which flows west from Frinton-on-Sea into the Holland Brook, close to its mouth.

21.5.1.2 Tenpenny Brook catchment

49. The brook (Main River) rises south-west of Great Bromley, from where it flows in a southerly direction towards Mill Dam and into Alresford Creek and the Colne Estuary. The latter is designated as a SSSI for littoral sediment, inshore sublittoral sediment and neutral grassland (Natural England, 2022b).

21.5.1.3 Wrabness Brook

50. The brook, which is an Ordinary Watercourse apart from a short section of Main River close to its confluence with the Stour, rises north of the A120 near Horselycross Street. It then flows in a north easterly direction to join the River Stour at Wrabness Point. The catchment is rural and for most of its length the watercourse flows in a relatively narrow, confined valley. At the coast the channel is straight and is joined by other engineered ditches in a relatively wide valley that is protected from inundation by an embankment. The lower course of the brook overlaps with several designated sites. These are: Stour Estuary SSSI, Stour and Orwell Estuaries SPA, Stour and Orwell Estuaries Ramsar, Suffolk Coasts Heaths Area of Outstanding Natural Beauty (AONB) and Wrabness Local Nature Reserve (LNR). The SSSI is nationally important for 13 species of wintering waterfowl and three species on autumn passage. The estuary is also of national importance for coastal saltmarsh, sheltered muddy shores, two scarce marine invertebrates and a scarce vascular plant assemblage (Natural England, 2022c). The SSSI is at mostly (98%) favourable status.

21.5.1.4 Coastal catchment associated with Hamford Water

51. The coastal catchment associated with Hamford Water has an area of ~40 km^2. The onshore project area crosses a tributary section of Main River that rises near Beaumont and flows in a southerly and then easterly direction to join Beaumont Cut near Quay Farm. Beaumont Cut joins Landermere Creek, which then flows to Hamford Water. The catchment is predominantly rural and the channel flows in a relatively narrow valley before turning east towards Beaumont Bridge, where it occupies a wide and shallow east facing valley. Hamford Water is also designated as an SPA, SAC, Ramsar site and SSSI (see Section 21.5.8).

21.5.2 Geomorphology

52. The methodology and results of the geomorphological baseline survey undertaken in August 2022 are discussed in detail in Appendix 21.1 (Volume III). Summary details of each watercourse within the onshore project area are provided below:

- **Holland Brook headwaters (Abbott's Farm)**. The headwater channel of Holland Brook is ~1 m wide and incised in places with evidence of bank erosion. Flows were mainly ponded/stagnant and there were no visible bedforms. Some sections of the channel had been recently cleared of vegetation, and the channel bed and banks are artificial (concrete culverts) where crossed by farm access tracks. Several concrete and plastic field drains line the banks.

- **Holland Brook lower course**. The lower course of Holland Brook is ~6 m wide the flows are impounded by a large sluice. Flows are sluggish to stagnant with evidence of frothy surficial scum and an unpleasant (sewage) odour at the time of survey. The channel is set within a well-defined riparian corridor characterised by reeds and rushes next to the channel, and scrubby woodland and undergrowth close to the floodplain. The floodplain covers a wide area of Holland Haven Marshes, but water levels are managed. Close to the sluice, banks are artificial (metal sheeting).
- **Holland Brook tributaries**. Near Great Holland Pits Nature Reserve two left bank tributaries (i.e., in the eastern part of the catchment) join Holland Brook. Both watercourses are very similar and comprise an incised channel (~1 m wide) set within a densely vegetated scrubby riparian corridor, which cuts through arable fields. The extent of undergrowth made it difficult to access the channel. Where visible, flows were ponded and sluggish with no evidence of bedforms. Banks are artificial (concrete culverts) where crossed by farm access tracks. These two tributaries are directly connected to the upstream area of Holland Haven Marshes SSSI, near Hunter’s Bridge.
- **Kirby Brook**. Kirby Brook drains the eastern area of Holland Brook’s wider catchment. It flows around Frinton and then across Holland Haven Marshes, close to the sea wall. The channel is 2-3 m wide and the upstream end of the watercourse, near Frinton, has a straight/engineered planform. Across Holland Haven Marshes the channel has a meandering planform. The entire channel length is very densely vegetated with reeds and rushes. Where visible, flows where ponded and there were no bedforms. A low rubble embankment and water level management associated with the sluice on Holland Brook may limit channel-floodplain connectivity.
- **Tendring Brook**. Tendring Brook joins Holland Brook upstream of Weeley. The channel flows in a relatively narrow/confined valley over most of its length and channel planform is typically straight. The channel is incised approximately 1-1.5 m below the surrounding floodplain and there appears little opportunity for connectivity. The channel occupies a 10 m riparian corridor that is densely overgrown with scrub, making access difficult. Where visible, there was no evidence of flows or bedforms. A substantial concrete farm bridge partially impounds the channel at the upstream end of the reach.
- **Tributary of Bromley Brook**. At the northern limit of the onshore project area, close to the onshore substation zone, a tributary of Bromley Brook flows in a southerly direction. The channel is ~1 m wide and has a distinct trapezoidal cross-section, indicative of regular maintenance. Upstream sections of the reach had been cleared of vegetation whilst downstream the channel is dominated by scrubby vegetation. The channel was either dry or characterised by ponded water with no evidence of bedforms. Channel bed and banks are artificial (concrete) where they are formed by culverts and there are permanent irrigation pipes and field drains on the banks.
- **Tributary of Landermere Creek/Hamford Water**. The tributary section of Main River that flows to Landermere Creek and Hamford Water is incised up to 2 m below the surrounding floodplain and the channel area is densely

vegetated with grass and scrub. Where visible, flows were ponded, and other areas were dry. There was no visible evidence of bedforms.

21.5.3 Water quality

53. 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.

21.5.3.1 Holland Brook

54. Holland Brook (GB105037077810), which is designated as heavily modified, is at Moderate ecological potential (as assessed in 2019). Significant water quality pressures are shown by a Poor classification for biological quality elements (fish and invertebrates) and Moderate classifications for some physico-chemical quality elements (phosphate and mitigation measures assessment). The latter refers to the ecological potential of heavily modified water bodies, which is determined by an assessment of whether measures are properly in place to mitigate the impacts of any modification on the ecology of the water body. If one or more identified mitigation measures are absent, the water body has been classified as Moderate potential.

55. The water body is at Fail for chemical status due to high levels of priority hazardous substances (mercury and its compounds and polybrominated diphenyl ethers (PBDE)).

56. The water body's 'reasons for not achieving good' (RNAG) status include diffuse pollution associated with poor livestock, nutrient and soil management, and urban development. There are also issues associated with point source pollution (sewage), physical modifications (barriers and land drainage), as well as saline intrusion and fish stocking.

21.5.3.2 Tenpenny Brook

57. Tenpenny Brook (GB105037041310), which is designated as heavily modified, is at Moderate ecological potential (as assessed in 2019). Significant water quality pressures are shown by a Poor classification for biological quality elements (fish) and a Bad classification for phosphate (physico-chemical quality).

58. The water body is at Fail for chemical status due to high levels of priority hazardous substances (mercury and its compounds and PBDE).

59. RNAG include point source pollution from sewage and physical modifications (barriers and flood protection structures).

21.5.3.3 Wrabness Brook

60. Wrabness Brook (GB105036040800), which is designated as heavily modified, is at Good ecological potential (as assessed in 2019), although the waterbody is does not support a good hydrological regime.

61. The water body is at Fail for chemical status due to high levels of priority hazardous substances (mercury and its compounds and PBDE).

62. Although at Good ecological potential, there are water quality issues associated with diffuse pollution (poor livestock and nutrient management), point source pollution (private sewage treatment) and flow (surface water abstraction).

21.5.3.4 Coastal catchment

63. There are no data available to determine water quality of the tributary section of Main River in the onshore coastal catchment. The coastal water body immediately downstream (Hamford Water (GB680503713700)) is at Moderate ecological potential due to Moderate classifications for invertebrates, phytoplankton and dissolved inorganic nitrogen. The coastal water body is at Fail for chemical status due to high levels of priority hazardous substances (mercury and its compounds and PBDE).

21.5.4 Abstractions and discharges

21.5.4.1 Abstractions

64. The following abstractions (annual volumes) for agricultural use have been identified within the onshore project area from Environment Agency data (unpublished data, available on request):

- Abbotts Hall, Mistley: 18,200m^3 (spray irrigation);
- Wolves Hall, Tendring: 12,700m^3 (spray irrigation);
- Wolves Hall, Tendring: 36,300m^3 (spray irrigation);
- Strutt and Parker Farms Ltd, Chatham Green: 91,327m^3 (spray irrigation storage); and
- Dairy House Farm, Great Holland: 5,000m^3 (spray irrigation).

21.5.4.2 Discharges

65. 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 shows there is a single discharge exemption within the onshore project area, at Frinton Golf Club. The discharge exemption relates to sewage effluent from a septic tank which shall not exceed 1m^3 in 24 hours and contain no oil or grease. The exemption also states that the septic tank must not be within 10m of any ditch, pond or watercourse, or within 50 m of a borehole.

21.5.5 Utilities

21.5.5.1 Potable water, raw water and sewerage

66. A potable water main follows the course of the onshore project area from near Kirby Cross in the south to Horsleycross Street in the north. Raw water mains also cross the onshore project area between Horsley Cross and Horsleycross Street. A second potable water main also crosses the onshore project area between Kirby Cross and Thorpe Cross.

67. Sewerage mains are located in the landfall area of the onshore project area south of Great Holland and immediately west of Frinton-on-Sea.

21.5.6 Flood risk

21.5.6.1 River and sea flooding

68. Land at risk from river and sea flooding in the study area is shown in Figure 21.3 (Volume II). The majority of the onshore project area is in Flood Zone 1 (land with less than a 0.1% annual probability of river and sea flooding). There are four areas of the onshore project area at higher risk of flooding (Flood Zones 2 and 3):

- In the upper reaches of Holland Brook, immediately west of Abbott's Hall, there is a narrow (30-60 m) 450 m long area of valley floor that 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);
- On Tendring Brook, near Tending Green, there is a narrow (20 m), 200 m long area of valley floor in Flood Zone 3;

- In the Quay Bridge area on the Main River that flows to Landermere Creek and Hamford Water, there is an irregularly shaped area of valley floor (0.24 km^2) that is mostly in Flood Zone 3, with peripheral areas in Flood Zone 2 (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); and
- Associated with Kirby Brook and the lower course of Holland Brook at Holland Haven Marshes, there is a large area of land (1.9 km^2) in mostly in Flood Zone 3, with peripheral areas in Flood Zone 2. This area benefits from the presence of flood defences (sea wall). Due to the low gradient, the area benefitting from defences extends over 5 km upstream on Holland Brook, as far as Thorpe-le-Soken railway station.

21.5.6.2 Surface water flooding

69. High risk (areas with a 3.3% annual probability of flooding) surface water flow paths occur in the same areas as described for river and sea flooding. Across the onshore project area there are other very minor flow paths associated with hillslope hollows. In the area around Quay Bridge, just upstream of Landermere Creek and Hamford Water, there is a more extensive high risk area of surface water ponding and other narrow high risk flow paths.

70. The most extensive area of surface water flood risk is around Holland Haven Marshes. Much of this area overlaps with that described for river and sea flooding but there are also numerous flow paths that drain the low ridge above Holland Haven Marshes.

21.5.6.3 Reservoir flooding

71. Floodplain areas of Kirby Brook and the lower course of Holland Brook at Holland Haven Marshes are at risk of reservoir flooding under a dry-day scenario. The ‘dry-day’ scenario predicts the flooding that would occur if the dam or reservoir failed when rivers are at normal level.

21.5.7 Groundwater

72. Bedrock geology that underlies the onshore project area is dominated by the sedimentary Thames Group of clay, silt and sand, classified as unproductive strata. There is one, small, isolated patch of red crag sedimentary bedrock at Beaumont, which is classified as supporting a Principal aquifer (an aquifer of highly permeable rocks that support high levels of water storage). This aquifer is classed as having medium-high groundwater vulnerability. Groundwater vulnerability maps show the vulnerability of groundwater to a pollutant discharged at ground level based on the hydrological, geological, hydrogeological and soil properties within a single square kilometre.

73. Most of the onshore project area is underlain by unproductive strata, but there are areas of low groundwater vulnerability near Thorpe-le-Soken and medium-low vulnerability north of the A120.

74. North of Tendring the onshore project area lies within Zone III (total catchment) of a source protection zone (SPZ). SPZs are defined around large and public potable groundwater abstraction sites, and Zone III is defined as the total area needed to support the abstraction or discharge from the protected groundwater source.

75. Superficial deposits of glacial sands and gravels, river terrace deposits and Diamicton till overlay bedrock in this area. These superficial units support mainly Secondary A aquifers (smaller aquifers capable of supporting water supplies at a local scale) south of Tendring, and mainly Secondary B aquifers (lower permeability layers which can store limited amounts of groundwater) north of Tendring.

76. The onshore project area is underlain by a single WFD groundwater body (Essex Gravels (GB40503G000400)). The groundwater body is at Poor overall status, as assessed in 2019. It has Good quantitative status but Poor chemical status. RNAG are related to diffuse pollution (poor livestock and nutrient management).

21.5.8 Designated sites

21.5.8.1 Statutory designations

77. Land immediately north of the sea wall (i.e., Holland Haven Marshes) is designated as a SSSI. Holland Haven Marshes SSSI is a reclaimed estuarine saltmarsh and freshwater marsh with an extensive ditch system (Natural England, 2022a). The site is bisected by Holland Brook and its tributaries, from which an extensive ditch system radiates. The citation for the site states the ditch network represents an outstanding example of a freshwater to brackish water transition intimated by the aquatic plant communities, which include several nationally and locally scarce species. The site was last assessed in 2012 and all units were in favourable condition. NFOW has undertaken extensive vegetation, invertebrate and bird surveys of the SSSI in 2021 in order to inform the assessments for PEIR (see Chapter 23 Onshore Ecology, Volume I).

78. At the western end of Holland Haven Marshes, the floodplain of Holland Brook and Kirby Brook are part of Holland Haven LNR) and Holland Haven Country Park, the boundaries of which largely overlap. This floodplain area consists of coastal grassland, marshland, dykes and a large brackish pond around the mouth of the Holland Brook (Tendring District Council, 2021). Water levels are managed so that wildfowl and waders are attracted both to over-winter and to breed.

79. Immediately downstream (~400 m) of the onshore project area the tributary section of Main River that rises near Beaumont (see Section 21.5.1) connects to Hamford Water. This area of coast has the following designations:

- Hamford Water SSSI;
- Hamford Water SAC;
- Hamford Water SPA;
- Hamford Water Ramsar;
- Hamford Water National Nature Reserve (NNR); and
- Skipper's Island Nature Reserve (Essex Wildlife Trust).

80. Hamford Water is a large and shallow estuarine basin comprising tidal creeks, intertidal mud and sand flats, saltmarshes, islands, beaches and marsh grasslands. The SPA is of international importance for breeding little terns and

wintering dark-bellied brent geese, wildfowl and waders, and of national importance for many other bird species. It also supports communities of coastal plants which are rare or extremely local in Britain. The SSSI condition was last assessed in 2012 as mostly (72%) unfavourable (recovering).

81. The Annex II species that is the primary reason for the SAC designation is the Fisher's estuarine moth (*Gortyna borelii lunata)*. Hamford Water supports most of the Essex population and is the most important UK site for this species.

21.5.8.2 Local wildlife sites

82. Immediately west of Great Holland the onshore project area passes adjacent to Great Holland Pits Nature Reserve. The 16 ha reserve occupies a former gravel and old working hold ponds and wet depressions favoured by a range of wildlife.

83. Far Thorpe Green near Thorpe-le-Soken (0.86 km from the onshore project area) is a grassland site also supports a several ponds. The ponds are shaded with water mint (*Mentha aquatica*), yellow iris (*Iris pseudacorus*) and bulrush (*Typha latifolia*) growing along the margins.

84. Beaumont Marsh (1.2 km from the onshore project area) grassland is the only remnant of grazing marsh in the area. A small pond with sweet-grass (*Glyceria spp*.), soft-rush (*Juncus effusus*) and bulrush (*Typha latifolia*) is located in the western half of the site. Shallow ditches support species such as bulrush, common fleabane (*Pulicaria dysenterica*) and common reed (*Phragmites australis*).

85. Upper Holland Brook comprises grassland, scattered trees, secondary woodland, scrub and reservoir along the upper reaches of the Holland Brook, beyond the SSSI (downstream). Near Hunter's Bridge the site is floodplain grazing marsh – this includes UK Biodiversity Action Plan (UKBAP) priority coastal and floodplain grazing marsh.

86. Cattawade Marshes (3.4 km from the onshore project area) are adjacent to the Stour Estuary SSSI. The grazing marshes support open water and fen habitats that are of major importance for the diversity of their breeding bird community, which includes species that have become uncommon throughout lowland Britain because of habitat loss.

87. A full list of local wildlife sites within 5 km of the onshore project area can be found in Table 23.12 of Chapter 23 Onshore Ecology (Volume I).

21.5.9 Receptor sensitivity

88. Catchment receptor sensitivity is described in Table 21.10. Although most catchments have limited geomorphological diversity, high sensitivity catchments relate to designations (e.g., SSSI) which support scarce populations associated with inland ditch networks and coastal environments. Groundwater resources of the Essex Gravels are classed as being medium sensitivity due significant water quality pressures combined with the presence of a very small area of Principal aquifer.

Table 21.10 Catchment receptor sensitivity

Catchment	Sensitivity	Justification
Holland Brook	High	Holland Brook flows through Holland Haven Marshes SSSI. The SSSI units are classified as neutral grassland habitat that support habitats or species that are highly sensitive to changes in surface hydrology, geomorphology or water quality. The citation states the ditch network represents an outstanding example of a freshwater to brackish water transition intimated by the aquatic plant communities, which include several nationally and locally scarce species. The SSSI extends upstream as far as Hunter's Bridge. Outside the SSSI many of the surveyed watercourses (see Appendix 22.1, Volume III) have limited geomorphological diversity and appear to be regularly maintained (desilted and vegetation clearance). Water quality is adversely affected by a range of pressures (e.g., diffuse pollution).
Tenpenny Brook	Low	Surveyed watercourses (see Appendix 21.1, Volume III) support limited natural variations, geomorphology that supports limited natural processes, and water quality that may constrain some ecological communities. Tenpenny Brook is designated as heavily modified and water quality is Moderate (moderate ecological potential), Significant water quality pressures are shown by a Poor classification for biological quality elements (fish) and a Bad classification for phosphate (physico-chemical quality). Water quality pressures are related to point source pollution and physical modifications (barriers and flood protection structures).
Wrabness Brook	High	The lower course of Wrabness Brook overlaps with multiple designated sites in the Stour estuary. The Stour Estuary SSSI supports habitats or species that are highly sensitive to changes in surface hydrology, geomorphology or water quality. The is of national importance for coastal saltmarsh, sheltered muddy shores, two scarce marine invertebrates and a scarce vascular plant assemblage. Water quality in the catchment is good (Good ecological potential), although there are issues associated with diffuse and point source pollution and surface water abstraction.
Coastal catchment	Low	Surveyed watercourses (see Appendix 21.1, Volume III) support limited natural variations, geomorphology that supports limited natural processes, and water quality that may constrain some ecological communities. The channel appears to have been maintained in places (desilted) and no bedforms were observed that would support ecohydrological niches. The channel is incised and disconnected from its floodplain.
Essex gravels	Medium	The groundwater body is at Poor overall status. It has Good quantitative status but Poor chemical status. Water quality is adversely affected by diffuse pollution (poor livestock and nutrient management). Although most of the onshore project area is underlain by unproductive strata, there is one, small, isolated patch of red crag sedimentary bedrock at Beaumont which is classified as supporting a principal aquifer. North of Tendring the onshore project area lies within Zone III (total catchment) of a SPZ.

21.5.10 Future trends in baseline conditions

89. A description of the anticipated changes in future baseline conditions for water resources and flood risk has been carried out and is described within this section.

90. 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.

91. Ongoing measures to reduce existing pressures on geomorphology and water quality as part of the implementation of the WFD are likely to improve its condition over time, therefore a steady improvement in the baseline condition is expected.

92. Climate change is causing more extreme weather. 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. 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.

93. Groundwater resources face pressure from 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 WFD. This would suggest that groundwater quality and quantity is likely to improve in the future, although this would occur over long timescales.

21.6 Assessment of significance

94. The following sections describe the impacts upon those water resources and flood risk receptors described in Section 21.5 that have the potential to arise because of the construction, operation, and decommissioning phases of the Project. The assessment follows the methodology set out in Section 21.4.3. The assessments are based on the worst-case scenarios set out in Section 21.3.2 and include the incorporation of embedded mitigation and project commitments set out in Section 21.3.3.

21.6.1 Potential effects during construction

21.6.1.1 Impact 1: Direct disturbance of surface water bodies

95. The onshore project area will directly cross the following Main Rivers:

- Holland Brook;
- Kirby Brook;
- Tendring Brook; and
- Unnamed tributary (Main River) of Landermere Creek/Hamford Water.

96. The onshore project area will also directly cross some Ordinary Watercourses (which includes all land drainage channels, drains and ditches) within the catchments listed above. Numbers and types of crossings are given in Table 21.11.

Table 21.11 Watercourse crossings in surface water catchments

Catchment	Sensitivity	Trenchless crossings Main River and Ordinary Watercourses	Trenched crossings Ordinary Watercourses
Holland Brook	High	14	2
Tenpenny Brook	Low	0	2
Wrabness Brook	High	0	0
Coastal catchment	Low	3	4

97. Trenchless crossing techniques such as HDD have been embedded in the scheme design for Main Rivers and most Ordinary Watercourses (Table 21.3). The cable would be buried a minimum of 1.5m below hard bed level 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.

98. Trenchless crossings will also be used in the first instance for all Ordinary Watercourse crossings within the study area. However, in some instances the need for a trenched crossing has been retained within the Project's design envelope at this stage, where the need for such a crossing cannot be ruled out due to engineering constraints restricting the flexibility to use trenchless techniques at certain locations. Ongoing project design work will seek to explore options for introducing trenchless techniques at these remaining locations between now and the submission of the Project's ES. The crossing techniques proposed at each watercourse crossing at this stage is presented within Appendix 5.1 Crossing Schedule (Volume III).

99. Trenched crossings of watercourses 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. Alternative, a flume is placed and secured on the rover bed, and excavations conducted in the dry area beneath the flume.

100. These installation techniques 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.

101. 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. These could also be required on watercourses which will be crossed using trenchless techniques.

102. Temporary crossings are likely to 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.

103. 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. However, the 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.

21.6.1.1.1 Magnitude of impact

104. For the purposes of this assessment, magnitude of impact is assumed to be directly proportional to the total number of trenched watercourse crossings within each river water body catchment (Table 21.12). Magnitude of impact is negligible in all catchments (2 to 4 trenched crossings) (Table 21.11) except for Wrabness Brook. There are no trenched crossings in this catchment, and therefore no mechanism for impact.

Table 21.12 Magnitude of impact of trenched watercourse crossings

Magnitude of impact	Number of trenched watercourse crossings
Negligible	1-4
Low	5-9
Medium	10-14
High	>15

21.6.1.1.2 Sensitivity of receptor

105. As described in Table 21.10, receptor sensitivity is high for Holland Brook and Wrabness Brook and low for Tenpenny Brook and the coastal catchment.

21.6.1.1.3 Significance of effect

106. Taking into account best practice embedded mitigation for trenched crossings (Table 21.3), significance of effect for the catchment of Holland Brook is minor adverse, and negligible for Tenpenny Brook and the coastal catchment (Table 21.13). These effects are not significant in EIA terms.

Table 21.13 Effects associated with the direct disturbance of water bodies resulting from construction of the Project

Catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect
Holland Brook	High	Two trenched crossings are required in each of these catchments. Although	Negligible	Minor adverse

Catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect
Tenpenny Brook	Low	mitigation (Table 21.3) will not reduce the number of watercourses that would need to be crossed by the proposed cable corridor, mitigation to follow construction best practice and minimise impacts would be implemented. Significance of effect is minor adverse for Holland Brook (which is high sensitivity) and negligible for Tenpenny Brook.	Negligible	Negligible
Wrabness Brook	High	There are no watercourse crossings in this catchment.	No impact	No effect
Coastal catchment	Low	Four trenched crossings are required in this catchment. Although mitigation (Table 21.3) will not reduce the number of watercourses that would need to be crossed by the proposed cable corridor, mitigation to follow construction best practice and minimise impacts would be implemented. Significance of effect is negligible.	Negligible	Negligible

21.6.1.2 Impact 2: Increased sediment supply

107. The construction of the landfall, onshore cable corridor, haul road and onshore substation will involve earthworks, potentially some piling, excavation 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.

108. 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. Further 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.

109. In addition to the potential sources of sediment considered, temporary bridges may be employed to maintain haul road access across water bodies. These would also provide a mechanism by which sediment could be produced close to the water bodies which they cross.

110. Table 21.14 shows the criteria used to assess the magnitude of impact associated with increased sediment supply resulting from exposed land in a water body catchment.

Table 21.14 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	1.00 - 5.99%
Medium	6.00 – 10.00%
High	>10%

21.6.1.2.1 Magnitude of impact

111. Magnitude of impact is based on a 60m working corridor width and worst case dimensions for all compounds (temporary construction compounds, and compounds at the landfall, HDD and substation locations). This figure provides a high-level proxy for the magnitude of impact for the maximum area of exposed ground during construction in each water body catchment.

112. Results showing the maximum possible area of disturbed ground in each water body receptor are shown in Table 21.15. Areas of exposed land range from 0.06 to 1.16 km^2 and 0.58% to 1.21% catchment area. The higher figure of 1.21% is for Holland Brook, which has the longest section of cable corridor, landfall and most of the construction compounds.

113. Based on the criteria presented in Table 21.14, magnitude of impact is negligible for all catchments except Holland Brook, where it is low. As well as the numerical thresholds for determining magnitude of impact (Table 21.14), embedded best practice mitigation (Table 21.3) is also considered. Embedded mitigation will reduce the magnitude of impact in Holland Brook's catchment from low to negligible.

Table 21.15 Areas of disturbed ground in each water body catchment

Catchment	Estimated total area of disturbed ground during construction	
	km	%
Holland Brook	1.16	1.21
Tenpenny Brook	0.27	0.89
Wrabness Brook	0.06	0.58
Coastal catchment	0.36	0.92

21.6.1.2.2 Sensitivity of receptor

114. As described in Table 21.10, receptor sensitivity is high for Holland Brook and Wrabness Brook and low for Tenpenny Brook and the coastal catchment.

21.6.1.2.3 Significance of effect

115. Significance of effect for increased sediment supply associated with disturbed land due to construction activities is assessed in Table 21.16. Taking into account best practice embedded mitigation (Table 21.3), significance of effect for Tenpenny Brook and the coastal catchment will be negligible, and minor

adverse for Holland Brook and Wrabness Brook. These effects are not significant in EIA terms.

Table 21.16 Effects associated with increased sediment supply resulting from construction of the Project

Catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect
Holland Brook	High	Approximately 1.21% of Holland Brook's catchment could be affected by the construction activities in the onshore project area, which could increase sediment supply to the surface drainage network. The area affected is higher is this catchment because it has the longest section of onshore cable corridor, landfall and most of the construction compounds. With embedded mitigation in place (Table 21.3), magnitude of impact will be negligible and significance of effect is minor adverse.	Negligible	Minor adverse
Wrabness Brook	High	Approximately 0.58% of Wrabness Brook's catchment would be affected by construction activities in the onshore project area, which could increase sediment supply to the surface drainage network. Catchment sensitivity is high due to multiple designations in the Stour estuary. With embedded mitigation in place (Table 21.3), magnitude of impact will be negligible and significance of effect is minor adverse It should be noted that the onshore project area only just crosses into this catchment (the area of onshore cable corridor in this catchment is approximately 0.13 km^2). Depending on the final position of the onshore cable corridor and position of any temporary/HDD construction compounds, it may be avoided entirely.	Negligible	Minor adverse
Tenpenny Brook	Low	Approximately 0.89% of Tenpenny Brook's catchment and 0.92% of the coastal catchment would be affected by the construction in the onshore project area, which could increase sediment supply to the surface drainage network. However, as these are relatively small areas of each catchment and with embedded mitigation in place (Table 21.3), magnitude of impact and significance of effect are negligible.	Negligible	Negligible
Coastal catchment	Low		Negligible	Negligible

21.6.1.3 Impact 3: Supply of contaminants to surface and groundwaters

116. 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.

117. 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 23 Onshore Ecology, Volume I).

118. 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. This could be a particular issue in designated habitats supported by Holland Brook (Holland Haven Marshes SSSI).

119. 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.

21.6.1.3.1 Magnitude of impact

120. The magnitude of the potential impact upon a surface water catchment or body of groundwater is proportional to the maximum area of each water body catchment that would be affected during construction, as calculated in Section 21.6.1.2.1 and shown in Table 21.14. These areas, and associated magnitudes, are shown in Table 21.15. Based on the criteria presented in Table 21.14, magnitude of impact is low in Holland Brook and negligible in all other catchments.

121. As well as the numerical thresholds for determining magnitude of impact (Table 21.14), embedded best practice mitigation (Table 21.3) is also considered. Embedded mitigation will reduce the magnitude of impact in Holland Brook's catchment from low to negligible.

21.6.1.3.2 Sensitivity of receptor

122. As described in Table 21.10, receptor sensitivity is high for Holland Brook and Wrabness Brook and low for Tenpenny Brook and the coastal catchment. Sensitivity is medium for the Essex gravels groundwater body.

21.6.1.3.3 Significance of effect

123. Significance of effect for the supply of contaminants to surface and groundwaters associated with disturbed land due to construction activities is assessed in Table 21.17. Taking into account best practice embedded mitigation (Table 21.3), significance of effect for Tenpenny Brook and the coastal catchment will be negligible, and minor adverse for Holland Brook, Wrabness Brook and Essex Gravels body of groundwater. These effects are not significant in EIA terms.

Table 21.17 Effects associated with the supply of contaminants to surface and groundwaters resulting from construction of the Project

Catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect
Holland Brook	High	HDD activities 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. Approximately 1.21% of Holland Brook's catchment could be affected by the construction activities in the onshore project area, which could supply contaminants to surface and groundwaters. The area affected is higher is this catchment because it has the longest section of cable corridor, landfall, and most of the construction compounds. With embedded mitigation in place (Table 21.3), magnitude of impact will be negligible and significance of effect is minor adverse.	Negligible	Minor adverse
Wrabness Brook	High	Approximately 0.58% of Wrabness Brook's catchment would be affected by construction of the onshore project area, which could increase supply of contaminants to surface and groundwaters. Catchment sensitivity is high due to multiple designations in the Stour estuary. With embedded mitigation in place (Table 21.3), magnitude of impact will be negligible and significance of effect is minor adverse. It should be noted that the onshore project area only just crosses into this catchment (the area of onshore cable corridor in this catchment is approximately 0.13 km^2). Depending on the final position of the onshore cable corridor and position of any temporary/HDD construction compounds, it may be avoided entirely.	Negligible	Minor adverse
Tenpenny Brook	Low	Approximately 0.89% of Tenpenny Brook's catchment and 0.92% of the coastal catchment would be affected by the construction activities in the onshore project area, which could increase the supply of contaminants to surface and groundwaters. However, as these are relatively small areas of each catchment and with embedded mitigation in place (Table 21.3), magnitude of impact and significance of effect are negligible.	Negligible	Negligible
Coastal catchment	Low		Negligible	Negligible
Essex gravels	Medium	A very small proportion of the groundwater body (0.08%) would be directly affected by construction activities in the onshore project area. Across entire groundwater catchment, these activities would not lead to significant changes in groundwater quality. With embedded mitigation in place to limit	Negligible	Minor adverse

Catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect
		groundwater impacts (Table 21.3), magnitude of impact is negligible and significance of effect is minor adverse.		

21.6.1.4 Impact 4: Changes to surface and groundwater flows and flood risk

124. 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 project 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).

125. 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 project area.

126. 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 Project 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.

127. Note that the potential flood risk implications of the Project will be assessed in a separate FRA that will accompany the PEIR.

21.6.1.4.1 Magnitude of impact

128. The magnitude of the potential impact upon a surface water catchment or body of groundwater is proportional to the maximum area of each water body catchment that would be affected during construction, as calculated in Section 21.6.1.2.1 and shown in Table 21.14. These areas, and associated magnitudes, are shown in Table 21.15. Based on the criteria presented in Table 21.14, magnitude of impact is low in Holland Brook and negligible in all other catchments.

129. As well as the numerical thresholds for determining magnitude of impact (Table 21.14), embedded best practice mitigation (Table 21.3) is also considered. Embedded mitigation will reduce the magnitude of impact in Holland Brook's catchment from low to negligible.

21.6.1.4.2 Sensitivity of receptor

130. As described in Table 21.10, receptor sensitivity is high for Holland Brook and Wrabness Brook and low for Tenpenny Brook and the coastal catchment. Sensitivity is medium for the Essex gravels groundwater body.

21.6.1.4.3 Significance of effect

131. Significance of effect for changes to surface and groundwater flows and flood risk due to construction activities are assessed Table 21.18. Taking into account best practice embedded mitigation (Table 21.3), significance of effect for Tenpenny Brook and the coastal catchment will be negligible, and minor

adverse for Holland Brook, Wrabness Brook and Essex Gravels. These effects are not significant in EIA terms.

Table 21.18 Effects associated with changes to surface and groundwater flows and flood risk resulting from construction of the Project

Catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect
Holland Brook	High	Approximately 1.21% of Holland Brook's catchment would be directly affected by construction activities in the onshore project area. The area affected is higher is this catchment because it has the longest section of cable corridor, landfall, and most of the construction compounds. At a catchment scale, construction activities would not lead to significant changes in surface water drainage or flood risk, and the low number of temporary crossings to allow the haul road to continue at HDD locations will not affect flows or increase flood risk (e.g. through the exceedance or failure of pumps). With embedded mitigation in place (Table 21.3), magnitude of impact will be negligible and significance of effect will is minor adverse.	Negligible	Minor adverse
Wrabness Brook	High	Only a small proportion of each catchment (maximum of 0.58 – 0.92%) would be directly affected by construction activities in the onshore project area. At a catchment scale, these activities would not lead to significant changes in surface water drainage or flood risk, and the low number of temporary crossings to allow the haul road to continue at HDD locations will not affect flows or increase flood risk. In addition, embedded mitigation (Table 21.3) would minimise the impact of any changes to surface water flows. Magnitude of impact and significance of effect will be negligible in all catchments except Wrabness Brook (minor adverse). It should be noted that the onshore project area only just crosses into the catchment of Wrabness Brook (the area of onshore cable corridor in this catchment is approximately 0.13 km^2). Depending on the final position of the onshore cable corridor and position of any temporary/HDD construction compounds, it may be avoided entirely.	Negligible	Minor adverse
Tenpenny Brook	Low		Negligible	Negligible
Coastal catchment	Low		Negligible	Negligible
Essex Gravels	Medium	A very small proportion of the groundwater body (0.08%) would be directly affected by construction activities in the onshore project area. Across entire groundwater catchment, these activities would not lead to significant changes in groundwater drainage or flood risk. With embedded mitigation in place to limit groundwater impacts (Table 21.3), magnitude of impact is negligible and significance of effect is minor adverse.	Negligible	Minor adverse

21.6.2 Potential effects during operation

132. Once constructed, there is the potential for significant effects arising from general operation of the Project in the context of water resources and flood risk receptors. Those impacts that may occur are detailed below.

21.6.2.1 Impact 5: Supply of contaminants to surface and groundwater

133. Operational activities at the landfall, along the onshore cable corridor and at the onshore substation would 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 (including land drainage channels). This in turn could consequently impact upon aquatic ecology.

134. 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 (i.e., area of the Principal aquifer near Beaumont). This could have subsequent impacts upon aquatic ecology and the use of water resources for licensed and unlicensed abstractions.

135. The onshore substation is likely to be unmanned, with no, or at most minimal, welfare facilities on site. As a result, it is very unlikely that welfare facilities at the onshore substation 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.

21.6.2.1.1 Magnitude of impact

136. The scale of potential impact on a waterbody catchment is proportional to the area of permanent infrastructure in each catchment during operation. This has been estimated based on the area of the onshore cables (including joint bays) onshore substation and permanent land take required for transition joint bays (Table 21.19).

Table 21.19 Maximum area of permanent development in each water body catchment

Catchment	Estimated total area permanent development	
	m^2 (km^2)	%
Holland Brook	330,040 (0.33)	0.34
Tenpenny Brook	46,800 (0.047)	0.16
Wrabness Brook	21200 (0.021)	0.20
Coastal catchment	107,910 (0.108)	0.27
Essex gravels	242,040 (0.242)	0.02

137. The magnitude of impact in all catchment receptors is anticipated to be negligible due to the very small proportion (less than 0.5%) of each catchment containing operational above or below ground infrastructure.

21.6.2.1.2 Sensitivity of receptor

138. As described in Table 21.10, receptor sensitivity is high for Holland Brook and Wrabness Brook and low for Tenpenny Brook and the coastal catchment. Sensitivity is medium for the Essex Gravels groundwater body.

21.6.2.1.3 Significance of effect

139. Significance of effect in each water body catchment is assessed in Table 21.20. Operational effects are not significant in EIA terms for the supply of contaminants to surface and groundwaters. Considering best practice embedded mitigation (Table 21.3), effects resulting from operational activities at the landfall and along the onshore cable corridor are minor adverse (Holland Brook, Wrabness Brook, Essex Gravels) to negligible (Tenpenny Brook, coastal catchment) due to the relatively infrequent and highly localised nature of likely operation and maintenance activities.

140. Access to the onshore export cables would be required to conduct emergency repairs, if necessary and occasional non-intrusive maintenance visits. Access to each field parcel along the cable corridor would be from existing field entry points wherever possible.

141. In the event of a cable failure the affected section of cable would be pulled out of the duct and replaced. To do this the joint bays, which are below ground at either end of a section of cable, would be excavated to get access to those bays and then backfilled after the works are complete. There remains a risk of fuel spills or leakages associated with maintenance activities, although embedded mitigation includes emergency spill procedures and use of spill kits to reduce the risk of any such spill. The onshore substation is likely to be unmanned and it is very unlikely that welfare facilities could increase the supply of nutrients, such as nitrogen and phosphorus, to the drainage system.

142. Maintenance activities would be highly localised during the operational life of the cable infrastructure. It is unlikely that operational activities will generate large volumes of contaminants that could have a discernible alteration to the water quality of receptors.

Table 21.20 Effects associated with the supply of contaminants to surface and groundwater resulting from operation of the Project

Catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect
Holland Brook	High	Holland Brook's catchment contains the largest area of permanent infrastructure associated with the Project. However, this forms a very small proportion of the overall catchment (0.34%). Although some routine maintenance would be required throughout the operational life of the Project, embedded mitigation (Table 21.3) will be in place to control any potential accidental release of foul drainage and surface water drainage. Magnitude of impact is negligible and significance off effect is minor adverse.	Negligible	Minor adverse
Wrabness Brook	High	All catchments contain very small areas of permanent infrastructure associated with the Project. As a proportion of the overall catchment areas, it is equal to or less than 0.27%. Although some routine maintenance would be required throughout the operational life of the Project, embedded mitigation (Table 21.3) will be in place to control any potential accidental release of foul drainage and surface water drainage. Magnitude of impact is negligible in all catchments. Significance of effect is negligible in catchments with low sensitivity and minor adverse where sensitivity is high (Wrabness Brook, Essex gravels). Only a very small area of the onshore project area crosses the catchment of Wrabness Brook, which means there may not be any permanent infrastructure in this catchment.	Negligible	Minor adverse
Tenpenny Brook	Low		Negligible	Negligible
Coastal catchment	Low		Negligible	Negligible
Essex gravels	Medium		Negligible	Minor adverse

21.6.2.2 *Impact 6: Changes to surface and groundwater flows and flood risk*

143. The permanent above ground infrastructure, including the onshore substation 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 substation.

144. The presence of the buried cable ducting along the onshore cable corridor may affect subsurface flow corridors as it will introduce an impermeable barrier which could alter 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 project area (including shallow aquifers and deeper Principal aquifers). However, the relatively shallow depth of the cable infrastructure (0.9 to 2m (locally over 5m deep at trenchless crossings, and always at least 1.5m below hard bed level) means that any impacts are likely to be highly localised and confined to shallow near-surface groundwater bodies,

145. 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 to watercourses, including land drainage channels. Changes in surface water runoff and subsurface flows could be sufficient to affect 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, thereby encouraging geomorphological adjustment. Geomorphological changes may also impact upon in-channel habitat conditions for aquatic organisms. Effects on local geomorphology and in-channel habitats could potentially be locally significant if drainage from a large area is discharged at a discrete location within the existing surface drainage network.

146. 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.

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

21.6.2.2.1 Magnitude of impact

148. The scale of potential impact upon a sub-catchment is proportional to the area of permanent infrastructure in each catchment during operation. This has been estimated based on the area of the onshore cables, onshore substation and permanent access roads within each catchment (Table 21.19). The magnitude of impact in all catchment receptors is anticipated to be negligible due to the very small proportion (less than 1%) of the catchment containing operational above or below ground infrastructure.

21.6.2.2.2 Sensitivity of receptor

149. As described in Table 21.10, receptor sensitivity is high for Holland Brook and Wrabness Brook and low for Tenpenny Brook and the coastal catchment. Sensitivity is medium for the Essex Gravels groundwater body.

21.6.2.2.3 Significance of effect

150. Significance of effect in each water body catchment is assessed in Table 21.21. Operational effects are not significant in EIA terms for changes to surface and groundwater flows and flood risk. Taking into account best practice embedded mitigation (Table 21.3), effects resulting from operational activities at the landfall and along the cable corridor are minor adverse (Holland Brook, Wrabness Brook, Essex Gravels) to negligible (Tenpenny Brook, coastal catchment) due to the very small area of each catchment occupied by permanent infrastructure. This means it is unlikely that operational activities will alter the surface and groundwater flow patterns and flood risk of receptors.

Table 21.21 Effects associated with changes to surface and groundwater flows and flood risk resulting from operation of the Project

Catchment	Sensitivity	Assessment	Magnitude of impact	Significance of effect
Holland Brook	High	As a result of the very limited spatial extent of permanent development along the cable corridor and at the substation (<0.1% of each catchment), magnitude of impact will be negligible in all catchments. Due to their medium to high sensitivity, significance of effect will be minor adverse in the surface water catchments of Holland Brook, Wrabness Brook, and in the Essex gravels groundwater body. With embedded mitigation in place (Table 21.3), effects are anticipated as negligible in Tenpenny Brook's catchment and coastal catchment, and minor adverse in the surface water catchments of Holland Brook, Wrabness Brook and in the Essex gravels groundwater catchment.	Negligible	Minor adverse
Wrabness Brook	High		Negligible	Minor adverse
Tenpenny Brook	Low		Negligible	Negligible
Coastal catchment	Low		Negligible	Negligible
Essex Gravels	Medium		Negligible	Minor adverse

21.6.3 Potential effects during decommissioning

151. No decision has yet been made regarding the final decommissioning policies for the Project as it is recognised that industry best practice, rules and legislation change over time. The detail and scope of decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator with decommissioning plan provided.

152. However, it is considered likely that the proposed onshore substation would be removed and materials will be reused or recycled and that the onshore cables would also be removed and recycled, with the transition bays and cable ducts (where used) left in situ. For the purposes of a worst-case scenario, it is considered that impacts associated with the decommissioning phase would be no greater than those identified for the construction phase (Section 21.6.1) with similar embedded mitigation.

21.7 Potential monitoring requirements

153. Saline intrusion is listed as one of the reasons for the Holland Brook water body failing to achieve GEP. The Environment Agency has also noted the potential for saline intrusion at the landfall (Table 21.1) (i.e., in Holland Brook's catchment). Although best practice to minimise the risks associated with saline intrusion will be agreed with the Environment Agency, water quality monitoring (conductivity) may be required in the watercourses surrounding the landfall during the construction phase to ensure that there are no adverse impacts on existing freshwater resources.

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

21.8 Cumulative effects

21.8.1 Identification of potential cumulative effects

155. The first step in the CEA process is the identification of which residual effects assessed for North Falls on their own have the potential for a cumulative effect with other plans, projects and activities. This information is set out in Table 21.22. Only potential effects assessed in Section 21.6 as negligible adverse or above are included in the 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 21.22 Potential cumulative effects

Impact	Potential for cumulative effect	Rationale
Construction		
Direct disturbance of surface water bodies	Yes	Impacts to surface water bodies could act cumulatively with other projects if these cause direct disturbance to the same water bodies, particularly if there is a temporal or spatial overlap.
Increased sediment supply	Yes	Other projects being constructed within a precautionary 1km buffer of the onshore project area may also cause an increase in sediment supply to the surface water drainage system which could act cumulatively.
Supply of contaminants to surface and groundwaters	Yes	Other projects being constructed within a precautionary 1km buffer of the onshore project area may act cumulatively to reduce surface and groundwater quality if they cause a supply of contaminants to be released into the surface water drainage system.
Changes to surface and groundwater flows and flood risk	Yes	Any project involving construction within a precautionary 1km buffer of the onshore project area could also cause changes in surface flow patterns, compaction and an increase in impermeable area. This could act cumulatively to cause further changes to surface water runoff and flood risk.
Operation		
Supply of contaminants to surface and groundwaters	Yes	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 (as routine cable maintenance will be non-intrusive) and as such could only result in cumulative impacts in the catchments which contain the onshore substation (Holland Brook and Tenpenny Brook).
Changes to surface and groundwater flows and flood risk	Yes	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).

Impact	Potential for cumulative effect	Rationale
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.		

21.8.2 Other plans, projects and activities

156. The second step in the cumulative assessment is the identification of the other plans, projects and activities that may result in cumulative effects for inclusion in the CEA (described as 'project screening'). This information is set out in Table 21.23 below, together with a consideration of the relevant details of each, including current status (e.g. under construction), planned construction period, closest distance to North Falls, status of available data and rationale for including or excluding from the assessment.

157. The Project screening has been informed by the development of a CEA project list which forms an exhaustive list of plans, projects and activities within the study area relevant to North Falls. The list has been appraised, based on the confidence in being able to undertake an assessment from the information and data available, enabling individual plans, projects and activities to be screened in or out.

Table 21.23 Summary of projects considered for the CEA in relation to water resources and flood risk (project screening)

Project	Status	Construction Period	Closest distance to onshore project area	Confidence in data	Included in CEA	Rationale
Five Estuaries Offshore Wind Farm (Five Estuaries Offshore Wind Farm, 2021)	Pre-application	2028-2030	Scoping search area directly overlaps with North Falls onshore project area	Low	Yes	Scoping report impacts are similar to those identified for North Falls. These are: • Generation of turbid runoff which could enter the water environment. • Changes to surface and groundwater flows and flood risk. • Pollution or disruption of flow to groundwater through ground excavations or piling. If there is temporal overlap in construction phases, this could lead to cumulative impacts from: the direct disturbance of water bodies, contaminant and sediment release and changes to surface water drainage.
East Anglia GREEN Energy Enablement Project (National Grid, 2022)	Pre-application	2027-2031	<1 km in Tenpenny Brook's catchment	Low	Yes	There could be temporal overlap in the construction of these two projects. A new 400kV substation would be located close to the North Falls onshore substation zone, and a very short section of the construction corridor (for overhead wires/pylons) would be in

Project	Status	Construction Period	Closest distance to onshore project area	Confidence in data	Included in CEA	Rationale
						Tenpenny Brook's catchment. There is the potential for cumulative impacts associated with: the direct disturbance to channels, increased sediment supply, supply of contaminants and changes to surface water runoff and flood risk.
Elmstead Hall irrigation reservoir (Essex County Council, 2016)	Approved	2017-ongoing (initially cited as a four year construction period but a planning application for continuing construction was approved in August 2022).	3.7 km – in Tenpenny Brook's catchment	Low	Yes	Construction began in 2017 and is ongoing. Activities include excavation, processing and removal of sand, gravel and soils, engineering works, ancillary building, peripheral environmental bund, aggregate processing plant, mineral stockpile and storage areas, site entrance, internal access road, site water management and a mobile soil screening plant. There is the potential for cumulative impacts of: direct disturbance to channels. Increased sediment supply, supply of contaminants and changes to surface water runoff and flood risk.

21.8.3 Assessment of cumulative effects

158. Based on the Project screening in Table 21.23, three of the listed projects will be included in the CEA for further assessment: East Anglia GREEN, Five Estuaries Offshore Wind Farm, and Elmstead Hall irrigation reservoir. These projects are summarised below and assessed in Table 21.24 and Table 21.25.

21.8.3.1 Five Estuaries Offshore Wind Farm

159. At the time of drafting this PEIR, the latest publicly available information for Five Estuaries Offshore Wind Farm comprises of a Scoping Report (Five Estuaries Offshore Wind Farm Ltd., 2021).

160. The level of information contained within the Scoping Report is not sufficient to undertake a full CEA. However, the Applicant is in regular and on-going dialogue with Five Estuaries Offshore Wind Farm Ltd. and have established that the location of the landfall, onshore cable corridor and onshore substations will be broadly the same as North Falls and construction could occur at the same time and for a similar duration.

161. Recognising that the two projects (Five Estuaries and North Falls) are broadly comparable in terms of location and scale, it is possible to initially forecast potential high level cumulative construction and operational effects (Table 21.24 and Table 21.25).

162. The Applicant will incorporate relevant new information presented by Five Estuaries within the CEA in the ES.

21.8.3.2 East Anglia GREEN

163. At the time of drafting this PEIR, the latest publicly available information for East Anglia GREEN comprises of a Scoping Report (National Grid, 2022).

164. The level of information contained within this Scoping Report is not sufficient to undertake a full CEA. However, the Applicant is in regular and on-going dialogue with National Grid and will seek to continue working closely with National Grid, and with statutory consultees to assess potential cumulative effects. Infrastructure associated with East Anglia GREEN's new substation will very likely be located in Tenpenny Brook's catchment. Based on this likely location, it is possible to initially forecast potential high level cumulative construction and operational effects (Table 21.24 and Table 21.25).

165. The Applicant will incorporate relevant new information presented by East Anglia GREEN within the CEA in the ES.

21.8.3.3 Elmstead Hall irrigation reservoir

166. The continuation of construction works (which began in 2017 and are ongoing) associated with an irrigation reservoir at Elmstead Hall include excavation, processing and removal of sand, gravel and soils, engineering works, ancillary building, peripheral environmental bund, aggregate processing plant, mineral stockpile and storage areas, site entrance, internal access road, site water management and a mobile soil screening plant.

167. A review of the planning application site boundary (Essex County Council Development and Regulation Committee, 2016) and aerial imagery showing construction at the site since 2017, shows the site footprint does not overlap any

watercourses in Tenpenny Brook's catchment. The nearest watercourse is 700 m away. The site is also 3.7 km away from the North Falls onshore project area at its closest. Given the location of the site and its small scale (0.11 km^2 (10.7 ha)), no mechanism for cumulative effects have been identified. Furthermore, given the small construction footprint of the reservoir and the duration it has already been under development, it is highly likely construction will be complete by the time North Falls construction begins. The likely construction timescale will be clarified with Essex County Council and updated in the ES.

168. As assessed in Table 21.24 and Table 21.25, it is not anticipated that cumulative effects associated with any of the projects listed in Table 21.23 are likely to be significant in EIA terms.

Table 21.24 Cumulative effects from other projects on water resources and flood risk during construction

Project	Cumulative effect 1: Direct disturbance of surface water bodies	Cumulative effect 2: Increased sediment supply	Cumulative effect 3: Supply of contaminants to surface and groundwater	Cumulative effect 4: Changes to surface water and groundwater flows and flood risk
Five Estuaries Offshore Wind Farm	Details about potential trenched crossings or mitigation are not provided in the Five Estuaries Scoping Report. However, it is considered very likely there will be a commitment to using trenchless techniques for all Main River crossings. There may be trenched crossings of Ordinary Watercourses and best practice mitigation measures are described for helping to reduce the generation of turbid runoff. There are a low number of trenched watercourse crossings associated with North Falls, meaning cumulative effects are considered unlikely. Therefore, it is not anticipated that cumulative effects are likely to be significant in EIA terms.	Mitigation measures described in the Five Estuaries Scoping Report are very similar to those described in Table 21.3 for North Falls. They include best practice methods described in Environment Agency PPG, and CIRIA guidance, which will be formalised within a CoCP. These measures will define Five Estuaries principles for the management of surface water runoff on areas of construction, handling and stockpiling of soils, and stripped surface cover and control of vehicle movements. Considering the low percentage potential exposed ground in each catchment for North Falls, and the use of best practice mitigation measures on both projects, there is limited potential for cumulative effects. It is not anticipated that cumulative effects are likely to be significant in EIA terms.	The potential introduction of pollutants is only discussed regarding groundwater associated with excavations and piling in the Five Estuaries Scoping Report. Five Estuaries are committed to implementing mitigation based on various standard sectoral practices and procedures. Although not defined, it is likely these will include best practice described in Environment Agency PPG, and CIRIA guidance, which will be formalised within a CoCP. Considering the low percentage potential exposed ground in each catchment for North Falls that could supply contaminants, and the use of best practice mitigation measures on both projects, there is limited potential for cumulative effects. It is not anticipated that cumulative effects are likely to be significant in EIA terms.	The Five Estuaries Scoping Report notes that changes to surface water runoff patterns, which could affect flood risk, could arise from the removal of surface vegetation, compaction of soils through vehicle movement, development of temporary compounds, cable trenching excavations and dewatering of excavations. Environment Agency flood map zoning will be used to inform an FRA for proposed activities on site. Five Estuaries are committed to implementing mitigation based on various standard sectoral practices and procedures. Although not defined, it is likely these will include measures to limit runoff (e.g., restricting runoff to the existing greenfield rate). Considering the low percentage potential exposed ground in each catchment for North Falls that could change surface and groundwater flows, and the use of best practice mitigation on both projects, there is limited potential for cumulative effects. It is not anticipated that cumulative effects are likely to be significant in EIA terms.

Project	Cumulative effect 1: Direct disturbance of surface water bodies	Cumulative effect 2: Increased sediment supply	Cumulative effect 3: Supply of contaminants to surface and groundwater	Cumulative effect 4: Changes to surface water and groundwater flows and flood risk
East Anglia GREEN	A new onshore substation is proposed to be built as part of East Anglia GREEN, close to the North Falls onshore substation area. Two Ordinary Watercourses could be trenched in or close to the North Falls onshore substation area. However, the East Anglia GREEN search area does not cross these watercourses or any of their tributaries. This means there is no potential for cumulative effects associated with the direct disturbance of watercourses. It is not anticipated that cumulative effects are likely to be significant in EIA terms.	The new East Anglian GREEN substation will be located in Tenpenny Brook's catchment. A very short section (approximately 1 km) of East Anglian Green's overhead line construction search area also falls within the same catchment. The closest watercourse to both substations is near Norman's Farm (this is the watercourse referred to as a tributary of Tenpenny Brook in Appendix 21.1, Volume III). Although mitigation measures are not yet known for East Anglia GREEN, it is likely it will be subject to an EIA and therefore use best practice methods and environmental management plans to limit soil exposure and turbid runoff. Only 0.89% of Tenpenny Brook's catchment will be disturbed by construction of North Falls, which could increase sediment supply to surface waters. Given the limited spatial scale of works associated with East Anglian GREEN, cumulative effects are not anticipated. It is not anticipated that cumulative effects are likely to be significant in EIA terms.	Although mitigation measures are not yet known for East Anglian GREEN's new substation in Tenpenny Brook's catchment, it is likely they will include a construction environmental management plan and best practice measures to limit the likelihood contaminants, such as oils, fuels and lubricants entering surface and groundwater catchments. Only 0.89% of Tenpenny Brook's catchment will be disturbed by construction of North Falls, which could supply contaminants to surface and groundwaters. Given the limited spatial scale of works associated with East Anglian GREEN, cumulative effects are not anticipated. It is not anticipated that cumulative effects are likely to be significant in EIA terms.	Although mitigation measures are not yet known for East Anglian GREEN's new substation in Tenpenny Brook's catchment, they will likely include measures to limit runoff during construction (e.g., drainage management plan, restricting runoff to the existing greenfield rate). Only 0.89% of Tenpenny Brook's catchment will be disturbed by construction of North Falls, which could alter infiltration and runoff rates. Given the limited spatial scale of works associated with East Anglian GREEN, cumulative effects are not anticipated. It is not anticipated that cumulative effects are likely to be significant in EIA terms.

Table 21.25 Cumulative effects from other projects on water resources and flood risk during operation

Project	Cumulative effect 1: Supply of contaminants to surface and groundwater	Cumulative effect 2: Changes to surface and groundwater flows and flood risk
Five Estuaries Offshore Wind Farm	The overlapping nature of both project areas means that Five Estuaries permanent infrastructure could occupy the same surface water catchments as North Falls. However, all catchments contain very small areas of permanent infrastructure (Table 21.19). As a proportion of the overall catchment areas, it is significantly less than 1%. Given that Five Estuaries will very likely be using infrastructure that is similar in nature to North Falls, combined areas of permanent infrastructure will remain very low. Although some routine maintenance would be required throughout the operational life of the projects, embedded mitigation will be in place to control any potential accidental release of contaminants. It is not anticipated that cumulative effects are likely to be significant in EIA terms.	As the onshore project area for North Falls and Five Estuaries search area largely overlap, permanent infrastructure will very likely be in the same surface water catchments. However, all catchments contain very small areas (<1%) of permanent infrastructure (Table 21.19). Even if these figures are doubled to assume all the same permanent infrastructure for Five Estuaries, this would still equate to less than 1% of each catchment's total area. It is considered that operational changes to surface and groundwater flows and flood risk at the landfall and substation and along the cable corridor would be so small, and so localised, that they will not act cumulatively. It is not anticipated that cumulative effects are likely to be significant in EIA terms.
East Anglia GREEN	The area of permanent infrastructure associated with North Falls in Tenpenny Brook's catchment represents 0.16% of the total area. Assuming a similar land take for East Anglian GREEN's new 400kV substation, this would still equate to a total catchment land take area for both projects of less than 1%. At both substations, operational activities would be relatively infrequent and highly localised. This means it is unlikely that operational activities will generate large volumes or contaminants that could have a discernible alteration to the water quality of receptors. It is not anticipated that cumulative effects are likely to be significant in EIA terms.	The total catchment land take area for both substations and other permanent infrastructure would equate to less than 1%. It is considered that operational changes to surface and groundwater flows and flood risk along the onshore cable corridor and at the substations in Tenpenny Brook's catchment would be so small, and so localised, that they will not act cumulatively. It is not anticipated that cumulative effects are likely to be significant in EIA terms.

21.9 Interactions

169. Water receptors (including surface waters and groundwater) are intrinsically linked to:

- Ground conditions, which influence the quality of groundwater, how it moves through subsurface strata, and how it interacts with surface waters; and
- Ecology, which is to some extent controlled by the availability of habitat niches, and therefore the hydrology, geomorphology and chemical quality of surface waters and the distribution and quality of groundwater.

170. A summary of the potential inter-relationships between water resources, ground conditions and terrestrial ecology is provided in Table 21.26.

Table 21.26 Water resources and flood risk interactions

Topic and description	Related chapter (Volume I)	Where addressed in this chapter	Rationale
Construction			
Impact 1: Direct disturbance of surface water bodies Impact 2: Increased sediment supply Impact 3: Supply of contaminants to surface and groundwaters Impact 4: Changes to surface and groundwater flows and flood risk	Chapter 19 Ground Conditions and Contamination	Section 21.6.1.1 Section 21.6.1.2 Section 21.6.1.3 Section 21.6.1.4	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 23 Onshore Ecology	Section 21.6.1.1 Section 21.6.1.2 Section 21.6.1.3 Section 21.6.1.4	Potential changes to the hydrology, geomorphology and water quality of the Holland Haven Marshes SSSI during construction could impact upon water-dependent biological communities (including the designated interest features).
Operation			
Impact 1: Supply of contaminants to surface and groundwater	Chapter 19 Ground Conditions and Contamination	Section 21.6.2.1 Section 21.6.2.2	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.
Impact 2: Changes to surface and groundwater flows and flood risk	Chapter 23 Onshore Ecology	Section 21.6.2.1 Section 21.6.2.2	Potential changes to the hydrology, geomorphology and water quality of Holland Haven Marshes SSSI during construction could impact upon water-dependent biological communities (including the

Topic and description	Related chapter (Volume I)	Where addressed in this chapter	Rationale
			designated interest features).
Decommissioning			
Impacts associated with the decommissioning phase would be no greater than those identified for the construction phase.			

21.10 Inter-relationships

171. The effects identified and assessed in this chapter have the potential to interrelate with each other. The areas of potential inter-relationships between effects are presented in Table 21.27. This provides a screening tool for which effects have the potential to interrelate.

172. Table 21.28 provides an assessment for each receptor (or receptor group) as related to these effects. Within Table 21.28 the effects are assessed relative to each development phase (i.e., construction, operation, or decommissioning) to see if (for example) multiple construction effects affecting the same receptor could increase the significance of effect upon that receptor. Following this, a lifetime assessment is undertaken which considers the potential for effects to affect receptors across all development phases.

Table 21.27 Inter-relationships between impacts - screening

Topic and description				
Construction				
	Impact 1: Direct disturbance of surface water bodies	Impact 2: Increased sediment supply	Impact 3: Supply of contaminants to surface and groundwater	Impact 4: Changes to surface and groundwater flows and flood risk
Impact 1: Direct disturbance of surface water bodies	-	Yes	Yes	Yes
Impact 2: Increased sediment supply	Yes	-	Yes	Yes
Impact 3: Supply of contaminants to surface and groundwater	Yes	Yes	-	No
Impact 4: Changes to surface and groundwater flows and flood risk	Yes	Yes	No	-
Operation				
	Impact 1: Supply of contaminants to surface and groundwater		Impact 2: Changes to surface and groundwater flows and flood risk	
Impact 1: Supply of contaminants to surface and groundwater	-		No	
Impact 2: Changes to surface and groundwater flows and flood risk	No		-	

Table 21.28 Inter-relationship between impacts – phase and lifetime assessment

Receptor	Highest level of significance			Phase assessment	Lifetime assessment
	Construction	Operation	Decommissioning		
Surface watercourses	Minor adverse	Minor adverse	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 supply 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	Minor adverse	Minor adverse	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.

21.11 Summary

173. This chapter has provided a characterisation of the existing environment for water resources and flood risk based on both existing data (e.g., national flood risk and WFD classification datasets) and site-specific survey data (e.g., a geomorphological baseline survey).

174. The assessment has established that surface and groundwater receptors could be affected because of direct disturbance, the supply of fine sediment and contaminants, and changes to flow patterns during the construction and decommissioning phases. The significance of effect on receptors during these phases is negligible or minor adverse. It is not anticipated that effects are likely to be significant in EIA terms.

175. The assessment has also established that surface and groundwater receptors could be affected by the supply of contaminants and changes to flow patterns during the operational phase. However, given the passive or sporadic nature of operational activities, the resulting effects will be negligible or minor adverse. It is not anticipated that effects are likely to be significant in EIA terms.

176. A summary of the results of this assessment is provided in Table 21.29. This summarises the worst case scenario for all receptors and effects, as determined in Section 21.6.

Table 21.29 Summary of potential likely significant effects on water resources and flood risk

Potential impact	Receptor	Sensitivity	Magnitude of impact	Embedded mitigation	Significance of effect
Construction					
Impact 1: Direct disturbance of surface water bodies	Surface water bodies	Up to high	Up to negligible	Detailed in Table 21.3	Minor adverse
Impact 2: Increased sediment supply	Surface water bodies	Up to high	Up to negligible		Minor adverse
Impact 3: Supply of contaminants to surface and groundwater	Surface water and groundwater bodies	Up to high	Up to negligible		Minor adverse
Impact 4: Changes to surface and groundwater flows and flood risk	Surface water and groundwater bodies	Up to high	Up to negligible		Minor adverse
Operation					
Impact 1: Supply of contaminants to surface and groundwater	Surface water and groundwater bodies	Up to high	Negligible	Detailed in Table 21.3	Minor adverse
Impact 2: Changes to surface and groundwater flows and flood risk	Surface water and groundwater bodies	Up to high	Negligible		Minor adverse
Decommissioning					

Potential impact	Receptor	Sensitivity	Magnitude of impact	Embedded mitigation	Significance of effect
No decision has yet been made regarding the final decommissioning policies for the Project as it is recognised that industry best practice, rules and legislation change over time. The detail and scope of decommissioning works will be determined by the relevant legislation and guidance at the time of decommissioning and will be agreed with the regulator with decommissioning plan provided. However, it is considered likely that the proposed onshore substation would be removed and will be reused or recycled and that the onshore cables would also be removed and recycled, with the transition bays and cable ducts (where used) left in situ. For the purposes of a worst-case scenario, it is considered that magnitude of impact and effects associated with decommissioning would be no greater than those identified for the construction phase.					

21.12 References

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