REPORT

Boston Alternative Energy Facility – Environmental Statement

Chapter 17 Marine and Coastal Ecology

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Executive Summary

This chapter of the Environmental Statement assesses the potential impacts of the proposed Facility on marine and coastal ecology. The baseline (existing) environment is described, informed through a desktop study comprising of existing data relevant to the study area for the Application Site, relating to the Environment Agency's Boston Barrier project, additional data from other sources, consultation and on-site surveys.

All potential impacts during construction, operation and decommissioning of the Facility are identified and significance assessed using a standardised approach. The Facility is located near to the Boston Barrier, with which any potential cumulative impacts are considered. Any other schemes that may have the potential to have cumulative impacts were also agreed with Boston Borough Council and have been included in this chapter.

The worst-case scenario was considered when assessing the potential impacts. The main potential impacts arising from the construction period are habitat loss/alteration, increased suspended sediment concentrations and increased noise and vibration caused by piling and ship movements. The sensitive receptors include fish, benthic communities, birds, marine mammals, saltmarsh and mudflats.

For the operational phase, the key potential impacts are changes in vessel traffic and movement leading to increased ship wash, underwater noise and disturbance on fish, birds and mammals and collision risk with marine mammals. The potential impact of operational noise at the facility and an increase in operational air emissions on habitats is also considered. Mitigation has been applied to the impact assessment for both the construction and operational phase, to reduce the significance of some impacts.

Potential effects of the Facility on protected sites were assessed in the Habitats Regulations Assessment (HRA). The scope of the HRA identified that the following sites were relevant:

- The Wash Special Protection Area (SPA);
- The Wash Ramsar site; and
- The Wash and North Norfolk Coast Special Area of Conservation (SAC).

A summary table is included below, describing the potential significance of each impact identified during the construction, operation and decommissioning of the Facility, any proposed mitigation and the residual impact. No significant effects on marine and coastal ecology are predicted for the decommissioning phase.

Cumulative impacts were considered with the Boston Barrier, Port of Boston dredging scheme, Triton Knoll and Viking Link interconnector, with respect to simultaneous

maintenance dredging and operation activities, leading to increased human activity in The Haven. The cumulative impact of suspended sediment concentrations and consequent smothering from the plume from dredging for both projects being operated at the same time is considered **negligible** in line with **Chapter 16 Estuarine Processes.** Although the Environment Agency's Haven Banks project has the potential for cumulative impacts to arise with the Facility, it was not considered any further in the cumulative impact assessment, as it is planned to be completed prior to the beginning of the Facility's construction works.

Phase	Impact	Receptor	Impact Significance	Mitigation	Residual Effect
Construction	Loss of and/or change to estuarine habitats and associated species within the footprint of the wharf and dredging area	Mudflats	Minor adverse	Material removed to be restricted to minimum. The design of the quay wall and wharf has been set to minimise the volume of capital dredging required. A Landscape and Ecological Mitigation Strategy (LEMS) will be produced as a requirement of the Development Consent Order (DCO) which will contain measures to offset any habitat loss. Mitigation provided by enhancing adjoining habitat (in a Habitat Mitigation Area) to provide additional roosting and foraging opportunity for waterbirds. These measures will be secured through the LEMS.	Minor adverse
		Saltmarsh	Moderate adverse		Minor adverse
	Increased suspended sediment concentrations from capital dredging, with potential for sediment-bound contaminants to be released	Fish	Moderate adverse	Dredging should be undertaken during non-sensitive periods for fish (i.e. Avoidance of juvenile smelt and trout migration periods (March to June) is recommended). This measure is secured by condition 13 of the Deemed Marine Licence (DML) included in the DCO.	Minor adverse
		Benthic fauna	Minor adverse	No mitigation necessary for benthic communities.	Minor adverse

Phase	Impact	Receptor	Impact Significance	Mitigation	Residual Effect
	Disturbance due to human activity/increased human presence (excluding underwater noise, but including airborne noise)	Birds	Major adverse	Noisiest activities (piling) to be undertaken during non-sensitive periods for birds (May-September). This measure is secured as part of the piling method statement required by condition 14 of the DML. Monitoring of bird numbers and adherence to thresholds during construction to be undertaken. These monitoring measures are detailed in the OLEMS and secured by a requirement of the DCO.	Minor adverse
	Underwater noise (piling and dredging works)	Fish	Minor adverse	Marine mammal observer and soft-start procedures for piling undertaken in high tides. These measures are secured as part of the piling method statement required by condition 14 of the DML.	Minor adverse
		Harbour seal	Minor adverse		Minor adverse
	Underwater noise from an increase in vessels (permanent and temporary auditory injury; PTS and TTS)	Harbour seal	Negligible	Slow speed (max. 4 knots) to be kept for all vessels. Vessel movements to be incorporated in to recognised vessel routes. Best practice measures to minimise the disturbance (such as an observer on board each vessel, looking out for	Negligible
	Disturbance at harbour seal haul-out sites	Harbour seal	Minor adverse		Minor adverse

Phase	Impact	Receptor	Impact Significance	Mitigation	Residual Effect
	Increased collision risk (impact zone includes The Wash as a transit area)	Harbour seal	Minor adverse	marine mammals as the vessel makes its way through The Wash and up The Haven) These measures are secured as part of the Navigation Management Plans (NMP) required by requirement 14 of the DCO.	Minor adverse
	Increased emissions to air and deposition on marine and estuarine habitats	Marine and coastal habitats	Negligible	Not required as negligible.	Negligible
Operation	Habitat alteration due to hydrodynamic changes	Intertidal and subtidal habitats	Minor adverse	Dredging works to be minimised according to best practice and monitor the seabed and habitat level through regular bathymetric and habitat surveys. These measures will be secured through condition 13 of the DML.	Minor adverse
	Changes in vessel traffic and movement leading to increased ship wash, underwater noise, disturbance and collision risk	Increased risk of invasive species with ballast water	Negligible	Risk to be managed through an invasive species management measures to be included within the NMP as a requirement of the DCO.	Negligible
		Increased risk of invasive species with hull fouling	Negligible	Potential for high risk therefore management in the form of developing a biosecurity plan in conjunction with the Port of Boston is recommended, this plan will form part of the NMP.	Negligible

Phase	Impact	Receptor	Impact Significance	Mitigation	Residual Effect
		Intertidal habitats (increased ship wash)	Minor adverse	Dredging works to be minimised according to best practice and monitor the seabed and habitat level through regular bathymetric and habitat surveys. These measures are secured through condition 13 of the DML.	Minor adverse
		Increased visual and noise disturbance to bird species	Minor adverse	Not required but as per construction phase, plan to provide alternative feeding and roosting areas as biodiversity net gain within Frampton Marsh and Freiston Shore RSPB reserves which would benefit birds using the area. This plan is currently under discussion with Natural England, Lincolnshire Wildlife Trust and the Royal Society for the Protection of Birds (RSPB). Details will be provided within the final Landscape and Ecological Mitigation Strategy (LEMS), as secured by Requirement 5 of the DCO.	Minor adverse
		Disturbance from vessels – fish species	Minor adverse	Shipping to be kept to a minimum, as necessary. Best practice measures to minimise the disturbance (such as an observer on board each vessel, looking out for	Minor adverse
		Disturbance from vessels – harbour seal	Negligible		Negligible

Phase	Impact	Receptor	Impact Significance	Mitigation	Residual Effect
		Disturbance at harbour seal haul-out sites	Minor adverse	marine mammals as the vessel makes its way through The Wash and up The Haven). Slow speed (max. 4 knots) to be kept for all vessels. Vessel movements to be incorporated in to recognised vessel routes. These measures will form part of the NMP.	Minor adverse
		Increased risk of collisions for marine mammals (impact zone includes the Wash as a transit area)	Minor adverse		Minor adverse
	Increased suspended sediment concentrations due to maintenance dredging	Fish (migration and behaviour)	Minor adverse	Given that the maintenance dredging will form part of the existing wider maintenance programme, and the nature of the predicted impacts, no specific measures are considered necessary.	Minor adverse
		Benthic fauna	Negligible		Negligible
	Beaching of vessels at low tide	Benthic fauna	Minor adverse	No mitigation was deemed necessary.	Minor adverse
	Increased emissions to air and deposition on marine and estuarine habitats	Marine and coastal habitats	Minor adverse	Continuous monitoring of the emissions from the stack, which will be secured as a condition of the environmental permit.	Negligible
Decommissioning	No impacts on marine and coastal ecology are anticipated during the decommissioning phase because the wharf will remain in situ.				

17 Marine and Coastal Ecology

17.1 Introduction

17.1.1 This chapter of the Environmental Statement (ES) describes the existing environment in relation to marine and coastal ecology and provides an assessment of the potential effects during the construction, operational and decommissioning phases of the Boston Alternative Energy Facility (the Facility).

17.1.2 The chapter assesses potential effects caused by the Facility on marine and coastal habitats (including saltmarsh and mudflat), benthic species, fish, marine mammals and birds. Mitigation measures are identified, and an assessment of the potential residual effects provided.

17.1.3 This chapter draws on information within other chapters including **Chapter 10 Noise and Vibration**, **Chapter 14 Air Quality**, **Chapter 15 Marine Water and Sediment Quality**, **Chapter 16 Estuarine Processes** and **Chapter 18 Navigational Issues**. This chapter informs **Appendix 17.1 Habitats Regulations Assessment** (HRA) and **Appendix 13.1 Water Framework Directive Compliance Assessment**.

17.2 Legislation, Policy and Guidance

Legislation

17.2.1 International and National legislation and conventions relevant to marine and coastal ecology are:

- The Convention on Biological Diversity (1992);
- Convention on the Wetlands of International Importance, Ramsar (1971);
- EU Directive 2009/147/EC on the conservation of Wild Birds (Birds Directive); and,
- Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directive).

17.2.2 Relevant UK legislation associated with designated sites and associated habitats and species which are protected through planning and other controls are as follows:

- Wildlife and Countryside Act (WCA) 1981 (as amended).
    - The WCA 1981 provides legal protection for specific species of birds, wild

animals and plants. All birds under the WCA are protected against killing, injuring and taking, whilst their nests (while in use or being built) and eggs are protected against taking, destroying or damaging. The bird species listed in Schedule 1 are given greater protection against disturbance of birds at or near the nest or their dependant young.

- Natural Environment and Rural Communities (NERC) Act 2006
    - The NERC Act has a general purpose of ensuring that the natural environment is conserved, enhanced and managed, contributing to sustainable development.
    - Section 40 of the NERC Act places a duty to conserve biodiversity on English authorities, including public bodies, local authorities and the Environment Agency (EA), whilst carrying out their normal functions. Section 41 sets out a number of species of "principal importance" for conserving biodiversity in England.
- Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019
    - The Conservation of Habitats and Species Regulations 2017 are amended by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 ('the 2019 Regulations'), which came into force on 31 December 2020. The 2019 Regulations make relatively minor changes to the 2017 Regulations, mostly involving transferring functions from the European Commission to the appropriate authorities in England and Wales.
    - One of the changes introduced by the 2019 Regulations is that Special Areas of Conservation (SAC) and Special Protection Areas (SPA) in the UK no longer form part of the EU's Natura 2000 ecological network. Under the 2019 Regulations, a 'national site network' on land and at sea has been created which includes existing SACs and SPAs and new SACs and SPAs designated under the 2019 Regulations. Any references to Natura 2000 in the 2017 Regulations and in guidance now refers to the new national site network.
- Eels (England and Wales) Regulations 2009
    - These Regulations give powers to the EA to implement measures for the recovery of European eel stocks.

- Salmon and Freshwater Fisheries Act 1975
    - This Act protects salmon and trout from commercial poaching, as well as protecting their migration routes, preventing wilful vandalism and neglect of fisheries, and ensuring correct licensing and water authority approval.

National Planning Policy Framework

17.2.3 The updated National Planning Policy Framework (Ministry of Housing Communities and Local Government (MHCLG) (2019)) states the following in relation to habitats and biodiversity (paragraph 174), relevant to the Facility.

- To protect and enhance biodiversity and geodiversity, plans should:
    - *"Identify, map and safeguard components of local wildlife-rich habitats and wider ecological networks, including the hierarchy of international, national and locally designated sites of importance for biodiversity; wildlife corridors and stepping stones that connect them; and areas identified by national and local partnerships for habitat management, enhancement, restoration or creation";* and
    - *"Promote conservation, restoration and enhancement of priority habitats, ecological networks and the protection and recovery of priority species; and identify and pursue opportunities for securing measurable net gains for biodiversity".*

National Planning Policy and Guidance

17.2.4 The assessment of potential effects on marine and coastal ecology has been made with specific reference to the relevant National Policy Statements (NPS), which are the principal decision-making documents for Nationally Significant Infrastructure Projects (NSIP). The overarching NPS for Energy (EN-1) (July 2011) is relevant to marine and coastal ecology (Department for Energy and Climate Change (DECC), 2011a). The NPS for Renewable Energy (EN-3) was also checked, however there were no policy guidelines relevant to marine and coastal ecology for the technology type that the Facility will have (DECC, 2011b).

17.2.5 The relevant aspects of EN-1 are presented in **Table 17-1**. This chapter of the ES either directly addresses these issues or provides information which enables these issues to be addressed in other, more relevant chapters, such as **Chapter 16 Estuarine Processes**.

Table 17-1 NPS for Energy Assessment Requirements

NPS Requirement	NPS Reference	ES Reference
NPS for Energy (EN-1)		
"Where the development is subject to EIA the applicant should ensure that the ES clearly sets out any effects on internationally, nationally and locally designated sites of ecological or geological conservation importance, on protected species and on habitats and other species identified as being of principal importance for the conservation of biodiversity *The applicant should show how the project has taken advantage of opportunities to conserve and enhance biodiversity and geological conservation interests."*	Section 5.3, paragraph 5.3.3 and 5.3.4	These have been identified in **Section 17.2**, and have been considered throughout the impact assessment, specifically in **Appendix 17.1**, the HRA.
The applicant should include appropriate mitigation measures as an integral part of the proposed development. In particular, the applicant should demonstrate that: During construction, they will seek to ensure that activities will be confined to the minimum areas required for the works; During construction and operation best practice will be followed to ensure that risk of disturbance or damage to species or habitats is minimised, including as a consequence of transport access arrangements; Habitats will, where practicable, be restored after construction works have finished; and Opportunities will be taken to enhance existing habitats and, where practicable, to create new habitats of value within the site landscaping proposals.	Section 5.3, paragraph 5.3.18	Mitigation measures for each impact identified has been included throughout **Section 17.8**, with the details required as part of the NPS accounted for.

17.2.6 The Marine Policy Statement (MPS) (HM Government, 2011) provides the high-level approach to marine planning and general principles for decision-making that

contribute to achieving this vision. It also sets out the framework for environmental, social and economic considerations that need to be considered in marine planning. The key reference for marine ecological features is in Sections 2.6.1.3, 2.6.1.5 and 2.6.1.6 of the MPS which states:

> *"…As a general principle, development should aim to avoid harm to marine ecology, biodiversity and geological conservation interests (including geological and morphological features), including through location, mitigation and consideration of reasonable alternatives. Where significant harm cannot be avoided, then appropriate compensatory measures should be sought."*
> *"…The marine plan authority should ensure that appropriate weight is attached to designated sites; to protected species; habitats and other species of principal importance for the conservation of biodiversity; and to geological interests within the wider environment."*
> *"…The marine plan authority should ensure that development does not result in a significant adverse effect on the conservation of habitats or the populations of species of conservation concern and that wildlife species and habitats enjoying statutory protection are protected from the adverse effects of development in accordance with applicable legislation".*

East Inshore Marine Plan

17.2.7 The East Inshore Marine Plan covers The Wash and The Haven (up to high water mark) and as such the vision, objectives and policies are relevant for the proposed development. The vision for the East marine plan areas in 2034 is that "*By 2034, sustainable, effective and efficient use of the East Inshore and East Offshore Marine Plan Areas has been achieved, leading to economic development while protecting and enhancing the marine and coastal environment, offering local communities new jobs, improved health and well-being. As a result of an integrated approach that respects other sectors and interests, the East marine plan areas are providing a significant contribution, particularly through offshore wind energy projects, to the energy generated in the United Kingdom and to targets on climate change."* The objectives and policies are put forward to meet this vision and have been considered within this ES chapter.

Local Planning Policy and Guidance

17.2.8 Although Boston Borough Council (BBC) will not be responsible for granting planning permission for the Facility, the relevant policies that have been set out in the South-East Lincolnshire Local Plan (adopted in March 2019) have been

considered to be adhered to in this assessment on marine and coastal ecology (South East Lincolnshire Joint Strategic Planning Committee, 2019).

17.2.9 Policy 28: The Natural Environment, is (indirectly) relevant to marine and coastal ecology, and states that:

- development proposals that would cause harm to these assets (internationally designated sites, on land or at sea) will not be permitted, except in exceptional circumstances, where imperative reasons of overriding public interest exist, and the loss will be compensated by the creation of sites of equal or greater nature conservation value.
- a development proposal that would directly or indirectly adversely affect nationally or locally-designated sites (including Havenside Local Nature Reserve (LNR)) will not be permitted unless there are no alternative sites that would cause less or no harm; the benefits of the development at the proposed site, clearly outweigh the adverse effects on the features of the site and the wider network of natural habitats; and suitable prevention, mitigation and compensation measures are provided.
- Addressing gaps in the ecological network: by ensuring that all development proposals shall provide an overall net gain in biodiversity, by:
    - protecting the biodiversity value of land, buildings and trees (including veteran trees) minimising the fragmentation of habitats;
    - maximising the opportunities for restoration, enhancement and connection of natural habitats and species of principal importance;
    - incorporating beneficial biodiversity conservation features on buildings, where appropriate; and maximising opportunities to enhance green infrastructure and ecological corridors, including water space; and
    - conserving or enhancing biodiversity or geodiversity conservation features that will provide new habitat and help wildlife to adapt to climate change, and if the development is within a Nature Improvement Area (NIA), contributing to the aims and objectives of the NIA.

17.2.10 The Plan acknowledges that nationally protected wildlife sites will continue to be protected and enhanced, consistent with national legislation and the objectives in their management plans.

Lincolnshire Biodiversity Action Plan (BAP)

17.2.11 The Lincolnshire BAP (LBAP, 3rd Edition) identifies several habitats and species that are vulnerable to certain anthropogenic (e.g. urban development, agriculture) and natural pressures (e.g. climate change, sea level rise) that need greater actions.

17.2.12 Saltmarshes and mudflats are listed as priority habitats under the Lincolnshire BAP, and also the UK BAP, so as to protect their current extent. Both habitats provide important areas for the refuge of fish, and feeding, breeding and roosting areas for overwintering and breeding birds found in the area. More detailed information on the priority habitats have been included in **Section 17.6**.

17.3 Consultation

17.3.1 Consultation undertaken throughout the pre-application phase, including the Planning Inspectorate's Scoping Opinion, informed the approach and the information provided in this chapter. A summary of the consultation relevant to marine and coastal ecology is provided in **Table 17-2**.

Table 17-2 Consultation and Responses

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
The Planning Inspectorate, July 2018	Impact of operation of the wharf facility: The Scoping Report intimates that impacts to marine ecology and fisheries from operation of the wharf facility are to be scoped out. However, paragraph 6.9.11 of the Scoping Report contradicts this position and this leads to uncertainty overall. There is also an absence of justification to support a decision to scope this matter out. Therefore, in the absence of such information the Inspectorate cannot agree to scope this matter out of the assessment in the ES. Therefore, the ES needs to include an assessment of the likely significant effects associated with the operation of the wharf, supported by appropriate evidence.	**Section 17.7** assesses the potential impacts of the wharf operation on the marine and coastal ecological receptors.
	WFD ecological classification: The Applicant should ensure that the ES includes accurate baseline information regarding sensitive receptors. In this regard the Applicant is referred to comments by the EA noting that The Haven has a bad ecological potential, and not a moderate ecological potential as stated within the Scoping Report.	WFD compliance assessment has been included in **Appendix 13.1.**
	Study Area: The ES should clearly define the Study Area applied to the assessment. The Study Area must be established having regard to the extent of impacts and likely significant effects. Assumptions applied	The study area for the marine and coastal ecology assessment is defined in **Section 17.5**.

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
	when establishing the Study Area should be clearly set out in the ES.	
	Potential effects: The Scoping Report describes impacts as temporary for construction and permanent for the operational phase. The Inspectorate considers that resulting effects may not adhere to the same timescales, for example permanent effects can result from temporary construction activities. The ES should characterise the duration of predicted effects, and define any terms used e.g. temporary, intermittent, short term, long term etc. in terms of days/months/years.	The timescales have been applied to predicted impacts, outlined in **Section 17.8**, and it has been identified if an impact is of temporary or permanent nature.
	Mitigation/monitoring: The ES should demonstrate how mitigation and monitoring measures relied upon in the assessment would be secured and how any necessary remedial action would be undertaken. For example, if the proposed in-construction bathymetric surveys indicate that erosion and deposition are exceeding predicted values. The Inspectorate notes the intention to carry out surveys during operation to assess the need for channel maintenance. The Inspectorate advises that the anticipated nature of the maintenance dredging should be set out in the ES, where this information has been relied upon for the assessment of significant effects.	Mitigation measures have been listed for each potential impact, detailed in **Section 17.8**. Embedded mitigation is also considered an important method of reducing impacts and have been identified in **Section 17.7**.
	Methodology: The ES should explain how desk-study and modelling data has been used to inform the assessment. The Applicant should make effort to agree the approach with the relevant consultation bodies.	All consultee comments are incorporated into the relevant sections, with the relevant signposting highlighted in **Section 17.3.** The assessment methodology is included in **Section 17.4** and the data sources in **Section 17.5.**
Environment Agency, 3rd July 2018	The EIA must consider and address risks to resident fish species within the tidal Witham as well as the listed migratory species and where possible net gains and adequate mitigation included for at all stages of the proposed development.	**Section 17.6** identifies the key fish species (migratory and non-migratory). **Section 17.8** details the potential impacts on fish and relevant mitigation measures.
	Noise and vibration operating levels need to be agreed to minimise impact upon resident and migratory species that are known to be present.	**Section 17.6** outlines fish species sensitive to underwater noise and vibration, and the threshold values have been considered in the relevant mitigation measures listed in **Section 17.8**. Noise and vibration operating levels will be agreed in advance of the construction phase and

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
		identified in the working methodology for the Code of Construction Practice (CoCP). Noise and vibration operating levels associated with the licensable marine activities will also be identified in the details of the licensed activities approved by the MMO as part of condition 13 of the DML and the piling method statement approved by condition 14 of the DML.
	The new wharf should be designed to minimise future maintenance needs at the Wharf and within the wider Witham in regard to upstream and downstream sediment transport, erosion and bank stability.	The wharf design and justification have been presented in **Section 17.5**. Any design alterations relating to minimising future maintenance have been included in **Chapter 5 Project Description**.
	More information may be required to inform the final EIA for this proposed development as the Boston Barrier may not have considered any in combination impacts or information within the immediate area of this proposed development.	Cumulative impacts including the presence of the Boston Tidal Barrier have been considered in **Section 17.9**.
	We disagree with the conclusion that the impact of the project's operational phase on marine ecology and fisheries can be scoped out of the EIA. This is because the impacts of the operational phase on estuarine and geomorphological processes during the operational phase is scoped in. Estuarine processes and ecology are intrinsically linked. The applicant will need to determine the impacts on geomorphology and estuarine processes before concluding whether or not there is a risk of impacts to ecological elements.	Operational phase impacts of the Facility have been assessed in **Section 17.8**.
Marine Management Organisation, July 2018	The ES should include an assessment of the potential risk of impact of underwater noise on sensitive receptors. This should be supported by relevant and recent scientific literature, for example, Popper et al. (2014) for fish and National Marine Fisheries Service (NMFS) (NOAA) (2016) for marine mammals.	The impacts of underwater noise have been fully assessed in **Section 17.8**. For marine mammals this assessment has been based on the NMFS (2018) thresholds and criteria.
	Depending on the size and intensity of the marine works, i.e. whether excavation of marine sediments will be required, the necessary assessment would change. If piling and dredging are the only activities which will be required below the water line, then the MMO consider a desk-based assessment should suffice to inform the assessment of any potential risk to marine receptors, dependent on the scale and	The impacts of underwater noise have been fully assessed in **Section 17.8**, using a desk-based assessment.

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
	intensity of the works. Any significant change to proposed construction methods which significantly increase stress on the marine environment will potentially require more investigative assessment methods such as noise propagation modelling. If underwater noise modelling is deemed necessary, appropriate metrics should be used for each source type, i.e. the zero-to-peak sound pressure level (SPL) or peak-to-peak SPL for impulsive sources. The metric most suitable for continuous sounds is the root mean square (rms) SPL. The sound exposure level (SEL) can also provide an informative assessment. The noise assessment should assess the potential permanent (PTS) and temporary (TTS) threshold shifts to marine receptors by forecasting the significance of the zone of impact and detail any necessary mitigation with the findings of the assessment in the ES. Guidance such as Faulkner et al (2018) will be helpful in determining the best course of action.	
	Relevant mitigation for pilling and dredging works include but are not limited to: soft-start measures; observing periods of increased sensitivity such as spawning; vibratory piling methods; and, maximum piling days per week or hours per day. Mitigation will depend on piling method, how many piles, their diameter and the amount of time required to install them to the desired depth.	See **Section 17.8** for more information on the mitigation measures to be implemented to reduce impacts from piling activities.
	The MMO considers it is challenging to verify the potential Zone of Impact in relation to the Havenside Local Nature Reserve (HLNR) given that clarification is needed concerning construction methodology. Unlike the terrestrial species listed in Chapter 4.1.1, the common seal must use the river for key biological processes, though it is unlikely that they will move further upstream towards the development site given their life characteristics and non-migratory nature. This is further supported by the fact that the River Witham is not characterised as a haul out or breeding site such as Donna Nook and the Wash. If vibratory / softer piling does not prove practical, the impact to acoustically sensitive organisms, such as the common seal, is likely to increase. The MMO would expect to see some consideration of the potential impacts to seals inhabiting the HLNR in the ES.	Details of construction methodology is within **Section 5.2** of **Chapter 5 Project Description** (document reference 6.2.5). An assessment of seals within The Haven has been made in **Section 17.8**.
	Smelt, eel and sea trout can be considered relevant receptors to underwater noise due to possessing a swim-bladder. Whereas the River lamprey is not recognised as a species of particular concern for vulnerability to underwater noise. Anadromous fish	As assessment of underwater noise impacts on fish species has been undertaken **in Section 17.8**.

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
	(migratory) such as smelt are particularly vulnerable, given the potential threat of an acoustic barrier occurring from any piling activity. The MMO defers to the Environment Agency on mitigation of disrupting fish migration but note that this should be considered in the ES.	
	The MMO would expect the ES to have detailed the statutory sites of importance for nature conservation nearest to the proposed development and justified why they can be screened out. These sites are: The Wash (SPA) The Wash (Ramsar) The Wash and North Norfolk Coast (SAC).	These protected sites have not been screened out. Impacts on these sites have been included in the HRA in **Appendix 17.1**.
	The MMO welcomes the consideration of potential impacts to species in the Havenside Local Nature Reserve (LNR). Additional points for consideration of the impact on marine mammals at the site has been included in section 5.8 of this advice.	The Havenside LNR has been considered in **Section 17.6** and **17.8.** Impacts on marine mammals have also been assessed in **Section 17.8**, and in **Appendix 17.1** (relating to protected sites).
	Any fisheries data taken from past surveys that are used in the ES, should include or signpost to relevant information such as dates and times of surveys, locations, gear used, mesh size, duration of tow / soak times. The limitations of any data sources used in the assessment are presented in the ES.	The relevant information and signposting for fisheries data used in this impact assessment is included in **Section 17.6**.
	The ES should provide information on any known spawning and nursery grounds of fish. For migratory species, the impact assessment should consider the timing of upstream and downstream migrations in relation to construction and dredging activities. Areas of substrate suitable for smelt spawning should also be identified where possible.	**Section 17.6** details known spawning and nursery grounds for fish, as well as the migratory timing of relevant fish. The impact assessment in **Section 17.8** has also considered the timings of fish migration.
	A construction schedule indicating the months when dredging and piling works will be carried out should be presented within the ES. This will help identify the months that piling /dredging activity will overlap with the peak migratory seasons of fish.	A high-level construction programme has been included in **Chapter 5 Project Description**, the relevant parts of which have been incorporated into this ES where relevant.
	The MMO would expect a precautionary approach to the impacts of noise and vibration (from all forms of piling) on fish to be taken, to ensure that the mitigation is adequate.	This has been considered in the form of mitigation in **Section 17.8**.
	The MMO expect the ES to include detailed descriptions of marine and migratory fish in the Study Area, especially in relation to the seasonal movements	**Section 17.6** includes detailed baseline information on fish movements in the study area in

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
	of migratory fish.	The Haven.
	Section 6.9.31 of the Scoping Report, within the Marine Ecology and Fisheries chapter, states that "the impact of operation of the wharf facility is not anticipated to have any significantly adverse effects". The MMO consider that this requires further assessment given that the vessels using the wharf will ground on the seabed.	The operational impact of the wharf facility has been considered and included in **Section 17.8**. This includes the increased number of vessel movements as well as the grounding of vessels using the wharf at low tide.
Environment Agency, December 2018	The meeting with the Environment Agency was focused on the amendment of the flood defence due to the construction of the wharf. No specific issues or concerns relevant to marine and coastal ecology were mentioned.	This meeting with the Environment Agency is covered within **Appendix 13.2 Flood Risk Assessment** (document reference 6.4.13). This is not applicable to this chapter.
Natural England, February 2019	Consideration of how you will be able to demonstrate that the works across the inland fields (where the main facility is based) and along the channel (where the wharf is situated) will not affect breeding or over-wintering/ passage birds that are qualifying features of The Wash SPA. Project specific evidence will be needed to show that this area is not used as a supporting feature. We are aware from discussions with the Environment Agency that data is not held for the Boston Barrier or Boston Haven projects. In our opinion bird surveys should be started immediately for breeding birds, showing likely nesting and feeding areas, and for passage/ over-wintering. We understand that with your proposed submission in September – the over-wintering bird data will need to be submitted during the examination process. Considering the importance of this data we would suggest ensuring the survey protocol is sufficiently robust *i.e.* with 2 monthly visits between now and the project examination. We would like to review the survey protocol.	The impact of works across the inland fields has been assessed in **Chapter 12 Terrestrial Ecology**. Impacts that are likely to occur along the channel have been assessed in **Section 17.8.** Bird data has been purchased from the British Trust for Ornithology to provide information on roosting birds that may be using the site for roosting and potentially feeding. In addition, data used by the EA (from 2010 overwintering bird survey) to assess the impact of the Boston Barrier construction and operational phases, as well as overwintering bird information in The Haven obtained from Woodward *et al*., 2014 which have been used to inform the ES. In addition, site specific bird counts have been undertaken during 2019/2020 and 2021 to provide data for the site in terms of overwintering and breeding birds.
	Further details on the number of boat movements along the Boston Haven and into The Wash are necessary for the assessment. Please confirm the number of return boat trips related to the operation of	The number and sizes of vessels that will be used as part of the operation of the facility have been outlined in the

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	the Facility, and the size and type of the vessels. Will there be any seasonal differences throughout the year? The number of boat trips may affect marine mammals in The Wash as you highlighted, but also may cause erosion damage to the channel through wave action. We are also concerned about the use of water from the channel as ballast as this could cause a dewatering of the channel and could also cause the spread of invasive species.	impact assessment of increased ship wash and the risk of invasive species being introduced, in **Section 17.8**.
	• Considering the newly constructed wharf area will result in the dredging and loss of mudflat by ca. 40 m you will need to demonstrate (by sediment modelling both during the construction and operation phase) that the modification of the shoreline with the construction of the wharf at this location will not have a knock on affect to the adjacent priority habitats *i.e.* saltmarsh and mudflats and also to the SPA and SAC further downstream. Also that changing the channel will not cause a change in the erosion/ deposition rates along the channel. I understand as a general policy on The Wash, sediments dredged from the system need to be returned to The Wash offshore so that sediment is not lost.	Any changes on the hydrodynamics of the region have been assessed in **Section 17.8**. Additionally, it was agreed with Natural England that the HRA in **Appendix 17.1** includes only impacts on marine mammals and birds in The Wash.
	• The provision of an up-to-date botanical survey of the saltmarsh (to National Vegetation Classification level and reference to the Common Standards Monitoring approach for saltmarsh) which will be lost within the footprint of the wharf as well as the adjacent downstream section. This is necessary to assess the impacts to the priority habitat. There is a small chance that the Boston Horsetail (*Equisetum ramosissimum*) may be present. This is a Schedule 8 Plant species. There is also potential for Sea Wormwood (*Artemisia maritima*) which has a local distribution along the Boston Haven in The Wash.	Findings from the 2011, 2014 and 2017 surveys carried out by the EA were used to inform the existing status of the saltmarshes adjacent to the Project site. A site visit was also undertaken by RHDHV in October 2018 and by the ornithologist during the bird counts in 2019. Classifications of the most recent saltmarsh survey are presented in **Sections 17.6** and **17.8**.
Marine Management Organisation, April 2019	• Expressed concern over repeated berthing with contaminant metals moving back out of the sediment. There was also a concern that disturbing deeper sediments could lead to a potential pathway to The Wash SPA and Frampton Marshes.	Impacts from resuspended contaminants have been assessed in detail in **Chapter 15 Marine Water and Sediment Quality** and have been addressed in **Section 17.8.**
Eastern Inshore Fisheries and Conservation	• Expressed concern over navigation and impacts of dredging, impacts of piling noise on fish and any potential waste entering the water.	All impacts arising from dredging and piling, relating to fish have been assessed in **Section 17.8**. Any impacts relating to navigation are

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Authority, May 2019		assessed in **Chapter 18 Navigational Issues.**
Section 42 Consultation Response – BBC, 6th August 2019	• The proposal must not undermine the Wash nature conservation designation.	Impacts on designated features are addressed in **Appendix 17.1**.
Section 42 Consultation Response – Environment Agency, 6th August 2019	• In Section 17.6.21 and the 2017 infauna data (see additional EA data available below), it may be worthwhile highlighting which benthic species are important prey items for birds (if any) to support the understanding of potential bird feeding activity.	The impact on prey species is addressed through the removal of habitat and associated species during dredging and also through the beaching of vessels on the intertidal during operation.
	• We would advise that smelt, eels, and lamprey (as mentioned in 17.6.30 – 17.6.40) could be affected during dredging for construction, maintenance and lightweight aggregate production. Eels Regulations would apply to any pumping related to dredging, for example suction dredging, which would require pumps to be screened. This applies to construction, maintenance and operation activities and needs to be assessed in detail, with a suitable programme and method statement proposed to avoid impacts to eels.	It is expected that dredging would be undertaken using a mechanical dredge and therefore suction screens are not required.
	• We look forward to reviewing the Project Environmental Management Plan (PEMP) mentioned in Section 17.7.5. Will this be included in the Environmental Statement?	A CoCP will be produced post-construction as agreed with the regulators. The CoCP will cover this information rather than a separate document being produced., as agreed with the regulators. As part of this ES application an OCoCP has been provided (document reference 7.1).
	• In Table 17.9 invasive species would be an impact not a receptor. Maintenance dredging would not only increase suspended sediment but also cause direct disturbance of the benthic communities present.	This reference has been corrected in **Table 17-10**. With regard to the comment on maintenance dredging – agreed. To account for a worst-case scenario, the loss of the benthic species during operation has been included in the loss during construction; as the area of loss will not increase between the two phases. This is because during operation vessels will be

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		beached on the intertidal so this initial loss for the area of beaching is considered as permanent loss even though there will be times when it is still exposed when there are no vessels but species are not expected to recolonise this area successfully due to the beaching of the vessels.
	• Sections 17.8.14 to 17.8.18 describe the quantity of material being removed and loss of saltmarsh and mudflat habitat. We can provide a more accurate estimation of saltmarsh extent within The Haven by providing the latest mapped extent based on aerial imagery. There will be loss of intertidal habitat (mudflats and saltmarsh) through construction of the wharf and increased boat wash during operation. Mitigation is not outlined here but should be included in the Environmental Impact Assessment. The PEIR seems to suggest that because there is plenty of other intertidal habitat, the impact is low, but any permanent loss of this habitat requires mitigation in its own right (Natural Environment and Rural Communities Act 2006 & South East Lincolnshire Local Plan, Policy 28: The Natural Environment).	The loss of saltmarsh and mudflat will be assessed using the latest aerial imagery and discussed with the relevant consultees. A biodiversity metric calculation has been completed for the baseline loss in order to determine the requirement for net gain. This will be used to inform the ongoing discussions with NE, RSPB and LWT to develop the net gain measures. The baseline calculation is provided in the OLEMS and the outcome of the net gain measures will be included within the final Landscape and Ecological Mitigation Strategy (LEMS), as secured in the Development Consent Order (DCO).
	• The 2015 Water Framework Directive (WFD) classification for ecological elements in The Haven (Witham) was Moderate and in 2016 had decreased to Bad (source: EA Catchment Data Explorer). Is there anywhere in the Witham (The Haven) or adjoining WFD Water Bodies where the BAEF project could support the regeneration, restoration of 'higher value' saltmarsh in another location to compensate for that lost during the construction of the wharf and help prevent further deterioration in ecological status (Section 17.8.24)?	Possible locations for saltmarsh restoration are being investigated as part of the mitigation package. The net gain package, as discussed above, will also investigate the potential for restoration of higher value marsh in other areas.
	• To support the expert-based assessment regarding the sediment plume in Section 17.8.27, in-situ turbidity monitoring has been used by us to monitor levels during dredging activity and scour protection work for both the Ipswich and Boston tidal barrier projects. Has this been considered as a mitigation measure for this project?	As the dredging is mostly carried out from land-based plant and will be undertaken with a mechanical dredge the sediment plume is considered to be minimal. The assessment undertaken in **Chapter 16**

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		Estuarine Processes provides justification for this decision. Given that the turbidity levels within The Haven are relatively high it is not expected that the turbidity generated by this activity will have a significant effect.
	• In Sections 17.8.45 to 17.8.51 the impacts on benthic communities do not appear to mention direct losses due to capital and maintenance dredging. Although a smaller impact area when compared to potential sediment plume smothering, loss of communities should be acknowledged and considered here.	Impacts of loss of habitat and associated species are considered in **Section 17.8**.
	• In Section 17.8.93 ship ballast water has been given appropriate consideration with reference to the IMO Ballast Waters Convention, however there is no mention of hull fouling. Chapter 5 (specifically 5.5.6 and 5.5.21) states that approximately 624 ships (12 per week) will be required per year once the BAEF is fully operational and that these are likely to be coming from various locations in the UK (Leith, Grimsby and Tilbury). This presents a significant increased biosecurity risk with regards to hull fouling in particular, identified as one of the top 5 pathways facilitating the introduction and spread of non-native species by the GB Non-Native Species Secretariat Comprehensive Pathway Analysis Report, 2019 (available online from: http://www.nonnativespecies.org/index.cfm?sectionid=59). If the source ports are frequented by international shipping (e.g. Humber and Thames) BAEF vessels will be exposed to potential new non-native species arrivals and this presents a significant risk that new species will be spread to The Haven. Also, a population of *Rangia cuneata* (Gulf Wedge clams) has been found in a 10 km reach of the South Forty Foot Drain. Currently this is the only known location of this species in UK waters. What measures will be taken to mitigate the spread of non-natives species either in to or out of the Witham?	Hull fouling has been included as a potential risk. A biosecurity plan will be part of the Navigation Management Plan (NMP), as secured as a requirement of the DCO, to raise awareness of the potential issues and to ensure that any risk reduction measures are taken forward.
	• Additionally, we encourage the consideration of measures to implement biodiversity and environmental net gain through the project. Although it is not the Government's intention to make this compulsory for Nationally Significant Infrastructure Projects, the National Planning	A biodiversity net gain calculation has been carried out for the baseline habitat loss and biodiversity enhancement measures are being discussed with relevant stakeholders to

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	Policy Framework (NPPF), paragraph 170, requires planning decisions to enhance the natural and local environment by providing net gains for biodiversity and paragraph 118 encourages achieving net environmental gains to make effective use of land. Policies in the NPPF are also relevant to DCO decisions.	enable a net gain to be achieved. This has been included in the OLEMS and the final net gain measures will be included within the final LEMS, as secured in the DCO.
	Additional data available: We hold additional data, which may be of use in your assessment, for the following: 1. Fish surveys continue for the Boston Tidal Barrier project and more recent data is available from the 2017 to 2019 surveys (EA Report T. Consol, 2019 in draft) which is relevant for Chapter 17 Section 17.8.75. The data includes 128 Smelt (*Osmerus eperlanus*) caught in early May, 2019 which is the highest number seen to date. 2. The subtidal benthic infauna (10 x 0.1 m2 Day Grab sites) data referred to in Newton (2017) is now available on request from the EA.	This data was requested from and provided by the EA. The results of the data has been incorporated into this chapter. See **Section 17.6**.
Section 42 Consultation Response – Eastern IFCA, 6th August 2019	Eastern IFCA consider that the potential for cumulative impacts from the Project and nearby industrial sources should be fully considered. The combined effects of airbourne emissions from different sources and discharges (e.g. washing out of clay delivery vessels, release of sodium hydroxide-dosed water) into the river (Haven) and into The Wash should be set out for consideration. Also the combined effect of restrictions to navigation from the Boston Barrier (when operating) and the Project requires consideration in the navigation risk assessment.	Airborne emissions have been assessed within **Chapter 14 Air Quality** and potential impacts of these on marine and coastal ecology is covered under **Section 17.8**. Navigation impacts have been addressed in **Chapter 18 Navigational Issues.**
	Similarly, impacts on seabed habitats from the Project's increased shipping through The Wash and North Norfolk Coast SAC should be considered alongside existing activities that could impact the same habitats.	Consideration of impacts on marine and coastal ecological receptors from shipping levels is included within **Section 17.8**. This is compared against existing shipping levels.
	The Non-Technical summary reported that "potential impacts from increased emissions to air and deposits on marine and estuarine habitats will be assessed when results of the air quality assessment are available". Eastern IFCA query when such potential impacts on marine and estuarine habitats, including shellfish beds	Airborne emissions have been assessed within **Chapter 14 Air Quality** and potential impacts of these on marine and coastal ecology is covered under **Section 17.8**.

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	in The Wash, will be considered. Mussel and cockle beds are an economic resource for local inshore fishermen as well as being attributes of the intertidal mudflats and sandflats feature of The Wash and North Norfolk Coast Special Area of Conservation. If impacts on shellfish habitats are anticipated, consideration must be given to potential impacts on the food chain as well as on biodiversity.	
	Furthermore, Eastern IFCA highlighted in previous engagement (May 2019) the potential for subtidal habitats of The Wash & North Norfolk Coast Special Area of Conservation to be impacted by the increased level of anchoring associated with the Project. This has not been reflected in the Non-Technical Summary document. Eastern IFCA is currently expanding the extent of areas it has closed to towed demersal fishing in this SAC in order to protect habitats that are sensitive to abrasion and penetration – for further information, please see: https://www.eastern-ifca.gov.uk/wp-content/uploads/2019/09/2019_09_Management_measures_development_tracker.pdf . We suggest that this consideration needs to be raised with Natural England, the statutory conservation advisor.	Anchoring would only be within existing anchoring zones.
	Eastern IFCA welcome the detailed consideration given to potential impacts from the Project on fish populations in The Haven. We urge that best practice is followed to minimise impacts from underwater noise through appropriate timing of construction works. We also query whether noise reduction measures such as the use of bubble curtains, could be beneficial to further reduce impacts.	A full assessment of underwater noise impacts to fish species has been undertaken in **Section 17.8**, including proposed mitigation measures.
	The Project would result in a significant increase in the number of large vessels using The Haven (up to 624 additional vessel movements per year). These vessels will be required to turn in the Haven, either inside the Wet Dock or at the Knuckle (turning point) outside the Wet Dock. This increase in vessel activity in The Haven could impact on navigation of fishing vessels between The Wash (fishing grounds) and the London Road quay (fishing vessel moorings). Eastern IFCA acknowledge that the Project team have been liaising with representatives of Boston fishermen; we urge that this dialogue is continued with suitable frequency.	A Navigation assessment has been undertaken to consider impacts on other users, with the findings being reported in **Chapter 18 Navigational Issues**.
	The Wash supports shellfish production areas and has been highlighted in the East Marine Plan as an optimum potential aquaculture area.	Impacts of aerial deposition on marine and coastal habitats have been assessed within **Section 17.8** for the

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	Eastern IFCA seeks assurance that these shellfish production areas (as well as the naturally-occurring cockle and mussel beds in The Wash) will not be adversely affected by the "potential impacts from increased emissions to air and deposits on marine and estuarine habitats" noted in the Non-Technical Summary.	construction and operation phases.
Section 42 Consultation Response – Lincolnshire Wildlife Trust, 6th August 2019	Loss of Priority Habitats LWT has noted that there will be permanent loss of intertidal mudflat and saltmarsh, both of which are listed as priority habitats of principal importance for the conservation of biodiversity under Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006. There is currently no planned compensatory habitat or mitigation measure associated with this loss. We would query whether the Haven could be functionally linked to The Wash SPA, with bird species using it for a variety of reasons to compliment habitat in The Wash. We would like to see compensatory habitat created as close to the site as possible.	Loss of habitat has been considered in the impact assessments and a biodiversity calculation undertaken for the baseline loss in order to investigate the needs for biodiversity net gain measures. The OLEMS document provides a summary of the baseline calculation and ongoing discussion will inform the measures necessary to provide a net gain. The final LEMS will detail the measures needed to provide the net gain.
	We support mitigation measures detailed within Chapter 12 – Terrestrial Ecology and Chapter 17 - Marine and Coastal Ecology and outlined in table 24.1 Summary of PEIR Topic Impacts in Chapter 25 (Non-Technical Summary). Mitigation measures should address any impacts related to findings of further surveys planned for protected species. We would like to understand what the 'embedded mitigation' mentioned in the various chapters relates to in practice. Will details of mitigation be defined and included within the Construction Environmental Management Plan? We consider that this information should be reviewed by the conservation organisations, including Lincolnshire Wildlife Trust, before these are signed off. In particular, our marine specialist would like to have the opportunity to review mitigation measures associated with underwater noise piling and increased shipping on marine mammals when these are available and before they are signed off.	A full assessment of underwater noise impacts to marine mammals has been undertaken in **Section 17.8**, including proposed mitigation measures.
	The incident / emergency response plan. This should detail what actions will be taken to ensure protection of terrestrial, freshwater and marine habitats and species in various incident and emergency scenarios. We consider that this should be reviewed by the conservation organisations, including Lincolnshire Wildlife Trust, before these are signed off.	An incident/emergency response plan will be prepared prior to construction commencing. This will be developed in consultation with relevant conservation organisations.

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	Otter is a species designated as part of the SAC but is not mentioned specifically in the Marine & Coastal Ecology chapter. The Terrestrial Ecology chapter recognises they may use the tidal River Witham for commuting in the wider area. Further surveys and considerations for otter in Chapter 12 should include assessment as a designated species associated with the SAC.	Considerations regarding otter as a designated species associated with the SAC are included within **Chapter 12 Terrestrial Ecology**.
	There is no recognition of the potential impact or importance of the loss of habitat and disturbance to birds using the tidal haven from The Wash. This should be assessed. Removal of potential bird nesting sites is mentioned in the table of impacts in table 12.12 of Chapter 12. No replacement bird nesting habitat on the site is suggested. Habitat should be replaced and enhanced on site as mitigation for this loss.	This has been considered in terms of vessel numbers and potential for increased disturbance and the mitigation package is seeking to address the impacts predicted.
	Marine mammal assessment Chapter 17 (p 59 onwards): It is stated that the haven is not likely to be a key route for harbour seal, and they are likely to remain in The Wash. Please could you clarify what evidence is available to support this and if any monitoring been undertaken? In undertaking the noise impact assessment on harbour seal, assessment uses injury/Permanent Threshold Shift (PTS) criteria from Collet and Mason (2014). The advice from Statutory Nature Conservation Bodies (SNCBs) to offshore wind farm developers when undertaking noise impact assessment is to use the criteria outlined below. Could you clarify why the NFMS (2016) thresholds have not been used in the assessment? NMFS (National Marine Fisheries Service) (2016); Technical guidance for Assessing the Effects of Anthropogenic Sound on Marine Mammal Hearing: Underwater Acoustic Thresholds for Onset of Permanent and Temporary Threshold Shifts. U.S. Dept of Commer, NOAA. NOAA Technical Memorandum NMFS-OPR-55, 178 p.	The assessment of impacts to marine mammals has been updated to include consideration of harbour seal within The Haven. The underwater noise assessment has been updated to show potential impacts under the NMFS (2018) thresholds. See **Section 17.8**.
	Increase in vessel / traffic movement. It would be useful to understand in more detail, how the assessment of the impact of increased vessel movements on harbour seal within The Wash has been considered. Please could this be provided to our marine specialist?	The potential for impact to harbour seals as a result of an increase in vessel movement has been updated within **Section 17.8**.
	In line with paragraphs 170 and 175 of the National Planning Policy Framework (NPPF) and Policy 28	A biodiversity net gain calculation has been

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	(para 3) and Policy 31 (para 5) of the South East Lincolnshire Local Plan, biodiversity net gain requires developers to ensure existing habitats are assessed for wildlife benefit and left in a measurably better condition than they were before the development took place. The existing habitat and its condition should be assessed as part of this development. It should be clearly demonstrated how biodiversity will be improved, delivered and managed beyond the construction phase. It should include habitat creation, sowing and planting of native species of known benefit to wildlife, creation of green corridors and habitat linkages through and beyond the site and wildlife friendly margins. We would like to see how this has been incorporated within the plans."	undertaken and the need for habitat has been considered in the mitigation package, which is discussed within the OLEMS and further details will be provided within the final LEMS, as secured in the DCO.
Section 42 Consultation Response – Natural England, 6th August 2019	One of our key messages at the meeting was the lack of bird data and the age of the historical data that is available (for Boston Barrier project i.e. from 2010). In table 17.2 it is stated that data from the BTO has been purchased to provide information on the birds. The Haven is covered by 4 BTO areas one further upstream South Forty Foot Drain (the urban side of Boston); one near to the site known as Slippery Gowt Pits and two at Frampton. It should be noted that the closest one (Slippery Gowt Pits) provides data between 2001 and 2006 (which is 13 years old) (page 39). It also shows a real reduction in bird numbers in 2005 and 2006 which is not explained. Natural England has concerns with the reliance on data which is 13 years old. At the meeting we did suggest that 2 visits per month between February until the submission of the ES should be undertaken. The data for Frampton is more recent 2012 to 2017 but is a distance from the site and may only be relevant to consider bird disturbance from increased vessel movements when the site is operational. One point to note is that the BTO bird surveys do not cover the same time window so it is difficult to understand bird usage. We have recently received an Ecological Clerk of Works report from the Environment Agency (EA) focusing on the geotechnical works along the Haven in February-March this year which summarises bird activity during various samplings. The report notes, for example, bird hotspots (one is further to the south of the site and also one on the other side of the channel opposite the development). It also notes the activities that caused bird disturbance was people on the embankment and also large vessels moving up the channel. It may be possible for the Boston AEF to have access to this document from the EA.	Bird data has been collected for the site to include overwintering bird counts, breeding bird counts and bird disturbance at the mouth of The Haven.

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	We note that information on birds likely to use The Haven has been included in this chapter (page 37-38) i.e. Dark bellied Brent goose, Shelduck, Lapwing, Dunlin, Black-tailed Godwit, Redshank, Turnstone however there appears to be no actual survey data to support this. The 2010 Boston Barrier Bird report which was based on surveys between January and March 2010 is referenced which would not constitute a full winter-bird survey.	See comment above
	At paragraph 17.8.58 it is noted that noise disturbance under 50dBH is unlikely to cause a response but over 70dBH would be expected to result in disturbance to water birds. As yet we do not know how loud construction and operational noise will be but it is likely that it will exceed the 70dBH.	The section on bird disturbance has incorporated data on recent Environment Agency monitoring of noisy activities in The Haven and the results taken into consideration in the chapter update.
	The terrestrial ecology section refers to 0.4ha of saltmarsh and 0.8ha of mudflats lost during construction – they have listed this as a minor adverse impact as it is only a BAP habitat at this location and not part of the designated area. It has been assessed as being in poor condition although it identified 18 species which is actually quite species-rich for The Wash. It is explained that once construction is finished there will be an opportunity for some saltmarsh/ mudflats to naturally re-establish but this is likely to be restricted in area. The report notes that the boats will be grounded on the mudflats during low tide until the tide floods when the vessels will be able to leave the Facility which will re-suspend sediments and also cause ongoing permanent damage so it would seem uncertain on how much natural post-construction recovery could be achieved. The loss of saltmarsh / mudflat could potentially be an issue for bird feeding / resting areas. The report notes that the erosion of the saltmarsh along the channel is down to wind wave action rather than boat waves. This is recognised as a moderate adverse impact. However this is a permanent loss of habitat and (approx. 2 %) which should be compensated for and we would like to discuss further the potential for mitigating for this loss of saltmarsh/mudflat habitat.	The habitat loss for saltmarsh and mudflat is calculated in the construction impacts section and a biodiversity metric produced to assess the requirement for biodiversity net gain. This is provided in the OLEMS and ongoing discussions will finalise the measures required for net gain which will be reported in the final LEMS.
	Harbour Seals are considered within the report and we note that the data from our 2017 aerial survey is used and the shipping channel in relation to Harbour Seal use is shown at Figures 17.1 and 17.2. The report notes that seals are unlikely to haul out in the vicinity of the facility, but also assesses likelihood of boat collisions which they note could be a worst-case scenario of 5-10 % increase in collision which	Noted.

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	represents 1.7-3.3 Seals. Boat numbers arriving and leaving on The Haven will increase from 400/year to approximately 1024/year due to the operation of the Facility. It is noted in conclusion, although the increased vessel activity will be significant, the operational phase is not considered to have a significant impact because seals using areas close to existing vessel routes are expected to be habituated to vessel presence. The magnitude of the impact is therefore considered to be low.	
	We acknowledge that issues relating to the freeing up of sediment from the dredging process both during construction and ongoing maintenance around the wharf have been assessed including the impacts associated with suspended sediments, increased turbidity, and potential mobilisation of heavy metals / contaminants including hydrocarbons.	Noted.
	We note that no impacts to SAC/ SPA from air pollution deposition from the actual plant are identified (chapter 14 page 42) it notes that the maximum predicted NOx, SO2, NH3 and HF concentrations were below the relevant Critical Levels at The Wash and North Norfolk Coast SAC and The Wash SPA designated ecological sites. However PC values were predicted to be above the NOx 24-hour and the HF weekly mean Critical Level values at the Havenside LNR. The PC values represent the maximum pollutant concentrations from the process stacks and marine vessels combined to provide a conservative scenario.	Impacts from aerial deposition on marine and coastal habitats during the construction and operation phases have been included within **Section 17.8**.
	We consider that the mitigation measures given for much of the proposed works could be improved. We would like to discuss a list of measures that would need to be considered for when working on / near The Wash.	Mitigation is provided for each impact in the relevant sub-sections where it is required in order to reduce the significance of an adverse impact. Additionally, the OLEMS document provides a summary of the mitigation measures proposed.
	We note that underwater noise and the need for, and nature of, mitigation measures will be considered when the impact assessment is further progressed and the potential for underwater noise generation is better understood. We would like to see this additional information when it is provided and have also commented on this in our HRA comments.	An assessment of the potential for underwater noise impacts on marine mammals has been updated. See **Section 17.8**, including proposed mitigation measures.
	Appendix 17.1 Habitats Regulations Assessment The government has recently announced that it will mandate net gains for biodiversity on new	The net gain approach has been followed for this project for losses to mudflat and saltmarsh habitat for this

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	developments in England to deliver an overall increase in biodiversity. Furthermore, net gain is referenced in the new NPPF, and is included within the government's 25 year plan "A Green Future". Natural England therefore recommends that the applicants follow the net gain approach and take the opportunity within this proposal to demonstrate a net gain in biodiversity. Biodiversity net gain is a demonstrable gain in biodiversity assets as a result of a development project that may or may not cause biodiversity loss, but where the final output is an overall net gain. Net gain outcomes can be achieved both on and/or off the development site and should be embedded into the development process at the earliest stages. New Metrics for calculating the amount of biodiversity required to achieve net gain have recently been issued by Defra including a calculating tool which you may wish to consider: http://nepubprod.appspot.com/publication/5850908674228224). The advantage of using a recognised metric to deliver net gain is that it provides a clear, transparent and evidence-based approach to assessing a project's biodiversity impacts that can assist with "derisking" a development through the planning process and contribute to wider place-making. Natural England would be happy to advise further on this approach.	section and for the terrestrial section. Details will be provided within the final Landscape and Ecological Mitigation Strategy (LEMS), as secured by a requirement in the DCO.
	Appendix 17.1 Habitats Regulations Assessment 25 years is given for operational impacts, but some elements are not going to be decommissioned so permanent habitat loss.	Permanent habitat loss is assessed for the wharf area for the marine and coastal aspects.
	Appendix 17.1 Habitats Regulations Assessment The non-technical summary and HRA quote increase of 624 vessels but Chapter 15 and 16 state 560.	Increase in vessels is now updated to 580 per year during operation.
	Appendix 17.1 Habitats Regulations Assessment The Wash group is more commonly known as The Wash European Marine Site (EMS)	Noted.
	Appendix 17.1 Habitats Regulations Assessment 300 driven piles are likely to result in under water noise impacts unless undertaken at low tide and/or vibration installation is used as mitigation. This would need to be a condition of any Deemed Marine Licence (DML). This	An assessment of the potential for underwater noise impacts on marine mammals has been updated. See **Section 17.8**, including proposed mitigation measures.

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	is due to noise to marine mammals so out of context here. The excavation of 140,000 m^3 is not a small amount and will result in permanent loss of habitat and cause indirect impacts to the surrounding habitats. This needs to be considered further.	
	Appendix 17.1 Habitats Regulations Assessment 32,850 m^2 dredge of the berth area is also not insignificant given the width of the Haven. 150 % increase in vessel movement in the Haven is also not insignificant and could lead to increased erosion. 140,000 m^3 is a large capital dredge especially in this area of the Haven.	Noted and the dredge area is considered in the habitat loss calculation
	Appendix 17.1 Habitats Regulations Assessment Missing EA maintenance work over the life time of the project as well as for construction. Boston Harbour dredge has not been included.	These have been added to the assessment of possible in-combination impacts
	Appendix 17.1 Habitats Regulations Assessment Whilst contaminant level do not reach level 2 there are still a lot of contaminates. What can be done to reduce them? Natural England would value a discussion with CEFAS and EA on this matter. Is there any risk to shellfisheries in the Wash or prey availability for designated site features? This is not considered here.	Dredging with a mechanical dredge is a recognised method that reduces mobilisation of contaminants. In addition, not placing the material back into the system but using it on land for the lightweight aggregate production further reduces any mobilisation of contaminants.
	Appendix 17.1 Habitats Regulations Assessment Contamination of prey for wader and ducks not considered.	The mobilisation of contaminants as discussed above would include potential impacts on prey items.
	Appendix 17.1 Habitats Regulations Assessment Unable to agree with some of the HRA conclusions because there is not an adequate baseline provided especially in relation to Birds. The assessment only considered impacts from boat movements and not impacts to functionally linked land.	Additional bird count data collected to inform the ES and determine the importance as functionally linked land.
	Appendix 17.1 Habitats Regulations Assessment Natural England is surprised that some bird species are scoped in when there is no record of them in this area e.g. Little Tern. Likewise there are some impact pathways identified that with more consideration of the	Terns are scoped out of the assessment.

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
	impacts could have been scoped out for example boat traffic and reefs.	
	Appendix 17.1 Habitats Regulations Assessment No evidence provided to demonstrate that the project area is not functionally linked land used by designated features. Please note that features are protected outside of designated sites. Please note that Marine Mammals don't just get impacted by vessel movements but also piling and underwater noise. Even impact to one seal could result in either death or injury.	The assessment of impacts to harbour seal (as part The Wash and North Norfolk Coast SAC) has been updated to include the potential for effects at the Facility, including an assessment of underwater noise from piling and dredging activities.
	Appendix 17.1 Habitats Regulations Assessment Impacts from loss of potentially functionally linked land not considered.	This is included in the assessment of habitat loss.
	Appendix 17.1 Habitats Regulations Assessment 624 vessels is inconsistent with the numbers quoted in chapters 15 and 16.	Now updated to 580 vessels.
	Appendix 17.1 Habitats Regulations Assessment Discord between HRA and Chapters. Inconsistency with chapter that the port of Boston Dredge has been included in HRA but excluded from discussions in chapter. There is no evidence presented to support the conclusion about in-combination impacts.	Both now included in both sections.
	Appendix 17.1 Habitats Regulations Assessment Do not agree with statement as habitat adjacent to site not considered.	Habitat adjacent to the site is included in the assessment.
	Appendix 17.1 Habitats Regulations Assessment Natural England agrees that vessel disturbance can be minimised so that it is no AEOI. However, we advise that best practice is followed that we are happy to discuss further under DAS about.	Mitigation measures to reduce potential impact of vessel disturbance will be implemented. See **Appendix 17.1** for more information.
	Appendix 17.1 Habitats Regulations Assessment Construction phase doesn't consider underwater noise.	An assessment of the potential for effect within the construction phase (due to underwater noise associated with piling and dredging activities) has been included in **Section A17.6** of **Appendix 17.1**.
	Appendix 17.1 Habitats Regulations Assessment	Updated assessment includes loss of habitat and sensitive species of birds.

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
	Loss of supporting habitat not considered. Impacts to prey not considered. Some species of bird screen in, but not justification provided as to why.	
	Appendix 17.1 Habitats Regulations Assessment Why has same LSE for SPA as SAC been identified?	The assessment in the ES has included the loss of habitat as used by birds.
Section 42 Consultation Response – Royal Society for the Protection of Birds (RSPB), August 2019	The Haven as a winter refuge for The Wash SPA features. During cold weather birds can be forced off The Wash to more sheltered areas. This includes the Haven. It is not clear that the data presented has assessed the relative importance of the Haven and application area during these periods of cold weather and the potential impact that displacement from the application area could have to SPA populations relying on these alternative areas to safely feed and roost. This issue is critical, as no mitigation is proposed for the loss of the mudflat to provide alternative feeding or roosting areas.	Noted. The importance of The Haven during periods of cold weather is considered within the assessment in **Section 17.8.** The loss of saltmarsh and mudflat has been included in the biodiversity losses calculation and the loss for the birds is being mitigated through provision of additional roosting and foraging habitat within other areas of the roosting location. These measures are discussed further in the OLEMS and details will be provided within the final LEMS, as secured in the DCO.
	Bird distribution variability along the Haven. It appears that WeBS data have been used to determine potential impacts from the proposal. It does not appear from Figure 17.3 that any WeBS units cover the application area and therefore there does not appear to be an accurate assessment of species distribution along the Haven. Species will aggregate differently depending on habitat, prey availability and factors such as disturbance. Sufficient information must be presented to understand the importance of the intertidal habitat to be directly impacted by the proposal, as well as areas that will be exposed to increased disturbance around the planned wharf area. Greater information must be presented to demonstrate that the application site and its impact on adjacent intertidal areas will not adversely affect birds using the area and which are likely features of The Wash SPA. If data from the Boston Barrier works are being relied upon to fill in the WeBS data gaps the RSPB notes that the reports were written in 2014. The latest CIEEM guidance highlights any data that is over three years old would require updating to inform decisions on any projects. We request clarity on the full suite of data that has been used to inform decisions about the project and confirmation that all data are not more than three years old. Irrespective of the age of the data, if no bird data is currently held for the area of intertidal habitat that will be directly	Information has been provided on specific count information collated since the PEIR.

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
	impacted by the development the RSPB expects additional data to be collected in advance of a DCO application to ensure any decisions are based on up-to-date and appropriate evidence.	
	Impact of the planned wharf. Adding a new structure into the mudflat area has the ability to alter the dynamics of the river. This could increase erosion in some areas or affect accretion rates. This needs to be fully considered in understand potential impact on intertidal habitats and mitigation requirements. In addition, this will allow vessels to moor in areas they have not previously. This activity could cause disturbance and displace birds from an additional zone around the wharf. It is not clear that this has been adequately assessed at this time.	Hydrodynamic assessment has been undertaken and is reported in **Chapter 16 Estuarine Processes**.
	Increase in container vessels transiting the Haven and The Wash. Whilst it is stated that the increase in vessel movements will be a minor increase, this does not appear to appreciate the change in vessel type. It is anticipated that many of the movements will be smaller vessels, typically fishing boats, that will be smaller. It is essential that the impact of bigger vessels is clearly assessed. It is assumed that the wash from such vessels would be greater and the overall disturbance potential greater. The potential impact must be based on vessel type and not simply vessel numbers.	This has been addressed in operational impacts for disturbance to birds and mammals. The larger vessels have the higher impact in terms of presence of vessels.
	Appendix 17.1 Habitats Regulations Assessment Habitats Regulation Assessment (HRA). It is not clear why a relatively narrow range of issues have been covered by the HRA. Any factor that could potentially give rise to a Likely Significant Effect must be considered. As stated in 'Guidance on the use of Habitats Regulations Assessments' issued by the Ministry of Housing, Communities & Local Government in July 2019: "An appropriate assessment must contain complete, precise and definitive findings and conclusions to ensure that there is no reasonable scientific doubt as to the effects of the proposed plan or project."1 In making decisions about potential impacts, recent European Court Judgments "…clarified that when making screening decisions for the purposes of deciding whether an appropriate assessment is required, competent authorities cannot take into account any mitigation measures."1 The assessment must consider impacts on functional linked areas that support features such as cold weather refuges and high tide feeding and roosting areas. 1 https://www.gov.uk/guidance/appropriate-assessment	The updated HRA covers the habitat loss of functionally linked areas.

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
	The level of mitigation and enhancement to address impacts and deliver biodiversity net gains in line with the National Planning Policy Framework. It appears limited mitigation is being proposed to address impacts from the facility. There appears no evidence to justify the position that the mudflat for the wharf is of limited use by features from The Wash SPA, especially at certain times of year. The loss of intertidal habitat should, we believe, be mitigated. We also consider greater enhancement measures in line with the NPPF should be provided and support the statement provided by Lincolnshire Wildlife Trust on this point.	The loss of saltmarsh and mudflat has been included in the biodiversity losses calculation and is being included in the mitigation package. Details have been provided within the OLEMS and final measures will be provided within the final LEMS, as secured in the DCO.
Section 42 Consultation Response – Marine Management Organisation (MMO), August 2019	The PEIR has identified and adequately assessed potential cumulative and inter-related impacts. Further, the report states in paragraph 6.2.26, that "At the PEIR stage, a full CIA [Cumulative Impact Assessment] was not undertaken, as a definitive list of cumulative projects had not been agreed with stakeholders. A full CIA will be carried out for the Environmental Statement (ES), and the full list of plans or projects to be included in the CIA is being developed as part of on-going consultation with technical consultees". The applicant has identified that the only other development that could have a cumulative effect is the Boston Barrier Tidal Scheme. From our records the MMO agree that there are no other developments that should be assessed.	Noted.
	The Preliminary Environmental Impact Report (PEIR) has assessed the impacts of increased vessel traffic (ship wash) on the wave regime and concluded that "… the increase in vessel traffic is unlikely to affect the intertidal mudflats and saltmarsh as the contribution of the overall erosion of these areas by locally-generated wind waves would significantly exceed the contribution from ship waves". Whilst the MMO agree that "The contribution of wind waves in terms of frequency is much higher", thereby providing a source of persistent pressure, the waves generated by ship wash are considered likely to result in increased erosion. In addition, the PEIR does not explicitly state that the 150 % increase in vessel movements is the result of additional vessels of similar size and speed to the existing stock, which would have implications for the energy profile of the additional vessels. The MMO recommend that the impact of ship wash is assessed in greater detail within the Environmental Impact Assessment (EIA) and Environmental Statement (ES). Whilst this is not considered to have a major impact on physical and coastal processes within this already heavily modified site, it may have implications for habitats and/or flood defence.	Ship wash is assessed in more detail since the **PEIR in Chapter 16 Estuarine Processes**.

Consultee and Date	Response	Chapter Section Where Consultation Comment is Addressed
	The current preferred structure is a suspended concrete deck, constructed on approximately 300 driven piles. The impact of these structures on patterns of erosion and accretion have not been considered in the PEIR and should be quantitatively considered within the EIA and ES.	Impacts relevant to erosion and accretion from the suspended deck structure are assessed in **Chapter 16 Estuarine Processes**.
Marine Management Organisation (MMO), September 2020	The MMO would like to advise you that any application should contain assessment of the proposed project against the East Inshore Marine Plan, including consideration of the relevant policies within the Plan in relation to your application.	**Paragraph 17.2.7** notes that the vision of the East Inshore Marine Plan has been considered in this chapter.

17.3.2 In addition to the above consultation, A meeting was held on the 13th October 2020 with the RSPB to discuss and develop options for habitat creation within the RSPB reserves that could act as biodiversity net gain to be provided as a result of the loss of saltmarsh and mudflat at the proposed development site. Two options were discussed: habitat creation at Freiston Shore and habitat improvement at Frampton Marshes. Freiston Shore has planning permission and environmental permit for an additional shallow saline lagoon. This will be a 19-hectare lagoon with a suite of islands for roosting and breeding waders. This site will be important for redshank (*Tringa totanus*) and ruff (*Calidris pugnax*) species. Another option discussed was for maintaining a feeding habitat for waders such as golden plover (*Pluvialis apricaria*), lapwing (*Vanellus vanellus*) and redshank at Frampton Marshes as succession is causing creation of a fen / reedbed which is less suitable for feeding waders. Shallow drains also require an ongoing maintenance programme. Overall, it was concluded that improving roosting would be more beneficial at Freiston and improving breeding and feeding could be beneficial at Frampton Marshes. A follow up meeting will be held with NE and other stakeholders to further discuss options, and meetings will continue following submission of the DCO application.

17.3.3 The potential for vessel movements affecting red throated diver in the Greater Wash SPA was brought up at the meeting with RSPB as a potential in-combination effect. Red throated diver is not a designated feature of The Wash SPA, but is for the Greater Wash SPA, which is 25 km away from the mouth of The Haven at its nearest point. The Greater Wash SPA extends from Yorkshire to Suffolk, covering an area of 3,536 km^2. The Greater Wash SPA was not included in the HRA screening process, or the PEIR HRA document due to its location, size and the relatively small increase in vessel numbers within the shipping channel. No comments were raised on this during the screening or the

PEIR stage. The vessels will also be restricted in their entrance times to The Wash and The Haven due to the depth restrictions in The Haven, such that up to three vessels would be accessing the Facility at any one time. Vessels would be using the existing navigation channels and also be coming from the north and the south, meaning a more distributed vessel route through the Greater Wash SPA. This site has not been included for any further assessment.

17.3.4 Additional meetings have been held during 2020 and 2021 to enable further discussion of potential impacts and mitigation measures and these are detailed in **Appendix A17.1.3 (Consultation)** – Submitted as part of the Habitats Regulations Assessment (document ref 6.4.18).

17.4 Assessment Methodology

Impact Assessment Methodology

17.4.1 A desktop study was carried out to review all available information on the marine and coastal ecological baseline in The Haven. The Boston Barrier Environmental Statement (Environment Agency, 2014) provided a valuable source of information in this respect, as well as the Environment Agency's monitoring data in The Haven for sediment quality, saltmarsh quality, fish and bird behaviour.

17.4.2 Consultation was undertaken with the Environment Agency to discuss the work undertaken for the Boston Barrier and to ensure that all relevant available data was being reviewed to inform this assessment. Consultation was also undertaken with other statutory bodies and non-Governmental Organisations (Marine Management Organisation, Natural England, Eastern Inshore Fisheries and Conservation Authority, Lincolnshire Wildlife Trust and the Royal Society for the Protection of Birds) to inform this assessment.

17.4.3 A site visit was undertaken on the 8th October 2018 to the site of the proposed Principal Application Site to map the habitats within the intertidal areas. This was undertaken at a low spring tide to maximise the area available for survey. Bird surveys were commissioned for the period of October to June 2020 and for January and February 2021 in order to provide site specific information to inform the assessment. This covered overwintering, spring passage and breeding bird periods and also recorded disturbance information at the mouth of The Haven for the baseline situation. The bird surveys also incorporated a habitat survey of the area counted for birds. Further supplementary bird surveys have been commissioned for March to June 2021, and data from those surveys will be provided post-submission. It is not anticipated that the additional data from March to June will affect the outcome of the assessments undertaken. The previous

year's data showed a steep decline in wader and wildfowl numbers from March 2020 through spring passage and breeding periods.

17.4.4 The proposed methodology for the construction works and design of the Facility were considered to identify the potential for impacts. In addition, the results of other relevant assessments (such as the Boston Barrier Environmental Statement, subsequent sampling events in The Haven for fish, water and sediment quality etc.) were reviewed to obtain information on likely changes due to the construction and operation of the Facility that have the potential to impact on marine and coastal ecology. This included potential changes to water and sediment quality during construction and operation, changes to noise and vibration levels during the works, vessel numbers transiting to and from the Facility both during construction and operation and changes to estuarine geomorphology because of the Facility.

17.4.5 Three phases of development are considered, in conjunction with the present-day baseline, over the proposed life cycle of the Facility (at least 25 years). These are:

- Construction phase;
- Operational phase; and,
- Decommissioning phase.

17.4.6 Consideration of the potential impacts of the above phases on marine and coastal ecology was considered on two different spatial scales to determine the study area:

- Near-field – the area adjacent to the footprint of the proposed Application Site, within tens or hundreds of metres.
- Far-field – the wider area downstream and upstream of the footprint of the proposed Application Site that may also be affected by construction and operation (e.g. increased vessel movements, ship wash).

17.4.7 Potential effects have been assessed according to the methodology outlined in **Chapter 6 Approach to EIA.** Worst-case scenarios have been assessed where there is the potential for a range of impact levels to occur. Consideration of the sensitivity of each receptor to the potential effect is a key aspect, drawing on the tolerance to the change and recoverability potential of the receptor, together with the importance of the receptor (e.g. whether the receptor is of international, national, regional or local importance in a conservation context). The magnitude of the potential effect is also important and includes a prediction of the characteristics of the potential impact in terms of the resource affected, frequency and duration of change and the scale of effect. The impact is then assessed to

determine the likely significance both before and after mitigation, if necessary. Specific impact significance levels for marine mammals are outlined in **Table 17-18**.

Cumulative Impact Assessment

17.4.8 Potential cumulative impacts are assessed through consideration of the extent of influence of changes or effects on marine and coastal ecology arising from the Facility alone and cumulatively with other projects.

17.4.9 A screening process has been undertaken in consultation with Boston Borough Council to define which projects will be considered in the Cumulative Impact Assessment. The full list of projects that were considered in the Cumulative Impact Assessment have been tabulated in **Section 17.9**.

Transboundary Impact Assessment

17.4.10 Potential transboundary impacts are assessed through consideration of the extent of influence of changes or effects and their potential to impact upon marine and coastal ecological receptor groups that are located within other countries.

17.4.11 Given the distance of the Application Site from international boundaries, it is concluded that there is no pathway for transboundary impacts on marine and coastal ecology.

17.5 Scope

Study Area

17.5.1 This chapter addresses the potential effects on marine and coastal ecology along The Haven and into The Wash.

17.5.2 For the marine and coastal ecology assessment, the study area includes the direct zone of influence from the estuarine component of the Application Site, covering the wharf area in the intertidal area of The Haven, and the indirectly affected zone which includes vessel transition routes and areas potentially influenced by noise, water quality and changes to estuarine geomorphology.

17.5.3 It is expected that the zone of potentially significant impact will be within 8 km of the Application Site in a downstream direction, thereby capturing The Haven and The Wash, following the line of The Haven. The potential for impact in an upstream direction is lower than in a downstream direction and is restricted to potential hydrodynamic effects. Consequently, the study area currently extends a distance of 1 km upstream.

Data Sources

17.5.4 The assessment was undertaken with reference to several sources, as detailed in **Table 17-3**.

Table 17-3 Key Information Sources

Data Source	Reference
Boston Barrier Scoping Report	*Boston Barrier Order Updated Scoping Report*, Environment Agency (2014)
Boston Barrier Environmental Statement	*Boston Barrier Tidal Project Environmental Statement Volume 2b: Ecology and Nature Conservation Technical Report*, Environment Agency (2014)
Lincolnshire Biodiversity Action Plan	*Lincolnshire Biodiversity Action Plan 2011-2020 (3rd Edition),* Lincolnshire Biodiversity Partnership (2011). [Online] Available at: https://www.nelincs.gov.uk/wp-content/uploads/2016/02/201110-LincolnshireBAP-3rd-edition.pdf
Saltmarsh Monitoring Report from the Environment Agency	*Boston Barrier Tidal Project: 2017 Saltmarsh Survey Report,* Holden, E. (2017)
Boston Barrier Fish Report from the Environment Agency	Boston Barrier Fish Report. EA Report T. Consol, 2019 (in draft)
Boston Barrier Baseline Acoustic Report	*Boston Barrier – Baseline Acoustic Report,* Environment Agency (2018) Document Reference: ENVIMAN001472-BMM-00-00-RP-U-0306018
Boston Barrier Baseline Water and Sediment Quality Report	*Boston Barrier Project: 2017 Water quality and sediment quality report,* Newton, T. (2017) Report No: EA02/17NEAS
Boston Barrier benthic infauna data	Benthic data from the above-mentioned Newton (2017) study.
The Wash Bird Decline Investigation 2014	*The Wash Bird Decline Investigation 2014,* Woodward, I.D.; Ross-Smith, V.H.; Perez-Dominguez, R.; Rehfisch, M.M and Austin, G.E. (2015). BTO Research Report No. 660, *British Trust for Ornithology*.
Core Bird Count Data from: Frampton North 23, Frampton North 60, Slippery Gowt Pits, South Forty Foot Drain – Wyberton Fen to Hubbert's Bridge	British Trust for Ornithology, dates from: 2011 – 2016, 2011 – 2016, 2000 – 2005 and 2007 – 2012 (respectively)
Site specific bird counts for overwintering and breeding birds 2019/2020 Additional surveys undertaken during January and February 2021 to continue the counts as detailed	Bentley, A. 2020. Breeding Bird Survey Monitoring at Proposed Site of Boston Alternative Energy Facility Chick, A. and Bentley, A. 2020. Water Bird Survey Results for Land along the River Haven, Boston, Lincolnshire October 2019 – March 2020.

Data Source	Reference
above (results have been included in the body of this report and will be provided to NE, RSPB and LWT once produced into a formal report)	Bentley, A. Changes in waterbird behaviour due to river traffic in the mouth of The Haven, Boston, Lincolnshire. November 2019 to March 2020.
Sea Mammal Data	Sea Mammal Research Unit seals at sea distribution maps. Russel *et al.,* 2017 August 2017 counts of harbour seal around the UK, SCOS 2018 August 2018 counts of harbour seal around the UK, Thompson, 2019

17.5.5 The assessment uses available literature and data, including the Environmental Statement which supported the recently approved Boston Barrier scheme. Marine and coastal ecology data reported and cited in that document provided a useful baseline of relevance to the Facility, and this was obtained from the Environment Agency as appropriate. It was agreed with the Environment Agency that data from the Boston Barrier scheme was suitable to be used as a baseline for the Facility. Furthermore, the Marine Management Organisation confirmed that these data would be representative of the Facility location, in relation to the water and sediment quality.

17.5.6 With the exception of the observations during the site visit on 8th October 2018, no new marine ecology or fisheries data collection has been undertaken for this ES.

Assumptions and Limitations

17.5.7 Due to the large amount of data that was collected for the Boston Barrier EIA, and subsequent monitoring that has taken place in The Haven, there is a good understanding of the existing marine ecology status in the vicinity of the Application Site and the adjacent areas in The Haven that cover the proposed study area.

17.6 Existing Environment

Designated sites

17.6.1 The following nature conservation designations with a marine and coastal interest are found within the study area, shown in **Figure 17.1**;

- The Wash Special Protection Area (SPA);
- The Wash Ramsar site;

- The Wash and North Norfolk Coast Special Area of Conservation (SAC);
- The Wash Site of Special Scientific Interest (SSSI); and
- Havenside Local Nature Reserve (LNR).

17.6.2 Further details of these sites are provided below. The SPA, Ramsar site and SAC are all of which located approximately 3 km away from the location of the Application Site at the closest point. These are considered further in **Appendix 17.1**, which provides consideration of potential effects of the proposed Facility on the qualifying features and conservation objectives of these sites.

The Wash SPA

- The Wash SPA comprises very extensive mudflats, sand and mud banks, shallow waters and deep channels. The sheltered nature of the area provides suitable breeding conditions for shellfish (mussels, cockles and shrimps). The infauna-rich intertidal flats also provide an ideal and important food source for the breeding water birds dependent on the site, such as oystercatchers.
- The SPA is particularly important for internationally significant populations of breeding and non-breeding water birds.

The Wash Ramsar site

- The varied and rich habitats that are found in The Wash support a healthy and diverse ecosystem, due to the inter-relationship between its various features such as saltmarshes, intertidal sand and mudflats and the estuarine waters. The saltmarshes alongside the plankton in the water provide an important source of organic material. This forms the basis for a highly productive estuary, alongside other organic matter (JNCC, 1988).

The Wash and North Norfolk Coast SAC

- The Wash and North Norfolk Coast SAC covers a total area of 1,077 km^2 and is considered to be one of the best areas in the UK for sand banks, mudflats and sandflats and large shallow inlets and bays together with diverse saltmarsh communities (English Nature, 2000).
- This designation is based on the habitats present in the area as well as the species which occur in the proximity of the SAC boundaries. The following Annex I habitats and species that are a primary reason for selection of the site are as follows (JNCC, 2005):
    - Sandbanks which are slightly covered by sea water all the time.
    - Mudflats and sandflats not covered by sea water at low tide.

- Large shallow inlets and bays.
- Reefs.
- Salicornia and other annuals colonising mud and sand.
- Atlantic salt meadows.
- Mediterranean and thermo-Atlantic halophilous scrubs.
- Harbour seal *Phoca vitulina*.

The Wash SSSI

- The intertidal mudflats and saltmarshes of The Wash are one of Britain's most important winter-feeding areas for waders and wildfowl outside of the breeding season. Similar to the designation of the SPA in the same location, a very large number of birds are dependent on the habitats found in The Wash for the rich supply of invertebrates for food (English Nature, 1972).
- The plant species found in the saltmarshes and shingle communities are also of notable botanical interest and the mature saltmarshes are valuable bird breeding zones.
- Additionally, The Wash is a very important breeding ground for the harbour (common) seal.

Havenside LNR

- The Havenside LNR is locally important, with mixed habitats, such as grassland with scrub, cattle grazed meadows, shallow seasonal ponds, estuarine mudflats and saltmarshes. Common fauna includes oystercatchers, barn owls, bats and harbour (common) seals. The most common saltmarsh species are sea lavender and glasswort (Boston Borough Council, 2018).

Habitats

17.6.3 The site visit carried out in October 2018 identified both coastal saltmarsh and mudflats as the main habitats in and around the location of the proposed wharf. These habitats are listed under Section 41 of the NERC Act 2006 and the Lincolnshire BAP (Lincolnshire Biodiversity Partnership, 2011). These are, therefore, habitats of principal importance. Saltmarsh and mudflats are also priority habitats as identified within the Lincolnshire BAP, which also includes habitat action plans.

17.6.4 Intertidal mudflats, such as found within The Haven, are listed as an important feature of Lincolnshire in the Lincolnshire BAP, and are of high conservation value. These habitats support many species of benthic infauna, as well as representing feeding grounds for several bird species (Lincolnshire Biodiversity Partnership, 2011). However, as the needs of these habitats are well addressed through the management of the Humber and Wash Marine Sites, a new habitat action plan was not included in the latest Lincolnshire BAP. Nonetheless, the UK BAP states that land claim, barrage schemes, human disturbance are some of the relevant threats to these habitats (JNCC, 2011).

17.6.5 The Lincolnshire BAP states that saltmarshes are in a good condition within the county. Their natural extent, however, is at the expense of mudflats. It is considered important to maintain the current extent of the Lincolnshire saltmarshes, particularly in light of the national losses of the habitat.

17.6.6 Saltmarshes provide a suitable high-tide refuge for associated bird species that are feeding on the adjacent mudflats in the winter. These habitats can also act as nursery sites for several fish species and can export nutrients to nourish neighbouring mudflats (Lincolnshire Biodiversity Partnership, 2011).

17.6.7 The greatest threats to the saltmarshes in the Witham estuary are considered to be coastal squeeze and erosion, changes in sediment supply and eutrophication (Holden, 2017). The targets and actions for the saltmarshes up until 2020 include monitoring losses and gains to ensure no net loss, collect information on changes in the extent and quality of the habitat, ensure all saltmarsh is covered by appropriate designation, identify suitable sites for creation of saltmarsh habitat, if opportunities were to arise, and ensure appropriate management of the habitat through agreeing management plans and offering advice to key organisations (Lincolnshire Biodiversity Partnership, 2011).

17.6.8 The October 2018 site visit confirmed that the habitats surrounding the proposed

Plate 17-1 Mudflats adjacent to the Principal Application Site. Photographs taken by RHDHV on 8th October 2018.

wharf location consist of shallow mud banks on either side of The Haven, with the middle of the channel being approximately 4 m below the level of the shore. The width of the mudflats on either side of The Haven is approximately 15-20 m, with the slope of the mudflats steepening nearer the middle of the channel (**Plate 17-1**). A biotope map of the European Nature Information System (EUNIS) habitats in The Haven confirms the presence and extent of the mudflats along The Haven (**Figure 17.2**).

17.6.9 Worm burrows and evidence of bird use (footprints and faeces) on the mudflats were observed. Shallow channels running down the mudflats were also recorded, as seen in **Plate 17-1**.

17.6.10 The intertidal saltmarshes on either side of the channel are approximately 10-30 m wide, stretching from the base of the flood defence embankment to a small wall of boulders where the mudflats begin. The key species recorded on the saltmarsh were *Salicornia* sp., *Spergularia* sp., the sea lavender *Limonium vulgare*, alongside improved grassland species (**Plate 17-2**).

Plate 17-2 Saltmarshes adjacent to The Haven and the site of the proposed Principal Application Site.

17.6.11 A survey carried out in 2011 near the location of the proposed wharf defined the saltmarshes as of poor quality due to the limited extent, low diversity and

negligible zonation (Jacobs, 2011). This definition was confirmed by a survey carried out in 2014 (Environment Agency, 2014) and the site visit (as highlighted above) in October 2018 by Royal HaskoningDHV marine ecology staff. The poor quality of the saltmarshes generally in The Haven (which includes the Application Site) was also confirmed by the most recent monitoring survey carried out by the Environment Agency in 2017 (Holden, 2017).

17.6.12 The most recent survey (Holden, 2017) recorded 18 saltmarsh species in 2017, compared to 19 in 2014 and 17 in 2011 (**Plate 17-3, Figure 16.3**). The two transects taken in 2017, classified the saltmarshes to the north of the Project as SM13a *Puccinellietum maririmae* saltmarsh, *Puccinellia maritima* dominant sub-community (mid-low marsh), SM24 *Elymus pycanthus* (*Elytrigia atherica*) saltmarsh, dominated by *Elytrigia atherica* (high marsh) and SM10 transitional low marsh vegetation with *Puccinellia maritima*, annual *Salicornia* species and *Suaeda maritima* (Joint Nature Conservation Committee's (JNCC) National Vegetation Classification). The saltmarshes to the south of the Project site were classified to be SM16d tall *Festuca rubra* sub-community (high marsh), SM13a *Puccinellietum maritimae* saltmarsh, *Puccinellia maritima* dominant sub-community (mid-low marsh), SM13d *Puccinellietum maritimae* saltmarsh, *Plantago maritima-Armeria maritima* sub-community (mid-low marsh) and SM10 transitional low-marsh vegetation with *Puccinellia maritima*, annual *Salicornia* species and *Suaeda maritima*.

Plate 17-3 Saltmarsh areas surveyed by the Environment Agency – Transects B1 and B2 on the South Bank are the closest to the Principal Application Site. Source: Holden, 2017.

17.6.13 During the saltmarsh surveys carried out for the Boston Barrier, JNCC's Common Standards Guidance for saltmarsh habitats was used in determining the characteristics of saltmarsh zones.

17.6.14 Boston Horsetail (*Equisetum ramosissimum*) and Sea Wormwood (*Artemisia maritima*) were not recorded in the most recent 2017 survey carried out by the Environment Agency, which included the area that will be directly affected by the Facility.

17.6.15 The 2017 survey also recorded erosion on the banks of The Haven, which could be indicating erosion of saltmarsh habitats, specifically on the bank opposite to the Principal Application Site (the North Bank).

17.6.16 The saltmarsh directly adjacent to the location of the Principal Application Site were confirmed to be heavily grazed in areas, and trampling was evident due to dog walkers and other members of the public passing by (Jacobs, 2011). The section of the saltmarsh at the lower end of the intertidal zone was recorded to be often quite narrow, limited and fragmented. However, the flatter larger areas of the saltmarsh were typically more extensive with higher vegetation coverage.

17.6.17 Some grazing by semi-wild horses was observed during the 2014 surveys. Although the observed grazing can be attractive to wintering and passage birds due to the low sward height, overgrazing can have a negative impact on the saltmarsh habitat (Lincolnshire Biodiversity Partnership, 2011).

17.6.18 The site visit undertaken by Royal HaskoningDHV in October 2018 covered the area that would be affected by the Principal Application Site and an adjacent area, in order to determine whether the affected area was unique for any attributes. The area within the footprint of the proposed Principal Application Site appeared comparable with the adjacent areas in terms of habitat type present.

17.6.19 A habitat survey undertaken as part of the bird counts (as reported in Chick, A and Bentley, A. 2020) recorded the following: Above the intertidal zone is a narrow strip of saltmarsh with a small number of pools that are dominated by common saltmarsh grass *Puccinellia maritima* and sea couch *Elytrigia atherica*. The bank edge contains frequent sea aster *tripolium* with occasional spear-leaved orache *Atriplex prostrata*, common scurvygrass *Cochlearia officinalis* and glasswort *Salicornia sp*. Between the mud and saltmarsh an area of rocks line both banks on the inside at various levels, acting as a sea defence to minimise erosion of the banks.

17.6.20 To the rear of the saltmarsh is a flood defence embankment, which contains

rough grasses dominated by false oatgrass *Arrhenatherum elatius* and cock's foot *Dactylus glomerate* with occasional perennial herbs. The sea wall is managed and probably mown 2-3 times per year. Along the top of the seawall is a public footpath and to the rear is an unmanaged hawthorn hedgerow. The sea bank is occasionally littered with allied materials, plus discarded items of a domestic nature.

17.6.21 The habitat types and plant species recorded on the site are common and widespread in the Boston area. There are no habitats or plants of local importance or significance. None of the plant species recorded on site appear on Schedule 8 of the Wildlife and Countryside Act 1981 (as amended). No nationally rare or scarce plants as defined by Wiggington (1999) and Stewart *et al* (1994) respectively were found.

17.6.22 A list of all plant species recorded on site during the November 2019 survey is given in the Bird Survey Report (Winter Bird Survey along the River Haven, Boston, Lincolnshire (which is included as **Appendix 17.2**).

Benthic Ecology

17.6.23 Benthic ecology surveys were undertaken by the Environment Agency in The Haven between 2010 and 2014. A benthic invertebrate survey was carried out in 2010 at four sites by the Environment Agency, Jacobs and Halcrow Group Ltd, using a 0.05 m^2 Van Veen Grab with three replicate samples at each site. These samples were analysed for faunal and physicochemical content. The most recent benthic infaunal survey was carried out by the Environment Agency in 2017, at 16 locations in The Haven (locations marked with "SC" in **Figure 16.7**).

17.6.24 The survey carried out in 2010 recorded 15 species across the mudflats of The Haven, including oligochaetes, polychaetes, crustaceans (shrimp and crab species). These species were considered to be of district importance and are typical for estuarine habitats with fine sediments.

17.6.25 Additionally, 17 species were recorded within a 2 km radius of the Boston Barrier Project (approximately 1 km from the Application Site), most of which were annelids (Greater Lincolnshire Nature Partnership, 2015). These species are typical considering the fine sediment estuarine environment of The Haven. These species recorded by the Greater Lincolnshire Nature Partnership are presented in **Table 17-4** and are considered to be of district importance.

17.6.26 The survey carried out in 2017 recorded 24 benthic species, across 16 locations. The community observed was dominated by polychaetes, oligocheates and barnacles. The oligocheate *Baltidrilus costatus* was the most abundant species

across all sampling locations, with the polychaete *Hediste diversicolor,* the oligochaete *Tubificoides pseudogaster* and Cirripedia next most abundant across all locations. Some larvae of freshwater species such as mayflies, damselflies and water boatmen were also recorded. SC24, a sampling location downstream of the facility was the most diverse location, with 16 species recorded. All of these species and the others recorded are considered to be typical of an estuarine environment. The benthic species recorded during the 2017 survey have been presented in **Table 17-4**.

17.6.27 It is recognised that the majority of the benthic species recorded in **Table 17-4** may present an important food source for bird species in The Haven.

Table 17-4 Records of Benthic Invertebrates, Characteristic of Freshwater and Brackish Water, Recorded during the 2017 Benthic Invertebrate Survey by the Environment Agency, and Recorded to be Present Within 2 km of the Boston Barrier Project (Greater Lincolnshire Nature Partnership, 2015)

Common Name	Scientific Name	The Haven Sediment Samples (2017)	Environmental Records Centre (2015)
Bay barnacle	*Amphibalanus improvises*	✓	
Acorn barnacle	*Austrominius modestus*	✓	
Aquatic worm species (annelid)	*Baltidrilus costatus*	✓	✓
European Green Crab	*Carcinus maenas*	✓	
Aquatic worm species (annelid)	*Caulleriella killariensis*		✓
Barnacles	Cirripedia	✓	
Amphipod crustacean	Corophiidae	✓	
Amphipod crustacean	*Corophium multisetosum*	✓	
Shrimp	*Crangon*	✓	
White worm	*Enchytraeidae*		✓
Bristle worm	*Eteone longa*	✓	✓
Estuarine ragworm	*Hediste diversicolor*	✓	✓
Baltic clam	*Limecola balthica*	✓	
Aquatic worm species (annelid)	*Manayunkia aestuarina*	✓	✓
Mussels	Mytilidae (juv)	✓	

Common Name	Scientific Name	The Haven Sediment Samples (2017)	Environmental Records Centre (2015)
Aquatic worm species (annelid)	Nereididae (juv)	✓	
Aquatic worm species (annelid)	*Nereis sp. (*also see above *Hediste diversicolor)*		✓
Catworm	*Nephtys sp.*	✓	✓
Aquatic worm species (annelid)	*Nephtys hombergii*		✓
Aquatic worm species (annelid)	Oligochaeta	✓	✓
Aquatic worm species (annelid)	*Paranais litoralis*		✓
Mudsnail	*Peringia ulvae*	✓	
Aquatic worm species (annelid)	*Polydora cornuta*	✓	
Aquatic worm species (annelid)	*Pygospio elegans*	✓	✓
Peppery furrow shell	*Scrobicularia plana*	✓	
Aquatic worm species (annelid)	*Streplopsio spp*.	✓	
Aquatic worm species (annelid)	*Streblospio shrubsolii*		✓
Aquatic worm species (annelid) 'sludge worm'	*Tubifex tubifex*		✓
Aquatic worm species (annelid) 'sludge worm'	*Tubificoides benedii*	✓	✓
Aquatic worm species (annelid) 'sludge worm'	*Tubificoides diazi*		✓
Aquatic worm species (annelid) 'sludge worm'	*Tubificoides pseudogaster*	✓	✓

17.6.28 Some non-native species have previously been recorded from the lower Witham, which include the shrimps *Dikerogammarus haemobaphes* and *Hemimysis anomala* (Environment Agency, 2014). Additionally, the mitten crab *Eriocheir sinensis* and signal crayfish *Pacifastacus leniusculus*, both of which are Schedule 9 species (of the Wildlife and Countryside Act 1981 (as amended)), are likely to be present in the lower Witham, upstream of the Grand Sluice. A population of

Rangia cuneata (Gulf Wedge clams) has also been found in a 10 km reach of the South Forty Foot Drain. Currently this is the only known location of this species in UK waters (Environment Agency; Section 42 response).

17.6.29 Some species that have been recorded in The Haven are known to have sensory sensitivities, although the level of sensitivity and responses of invertebrates are virtually unknown. As these benthic species lack air-filled cavities, they are only likely to be sensitive to the particle motion component of noise/vibration only, rather than pressure (Popper, 2001). Due to the lack of mobility of benthic invertebrates, they are likely to be more susceptible to being affected from noise and vibration than more mobile species.

17.6.30 There is also uncertainty around the sensory abilities and sensitivities of the above-mentioned non-native species, due to the lack of data regarding this pressure. However, given their similar lifestyle and habitat preference to the species present, it is unlikely that their sensitivities or responses to noise/vibration (if present) would vary from the native species.

Fish

17.6.31 Previous fish surveys carried out in The Haven during 2010-11 (carried out quarterly at three sites along The Haven using a scientific beam trawl towed 2 m with a 15 mm cod-end mesh) and 2013-14, at locations close to the Application Site, recorded a total of 33 fish species (Environment Agency, 2014). Recent fish surveys carried out in 2017 spring and autumn, 2018 autumn and 2019 spring, recorded 11, 14, 15 and 12 species each sampling round, respectively (Environment Agency, 2019). The Boston Barrier EIA concluded that the fish community at the site was dominated by bottom-dwelling species that feed on benthic prey such as mysids, shrimps, amphipods and fish larvae (Environment Agency, 2014). Sand goby and flounder were the species found in highest abundance, recorded in all catches during the fish surveys. Of these fish species, some of them are protected under national or local legislation (**Table 17-5**).

17.6.32 None of the species are included as qualifying features of The Wash Ramsar site, The Wash and North Norfolk Coast SAC and The Wash SSSI. Additionally, The Haven itself is not designated for international or national importance. There is a local designation for the Havenside LNR.

Table 17-5 Species of Fish Recorded in the River Witham with Designation Under National and Regional Legislation (Environment Agency, 2014), Alongside Their Status Under the Lincolnshire BAP (Lincolnshire Biodiversity Partnership, 2011). Cells Highlighted in Green Signify the Protection of that Species Under the Relevant Legislation.

Common name	OSPAR	Bern Conv. A.III	EU Hab&Sp	NERC S.41	WCA Sch.5	Eel Regulations	SAFFA	LBAP
European Eel								The numbers of European eel entering local rivers from the sea have declined. Alongside flood barriers, disease, parasite, over exploitation and loss of freshwater habitats are contributing factors to this decline.
Herring								
Spined Loach								The spined loach population in Lincolnshire is considered healthy in low numbers.
Bullhead								
Cod								
River lamprey								The river lamprey has only been recorded at one site on the River Lymn and in the Humber Estuary.
Burbot								
Whiting								
Smelt								Smelt is limited to a small number of sites at low numbers

Common name	OSPAR	Bern Conv. A.III	EU Hab&Sp	NERC S.41	WCA Sch.5	Eel Regulations	SAFFA	LBAP
								in Lincolnshire. They're found in the lower reaches of the Witham.
Plaice								Lincolnshire has major nursery grounds. Large amount of discard from fishing vessels which has reduced the reproductive capacity of the species.
Common Goby								
Sand Goby								
Sea trout								Sea trout is present within the Witham but typically restricted to areas downstream of tidal sluices. It is essential that these species are able to migrate upstream to spawn.
Sole								The Wash is part of an important nursery ground for this species. Stock is declining and at risk of having reduced reproductive capacity.

OSPAR: OSPAR List of Threatened and/or Declining Species and Habitat; Bern Conv. A.III: Bern Convention on the Conservation of European Wildlife and Natural Habitats, Annex III (Protected fauna species); EU Hab & Sp: EU Council Directive on the conservation of natural habitats and of wild fauna and flora (92/43/EEC); NERC S.41: Natural Environment and Rural Communities Act 2006, Section 41 (Species of Principal Importance in England); WCA SCH.5: Wildlife and Countryside Act 1981 (Schedule 5); Eel regs: Council Regulation (EC) No 1100/2007 establishing measures for the recovery of the stock of European eel, and Eel (England &Wales) Regulations 2009; SAFFA: Salmon and Freshwater Fisheries Act 1975; LBAP: Lincolnshire Biodiversity Action Plan 2011-2020.

17.6.33 Some of the fish found in The Haven are migratory fish, most of which are marine species that spawn at sea and use inshore coastal waters such as estuaries for nursery grounds (Environment Agency, 2014). The main migratory species previously found in The Haven are:

- *Anguilla anguilla* (eel);
- *Osmerus eperlanus* (smelt);
- *Lampreta fluviatilis* (river lamprey); and,
- *Salmo trutta* (sea trout).

17.6.34 All of these species are listed in Section 41 of the NERC Act 41 (2006) and are also priority species on the Lincolnshire BAP.

17.6.35 The Environment Agency (2014) reports that these species were caught in low abundance during the baseline surveys for the Boston Barrier scheme, showing variable occurrences, which would suggest low importance of the estuary to the species. High levels of canalisation along the Witham could be reducing the availability and extent of suitable mudflats and shallow subtidal habitats, particularly when compared to other nursery grounds in the adjacent areas of The Wash which provide greater shelter for refuge from predators.

17.6.36 Eel is a catadromous species, meaning it migrates downstream to the sea to spawn, using the rivers as pathways. The adult individuals of eels (silver eels, 400-600 mm length) migrate downstream to spawn at sea, and the juveniles (elvers, 50-70 mm length) migrate upstream to use the upper reaches of the river as nursery grounds.

17.6.37 Eel is a critically endangered species across Europe and is listed on the IUCN Red List, with a generally decreasing population trend. Thus, eels are considered a species of principal importance under the NERC Act 2006, as well as being a UK BAP Priority Species.

17.6.38 The main reason for the decline in eel numbers is habitat loss due to residential and commercial development. In the case of The Haven, river bank modification through canalisation and artificial management of the water flows for flood protection purposes may likely be restricting the migration routes of eels through the Witham catchment (Defra, 2010).

17.6.39 The migrating times of eels and the other migratory species are visualised in **Table 17-6**. Fish species of extra sensitivity to noise are also included in **Table 17-6** so as to understand their seasonal presence in The Haven.

Table 17-6 Migration Periods for Diadromous Fish Species Found Near the Location of the Application Site. Arrows Indicate Whether the Migration is Upstream (↑) or Downstream (↓). (Source: Environment Agency (2014) Boston Barrier Project Environmental Statement Volume 2b: Ecology and Nature Conservation Technical Report, Natural England).

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Eel (juvenile)				↑	↑	↑	↑	↑	↑			
Eel (adult)										↓	↓	
Smelt (juvenile)				↓	↓	↓						
Smelt (adult) (spawning in estuary)			↑	↑								
River lamprey (juvenile)							↓	↓	↓			
River lamprey (adult)										↑	↑	↑
Sea trout (juvenile)			↓	↓								
Sea trout (adult)				↑	↑	↑	↑	↑	↑			
Herring												
Sprat												
Cod												
Whiting												

17.6.40 All other migratory fish species that use The Haven as a migratory pathway are anadromous, meaning they are mainly marine species, migrating upstream from the sea into less saline waters to spawn. They typically have adhesive eggs and will lay them on substratum such as coarse sandy or gravelly river beds, or vegetation.

17.6.41 The extensive mudflats and shallow sedimentary habitats found in The Haven are of particular importance to fish species such as smelt, due to their feeding habits, consisting of crustaceans and shrimps. Smelt is a UK BAP Priority species and is a species of principal importance under the NERC Act 2006. The adults migrate upstream in the spring to spawn on sandy or gravelly bottoms (Kottelat, 1997). The eggs have a 3-4-week long incubation period before hatching (Maitland, 2003).

17.6.42 Historically, smelt has been abundant in the estuarine waters of Boston Docks (Smith, 1915). The species was also frequently and consistently recorded during the fish surveys carried out as part of the Boston Barrier Project baseline study in 2010-11 and 2013-2014 (Environment Agency, 2014). Smelt can locally be threatened due to pollution and barriers to migration.

17.6.43 The river lamprey is anadromous, the UK populations of which are considered important for the conservation of the species at an EU level. Typically, they live on hard bottoms, or attached to larger fish such as cod and herring (Fricke, 2007). The adults are parasitic, and feed on such larger fish by sucking their blood and consuming their flesh afterwards (Scott & Crossman, 1998).

17.6.44 The upstream migration of adults usually takes place in the autumn, to the shallow middle or upper reaches of rivers and streams with strong currents (1–2 m/s) and gravel (Kottelat & Freyof, 2007). Mature migrating adults require a route free of obstacles (man-made weirs, barriers, dams, etc.) to reach their spawning grounds. The larvae (ammocoetes) live for 3-5 years buried in fine sediments before metamorphosing and migrating to the sea. No feeding takes place during reproductive migration and reproduction; instead, the adults use up their lipid reserves (Billard, 1997).

17.6.45 Adult sea trout typically feed in the sea or estuary, and migrate upstream from April onwards, throughout the summer until September, to reach gravelly shallows for spawning and laying their eggs. The hatched fry typically continue to live in the gravelly river bed, until after 1-3 years, when they metamorphose into smolts and are able to survive in salt water. They then migrate to sea, generally at night in shoals. Many adults return back to sea after spawning (Wild Trout Trust, 2018). The young feed on insects such as mayflies and freshwater invertebrates, while

the adults are hunters and their diet will consist of smaller fish.

17.6.46 Although the Boston Barrier project presents a physical barrier to fish migration, the Environmental Statement states that the barrier would lay flat (no obstruction) for most of the time and would only be raised in situations of flooding events or maintenance. Thus, the presence of this barrier is not expected to have a long-term significant impact on fish migration.

Vibroacoustic detection abilities of fish species

17.6.47 Fish vary in their ability to detect underwater noises, and their sensitivity to sound varies depending on the species. One of the most important factors that determines their sensitivity to sound is the presence of a swim (gas) bladder in the body, which make fish more vulnerable towards pressure-mediated injury to the ears and general body tissues (Stephenson, *et al.*, 2010). Additionally, the presence of a swim bladder can increase the sound-detection ability of many fish species over a broader frequency range and at greater distances from the sources. Therefore, although fish with swim bladders are more susceptible to damages caused by man-made underwater noises, they are able to detect sound sources from further away than fish without bladders (Popper, *et al.,* 2014).

17.6.48 Popper *et al.* (2014) grouped fish into three categories for analysing the effects of sounds upon them:

- **Category 1** - Fish with no swim bladder or other gas chamber
  - Less susceptible to barotrauma, and only detect particle motion, not sound pressure.

- **Category 2 -** Fish with swim bladders in which hearing does not involve the swim bladder or other gas volume
  - Susceptible to barotrauma, although hearing only involves particle motion, not sound pressure.

- **Category 3 -** Fish in which hearing involves a swim bladder or other gas volume
  - Susceptible to barotrauma and detect sound pressure as well as particle motion.

17.6.49 As such, **Table 17-7** summarises the species that are known to be present in or near the Application Site, alongside their known sensory abilities, distribution in the water column and associated references (Environment Agency, 2014).

Table 17-7 Fish Species in the Vicinity of the Application Site that are Known to have Sensory Abilities, Their Distribution Throughout the Water Column, and Key References.

Common name	Scientific name	Family	Sensitivity to Sound	Sensitivity reason	Highest frequency Detected (Hz)	Distribution in water column	Reference	Notes
European sea bass	*Dicentrarchus labrax*	Moronidae	Medium	Pressure and particle motion	1,000	Demersal	Ramcharitar (unpublished) Nedwell *et al*. (2004); Lovell *et al*. (2005)	-
Common goby	*Pomatoschistus microps*	Gobidae	Medium	High sensitivity to pressure	400	Demersal	Lu & Xu (2009)	-
Crystal goby	*Crystallogobius linearis*							-
Rock goby	*Gobius paganellus*							-
Sand goby	*Pomatoschistus minutus*							-
Atlantic cod	*Gadus morhua*	Gadidae	Medium - high	Pressure and particle motion	500	Benthopelagic	Chapman and Hawkins (1969); Offutt (1970); Sand and Karlsen (1986)	Can likely detect infrasound (below 40 Hz). Best hearing between 100 – 300 Hz
Whiting	*Merlangius merlangus*							
Atlantic herring	*Clupea harengus*	Clupeidae	High		4,000		Enger (1967); Ladich and	Cannot detect ultrasound, and

Common name	Scientific name	Family	Sensitivity to Sound	Sensitivity reason	Highest frequency Detected (Hz)	Distribution in water column	Reference	Notes
Sprat	*Sprattus sprattus*					Pelagic	Fay (2013), Mann *et al.* (2001)	relatively poor sensitivity
Plaice	*Pleuronectes platessa*	Pleuronectidae	Low	Particle motion	400	Demersal	Ladich and Fay (2013); Nedwell *et al*. (2004)	-
European flounder	*Platichthys flesus*							-
Dab	*Limanda limanda*							-
Sole	*Solea solea*	Soleidae						-
Three and nine spined stickleback	*Gasterosteus aculeatus* *Pungitius pungitius*	Gasterosteidae	Low – medium	Pressure and particle motion	< 400	Benthopelagic		-
European eel	*Anguilla anguilla*	Anguillidae	Low	Pressure	300	Demersal	Jerkø *et al*. (1989)	-
Northern pike	*Esox lucius*	Esocidae	Low - medium	Particle motion	<400		Ladich and Fay (2013)	-
European smelt	*Osmerus eperlanus*	Osmeridae	-	-	-	Pelagic-neritic	-	-
Sea trout	*Salmo trutta*	Salmonidae	Low - medium	Particle motion sensitive	-	Pelagic	Ladich and Yan (1998)	-

Common name	Scientific name	Family	Sensitivity to Sound	Sensitivity reason	Highest frequency Detected (Hz)	Distribution in water column	Reference	Notes
River lamprey	*Lampetra fluviatilis*	Petromyzontidae	Low	Particle motion	-		Popper (2005)	-
Lesser pipefish	*Syngnathus rostellatus*	Syngnathidae	Unknown	-	-	Demersal	-	-
Spined loach	*Cobitis taenia*	Cobitidae	Unknown	-	-		-	-

17.6.50 Fish species such as herring (*Clupea harengus*), and sprat (*Sprattus sprattus*) are of high hearing sensitivity, as they can detect sound pressure as well as particle motion, with a specialised auditory system (Blaxter, *et al.,* 1981; Enger, 1967). They are classed as category 3 species according to the Popper *et al.* (2014) classification. The hearing range of these fishes extends to at least 4,000 Hz. Considering this information, and the results of the previous fisheries surveys undertaken near the Application Site, herring and sprat are likely to be the species most affected species by noise related to the Facility.

17.6.51 Species such as cod (*Gadus morhua*) and whiting (*Merlangius merlangus*) are also considered to be category 3 species, due to their benthopelagic feeding habits as well as their similar hearing abilities and sensitivities to the aforementioned gadoids. They are sensitive to both particle motion and pressure changes.

17.6.52 Gobies, three- and nine-spined sticklebacks (*Gasterosteus aculeatus, Pungitius pungitius*) and pike (*Esox lucius*), being sensitive to both pressure and particle motion are likely to have medium sensitivity to sound, despite their hearing not involving the swim-bladder.

17.6.53 Species lacking a swim bladder are typically only sensitive to the particle motion of sound. With regards to the proposed Facility, this mainly comprises flatfish caught in The Haven during the 2010-11 and 2013-14 fish surveys, such as plaice (*Pleuronectes platessa*), European flounder (*Platichthys flesus*), dab (*Limanda limanda*) and Dover sole (*Solea solea*) (Ladich & Fay, 2013; Nedwell, *et al.,* 2004). Dab is considered to be the most sensitive of flatfish to underwater noise, although it is generally of low sensitivity (Nedwell & Barham, 2014).

17.6.54 There is little data on the noise sensitivity of fish eggs and larvae. However, the species studied do appear to have similar hearing ranges to the adults. The larvae of some fish species may develop swim bladders which would render them vulnerable to pressure-related injuries. All of these species are known to lay their eggs in coarse sediment and gravelly environments. Considering the section of The Haven which is likely to be affected by the construction of the proposed Facility is intertidal and comprises mudflats which are thought to continue into the subtidal area, it is unlikely that eggs or larvae would be present at any time of the year.

Ornithology

17.6.55 The Wash (the closest point of any designated area within the Wash is about 3 km away from the Application Site) constitutes an internationally important area for birds because of the high level of habitat diversity and the rich feeding and

roosting grounds that the area supports. Most species are overwintering in the area, feeding on the extensive mud and sand flats exposed at low tide and roosting on the marshes bordering the feeding grounds at high tide. The area also supports resident species and breeding birds. **Table 17-8** summarises the protected species that use The Wash and their seasonality.

Table 17-8 Presence Patterns of Protected Bird Species Within the Wash SPA. Orange cells = summer; green cells = resident; blue cells = wintering; purple = passage (Source: Royal Society for the Protection of Birds).

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Common tern												
Little tern												
Marsh harrier												
Avocet												
Bar-tailed godwit												
Golden plover												
Whooper swan												
Ringed plover												
Sanderling												
Black-tailed godwit												
Curlew												
Dark bellied Brent goose												
Dunlin												
Grey plover												
Knot												
Oystercatcher												
Pink-footed goose												
Pintail												
Redshank												

Species	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Shelduck												
Turnstone												
Red-throated diver												
Little gull												
Common scoter												
Sandwich tern												

17.6.56 Several species of birds that use The Wash also use The Haven, moving from areas of higher abundance to feed and roost. The birds are most likely to be flying into The Haven from roosting grounds further out into The Wash or from nearby fields. Although the section of The Haven where the Application Site is located is not designated, it is likely that the designated bird species of The Wash SPA and Ramsar Site may still utilise The Haven, especially during extreme weather events, when The Haven can provide an area for refuge. Because of this, RSPB's Frampton Marshes Reserve at the mouth of The Haven, which covers extensive areas of saltmarsh and wetlands, and to some extent the habitats along The Haven, provide important areas of functionally linked land that are utilised by many birds in the area.

17.6.57 The Environment Agency monitored bird numbers and behaviours to note any impacts from ground investigation (GI) works along both banks of The Haven, in March 2019 (Environment Agency, 2019). The results indicated that the impact of visual or noise disturbance to non-breeding waterbirds from the GI activities was not significant. At most locations there were relatively few birds within the 500 m radius that was being monitored, the exception being within and adjacent to the RSPB's Frampton Marsh nature reserve, though even here the birds appeared habituated to a level of visual and noise stimuli. The largest numbers of birds that were typically found within 500 m were Brent Geese as they regularly move between locations and exploit a variety of habitats, including agricultural farmland. There was localised disturbance and displacement of waders and wildfowl but the numbers involved was very small and tended to only occur at short range - up to 100 m but generally at less than 50 m.

17.6.58 The species of invertebrates and plants colonising the intertidal mudflats and shallow subtidal areas in The Haven will provide a source of food for birds, particularly those species overwintering in The Wash.

17.6.59 The following species are known to use The Haven area (Woodward, *et al.*, 2015):

- Dark bellied Brent goose
  - High concentrations (out of the 22,248 population in 2014) in The Haven (Woodward, *et al.*, 2015). This species feeds on plants below the high-water mark and roosts on estuaries. It has increasingly begun to use coastal grassland and winter cereal crops as a feeding habitat.

- Shelduck
  - The distribution of this species is closely associated with the muddier sections of The Wash, especially the areas in the vicinity of The Haven. It feeds on invertebrates in the intertidal area such as worms, crabs, amphipods and bivalves.

- Lapwing
  - Higher densities of this species are associated with muddier areas adjacent to the inflows of The Haven. Lower densities occur on sandier sectors. This species feeds mainly on pasture, wet meadows and arable farmland in winter. It uses estuarine and saltmarsh habitats for roosting. Use of estuarine sites are important in cold weather when other sites freeze (Delany *et al*., 2009)

- Dunlin
  - The distribution of dunlin is widespread across The Wash, but there is also a clear association with muddier areas adjacent to the inflows of The Haven. This species mainly eats polychaete worms and small gastropods during winter (Birdlife, 2014). Dunlin prefer estuarine mudflats and uses open fields for roosts near feeding areas during highest tides (Delany *et al 2009*, Shepherd and Lank, 2004).

- Black-tailed godwit
  - This species occurs across The Wash, with greatest concentrations found in areas adjacent to the inflows of The Haven. These areas represent where British Trust of Ornithology (BTO) data is available (i.e. Frampton North, approximately 3 km from the Application Site) and has been reviewed for this report. The black-tailed godwit is known to commonly feed on mudflats in the upper reaches of estuaries, preying on invertebrates such as beetles, polychaetes, molluscs and crustaceans (Birdlife, 2014).

- Redshank
  - Redshank are widespread across The Wash, with higher densities being supported by areas adjacent to the river mouths, particularly the inflows

of The Haven. This species feeds on invertebrates such as insects, spiders, annelid worms, molluscs and amphipods.

- Turnstone
  - This species only occurs in relatively small numbers on The Wash. However, the highest densities are found in the vicinity of the inflow of The Haven. Their diet comprises of a range of food sources including small worms, crustaceans and molluscs which are exposed by the receding tide.

17.6.60 Information on the above bird species were obtained from Woodward *et al*., which was based on a literature review and the existing WeBS data.

17.6.61 Wintering bird surveys were carried out by the Environment Agency on six occasions between January and March 2010 in The Haven (from Boston town centre to The Wash). Seventy-two wintering bird species were recorded, of which 12 were from the regular wintering bird community of The Haven. This community included the Brent goose, shelduck, oystercatcher, grey plover, dunlin, turnstone, curlew and redshank.

17.6.62 The wintering bird populations towards the more downstream reaches of The Haven are more diverse and support the wintering bird assemblage of The Wash SPA and Ramsar site. The narrower, channel-like area of The Haven (where the proposed Facility would be located) supports a restricted community of wintering birds (Environment Agency, 2014). This conclusion is confirmed by the British Trust for Ornithology's core bird counts, obtained from the four nearest count sectors to the Project location (**Figure 17.3**):

- South Forty Foot Drain (Wyberton Fen to Hubbert's Bridge) (counts available from 2008 to 2012);
- Slippery Gowt Pits (counts available from 2001 to 2006);
- Frampton North 23 (counts available from 2012 to 2017); and
- Frampton North 60 (counts available from 2012 to 2017).

17.6.63 Across all available bird count data, the highest diversity of birds was recorded at Frampton North 23, at the mouth of The Haven, in The Wash with 41 species of birds recorded to be using the sector across six years. Waders were the most abundant group of birds (16,065 individuals across six years), followed by gulls and terns (4,625 individuals across six years). Gulls and terns were the most abundant group in the sector closest to the Project site, at Slippery Gowt Pits, with 2,729 individuals counted across five years (**Figure 17.4**). This sector had a total

of 25 species recorded, much less diverse and abundant than the sectors closer to The Wash.

17.6.64 However, the number of birds recorded at Slippery Gowt Pits showed a steep decline in the number of birds recorded in 2005 and 2006 (**Figure 17.4a**), mainly due to the steep reduction in the number of gulls and terns recorded in this sector. Significantly less (or none) gulls and terns were counted during these years. The counting of gulls and terns are optional for WeBS counts, as the counters can sometimes find them difficult to identify. As such, gulls and terns were not counted in 2005 and 2006 (expect for a small number of gulls identified in 2005). At the time it was noted that the water area in this sector had reduced by 40 % (which could possibly account for fewer birds), and the counter at the time recorded that the site may not be viable for much longer.

17.6.65 Slippery Gowt Pits is a vacant WeBS site currently, which means that there is no one available to carry out counts. As such, there is no more recent data than 2006 available for this sector, and the latest data is currently 14 years old.

17.6.66 This would suggest that the habitat available for birds at Frampton North 23 and Frampton North 60 is more suitable for nesting and feeding, considering the mudflats are backed by wide saltmarshes. Upstream of these sectors, although the mudflats are observed to be slightly wider and of a shallower gradient, the mudflats are backed by the sea wall for 2.2 km up to the Principal Application Site location. Therefore, the available data suggests that birds of importance, especially designated species would not necessarily choose to travel further upstream of The Haven towards Boston to feed and roost.

17.6.67 In addition to the above available data, counts were undertaken on the mudflats within the area of the proposed development to establish species and numbers of breeding birds and overwintering birds using the area. The count data is reported in two reports (Bentley, A. 2020: A. Chick and A Bentley 2020). The overwintering surveys were undertaken during the winter of 2019/2020 (October to March) and involved two surveys every month, one around low tide and one around high tide. The breeding bird surveys were undertaken once a month between April and June 2020. Both surveys covered the proposed development area and an adjacent area.

17.6.68 For the overwintering birds, generally feeding on the intertidal mudflats, a typical assemblage of common British birds was recorded on the site and in the immediate environs of the site. Overall, 49 bird species were recorded across both sections between October 2019 – March 2020; of these 19 appear on the amber list and 11 are on the red list. Most birds do not occur in significant

numbers.

17.6.69 However, both redshank and ruff were shown to occur in locally significant numbers. Redshank (a species named in the SPA designation) was recorded in all visits, with the peak count for Area A (northernmost section) being 162, 2.84 % of the estimated winter population for The Wash (**Table 17-9**). Ruff were recorded on eight visits, with a peak count of six, estimated to be 8.1 % of The Wash population. Both counts are significant when the size of the site is taken into consideration and compared to the size of The Wash. However, ruff are known to be opportunistic species and are not site faithful to any location. Redshank however, are site faithful and will return to the same area for roosting and foraging year on year.

Table 17-9 Redshank counts for Areas A and B (percentages show the % of the 5-yr latest WeBS species counts for The Wash SPA and the shaded numbers show where the % was greater than 1%)

Redshank Counts	Count Sector A (within proposed development area)		Count Sector B (adjacent to proposed development area)	
Survey month	Low Tide	High Tide	Low Tide	High Tide
October 2019	18 (0.32 %)	20 (0.35 %)	25 (0.44 %)	78 (1.37 %)
November 2019	26 (0.46 %)	19 (0.33 %)	61 (1.01 %)	38 (0.67 %)
December 2019	14 (0.25 %)	27 (0.47 %)	19 (0.33 %)	33 (0.58 %)
January 2020	27 (0.47 %)	162 (2.84 %)	36 (0.63 %)	3 (0.05 %)
February 2020	26 (0.46 %)	29 (0.51 %)	21 (0.37 %)	93 (1.63 %)
March 2020	17 (0.30 %)	13 (0.23 %)	31 (0.54 %)	73 (1.28 %)
April 2020	0	0	0	0
May 2020	0	0	0	0
June 2020	0	0	0	0
January 2021	29 (0.51 %)	44 (0.77 %)	34 (0.6 %)	61 (1.01 %)
February 2021	18 (0.32 %)	18 (0.32 %)	16 (0.28 %)	21 (0.37 %)

17.6.70 For breeding birds, 25 species were recorded, mostly using the terrestrial areas but three species appear to have been observed within or on the edge of the saltmarsh areas: meadow pipit, reed bunting and stock dove. One of the concerns being investigated was whether redshank were using the saltmarsh areas for breeding. No redshank were observed in the area during any of the breeding bird surveys.

Marine Mammals

17.6.71 As requested in the Scoping Opinion, an assessment of the impacts to harbour seal *Phoca vitulina* has been undertaken. Due to the nature of the site, and location in relation to the open sea, all other marine mammal species have been scoped out of further assessment.

17.6.72 Harbour seal come ashore in sheltered waters, typically on sandbanks and in estuaries, but also in rocky areas. Harbour seal regularly haul-out on land in a pattern that is often related to the tidal cycle (SCOS, 2018). Harbour seal give birth to their pups in June and July and pups can swim almost immediately after birth (SCOS, 2018). Harbour seals moult in August and spend a higher proportion of their time on land during the moult than at other times (SCOS, 2018).

17.6.73 Harbour seal take a wide variety of prey including sandeels, gadoids, herring and sprat, flatfish and cephalopods. Diet varies seasonally and regionally, prey diversity and diet quality also showed some regional and seasonal variation (SCOS, 2018).

17.6.74 Harbour seal normally forage within 40-50 km around their haul out sites. Although, tracking studies have shown that harbour seal can travel 50-100 km offshore and travel 200 km between haul-out sites (Lowry *et al.,* 2001; Sharples *et al.,* 2012). Harbour seal exhibit relatively short foraging trips from their haul out sites. The range of these trips does vary depending on location and the surrounding marine habitat.

17.6.75 The Application Site is approximately 3 km from The Wash and North Norfolk Coast SAC (**Figure 17.1**), which includes the harbour seal, as a qualifying feature. Havenside Local Nature Reserve (LNR) is also nearby (**Figure 17.1**), and notes that harbour seal can be seen (although rarely) within The Haven.

17.6.76 One individual seal was observed in The Haven channel close to the Application Site by Royal HaskoningDHV staff during the site visit on the 8th October 2018, and also on 18th August 2020 as the fishing fleet was coming into the Haven. However, the seal most recently seen was observed to have dived and assumed to have vacated the area before the fishing fleet got close. As reported in the Boston Barrier Environmental Statement, there are no other recent records of harbour seals within 2 km of the Application Site (Environment Agency, 2014).

17.6.77 The extensive intertidal flats at The Wash provide ideal conditions for the breeding and hauling-out of the harbour seal. The seal colony present in The Wash is the largest colony of harbour seals in the UK, containing 7 % of the total UK

population.

17.6.78 The final 3 km of The Haven before it reaches The Wash at Tab's Head is part of The Wash and North Norfolk Coast SAC. As noted above, harbour seal have been observed within The Haven, although in much smaller numbers compared to within The Wash itself. As such, there is potential that the seals utilise the subtidal area in The Haven on occasions for foraging.

17.6.79 Marine Scotland commissioned the Sea Mammal Research Unit (SMRU) to produce maps of grey seal distribution in UK waters (Russell *et al.,* 2017). These maps were produced by combining information about the movement patterns of electronically tagged seals with survey counts of seals at haul-out sites. The resulting maps show estimates of mean seal usage (seals per 5 km x 5 km grid cell) within UK waters. The maps indicate that harbour seal usage is high in and around the shipping channel for the Facility and anchorage area, with a harbour seal density of 3.189 per km^2 within the shipping channel and anchorage location (**Figure 17.5**; Russel *et al.,* 2017). This is similar to the harbour seal density within the whole of The Wash, with an estimated density of 3.2 per km^2, based on the data provided by Russel *et al.* (2017). The harbour seal density is lower within The Haven itself, with an estimated density of 0.80/km^2.

17.6.80 There is an estimated 4,965 harbour seal in the south-east England Management Unit (MU), based on the most recent August counts (2017) at haul-out sites (Special Committee on Seals (SCOS), 2018). The August 2017 counts of harbour seal at haul-out sites on the south-east coast of England were 290 at Donna Nook, 3,210 at The Wash, 399 at Blakeney Point, 271 at Scroby Sands and 694 along the Essex and Kent coast (the Essex and Kent sites were not surveyed in 2017, and so the 2016 count is noted here) (SCOS, 2018).

17.6.81 The haul-out sites in The Wash and adjacent to the proposed shipping channel have been shown in **Figure 17.6**. Within The Wash, there are a number of different harbour seal haul-out and pupping sites (a total of 50 sites within The Wash; **Figure 17.6** (SCOS, 2018)). Of these sites, none are located within 500 m of the anchorage location and shipping channel to be used for the proposed Boston project, with the closest site being the Friskney South site, at approximately 790 m from the shipping channel (**Figure 17.6**).

17.6.82 The 2018 count (Thompson, 2019) of harbour seals of the three closest sites to the shipping channel and anchorage location (**Figure 17.6**) recorded a total of 38 adults and 16 pups at Friskney South, seven adults and no pups at the Rodger site (approximately 830 m from the shipping channel), and one adult and one pup at the Ants site (approximately 970 m from the shipping channel, and 2.1 km from

the anchorage area). This equates to a small proportion of the total harbour seal count, of 3,747 adults (1.2 %) and 1,498 pups (1.1 %) in 2018 (Thompson, 2019). The nearest site with a significant number of harbour seal is Kenzies Creek (4.05 km from the shipping channel), with 143 adults and 94 pups recorded in 2018 (3.8 % of all adults recorded in The Wash, and 6.3 % of all pups).

17.6.83 In the assessments of impacts on the harbour seal population, the following density and reference populations will be used:

- Harbour seal density at the Application Site:
  - **0.80 / km^2** (to take account of the expected lower number of harbour seal present within The Haven).

- Harbour seal density for the project:
  - **3.189 / km^2** (to take account of the high number of harbour seal expected to be present within the shipping channel and anchorage area).

- Harbour seal reference populations:
  - **4,965** in the south-east England MU; and
  - **3,747** in The Wash.

17.6.84 It is acknowledged that, at the time of the planning application submission, more recent data on harbour seal within The Wash was available (SCOS, 2019). However, this was not available at the time of the assessments being undertaken. As the updated harbour seal data (within SCOS, 2019) was not significantly different to that within the data used in this assessment (SCOS, 2018), the resultant impact assessments have therefore not been updated. The reference population is similar in both reports (4,961 in the updated south-east England MU (SCOS, 2019)), and the population of harbour seals within The Wash is the most recently available data.

Anticipated Evolution of the Baseline Condition

17.6.85 If the Facility was to not go ahead, the baseline conditions would only be impacted by the existing natural events and activities, as well as consented schemes in the area. The distribution and abundance of species/habitats assessed in the sections above are unlikely to change. Erosion of the salt marshes was observed during the Environment Agency surveys and the Royal HaskoningDHV site visit mentioned previously. This erosion is likely to continue in the absence of the Facility, due to the vessel movements related to the Port of Boston commercial traffic and the fishing and leisure craft using The Haven, and the naturally-occurring wind-waves.

17.6.86 The harbour seal population along the east coast of England (mainly in The Wash) was reduced by 52 % following the 1988 phocine distemper virus (PDV) epidemic. A second epidemic in 2002 resulted in a decline of 22 % in The Wash but had limited impact elsewhere in Britain. Counts in the Wash and eastern England did not demonstrate any immediate recovery from the 2002 epidemic and continued to decline until 2006. The counts increased rapidly from 2006 to 2012 but have remained relatively constant since (SCOS, 2018).

17.6.87 Overall, the UK population of harbour seal has increased since the late 2000s and is close to the 1990s level (SCOS, 2017). Counts for the East coast of England appear stable, although the 2017 count was 3.9 % lower than in 2016, and similar to the counts of 2014 and 2015; this may be an early indication that the population is nearing carrying capacity (SCOS, 2018).

17.6.88 All other baseline conditions relating to marine and coastal ecology are unlikely to evolve in the absence of the Facility, due to the disturbed nature of the existing environment.

17.7 Mitigation Relevant to Marine and Coastal Ecology

17.7.1 As part of the project design, several embedded mitigation measures have been proposed to reduce potential effects on marine and coastal ecology. Embedded mitigation is a type of primary mitigation and is an inherent aspect of the EIA process.

Design Mitigation

17.7.2 The design has committed to several techniques and engineering designs/modifications, during the pre-application phase, to avoid several impacts or reduce the impacts as far as possible. Five main embedded mitigation measures have been proposed to reduce potential effects on marine and coastal ecology, as outlined below:

- The volume of capital dredging will be minimised by setting the wharf as close to the channel as possible, whilst still allowing safe passage of other vessels when vessels are moored at the wharf;
- The design of the wharf will likely be an open structure (e.g. a suspended deck), as opposed to the other option of a double sheet-piled wall (see **Chapter 5 Project Description** for more detail on the design);
- Capital dredged sediment will be managed on land rather than disposed at sea;

- The majority (about two-thirds) of the capital dredging will be carried out from land and will be undertaken with a mechanical dredge, in order to minimise the resulting sediment plume and minimise impacts on fish due to suction if other techniques were used;
- Use of maintenance dredged sediment as a binding agent for aggregate production at the Facility; and
- Use of the water run-off from maintenance dredged sediment in the aggregate production at the Facility.

17.7.3 Good environmental practices (as set out in the Construction Industry Research and Information Association (CIRIA): Coastal and Marine Environmental Site Guide, second edition, August 2015) during construction works will be followed to reduce the scale of certain impacts, particularly with respect to potential changes to water quality. This relates to maintaining equipment in good working order to reduce spillages and incidents that could cause pollution, ensuring that works where spillages could occur and could leak into the natural environment are bunded and that contingency planning measures are put into place to reduce the likelihood of issues arising if spillages do occur.

Risks of Spillages

17.7.4 All work practices and vessels would adhere to the requirements of the International Convention for the Prevention of Pollution from Ships (MARPOL) 73/78; specifically Annex 1 Regulations for the prevention of pollution by oil concerning machine waters, bilge waters and deck drainage and Annex IV Regulations for the prevention of pollution by sewage from ships concerning black and grey waters.

17.7.5 Additionally, in order to reduce any impacts from spillages, all works relating to the marine environment will be bunded, concrete sealed, and a Sustainable Drainage System installed. If a discharge for the construction works is needed, a permit would be applied for to the Environment Agency to control any potential pollution incidents. Relevant parties would be informed of any pollution events. All management with regards to managing water pollution will be carried out through the Internal Drainage Board (IDB).

17.7.6 A contingency plan for any possible spillages during both construction and operation will be produced and will include potential for impacts, and all possible clean-up measures, and will be agreed with the nature conservation organisations.

Introduction of Invasive Species

17.7.7 The risk of spreading marine invasive non-native species (INNS) would be mitigated through use of best-practice techniques, including appropriate vessel maintenance following guidance from The International Maritime Organisation (IMO). These commitments would be secured in the NMP, which will be developed after the ES is submitted, in order to incorporate any conditions associated with the DCO. Additionally, impacts relating to the introduction of invasive species have been assessed in **Section 17.8** below.

17.7.8 The above measures are considered standard good practice measures and/or legal requirements. The risks of spillages during both the construction and operational phase are not, therefore, considered further in the assessment.

Underwater Noise

17.7.9 As a precautionary approach, mitigation will be undertaken for piling works undertaken during high tides, to ensure that any potential for impact to marine mammals (and fish species) are reduced as far as is possible. See **Section 17.8** for more information.

17.8 Impact Assessment

17.8.1 A full project description of the Facility is provided in **Chapter 5 Project Description**.

17.8.2 The main component of the proposed Facility that is most likely to impact the marine and coastal ecology during both construction and operation are the proposed wharf and the capital and maintenance dredging necessary for vessel access. Full details of the worst-case envelope assumed for the prediction and assessment of geomorphological changes because of the construction and operation of the wharf and the results of the assessment are provided in **Chapter 16 Estuarine Processes**.

17.8.3 Potential effects on water quality (described in **Chapter 15 Marine Water and Sediment Quality**) have an influence on marine and coastal ecological receptors and are assessed in this chapter.

17.8.4 There is potential for partial infilling of the dredged area during the operational phase, as the deepened areas would be expected to act as a sink for sediment and, therefore, future maintenance dredging of the berthing area is anticipated to be required and would be carried out in accordance with the terms of the DML approved as part of the DCO.

17.8.5 Natural accretion rates on the mudflats and saltmarsh along areas like The Haven are estimated at about 0.6 – 1.2 m/year (Van Rijn, 2016), where there are high suspended sediment concentrations (200 mg/l to greater than 1,000 mg/l) and major density current effects. These rates would be conservative for The Haven because of the potential erosional effect of opening the sluice structures during high winter fluvial flows.

17.8.6 The Port of Boston currently dredges an average of 24,000 tonnes of sediment per year from the Port and various locations along The Haven (Marine Management Organisation, 2015) but no dredging takes place at the proposed Application Site. However, given the greater potential for the dredging areas to accumulate sediment during times of sluice closure, a conservative estimate of 0.5 m/year (50 cm/year) is assumed for the purposes of assessment.

17.8.7 Using 0.5 m/year as a baseline sedimentation rate in the berthing area over an area of 16,000 m^2 (dredged footprint of the berthing areas; 400 m long by 40 m wide) would lead to accumulation of sediment of approximately 8,000 m^3/year (**Chapter 16 Estuarine Processes**).

17.8.8 The number of vessels using The Haven would increase during the operational phase of the scheme. This has the potential to increase the frequency of ship wash on the intertidal areas of The Haven, which could potentially lead to erosion. It also has the potential to increase the levels of disturbance to birds, fish and marine mammals using The Haven area.

17.8.9 With regard to decommissioning, after the operational lifetime of the proposed Facility of 25 years, it is proposed that the wharf will not be decommissioned and will be kept in place because it maintains the flood protection line. As such, no significant adverse impacts from decommissioning are predicted. There would be potential benefits from the reduction in number of vessels using the area and from reduced disturbance from activities associated with the wharf.

17.8.10 The assessment in this ES is undertaken on the current assumed design as described in **Chapter 5 Project Description.**

17.8.11 **Table 17-10** summarises the potential impacts of the proposed Facility on marine and coastal ecology.

Table 17-10 Potential Impacts on Marine and Coastal Ecology

Impact	Receptor
Construction	
Construction impact 1 - Loss of and/or change to estuarine habitats and associated species within	Saltmarsh habitat and species Mudflat habitat and species

Impact	Receptor
the footprint of the wharf and dredging area	Birds
Construction impact 2 - Increased suspended sediment concentrations from capital dredging, with potential for sediment-bound contaminants to be released	Fish (migration and behaviour) Benthic communities
Construction impact 3 - Disturbance due to human activity/increased human presence (excluding underwater noise but including airborne noise), including vessel movements	Birds and mammals
Construction impact 4 - Underwater noise (piling and dredging)	Fish (migration and behaviour) Marine mammals
Construction impact 5 - Increased emissions to air and deposition on marine and estuarine habitats	Marine and coastal habitats
Operation	
Operation impact 1 - Habitat alteration due to hydrodynamic changes	Intertidal and subtidal habitats
Operation impact 2 - Changes in vessel traffic and movement leading to increased ship wash, underwater noise, disturbance, collision risk, and risk from invasive species	Intertidal habitat Fish Birds Marine mammals
Operation impact 3 - Increased suspended sediment concentrations due to maintenance dredging	Benthic communities Fish (migration and behaviour)
Operation impact 4 - Beaching of vessels at low tide	Benthic communities
Operation impact 5 - Increased emissions to air and deposition on marine and estuarine habitats	Marine and coastal habitats
Decommissioning	
No significant adverse impacts are anticipated	-

Potential Impacts during Construction

Impact 1 - Loss of and/or change to estuarine habitats and associated species within the footprint of the wharf and dredging area

17.8.12 Part of the mudflats and the saltmarshes adjacent to the Principal Application Site will need to be removed to allow for the construction of the wharf. Impacts of the wharf construction and capital dredging on these habitats are, therefore, certain to occur and there would be a permanent loss of the existing saltmarsh and mudflat with a resulting change to the remaining mudflat habitat in relation to the emergence pattern. The removal of associated species from these areas would also occur during the construction phase.

17.8.13 An existing area of mudflat would be removed through dredging (refer to **Figure 5.2** showing dredge area) which would leave an area of intertidal mudflat which is much lower in relation to the tidal levels and therefore will have a much shorter pattern of tidal emergence. It is expected that the remaining habitat would re-

colonise (due to its operational position being underneath the wharf, some of this area will not be subject to maintenance dredging) but this would not provide such a valuable habitat given its position in relation to the tidal cycle. The remaining mudflat will be much flatter and much deeper in the water with only limited emergence. It will also have boats beached on it during low tide as they wait for higher water to re-float and exit The Haven. Although this particular impact occurs during operation it is included here in order to fully calculate the overall loss of habitat due to the scheme construction and operation (and is not recalculated in the operational phase). It is expected that some saltmarsh vegetation would recolonise in the upper intertidal area once the wharf is in place. The wharf is an open structure and as such the habitats beneath it will still be subject to tidal influence. With saltmarsh adjacent to the wharf, species should recolonise from such areas onto appropriate habitat. Seeds will also assist with re-colonisation. The specific habitat loss will be within the footprint of the wharf as well as the adjacent working areas that will be required for the construction of the wharf.

17.8.14 It is proposed that up to 225,000 m^3 of material will be removed by capital dredging, allowing development of a 400 m long and 30 m wide wharf (**Figure 5.2**), as a worst-case scenario. This estimate has assumed a material removal depth of approximately 7 m. Part of this will be dredging of silty material from the intertidal mudflats, and part of it is within the intertidal saltmarsh.

17.8.15 At least two-thirds of the dredging is planned to be undertaken using land-based equipment, and one-third using floating plant. It is anticipated that the dredging will all be carried out using mechanical dredging techniques. The dredged material will all be used on land with any run-off retained within the facility.

17.8.16 To estimate the amount of existing habitat that will be affected during construction in the context of The Haven, the approximate area of similar mudflat and saltmarsh habitat in The Haven has been calculated. This has then been compared against the area of habitat (comprising both mudflats and saltmarsh) that will be lost.

17.8.17 The area of intertidal mudflat and saltmarsh habitat that will be lost due to the construction works is estimated at 2.54 ha. This comprises 1.54 ha of mudflat and 1 ha of saltmarsh.

17.8.18 The Haven stretches for approximately 9 km from the Grand Sluice in Boston to The Wash, with saltmarsh of approximately 10 m width and mudflat of 20 m width on either side of The Haven, this equates roughly to 0.18 km^2 (18 ha) of saltmarsh and 0.36 km^2 (36 ha) of mudflat in The Haven from the Principal Application Site to just before the mouth of The Haven where the saltmarsh and mudflat habitats

widen considerably.

17.8.19 The loss of mudflat and saltmarsh and the presence of the wharf during the construction phase will mean the loss of some feeding and roosting habitat for bird species that utilise the area, which will be confined to the direct footprint of the Principal Application Site. Bird counts from the surveys that were carried out throughout the winter of 2019/20 and January and February 2021 within two count areas (Areas A and B) (**Figure 17.8**) for these intertidal areas revealed that a number of waterbirds use the intertidal area within the footprint of the Principal Application Site (surveyed as Area A) for feeding and/or roosting. Redshank numbers at low tide (when most individuals were foraging on the intertidal) varied between 14 and 29 in Area A (which includes both sides of the river), whereas numbers in Area B (adjacent area surveyed towards the mouth of the Haven, on both sides) were between 16 and 61. For ruff, the number at low tide in Area A was 1 on one occasion and between 1 and 6 for Area B on three occasions. A peak number of 223 individual birds were recorded to be using Area A in November 2019.

17.8.20 Area B would remain available for feeding and roosting at low and high tide and at low tide there will be no vessel movements occurring relating to the facility due to the depth of the channel in this area. The opposite side of the river to the Principal Application Site within Area A will also still be available for feeding and roosting.

17.8.21 The area of intertidal that will be lost does not represent a main feeding area for birds which are more likely to be feeding on the extensive flatter mudflats closer to the mouth of The Haven, which are also less steep in their profile. These areas do however provide a valuable feeding area for particular species as observed during the overwintering counts as discussed above (Chick, A. and Bentley, A. 2020).

17.8.22 For the Boston Barrier Environmental Statement, it was concluded that the barrier was unlikely to have a significant effect on bird species designated under The Wash SPA and Ramsar site. It was also concluded that the amount of habitat loss was minimal, considering the availability of alternative feeding and roosting habitats along The Witham. This accounted for a loss of mudflat of 735 m^2, as well as a 160 m section on one bank of the river, as opposed to the 25,400 m^2 estimation of habitat loss resulting from the Facility.

17.8.23 Overall, it is not expected that feeding birds will be adversely affected by habitat

loss, due to the relatively low numbers (in the context of the wider Haven and The Wash; addressed in **Appendix 17.1**) using Area A, the small area lost and the continued availability of adjacent feeding areas. However, in order to mitigate for the loss, some of the saltmarsh habitat in Area B will be enhanced for foraging birds as described further below within a Habitat Mitigation Area.

17.8.24 Similarly, the number of birds utilising the saltmarsh area for roosting is relatively low (in the wider context), with the peak count of waterbirds using Area A recorded as 260. The adjacent saltmarsh to Area A, that will continue to be available within Area B, is much wider than the area that would be lost, and also provides a roosting habitat for a greater number of waterbirds on average. The numbers of birds using the surveyed area was highly variable and birds seemed to move around the adjacent areas whilst feeding and roosting. It is recognised that birds do move around the roost sites within a limited area. Studies on roosting sites in The Wash have been undertaken (Rehfisch, et al, 1996) based on extensive ringing data. The studies were looking into positioning of proposed intervals between roosting refuges based on movements of birds between roosts to ensure that birds could reach at least one refuge without excessive energy expenditure. To do this they looked at how far waders dispersed between roosts. For redshank they concluded that roosting refuges should be placed up to 3.5 km apart in order to cater for 90 % (5.5 km and 9.5 km for 75 % and 50 %) of the population being able to reach refuges by flights similar in distance to their between-roost movements. This would indicate that waders will move between roost sites within a given area that they use each year. This would follow from the data that shows only one occasion out of 11 with numbers of redshank reaching >1 % of the WeBS 5-year average. The roost site was not supporting this high number of birds on each occasion so the redshank must have also been visiting an alternative roost site elsewhere and it is likely, from the above information collated for the wader roost study, within the 3.5 km (and up to 9.5 km for some individuals) distance that redshank were shown to fly between roost sites. This would indicate that alternative roost sites are available along The Haven and around the mouth of The Haven that the same redshank are likely to be using on a regular basis. Based on this, it is not expected that the loss of the small area of saltmarsh habitat within Area A would represent an effect that would have a major significant impact on the birds using this area. This impact is mitigated through enhancing the roosting habitat in the Habitat Mitigation Area as outlined below within the mitigation section.

17.8.25 Saltmarsh and mudflat are both BAP priority habitats and represent supporting habitat for fish and birds, as well as the invertebrates and vegetation that colonise these habitats. As these habitats are not designated as national or international

habitats of importance at this location, they are considered to have a value of regional importance.

17.8.26 The habitat that will be lost is considered to be of regional conservation importance for non-breeding birds and is larger than what was deemed acceptable for the Boston Barrier. However, the loss is considered to be small-scale in the context of The Haven as a whole. It should also be noted that the habitat that will be lost is similar in nature to the adjacent areas of habitat. The benthic species will be lost from the dredge area and an area immediately surrounding this. The species lost are typical of the area and the loss of benthos also constitutes a loss of prey species for birds and fish. The magnitude of impact is therefore considered to be medium for the mudflats and associated species and medium for the saltmarsh and associated species.

17.8.27 The saltmarsh and mudflats in The Haven can present an important habitat for birds as discussed above, where they are considered as functionally linked land as birds are known to use these areas in extreme weather events (i.e. when a winter is colder than normal in The Wash) (personal communication, RSPB). As such, these habitats are still important for birds, even though they may not be used regularly by the majority of bird species in the area (the potential impacts in relation to The Wash SPA are discussed in the HRA in **Appendix 17.1**).

17.8.28 The saltmarsh in Area A only consists of a very thin strip because it is restricted by the flood defence embankment on one side and the rock armour between the saltmarsh and the mudflat. Previous surveys identified above (**Section 17.6**) describe the saltmarsh as of poor quality and surveys undertaken during the bird counts in 2019 did not record any botanical species or habitats of local importance or significance. The habitat does not appear to be of key importance for breeding birds but does support roosting birds, although numbers were only relatively high (>1 % of the WeBS latest 5-year mean) on one occasion of twelve counts (six low water and six high water counts) over the winter of 2019/20. It is also understood that redshank will move between roosting sites within a given area and this area is likely to include the larger marshes adjacent to the site and towards and around the mouth of The Haven. The mudflats provide feeding habitat for relatively high numbers of birds but all numbers recorded from area A during low tide counts were <1 % of the latest WeBS counts for The Wash. Due to the construction activities resulting in direct loss of existing saltmarsh and mudflats, these habitats will not have an opportunity to recover to provide habitat for the same species because the wharf will be located on this area. However, some recovery of habitat (i.e. a strip of saltmarsh under the wharf and intertidal habitat within the footprint of mudflat habitat (albeit a different type of habitat and lower in the tidal cycle) for

fish and benthic invertebrates) is likely to occur in the area within the footprint of works albeit still affected by operational activities. The relative loss of saltmarsh is slightly higher than the relative loss of mudflat when considered in context of The Haven and as saltmarsh would take longer to recolonise with a smaller area of recovery. Given that the saltmarsh that recovers would be underneath the wharf it wouldn't provide a similar habitat for roosting birds. The loss of saltmarsh and its associated species can be considered of medium sensitivity and mudflat (which would recover within a similar area to provide a feeding resource for fish and in some areas for birds) and its associated species of low sensitivity.

17.8.29 In line with the significance determination matrix set out in **Chapter 6 Approach to EIA**, the significance of this effect is considered to be **moderate adverse** on saltmarshes and **minor adverse** on mudflats.

Table 17-11 Summary of Impact Assessment

Impact: Loss of habitats (Construction)	Magnitude	Sensitivity	Significance
Loss of saltmarshes	Medium	Medium	Moderate adverse
Loss of mudflats	Medium	Low	Minor adverse

Mitigation

17.8.30 The area of mudflat and saltmarsh affected will be restricted to only what is necessary for the construction of the wharf. Additionally, the dimensions of the quay wall and wharf have been set to minimise the volume of capital dredging required to minimise impacts and also allow a safe clearance between a berthed vessel and others passing through the channel. With saltmarsh adjacent to the wharf, it is expected that species will recolonise from such areas onto appropriate habitat.

17.8.31 As the above measures are embedded, they have been considered in the impact assessment.

17.8.32 In order to mitigate the habitat loss specifically for the birds using this area, habitat enhancement in the Habitat Mitigation Area will provide additional foraging and roosting habitat to ensure that the birds will still be able to use this localised area. Existing shallow scrapes that are becoming overgrown will be reinstated and new scrapes dug in the marsh area providing habitats that are a common component of saltmarsh habitats. Shallow pools already exist in this area and the works would increase the number of pools. In addition, re-profiling of some of the low banks will be undertaken to provide clear lines of sight for redshank, and the number of

rocks along the frontage of the marsh (where rocks already exist) will be increased (using the rocks from Area A) to provide additional roosting habitat. **Figure 17.9** illustrates the proposed mitigation measures. These measures are discussed further in the Outline Landscape and Ecological Mitigation Strategy (OLEMS) (document ref 7.4) and they would be secured by Requirement 5 of the DCO, which requires a final Landscape and Ecological Mitigation Strategy to be approved which must be substantially in accordance with the OLEMS. In terms of land ownership of the Mitigation Works Area, The Crown Estate owns the land below Mean High Water Springs (MHWS) within the Habitat Mitigation Area (i.e. the tidal creeks and pools). Correspondence from The Crown Estate confirms it is, 'supportive of its use as environmental mitigation land.' The Applicant is in discussions with The Crown Estate to secure its agreement in respect of the necessary rights to implement and maintain the proposed mitigation measures. Following diligent enquiry, the remaining part of the Habitat Mitigation Area is confirmed to be of unknown ownership (and unregistered). For certainty, the powers to compulsorily acquire the necessary rights to undertake the mitigation works and for them to be maintained and remain in situ have been incorporated within the DCO.

17.8.33 These measures are not expected to have any additional impacts in themselves. The works are relatively minor, and it is expected that they could be undertaken through both landward and seaward works and either retaining material in the marsh where this benefits the habitat or removing to use within the Principal Application Site. The re-profiling of the banks would be undertaken on low profile banks currently in the marsh. The works are reinstating or increasing habitats that generally occur in healthy marsh systems and the works would be undertaken outside the overwintering period to avoid disturbing any birds using these habitats at this time. Works would include one long-reach excavator on-site for a week at most and would take place in advance of the wharf construction.

17.8.34 In addition, as the habitat loss is considered to be permanent (given the beaching of vessels on part of the intertidal adjacent to the wharf), measures to provide a net gain of biodiversity should be put in place. A calculation for the loss of biodiversity has been undertaken and the results are provided in the OLEMS. Habitat restoration and creation measures will be developed to provide a net gain, and in this respect, the measures should aim to provide at least 10 % increase in biodiversity units.

17.8.35 The potential for such measures is currently under discussion with the relevant conservation organisations (Natural England, Lincolnshire Wildlife Trust and the Royal Society for the Protection of Birds) and is expected to include measures to

improve or create habitat for birds at the Frampton Marshes and Freiston Shore Reserves run by RSPB. The measures would aim to provide habitat for feeding, roosting and nesting for those bird species know to use The Haven. The proposed measures discussed to date are outlined in the OLEMS. The specific measures that will be carried out at the Reserves would continue to evolve post-DCO submission and would be documented in detail within the final LEMS which will be agreed with the conservation organisations detailed above and is secured by Requirement 5 of the DCO.

17.8.36 It is expected that the measures put in place would provide additional habitat for the birds that use the sites within The Haven and also within The Wash SPA and Ramsar site.

17.8.37 Consequently, the residual effect is assessed as **minor adverse** significance for both saltmarsh and mudflat habitat, subject to the successful implementation of the mitigation measures. The biodiversity net gain measures would provide an additional benefit. These measures would be agreed with the conservation organisations detailed above.

Impact 2 - Increased levels of suspended sediments due to capital dredging

Suspended sediment concentrations

17.8.38 Capital dredging of up to 225,000 m^3 of sediment from the intertidal area would be undertaken to create the berthing pocket for the wharf. The dredging activities will disturb sediment, resulting in localised and short-term increases in suspended sediment concentrations. The dredging method would be excavators / backhoe operating mostly from the land but also where necessary from within The Haven. The use of the mechanical dredge method reduces the plume dispersion and retains the sediment structure more in comparison to a hydraulic dredger. This results in less of a plume and less run-off from the sediment when placed on land. The impacts associated with plume dispersal and sediment transfer is provided in **Chapter 16 Estuarine Processes.** The dredged sediment would not be disposed to sea but managed on land in accordance with the waste hierarchy (see **Chapter 23 Waste**).

17.8.39 A small volume of the dredged sediment would be lost from the excavator during the dredging process which could enter the water column. Expert-based assessment would suggest that a low concentration plume of suspended sediment would be created, which would be dispersed by tidal currents (and waves) away from the site. This dispersion would either be upstream on the flood tide or downstream on the ebb tide. Larger particles such as sand would rapidly

fall (within minutes) to the estuary bed upon the disturbance of the sediment, which would be expected to occur within a few tens of metres along the axis of the tidal flow (**Chapter 16 Estuarine Processes**).

17.8.40 Due to the small volume of sediment released and the fine size of the particles (silt and clay), the plume is likely to be rapidly dispersed. As such, the dredging works are not anticipated to have significant knock-on impacts on priority habitats adjacent to the Principal Application Site such as saltmarshes, mudflats, or within The Wash SPA and SAC located further downstream. The plume is predicted to contain measurable, but modest, suspended sediment concentrations (less than 100 mg/l close to the excavator, reducing to less than tens of mg/l within a few hundred metres of the excavator). These suspended sediment concentrations are much lower than the natural variability in The Haven (134 mg/l to 1,790 mg/l) and are expected to be indistinguishable from background levels within a very short distance from the dredger.

Potential for Remobilisation of Contaminants

17.8.41 Sediment disturbance could also lead to the mobilisation of contaminants which may be bound within the sediment and which could be harmful to the benthos and fish. Vibrocore samples of sediment along The Haven were collected in 2017 by Environment Agency Estuarine and Coastal Monitoring and Assessment Service (ECMAS) to assess the sediment conditions of the area which may be impacted by dredging during the Boston Barrier flood alleviation scheme (Newton, 2017). Trace metals were analysed, and the following metals were present at levels below Cefas Action Level 1 in all samples taken: cadmium, copper, lead, mercury and zinc. Other metals were present at levels, which for some of the samples slightly exceeded level 1, such as arsenic (one sample out of 19 exceeded level 1), chromium (two out of 19 exceeded level 1), nickel (10 out of 19 exceeded level 1) and zinc (one out of 19 exceeded level 1). None of the samples exceeded the Cefas Action Level 2 value.

17.8.42 The vibrocore samples were also analysed for hydrocarbons and the results were compared to the Environment Canada guideline values below (Canadian Council of Ministers of the Environment, 2014):

- Below the Thresholds Effect Level (TEL); the minimal effect range within which adverse effects rarely occur.
- Between the TEL and Probable Effect Level (PEL); the possible effect range within which adverse effects occasionally occur.
- Above the PEL; the probable effect range within which adverse effects frequently occur (Canadian Council of Ministers of the Environment, 2014).

17.8.43 The results showed that the samples were either below the TEL or between the TEL and the PEL. No samples exceeded the PEL.

17.8.44 The results of the analysis of the vibrocores showed that the concentrations of chemicals in the samples were relatively consistent from the sampling zone. There were some anomalies generally associated with deeper samples, specifically, adjacent to the port entrance.

17.8.45 Additionally, intertidal sediment samples were taken (via grab sample) from three stations along The Haven in 2010. The main contaminants recorded during this sampling event were the trace metals such as arsenic, chromium, copper, lead, nickel and zinc, all of which were recorded above their respective TELs (Jacobs/Halcrow, 2011) but below the PELs. When compared to Cefas Action levels the following were below the Level 1 action level: arsenic, cadmium, copper, lead, mercury and zinc. Samples which exceeded level 1 but were below level 2 were: one out of 11 chromium samples (the rest were on or below the level) and five out of 11 nickel samples (the rest were on or below the level). All samples analysed were below Cefas Action level 2.

17.8.46 Three of the samples collected during the ECMAS study were within the footprint of the proposed dredge area for the Facility.

17.8.47 In light of the available data it is not proposed that further sampling will be required. This conclusion was confirmed with the MMO during a consultation meeting in April 2019. Sediment data from the samples taken at depth is not likely to have changed at all because it has remained covered by other layers of sediment which will bind in any chemicals. The sediment will be mechanically dredged which will reduce the potential for mobilisation of any contaminants and it is not proposed that the material will be used for placement in the marine environment.

Fish migration and behaviour

17.8.48 Increased levels of suspended sediments are expected during capital dredging and installation/construction of the quay wall. As stated above, levels of certain chemicals are between the TEL and PEL levels which infers that they are in the possible effect range within which adverse effects occasionally occur. Although the contaminants are within this range, the dredging method and removal of the sediment from the system are expected to reduce any impacts. The release of such sediments with limited elevated concentrations of contaminants, over a short timescale, is unlikely to influence the health and/or behaviour of fish feeding or migrating near the proposed dredge footprint. The guidance levels show that there is limited chance of contamination.

17.8.49 Increased levels of suspended sediments lead to an increase in turbidity, which can have both positive and negative impacts on fish. Fish are likely to appear more hidden and have more visual protection from predators. However, at levels of suspended sediment concentrations higher than 14 g/L (approximately 2,800 Nephelometric Turbidity Units (NTU)), the suspended sediment can lead to negative impacts such as clogging of the gills, producing sub-lethal effects (Franco, *et al.,* 2006), (Environment Agency, 2014), (Marshall, 1998). Furthermore, a study conducted by Rowe *et al*. (2002) concluded that the feeding ability of adult smelt was not significantly reduced by turbidity levels of up to 160 NTU (approx. 750 mg/L).

17.8.50 The fish species found in The Haven are likely to be able to tolerate conditions of elevated suspended sediment concentrations and highly turbid conditions, as demonstrated by their presence and abundance in other highly turbid environments, such as the Humber estuary (Marshall, 1998). Suspended sediment concentrations measured during the baseline studies for the Boston Barrier project showed background concentrations of 134 – 1,790 mg/L, with the highest concentrations being recorded nearest the seabed. Predicted increases due to dredging are likely to be in the lower range and will only be temporary as dredging occurs. The plume will disperse along the channel and merge with background levels.

17.8.51 Any impacts on fish during construction will be temporary for the duration of the construction works of the wharf, which is estimated to be a maximum of 18 months. However, the turbidity inducing works will not last for the whole of this period.

17.8.52 Fish species found in The Haven are also susceptible to increased levels of contaminants that could occur during re-suspension of sediment during the capital dredging activities. Species such as smelt are often used as indicators for clean waters, therefore can be sensitive to pollution in the water.

17.8.53 The exposure for the migratory species found in The Haven will likely be limited to when they are present in The Haven. Migratory species such as the European eel migrate at night-time. No dredging works are anticipated to be undertaken at night-time; therefore, the exposure of such species will be minimised. The species most likely to be affected could be trout and smelt and given the relatively small increase in excess concentrations (100 mg/l next to the excavator) above background levels (134-1790 mg/l) it is unlikely that adult fish would be affected. However, juveniles of the above species may be affected given the narrow nature of The Haven and their increased sensitivity. Juvenile smelt would be migrating through The Haven between April and June and juvenile trout between March and

April.

17.8.54 Although the subtidal area in this location is relatively narrow, the dredging activity has been assessed as having a low likelihood of resulting in a significant effect on water quality in relation to background beyond the immediate vicinity of the dredging activity (as mentioned above and assessed in **Chapter 15 Marine Water and Sediment Quality** and **Chapter 16 Estuarine Processes**). The estimated suspended sediment concentrations are likely to be less than 100 mg/L close to the excavator and reducing to less than tens of mg/L within a few 100 m of the excavator).

17.8.55 Given the dredge programme and duration, in line with the assessments of the **Chapter 15 Marine Water and Sediment Quality** and **Chapter 16 Estuarine Processes**, the magnitude of increased suspended sediments within the water column is considered to be medium due to the narrow nature of The Haven. The sensitivity of the receptor is considered to be medium because of the regional importance of the receptor (as stated in the baseline description for fish) and the likely tolerance of high levels of turbidity. Therefore, it is concluded (on a worst-case basis) that the effect will be of **moderate adverse** significance on fish behaviour and migration.

17.8.56 The level of impact will be dependent on the dredging schedule in relation to migratory periods for fish. Mitigation should include avoidance of seasonal sensitivities and key migration periods wherever possible to potentially minimise this level of significance to one of minor or negligible significance. These mitigation measures are secured by condition 13(h) of the DML.

Benthic communities

17.8.57 The possible increased amount of suspended sediments in the water column, as discussed above, has the potential to deposit and smother the benthic communities, whilst also potentially releasing contaminants in the sediment. The disturbed sediment resulting from capital dredging is very likely to deposit within The Haven, and not be carried down to The Wash as discussed above. However, there is the potential for the very fine sediment to be flushed out to The Wash on an ebb tide.

17.8.58 Given the low release rate of sediment from the dredging, the low suspended sediment concentrations in the dredge plume (**Chapter 15 Marine Water and Sediment Quality** and **Chapter 16 Estuarine Processes**), and the likelihood of resuspension of any settled sediment as part of the natural sediment movement within The Haven, it is predicted that the deposited sediment layer within The Haven will be less than one millimetre (**Chapter 16 Estuarine Processes**), which

is considered to be within the range of natural deposition on the habitats in this area (mudflats and saltmarshes).

17.8.59 During the previous baseline surveys undertaken in The Haven, in very close proximity to the Application Site, and during the site visit undertaken specifically for this project, the benthic community identified was comprised of a variety of annelids, including oligochaetes and polychaetes. All of these species are characteristic of the estuarine environment and are either mobile and/or burrowing fauna, although some are filter feeders, which are more susceptible to increased levels of suspended solids and smothering, regardless of their mobility. However, benthic mud communities (especially oligochaete dominated) are resilient to smothering up to a deposit of 5cm because they are able to burrow and reposition within the new sediment (Whomersley, *et al.*, 2010). Furthermore, the benthic community near the Application Site is considered to have low sensitivity to smothering, which is supported by sensitivity data from The Marine Life Information Network (MarLIN) (https://www.marlin.ac.uk/) (where available) for the invertebrate species present within The Haven.

17.8.60 As the birds that utilise The Haven are likely to be relying on the benthic invertebrates in the area for feeding, there is also the potential for these bird species to be affected by the increased risk of sedimentation and contamination. However, the levels of contaminants are not expected to have a significant impact, particularly given the methods of dredging which reduce the likelihood of contaminant mobilisation. The impacts of the increased levels of contaminants and suspended sediment concentrations on benthic species are expected to be temporary, as this will be caused during the capital dredging, prior to the construction of the wharf. The affected footprint of benthic communities will also be very small in the context of The Haven, where birds would be expected to find alternative food sources not far away from the Principal Application Site.

17.8.61 Additionally, due to the potential for rapid dispersion of the fine sediment that is likely to be suspended from capital dredging activities, a negligible amount of smothering is expected to occur in any one localised area (**Chapter 16 Estuarine Processes**, **Section 16.7**). This can be classified as light siltation, defined as siltation of up to 5 cm (Tillin & Tyler-Walters, 2015). Thus, the magnitude of this effect on benthic communities, and any linked receptors is considered to be low.

17.8.62 In line with the significance determination matrix set out in **Chapter 6 Approach to EIA**, the significance of this effect is considered to be **minor adverse**.

Table 17-12 Summary of Impact Assessment

Impact: Increased levels of suspended sediments (Construction)	Magnitude	Sensitivity	Significance
Increased levels of suspended sediments impacting fish migration and behaviour	Medium	Medium	Moderate adverse
Smothering of benthic communities	Low	Low	Minor adverse

Mitigation

17.8.63 It is concluded that the residual effect for the most sensitive fish receptors (potentially juvenile smelt and trout) will be of **moderate adverse** significance if a worst-case scenario is considered, with activities that increase suspended sediments undertaken at times of high sensitivity. In order to mitigate this impact turbidity inducing works will be undertaken during least sensitive times which would involve avoidance of dredging between March and June. This mitigation measure is secured by condition 13(h) of the DML.

17.8.64 No mitigation is considered necessary for the potential smothering impact on benthic communities. Given the above mitigation the residual effect for benthic communities is therefore assessed as **minor adverse** significance.

Impact 3 - Disturbance due to construction activity through increased human presence, noise (excluding underwater noise, but including airborne noise) and vessel movements

17.8.65 The presence of humans and the increased levels of activity resulting from the construction works will inevitably generate airborne noise, with the potential to result in disturbance to birds. There is also potential for disturbance from increased number of vessel movement during construction. The number of vessels during construction is expected to be 89 vessels during the construction phase, with a maximum of five in any week.

17.8.66 The potential impact of underwater noise is considered separately below.

Birds

17.8.67 Human presence and increased levels of activity, alongside increased levels of airborne noise, can result in disturbance effects to marine and coastal bird species mentioned in **Section 17.6**, namely the dark-bellied Brent goose, shelduck, lapwing, dunlin, black-tailed godwit, redshank and turnstone, all of which are sensitive to airborne noise. All these species are also considered to be sensitive to visual disturbance (Woodward, *et al.*, 2015). Impacts on terrestrial species are

considered in **Chapter 12 Terrestrial Ecology**).

17.8.68 The bird species mentioned in the paragraph above (and also the species that are qualifying interest features of The Wash SPA and Ramsar site) are sensitive to such disturbance as they use the mudflats and saltmarsh in The Haven and The Wash as feeding and roosting areas (noting that birds supported by habitats within boundaries of The Wash are too distant to be affected by construction noise).

17.8.69 It should be noted that the BTO count sectors where core count data was obtained from, showed that the most ideal habitat for bird species (assessed from the density and diversity of bird species) that would be sensitive to construction works are located at the mouth of The Haven, in The Wash SPA and Ramsar site – far enough from the site to not be directly impacted by construction works. However, it is recognised from the data collated for the overwintering bird numbers that the site is used by relatively high numbers of particular species, namely redshank and ruff, amongst other species at lower relative numbers (compared with overall populations using The Wash).

17.8.70 Wright *et al.* (2010) investigated the effects on waterbirds from impulsive noise and identified a range of L_{Aeq} values which caused a behavioural response (based on a measured L_{Aeq}).

17.8.71 They concluded that below 50 dBA, no behavioural effect would be expected, but when noise levels increase, particularly approaching 70 dBA, there is a range of bird responses, with the potential for birds to experience significant effects.

17.8.72 Further information on noise levels affecting water birds is provided by Cutts *et al*. (2008). This provides a useful figure of water bird response to construction disturbance, reproduced below within **Plate 17-4**. Cutts *et al.* (2008) comment that:

> *"…. ambient construction noise levels should be restricted to below 70dBA, birds will habituate to regular noise below this level. Where possible sudden irregular noise above 50dBA should be avoided as this causes maximum disturbance to birds".*

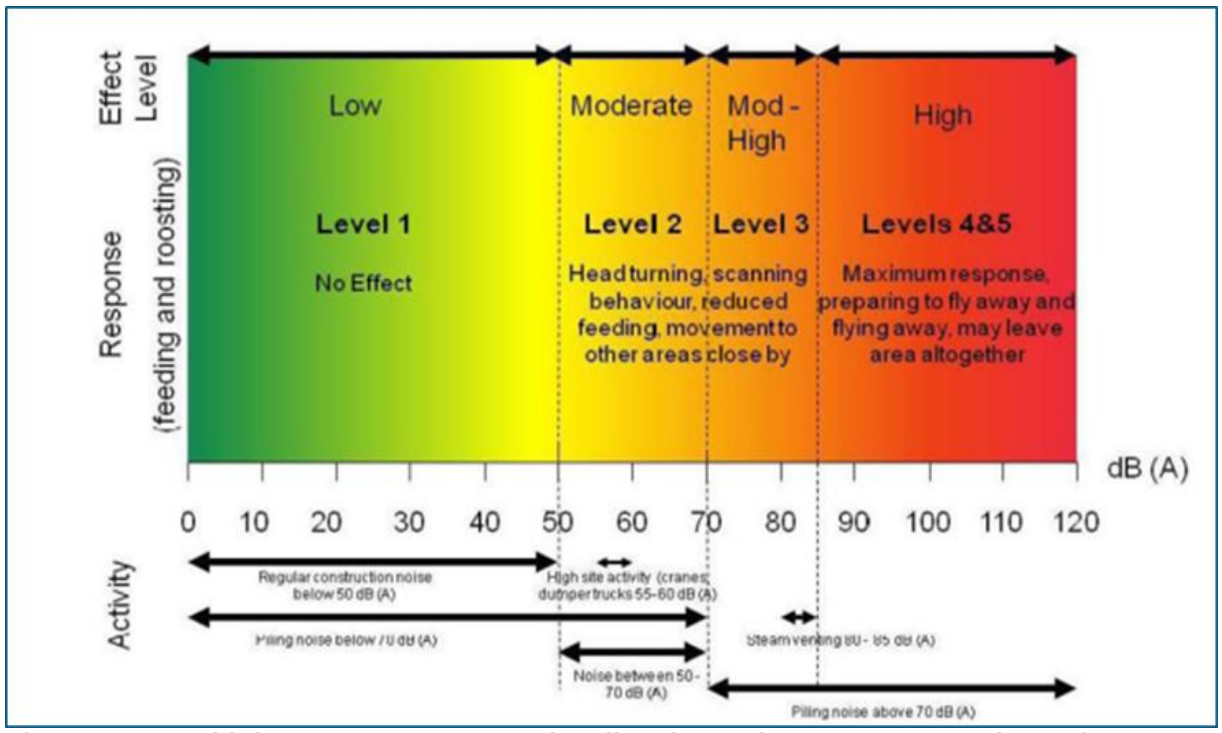

Plate 17-4 Waterbird response to construction disturbance (Source: Cutts *et al.*, 2008)

17.8.73 Based on these studies, a noise level of <50 dBA for general construction noise is considered to be a suitable threshold to indicate a level of effect where disturbance due to noise would not cause a behavioural response. Piling noise, which would be expected to generate noise in excess of 70 dBA, would be expected to result in disturbance to water birds.

17.8.74 The Boston Barrier ES concluded no significant effects to birds resulting from disturbance, including human presence and airborne noise, which is likely to cause displacement due to the low number of birds recorded in the Barrier location (Paragraph 5.6.5 in Environment Agency, 2014).

17.8.75 The Environment Agency undertook some Ground Investigation (GI) works within The Haven area and out to the Mouth of The Haven during February and March 2019. Due to the large numbers of birds present, there was an agreement with Natural England to monitor the works for signs of disturbance. The monitoring included provision to temporarily stop works if "trigger" levels of any of the target species came within 500 m of the works.

17.8.76 The monitoring involved recording numbers of birds present and any response to visual and noise stimuli caused by either the GI or other sources, including walkers, aircraft, birds of prey and noise from the nearby docks and industrial estate.

17.8.77 The results (Environment Agency, 2019) indicated that

> "*the impact of visual or noise disturbance to non-breeding waterbirds from the GI activities was not significant. At most locations there were relatively few birds within the 500 m radius that was being monitored, the exception being within and adjacent to the RSPB's Frampton Marsh nature reserve, though even here the birds appeared habituated to a level of visual and noise stimuli. The largest numbers of birds that were typically found within 500 m were Brent Geese as they regularly move between locations and exploit a variety of habitats, including agricultural farmland. There was localised disturbance and displacement of waders and wildfowl but the numbers involved were very small and tended to only occur at short range - up to 100 m but generally at less than 50 m. In most cases where birds took flight because of the GI they tended to land nearby and continue feeding or loafing. This was particularly noticeable along The Haven where, other than for a short period either side of high tide, there is a continuous linear strip of mudflat available on both sides of the channel. The most significant sources of disturbance were birds of prey and low-flying helicopters. The observations of the monitoring suggest that 250 m is a more reasonable distance to consider potential disturbance effects of GI activities on non-breeding waterbirds. There was no evidence of any visual or noise disturbance affecting birds over this distance*".

17.8.78 The data for the Boston Haven North area reported "A good range of wader species was noted along the mudflats although numbers never reached any of the trigger levels. The principal species that were always present were Black-tailed Godwit *Limosa limosa limosa*, Oystercatcher *Haematopus ostralegus*, Curlew *Numenius arquata*, Ruff *Calidris pugnax* and Redshank. Avocet *Recurvirostra avosetta*, Ringed Plover *Charadrius hiaticula* and Grey Plover *Pluvialis squatarola* were occasionally seen. The only other species observed using the mudflats were Canada Goose *Branta canadensis*, Mallard *Anas platyrhynchos* Shelduck *Tadorna tadorna*, Cormorant *Phalacrocorax carbo* and Little Egret *Egretta garzetta*. Brent Geese occasionally used the channel and mudflats but tended to be confined to the larger areas of saltmarsh either side of the Hobhole outfall. Birds using the mudflats were often as close as 30 m to the GI works but more typically would feed or loaf undisturbed at distances beyond 50 m. Birds at the upstream end were generally unconcerned with the noise coming from Boston docks and the surrounding residential areas and roads. The main forms of disturbance that caused flight response were people walking along the bank and the occasional boat. Given the large, linear extent of habitat available birds generally re-settled nearby rather than leaving the area. The Brent

Geese would be more approachable when resting or bathing in the channel but would flush readily when feeding on adjoining saltmarsh. The distance at which they flushed varied between 30 m and 150 m but was typically over 100 m. No Brent Geese were seen using any of the arable fields on the north side. The only waterbirds observed using nearby fields were a flock of 130 Golden Plover *Pluvialis apricaria* on one occasion. Small numbers of Mallard, Teal *Anas crecca* and Moorhen *Gallinulla chloropus* were recorded on the pools within the Local Nature Reserve with the ducks tending to flush when the Environmental Clerk of Works walked by on the bank crest."

17.8.79 The works for the wharf will be undertaken immediately adjacent to the area where birds feed and roost. Given that there will be piling works involved this is likely to give values of greater than the thresholds for disturbance as discussed above with typical values for piling to be around 110 dBA (taken from https://www.nonoise.org/resource/educat/ownpage/soundlev.htm). Although the piling works will be temporary, the works for the wharf could be up to 18 months in duration with intermittent noise and physical presence of workers during this time. With regard to vessel traffic at the construction site the vessels will only be able to access the area around high water which would not coincide with key feeding times. Although there may be some birds still feeding around high water and just before, the main feeding periods will not be affected by vessel movements.

17.8.80 There could be some disturbance due to vessel movements on roosting birds, particularly around the mouth of The Haven. During construction, the number of vessels is expected to be 89. The construction phase that involves deliveries by vessel is expected to be approximately 24 months. This would equate to approximately 4 vessels per month (with a predicted peak of 5 vessels per week). There were 420 large commercial cargo vessels visiting the Port of Boston in 2019 which averages out at 8 vessels per week. Furthermore, there are 26 registered fishing boats to Boston, which make daily visits to The Wash. The monitoring that was undertaken at the mouth of The Haven (Bentley, A. 2020) to observe disturbance due to the baseline conditions, found that overall, 24 bird species altered their behaviour due to existing levels of boat presence or vessel wash. Most occurred in small numbers, but black-tailed godwit, golden plover and lapwing occurred in significant numbers. The peak count of lapwing disturbed (c1,100) is equivalent to 7.53 % of the Wash population. c3,000 golden plover is equivalent to 21.2 % of the Wash population. Whilst black-tailed godwit (c2,000) equates to 23.8 % of the Wash population and is also over double the count required to identify a site holding internationally important numbers.

17.8.81 Changes in behaviour were observed to be altered depending on the type of river traffic. The vast majority of birds were disturbed due to river traffic presence. The larger counts of birds disturbed were mainly caused by the large cargo ships, although smaller ships did cause some disturbance. Boat wash caused minimal disturbance mostly to feeding waders. Wash caused by small boats varied; most fishing/private vessels caused very little wash on the mudflats, whereas the pilot boat caused a much higher wash similar to that of the large cargo ships due to the higher speed of travel.

17.8.82 At the river mouth all birds were able to find another roosting/feeding location, but during this process they would have exerted energy. The number of vessels during construction has the potential to increase the frequency of this impact occurring. However, it is important to note that all of the vessels arriving into/departing from The Haven will be travelling at the same time of day to take advantage of the high tide window. The high tide window during spring tides (maximum duration of high tide window) would be approximately 3.5 hours which includes for the journey time along The Haven, which takes approximately 60 minutes. During the observations at the mouth of The Haven the tidal window for the large vessels appeared to be approximately 60 minutes. As such, the birds are only likely to be disturbed and move on during this period. As the presence of the large vessels will only occur around high water and therefore would not cause disturbance to feeding birds using the exposed mudflats.

17.8.83 The impact of vessel-induced disturbance to birds in The Haven is more widely discussed and the significance assessed in the operational impacts (Section 17.8.168), as the impact at the operational stage will be a much longer duration and larger scale. However, based on the information presented within the operational impact section, the magnitude of effect for the construction phase (disturbance from vessels on a temporary basis) on the receptor is considered to be low because most of the birds fly off to alternative roost sites as a result of the baseline level of disturbance as caused by existing vessel movements. Because of this, there is a limited number of birds remaining to be disturbed by additional vessel movements, and those that do remain are considered to be of lower sensitivity to disturbance.

17.8.84 The saltmarsh and mudflat areas around the proposed development site are used by birds for feeding and roosting. Given the location of the construction works (including piling) so close to the bird feeding and roosting areas the impact magnitude is given as medium.

17.8.85 The sensitivity of birds to other construction noise varies depending on species. The most numerous bird species using the foreshore in this area is the redshank,

which is relatively tolerant to visual disturbance, but is highly sensitive to noise disturbance. The following summary is taken from the Waterbird Disturbance Mitigation Toolkit Informing Estuarine Planning & Construction Projects produced by IECS, University of Hull, 2013. "Redshank are very tolerant of moderate and even high-level visual disturbance stimuli. However, birds that are closer than 100 m of works should be considered when commencing works and efforts should be made to avoid high level disturbance at such time if possible, especially if it includes workers on the mudflat/fronting intertidal zone. Redshank are conversely particularly sensitive to noise stimuli, especially in conjunction with visual stimuli. As such a noise of up to 70dB is acceptable at the bird but with caution above 55 dB (60 dB in a highly disturbed area). As redshank will forage extremely close to plant (75 m to workers, this means that a source noise threshold of 100-105 dB should be applied, with caution above 87- 92 dB." It is also acknowledged that redshank is highly site specific and will therefore return to the same areas to feed each year. Redshank is therefore identified as one of the higher sensitive species so is used to determine the level of impact overall. Sensitivity is therefore considered to be medium.

17.8.86 The disturbance due to noise generated during construction works, including piling and vessel disturbance at the construction area and close to the Principal Application Site; and vessel disturbance throughout The Haven and at the mouth of the Haven is therefore predicted to have a **moderate adverse effect** on the birds in this area, principally due to the disturbance due to piling noise at the development site. The increase over baseline for the vessel disturbance is only expected to be of lower significance as the birds are either habituated to the vessel presence or disperse to alternative roosting locations due to the baseline levels of vessel presence. Additional vessels traversing through The Haven are not therefore expected to cause additional significant disturbance levels. Many of the birds affected will be from the populations that use the SPA and Ramsar site. However, no effect directly on The Wash SPA and Ramsar site are predicted.

17.8.87 The impacts of disturbance during construction will be temporary and it is predicted to take up to 18 months to complete the wharf construction. The disturbance will be mitigated by ensuring that the noisiest activities (such as the piling works) are undertaken during periods which are not so sensitive for birds feeding on the mudflats or roosting on the saltmarsh. This would include undertaking the piling works during May to September. This measure is secured by condition 14 of the DML In addition, given the success of the mitigation undertaken for the Ground Investigation works by the Environment Agency, for general construction works, monitoring and adherence to thresholds as recommended in the findings for this project is recommended. This would involve

monitoring of bird numbers and behaviour associated with any noisy activities and stopping works if a threshold value is exceeded for numbers of birds within a 250 m radius. The thresholds of bird numbers will be agreed with Natural England but is expected to be the same as for the works by the Environment Agency. These monitoring measures are detailed within the OLEMS and are secured by Requirement 5 of the draft DCO which requires a final LEMS to be approved that is substantially in accordance with the OLEMS.

17.8.88 Given the mitigation as recommended above it is predicted that the significance for disturbance during the construction phase would be reduced to **minor adverse**.

Marine mammals

17.8.89 Harbour seal is a designated feature of The Wash and North Norfolk SAC. Although the Application Site is not located within the SAC, the harbour seal is still protected outside the boundaries of the SAC, and the shipping channel and anchorage area is within the SAC (**Figure 17.1**, **sheet 2 of 2**).

17.8.90 It is likely that seals use The Haven just for occasional foraging and may haul-out along the banks. It is not expected to be a key route for seals, as it is expected that they would mostly remain in The Wash or in the lower estuarine areas. Additionally, the Application Site is unlikely to be used as a haul-out site for the seals.

17.8.91 In light of the above, no consideration is given to effect of airborne noise on marine mammals, however, the potential for disturbance impacts at haul-out sites is considered in **Table 17-23.**

Impact 4 - Underwater noise (piling and dredging)

Fish behaviour and migration

17.8.92 The fish species at greatest risk from the underwater noise generated by the construction activities are the migratory species (European eel, smelt, river lamprey, sea trout) and the species with highest sensitivity to noise (herring, sprat, cod and whiting).

17.8.93 Herring, sprat, cod and whiting all are considered to be Category 3 species as they have sensitivity to both pressure and particle motion (**Table 17-7**) (Popper, *et al.*, 2014). However, it should be noted that these species are mobile, which may reduce their risk for impact (Environment Agency, 2014).

17.8.94 Pile-driving and increased vessel movements are likely to be the most significant source of noise for fish, eggs and larvae in relation to the proposed Facility. The

values in **Table 17-13** broadly present the guideline sound exposure levels. Although the values in **Table 17-13** were obtained from studies carried out on Chinook salmon, Nile tilapia, hybrid striped sea bass and lake sturgeon, these fish are widely variable in their morphologies and body types, so it is considered that the guideline values in the table can broadly be applied to a wider range of fish species.

Table 17-13 Data on Mortality and Recoverable Injury Caused from Pile Driving, Based on 960 Sound Events at 1.2 Second Intervals. (Source: Mortality and Recoverable Injury Data - (Halvorsen, *et al.,* 2011; Halvorsen, *et al.*, 2012a; Halvorsen, *et al.*, 2012c), TTS data - (Popper, *et al.,* 2005)) (taken from Popper *et al.,* 2014).

Type of Fish	Mortality and potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Category 1 Fish - No swim Bladder	>219 dB SEL_{cum} or >213 dB peak	>216 dB SEL_{cum} or >213 dB peak	>> 186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Category 2 Fish - Swim bladder is not involved in hearing	210 dB SEL_{cum} or >207 dB peak	203 dB SEL_{cum} or >207 dB peak	>186 dB SEL_{cum}	(N) Moderate (I) Low (F) Low	(N) High (I) Moderate (F) Low
Category 3 Fish - swim bladder involved in hearing	207 dB SEL_{cum} or >207 dB peak	203 dB SEL_{cum} or >207 dB peak	186 dB SEL_{cum}	(N) High (I) High (F) Moderate	(N) High (I) High (F) Moderate
Eggs and larvae	>210 dB SEL_{cum} or >207 dB peak	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) Moderate (I) Low (F) Low

Notes: Peak and route-mean-square (rms) sound pressure levels dB re 1 µPa; SEL dB re 1µPa^2.s. All criteria are presented as sound pressure even for fish without swim bladders, since no data for particle motion exist. Relative risk (high, moderate, low) is given for animals at three distances from the source, defined in relative terms as near (N) (10s of metres from source), intermediate (I) (100s of metres from source) and far (F) (1000s metres from source).
TTS: temporary threshold shift – temporary reduction in hearing sensitivity.
Masking: Reduction in the detectability of a given sound (signal) as a result of the simultaneous occurrence of another sound (noise).

17.8.95 Increased levels of vessel movements are also likely to impact the hearing of fish within The Haven. Although there is no direct evidence of mortality or life-

threatening injuries to fish from ship noise, this is known to cause temporary damage to the hair cells and auditory tissue effects, some recovery of which was noted after 48 hours from the exposure to white noise at 170 dB re 1 µPa rms (Smith *et al*., 2006). Recovery of TTS in fishes from a continuous noise source was noted following the exposure to 158 dB re 1 µPa rms (Amoser and Ladich, 2003). **Table 17-14** provides an approximate guideline of values or relative risks to different categories of fish (as classed by Popper *et al*. (2014) according to their sensitivities to vibroacoustics).

Table 17-14 Guidelines for the Noise Impacts on Fish from Shipping and Other Continuous Sounds

Type of Animal	Mortality and potential mortal injury	Impairment			Behaviour
		Recoverable injury	TTS	Masking	
Category 1 Fish - No swim Bladder	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Category 2 Fish - Swim bladder is not involved in hearing	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Moderate (I) Low (F) Low	(N) High (I) High (F) Moderate	(N) Moderate (I) Moderate (F) Low
Category 3 Fish - swim bladder involved in hearing	(N) Low (I) Low (F) Low	170 dB rms for 48 hours	158 dB rms for 12 hours	(N) High (I) High (F) High	(N) High (I) Moderate (F) Low
Eggs and larvae	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) Low (I) Low (F) Low	(N) High (I) Moderate (F) Low	(N) Moderate (I) Moderate (F) Low

Notes: rms sound pressure levels dB re 1 µPa. All criteria are presented as sound pressure even for fish without swim bladders, since no data for particle motion exist. Relative risk (high, moderate, low) is given for animals at three distances from the source defined in relative terms as near (N) (10s of metres from source), intermediate (I) (100s of metres from source) and far (F) (1000s metres from source).

17.8.96 The specific noise levels that will be generated by the piling activity is currently unknown, although it is anticipated that there will be 300 piles. A literature search for available data regarding potential noise levels and impact ranges was carried out.

17.8.97 Parameters of the planned piling and dredging works are outlined below:

- Piling
  - 310 x 762 mm diameter steel tubular or bored concrete piles for the

construction of the wharf.
    - Expected to take approximately six months.
  - In addition, approximately 6,000 m of sheet piling to be installed to form the flood defence.
    - Expected to take approximately three months.

- Dredging
  - Will likely be undertaken from landside, or from a floating marine plant, and in the dry wherever possible (noting that some areas to be dredged will be fully underwater at all times, and therefore there will be some dredging activities underwater).
  - 225,000 m^3 of soft silt and clay to be dredged.
    - Expected to take approximately five months in total; two months prior to the wharf construction, and three months following the wharf construction.

17.8.98 A desk based assessment of other similar projects was undertaken, in order to estimate the potential impact ranges for fish species (and harbour seal as included in paragraphs below). The impact ranges (and areas) as shown in **Table 17-15** below will be used to inform the assessment on fish species.

Table 17-15 Impact ranges to fish species from underwater noise generating activities

Project (source)	Activity and parameters modelled	Species	Threshold	Impact range (and area)
Invergordon Service Base Phase 4 Development (Port of Cromarty Firth, 2018)	Impact piling • 2 m cylindrical piles • 500 kJ hammer energy • 60 strikes per minute • Piling period of 1 hour • Worst-case source noise levels of 217.7 dB re 1 µPa SPL_{peak} @ 1 m and 192.8 dB re 1 µPa2s SEL_{ss} @ 1 m	Fish - No swim bladder	Recoverable injury 213 dB re 1 µPa unweighted SPL_{peak} (Popper *et al.,* 2014)	<10 m
			Mortality and potential mortal injury 219 dB re 1 µPa unweighted SEL_{cum} (Popper *et al.,* 2014) Stationary receptor	<10 m
			Recoverable injury 216 dB re 1 μPa^2s unweighted SEL_{cum} (Popper *et al.,* 2014) Stationary receptor	10 m
		Fish - Swim bladder is not involved in hearing and	Recoverable injury 207 dB re 1 µPa unweighted SPL_{peak} (Popper *et al.,* 2014)	<10 m
			Mortality and potential mortal injury 210 dB re 1 µPa unweighted SEL_{cum} (Popper *et al.,* 2014) Stationary receptor	30 m

Project (source)	Activity and parameters modelled	Species	Threshold	Impact range (and area)
			Recoverable injury 203 dB re 1 μPa^2s unweighted SEL_{cum} (Popper *et al.*, 2014) Stationary receptor	100 m
		Fish - Swim bladder is involved in hearing	Recoverable injury 207 dB re 1 µPa unweighted SPL_{peak} (Popper *et al.*, 2014)	<10 m
			Mortality and potential mortal injury 207 dB re 1 µPa unweighted SEL_{cum} (Popper *et al.*, 2014) Stationary receptor	50 m
			Recoverable injury 203 dB re 1 μPa^2s unweighted SEL_{cum} (Popper *et al.*, 2014) Stationary receptor	100 m
	Impact piling • Sheet piles • 120kJ hammer energy • 60 strikes per minute • Piling period of 1 hour • Worst-case source noise levels of 207.5 dB re 1 µPa SPL_{peak} @ 1 m and 182.6 dB re 1 μPa^2s SEL_{ss} @ 1 m • Fleeing animal model	All fish species (using threshold for fish with swim bladder involved in hearing as the worst-case)	Injury and TTS 170 dB re 1 µPa (for 48 hours) unweighted SPL_{RMS} continuous sound (Popper *et al.*, 2014)	<10 m
			Injury and TTS 158 dB re 1 µPa (for 12 hours) unweighted SPL_{RMS} continuous sound (Popper *et al.*, 2014)	40 m
Victoria Harbour, Hartlepool (PD Teesport, 2018)	Dredging • Trailer Suction Hopper Dredging (TSHD) • 175.6 dB re 1 µPa SPL_{RMS} @1 m • 24 hours	All fish species	Recoverable injury 213 dB re 1 µPa unweighted SPL_{peak} (Popper *et al.*, 2014) Stationary receptor	-
			Mortality and potential mortal injury 219 dB re 1 µPa unweighted SEL_{cum} (Popper *et al.*, 2014) Stationary receptor	-

Project (source)	Activity and parameters modelled	Species	Threshold	Impact range (and area)
	Dredging • Backhoe dredger • 165.0 dB re 1 µPa SPL_{RMS} @1 m • Fleeing animal model	All fish species	Recoverable injury 213 dB re 1 µPa unweighted SPL_{peak} (Popper *et al.*, 2014) Stationary receptor	<10 m
			Mortality and potential mortal injury 219 dB re 1 µPa unweighted SEL_{cum} (Popper *et al.*, 2014) Stationary receptor	<10 m

17.8.99 Considering the narrow width of the channel, it is likely that the sensitive fish species in the area will have less of an area / buffer zone to avoid the zones where noise is generated. It should be noted for potential seasonal mitigation purposes, that the most recent fish survey carried out by the Environment Agency in 2017 for the Boston Barrier project recorded higher numbers of fish species with swim bladder involved in hearing during the autumn than in the spring, in the area just upstream of the Principal Application Site (**Table 17-16**) (Waugh, 2017).

Table 17-16 Guild Abundances of Noise-Sensitive Species Recorded During the Environment Agency's 2017 Survey (Waugh, 2017).

Species name	Spring 2017	Autumn 2017
Herring, *Clupea harengus*	3	220
Sprat, *Sprattus sprattus*	1	16
Whiting, *Merlangius merlanguis*	-	3

17.8.100 Fish species are mobile, and would be expected to vacate the area with the onset of piling, and therefore are of low sensitivity to impacts over the course of piling (impact ranges modelled over the course of piling; modelled on an hour in the results shown in **Table 17-15**). However, as outlined above, given the width of The Haven, there may be less potential for fish species to vacate the area, and are therefore given a sensitivity of medium in the following assessments. Fish species present in the area of the Application Site are therefore considered to have a medium sensitivity to underwater noise from both piling and dredging works, as a precautionary approach. The magnitude of impacts from piling and dredging activities are discussed below.

17.8.101 With regard to the underwater noise impacts from piling, the most sensitive fish species group (swim bladder is involved in hearing) would be at risk of serious injury or fatality if they were closer than 50 m to the source of the piling noise (**Table 17-15**). Any further than this, and the risk and severity of injury is lowered.

For less sensitive fish species (fish with no swim bladder, and swim bladder not involved in hearing), the potential impact area for mortality or potential mortal injury is lower, and less than 10 m and 30 m respectively. The section of The Haven near the Principal Application Site is approximately 40 m wide at low tide and approximately 100 m wide at high tide. Underwater noise would only be induced if piling was done at high tide, in which case, there would be room within The Haven for the noise-sensitive fish species to avoid the noisiest areas whilst travelling up/down The Haven. If piling is carried out at low tide when The Haven is at its narrowest, no underwater noise would be generated due to the piling being carried out in the dry (whilst the tide is out). Considering this, the very localised area of impact, and the short-term nature of the works, the potential for mortality or potential mortal injury is considered to be of low magnitude, resulting in a **minor adverse** impact (**Table 17-17**).

17.8.102 Recoverable injury is estimated to occur within 10 m of piling for the least sensitive fish species (no swim bladder), and 100 m for the other fish species groupings (fish species with swim bladder both involved and not involved in hearing). This is based on a piling period of one hour, and a stationary receptor. In reality, however, it is considered unlikely that a fish would remain within the vicinity of the piling works for that period of time. Considering the very localised area of impact, the short-term nature of the works, and the temporary impact, the potential for recoverable injury is of negligible magnitude, resulting in a **minor adverse** impact (**Table 17-17**).

17.8.103 With regard to underwater noise impacts from dredging activities, only backhoe dredging has the potential to impact on fish species (**Table 17-15**), with mortality and potential mortal injury, and recoverable injury, predicted to occur less than 10 m from the dredging activities. Considering the very localised area of impact, the short-term nature of the works, the potential for recoverable injury is of low magnitude, resulting in a **minor adverse** effect (**Table 17-17**).

Table 17-17 Summary of Impact Assessment

Impact: Underwater noise (Construction)	Magnitude	Sensitivity	Significance
Fish behaviour and migration	Negligible to Low	Medium	Minor adverse

17.8.104 Mitigation measures have been included for piling works, as a precautionary approach to ensure that the potential impact to fish species (and marine mammals as set out below) is reduced as far as is possible. This includes a soft-start and ramp-up procedure for any piling activities taking place at high tides. This would allow for any fish species to move away from piling activities prior to them reaching full hammer energies. Mitigation could also include seasonal windows for any

piling in the water to avoid the periods of maximum abundance of the sensitive species.

Marine mammals

17.8.105 The harbour seal is a designated feature of The Wash and North Norfolk Coast SAC. Although the Application Site is not located within the SAC, the harbour seal is still protected outside the boundaries of the SAC. As such, harbour seals have been considered in this assessment.

17.8.106 It is likely that harbour seals use The Haven just for occasional foraging rather than as a key habitat. It is not, therefore, expected to be a key route for harbour seals as they would mostly remain in The Wash or in the lower estuarine areas, although, as noted above, they have been sighted within The Haven, and as such an assessment will be made of underwater noise at the Principal Application Site location based on the lower seal densities within The Haven.

17.8.107 During construction works, harbour seals are likely to avoid noisy activities. Nonetheless, seals are very sensitive to underwater noises, in particular, piling noise. Piling noise and dredging have therefore been assessed below.

Impact significance levels for marine mammals

17.8.108 In addition to the methodology for the impact assessment outlined in **Chapter 6 Approach to EIA**, the magnitude of effect on marine mammals also took into account the criteria outlined in **Table 17-18** below. The thresholds used to define the level of magnitude for each impact have been defined by expert judgement, current scientific understanding of marine mammal population biology and JNCC *et al.* (2010) draft guidance on disturbance to Protected Species. For each effect, the assessment describes the magnitude in a qualitative or quantitative way.

Table 17-18 Example definitions of the magnitude levels for marine mammals

Magnitude	Definition
High	Permanent irreversible change to exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that more than 1 % of the reference population are anticipated to be exposed to the effect. OR Temporary effect (limited to phase of development or proposed scheme timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that more than 10 % of the reference population are anticipated to be exposed to the effect.

Magnitude	Definition
Medium	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that between 0.01% and 1% of the reference population anticipated to be exposed to effect. OR Temporary effect (limited to phase of development or proposed scheme timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that between 5 % and 10 % of the reference population anticipated to be exposed to effect.
Low	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that between 0.001% and 0.01% of the reference population anticipated to be exposed to effect. OR Intermittent and temporary effect (limited to phase of development or proposed scheme timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that between 1 % and 5 % of the reference population anticipated to be exposed to effect.
Negligible	Permanent irreversible change to exposed receptors or feature(s) of the habitat of particular importance to the receptor. Assessment indicates that less than 0.001 % of the reference population anticipated to be exposed to effect. OR Intermittent and temporary effect (limited to phase of development or proposed scheme timeframe) to the exposed receptors or feature(s) of the habitat which are of particular importance to the receptor. Assessment indicates that less than 1 % of the reference population anticipated to be exposed to effect.

Piling and dredging activities

17.8.109 Impact piling has long been established as a source of high level underwater noise (Würsig *et al.,* 2000; Caltrans, 2001; Nedwell *et al.,* 2003; 2007; Parvin *et al.,* 2006; Thomsen *et al.,* 2006). If a marine mammal is located very close to the piling sound source, the high peak pressure sound levels have the potential to cause death or physical injury, with a severe injury having the potential to lead to death, without mitigation. High exposure levels from underwater noise sources (such as impact piling) can cause permanent auditory injury or hearing impairment, through permanent loss of hearing sensitivity (Permanent Threshold Shift; PTS); and / or a temporary loss in hearing sensitivity (Temporary Threshold Shift; TTS) and / or fleeing response.

17.8.110 The potential for permanent or temporary auditory injury is not just related to the level of the underwater sound and its frequency relative to the hearing bandwidth of the animal but is also influenced by the duration of exposure. The level of impact on an individual is related to the Sound Exposure Level (SEL) that an individual receives.

17.8.111 For harbour seal, a fleeing response is assumed to occur at the same noise levels as TTS. As outlined in Southall *et al.* (2007) the onset of behavioural disturbance is proposed to occur at the lowest level of noise exposure that has a measurable transient effect on hearing (i.e. TTS onset). Although, as Southall *et al.* (2007) recognise that this is not a behavioural effect per se, exposures to lower noise levels from a single pulse are not expected to cause disturbance. However, any compromise, even temporarily, to hearing functions could have the potential to affect behaviour. Therefore, any fleeing response from harbour seals would the same as for TTS onset and would be within the assessment for temporary auditory impacts (TTS) as outlined below.

17.8.112 All marine mammals, including harbour seal, are considered to have high sensitivity to any permanent auditory injury (PTS). The effect would be permanent and harbour seals within the potential impact area are considered to have very limited capacity to avoid such effects and unable to recover from the effects. Pinnipeds (such as harbour seal) use sound both in air and water for social and reproductive interactions (Southall *et al.,* 2007), but not for finding prey. Therefore, Thompson *et al.,* (2012) suggest damage to hearing in pinnipeds may not be as sensitive as it could be in other species of marine mammals; therefore, using the precautionary approach, harbour seal are given a sensitivity of medium to the potential risk of any temporary auditory injury (TTS).

17.8.113 PTS and TTS can occur instantaneously from acute exposure to high noise levels, such as single strike (SEL_{ss}) of the maximum hammer energy during piling. PTS and TTS can also occur as a result of prolonged exposure to increased noise levels, such as during the duration of pile installation (SEL_{cum}). **Table 17-19** outlines predicted impact ranges (and areas) for harbour seal. The following assessments are based on these impact ranges, and the impact magnitude levels as shown in **Table 17-18**.

Table 17-19 Impact ranges for harbour seal from underwater noise generating activities

Project (source)	Activity and parameters modelled	Species	Threshold	Impact range (and area)
Port of Cromarty Firth	Impact piling • 2 m cylindrical piles • 500 kJ hammer energy • 60 strikes per minute • Piling period of 1 hour	Harbour seal	PTS 218 dB re 1 µPa SPL_{peak} unweighted (NMFS, 2018)	-
			TTS 212 dB re 1 µPa SPL_{peak} unweighted (NMFS, 2018)	<10 m

Project (source)	Activity and parameters modelled	Species	Threshold	Impact range (and area)
	• Worst-case source noise levels of 217.7 dB re 1 µPa SPL_{peak} @ 1 m and 192.8 dB re 1 µPa2s SEL_{ss} @ 1 m		PTS 185 dB re 1 μPa^2s SEL_{cum} weighted (NMFS, 2018) Fleeing animal model	90 m (<0.01 km^2)
			TTS 170 dB re 1 μPa^2s SEL_{cum} weighted (NMFS, 2018) Fleeing animal model	690 m (0.46 km^2)
	Impact piling • Sheet piles • 120 kJ hammer energy • 60 strikes per minute • Piling period of 1 hour • Worst-case source noise levels of 207.5 dB re 1 µPa SPL_{peak} @ 1 m and 182.6 dB re 1 μPa^2s SEL_{ss} @ 1 m • Fleeing animal model	Harbour seal	PTS 218 dB re 1 µPa SPL_{peak} unweighted (NMFS, 2018)	-
			TTS 212 dB re 1 µPa SPL_{peak} unweighted (NMFS, 2018)	-
			PTS 185 dB re 1 μPa^2s SEL_{cum} weighted (NMFS, 2018) Fleeing animal model	10 m (<0.01 km^2)
			TTS 170 dB re 1 μPa^2s SEL_{cum} weighted (NMFS, 2018) Fleeing animal model	280 m (<0.01 km^2)
Victoria Harbour, Hartlepool	Dredging • Trailer Suction Hopper Dredging (TSHD) • 175.6 dB re 1 µPa SPL_{RMS} @ 1 m • 24 hours	Harbour seal	PTS 201 dB re 1 μPa^2s SEL_{cum} weighted non-impulsive (NMFS, 2018) Fleeing animal model	<10 m
			TTS 181 dB re 1 μPa^2s SEL_{cum} weighted non-	<10 m

Project (source)	Activity and parameters modelled	Species	Threshold	Impact range (and area)
			impulsive (NMFS, 2018) Fleeing animal model	
	Dredging • Backhoe dredger • 165.0 dB re 1 µPa SPL_{RMS} @ 1 m • Fleeing animal model	Harbour seal	PTS 201 dB re 1 μPa^2s SEL_{cum} weighted non-impulsive (NMFS, 2018) Fleeing animal model	<10 m
			TTS 181 dB re 1 μPa^2s SEL_{cum} weighted non-impulsive (NMFS, 2018) Fleeing animal model	<10 m

17.8.114 As shown in **Table 17-19**, there is no potential for permanent auditory injury (PTS) as a result of a piling (single strike) activity. There is therefore no requirement for mitigation to ensure no risk of any permanent auditory injury (PTS) to harbour seal.

17.8.115 The number of harbour seal that could therefore be anticipated to be exposed to the potential for PTS or TTS is presented in **Table 17-20**.

Table 17-20 Maximum number of harbour seal (and % of reference population) that could be at risk of permanent and temporary auditory injury (PTS and TTS) from a single piling strike or cumulative exposure

Potential impact	Criteria and threshold	Impact range (and area)	Maximum number of individuals (% of reference population)	Magnitude
PTS from single strike piling	218 dB re 1 µPa SPL_{peak} unweighted (NMFS, 2018)	0 m (0 km^2)	0	No potential for impact.
PTS from cumulative piling	185 dB re 1 µPa2s SEL_{cum} weighted (NMFS, 2018)	90 m (<0.01 km^2)	0.008 (based on the harbour seal density of 0.80/km^2 at the Application Site).	Permanent effect with negligible magnitude (less than 0.001 % of the reference population

Potential impact	Criteria and threshold	Impact range (and area)	Maximum number of individuals (% of reference population)	Magnitude
			0.0002 % (of the SE England MU population). 0.0002 % (of the most recent count of adult seals in The Wash).	anticipated to be exposed to effect).
TTS from single strike piling	212 dB re 1 µPa SPL_{peak} unweighted	<10 m (0.0003 km^2)*	0.0002 (based on the harbour seal density of 0.80/km^2 at the Application Site). 0.000005 % (of the SE England MU population). 0.000005 % (of the most recent count of adult seals in The Wash).	Temporary effect with negligible magnitude (less than 1 % of the reference population anticipated to be exposed to effect).
TTS from cumulative piling	170 dB re 1 µPa2s SEL_{cum} weighted (NMFS, 2018)	690 m (0.46 km^2)	0.37 (based on the harbour seal density of 0.80/km^2 at the Application Site). 0.007 % (of the SE England MU population). 0.01 % (of the most recent count of adult seals in The Wash).	Temporary effect with negligible magnitude (less than 1 % of the reference population anticipated to be exposed to effect).
PTS from dredging activities (cumulative)	201 dB re 1 µPa2s SEL_{cum} weighted non-impulsive (NMFS, 2018)	<10 m (0.0003 km^2)*	0.0002 (based on the harbour seal density of 0.80/km^2 at the Application Site). 0.000005 % (of the SE England MU population).	Permanent effect with negligible magnitude (less than 0.001 % of the reference population anticipated to be exposed to effect).

Potential impact	Criteria and threshold	Impact range (and area)	Maximum number of individuals (% of reference population)	Magnitude
			0.000005 % (of the most recent count of adult seals in The Wash).	
TTS from dredging activities (cumulative)	181 dB re 1 µPa2s SEL_{cum} weighted non-impulsive (NMFS, 2018)	<10 m (0.0003 km^2)*	0.0002 (based on the harbour seal density of 0.80/km^2 at the Application Site). 0.000005 % (of the SE England MU population). 0.000005 % (of the most recent count of adult seals in The Wash).	Temporary effect with negligible magnitude (less than 1 % of the reference population anticipated to be exposed to effect).

** based on the area of a circle*

17.8.116 Taking into account the receptor sensitivity (of high for PTS and medium for TTS) and the potential magnitude of the effect (of negligible in all cases), the impact significance for permanent auditory injury (PTS) and temporary auditory injury (TTS) in harbour seal is of **minor adverse effect** (**Table 17-21**).

Table 17-21 Summary of Impact Assessment

Impact: Underwater noise (Construction)	Magnitude	Sensitivity	Significance
Risk of any permanent auditory injury (PTS) in harbour seal during piling or dredging	Negligible	High	Minor adverse
Potential for temporary auditory injury (TTS) or fleeing response in harbour seal during piling or dredging	Negligible	Medium	Minor adverse

Mitigation

17.8.117 As a precautionary approach, mitigation will be undertaken for piling works during high tides, to ensure that any potential for impact to marine mammals (and fish species) are reduced as far as is possible. This mitigation would include:

- Pre-piling watch for marine mammals, when piling activities are undertaken during high tides, following the JNCC protocol for minimising the risk of injury to marine mammals from piling noise[1].
- Soft-start and ramp-up procedures, for piling activities undertaken during high tides, following the standard JNCC protocol for minimising the risk of injury to marine mammals from piling noise[1].

17.8.118 These measures will form part of the piling method statement secured by condition 14 of the DML.

Impacts from an increase in vessels

Potential for effects on harbour seal due to vessel disturbance (presence and noise)

17.8.119 As stated in **Section 17.8** of **Chapter 17 Marine and Coastal Ecology**, there will be an increase in the number of vessels through the construction phase of the Facility. However, it is unlikely that vessel noise would be sufficient to cause the onset of either a permanent auditory injury (PTS) or a temporary auditory injury (TTS) in harbour seal.

17.8.120 Thomsen *et al.* (2006) reviewed the effects of ship noise on seal species. As seals use lower frequency sound for communicating (with acute hearing capabilities at 2 kHz) there is the potential for detection, avoidance and masking effects in seals. Thomsen *et al.* (2006) consider that ship noise around 2 kHz could be heard above ambient noise (but not necessarily avoided) at a distance of approximately 3 km for harbour seal, and the zone of audibility will be approximately 20 km for vessels with a much lower frequency noise of 0.25 kHz (ambient noise = 94 and 91 dB rms re 1µPa at 0.25 and 2 kHz, respectively). The zone of responsiveness of harbour seal is considered to be at a maximum of 400 m from the vessel, although the frequency of the sound source, and the speed at which the vessel is travelling would affect the distance at which harbour seal may react (Thomsen *et al*., 2006). The Southall *et al*. (2007) TTS / fleeing response for seal species underwater is 171 dB re 1µPa. The noise levels for vessels estimated by Thomsen *et al*. (2006) are lower than this threshold for seals. Therefore, suggesting that vessel noise would not adversely affect harbour seals.

17.8.121 A study of the noise source levels from several different vessels (Jones *et al*., 2017) shows that for a cargo vessel of 126 m in length (on average), travelling at a speed of 11 knots (on average) would generate a mean sound level of 160 dB re 1 µPa @ 1 m (with a maximum sound level recorded of 187 dB re 1 µPa @

[1] *http://data.jncc.gov.uk/data/31662b6a-19ed-4918-9fab-8fbcff752046/JNCC-CNCB-Piling-protocol-August2010-Web.pdf*

1 m). For harbour seal, the sound level required to result in a permanent auditory injury (PTS) or temporary auditory injury (TTS) under the NMFS (2018) threshold guidance for marine mammals, would be 218 dB re 1 µPa and 212 dB re 1 µPa, respectively, if an individual were to be exposed to vessel noise for a period of 24 hours.

17.8.122 Taking in to account that a harbour seal would need to be exposed to vessel noise, at the maximum sound level recorded, for a period of 24 hours to be exposed to sound levels that could cause a auditory injury, it is considered unlikely that vessels could cause auditory injury in harbour seal. The sound levels that could result in a permanent or temporary auditory injury in harbour seal are higher than the maximum recorded sound levels for large cargo vessels, therefore, the only potential effect of underwater noise from vessels would be disturbance.

17.8.123 The vessels travelling to and from the Facility will be slow moving (travelling at a speed of 6 knots or less), or would be stationary within the anchorage location, and most noise emitted is likely to be of a low frequency. Furthermore, shore to ship power will be provided at the wharf to ensure the ships are not required to 'idle' with engines running whilst docked at high tide. However, the levels could be sufficient to cause local disturbance to sensitive marine mammals in the immediate vicinity of the vessel, depending on ambient noise levels.

17.8.124 Marine mammals present within or near the Facility shipping channel would be habituated to the presence of vessels given the existing levels of marine traffic in the area. The current marine traffic data indicates that there are approximately 11,000 vessels using the proposed shipping channel annually (22,000 movements), or 30 vessels per day, as shown by the Marine Traffic data (www.marinetraffic.com, 2017) (**Plate A17-1, Appendix 17.1**). The increase of a maximum of 89 vessels, or 178 movements, per year in the construction period is a small increase compared to the number already present within The Wash (equating to an additional 0.8 % of vessel movements within The Wash).

17.8.125 Similar levels of shipping traffic were also recorded by the MMO in 2015, which shows that there were 11,917 vessels entering the shipping channel and anchorage area in 2015, or 33 vessels per day (as shown by the Vessel Density Grid Data 2015 from the MMO (MMO, 2017)). The increase of 89 vessels, or 178 vessel movements, in the construction period is a small increase compared to the number already present within the shipping channel and anchorage area (equating to an additional 0.8 % of existing vessels). The number of ships travelling to the Port of Boston, using the same shipping channel as for the Facility was 420 in 2019 (or 8 per week), as described in **Section 18 Navigational Issues**.

17.8.126 As a worst-case scenario, the number of harbour seals that could be disturbed by underwater noise from vessels has been assessed based on the total proposed scheme area, including the shipping corridor from The Wash to the project location, and the vessel anchorage area; a total area of 10.46 km^2 (shown as the shipping channel on **Figure 17.6**). This is very precautionary, because it is highly unlikely that underwater noise from vessels could result in disturbance to the entire area at any one time. Any disturbance is likely to be limited to the immediate vicinity around the actual vessel (for example, less than 10 m) at any one time.

17.8.127 Best practice measures will be put in place in order to minimise the disturbance that is caused to marine mammals from the vessel traffic. This will mainly be in the form of an observer on board each vessel, looking out for marine mammals as the vessel makes its way through The Wash and up The Haven. This is will form part of the NMP secured by Requirement 14 of the draft DCO.

17.8.128 Any disturbance of harbour seals due to vessel noise would be temporary and could affect up to 33.4 harbour seals (or 0.7 % of SE England MU population; or 0.9 % of the most recent count of adult seals in The Wash (Thompson, 2019)) based on the harbour seal density within the shipping corridor and anchorage area of 3.189 harbour seals per km^2 (Russel *et al*., 2017). This equates to a negligible magnitude of impact. Taking into account the low sensitivity of harbour seal from disturbance from the presence and movements of vessels the overall effect significance is **negligible**.

17.8.129 **Table 17-22** below summarises the impact of increased underwater noise form vessel presence during the construction phase.

Table 17-22 Summary of Impact Assessment

Impact: Increased underwater noise from increased vessel traffic and movement (Construction)	Magnitude	Sensitivity	Significance
Disturbance from vessels – harbour seal	Negligible	Low	Negligible

Potential disturbance at harbour seal haul-out sites

17.8.130 Harbour seal may become disturbed from haul-out sites due to the presence of vessels, which, if occurring in the breeding season, can result in the abandonment of pups. Due to this, harbour seals are considered to be highly sensitive to vessel disturbance at haul-out sites, particularly if that occurs within the breeding season.

17.8.131 Studies on the distance of disturbance, on land or in the water, for hauled-out harbour seals have found that the closer the disturbance, the more likely seals are to move into the water. The estimated distance at which most seal movements into the water occurred varies from study site and type of disturbance but has been estimated at typically less than 100 m (Wilson, 2014). Grey and harbour seals have also been reported to move into the water when vessels are at a distance of approximately 200 m to 300 m (Wilson, 2014).

17.8.132 A study was carried out by SMRU (Paterson *et al.,* 2015) using a series of controlled disturbance tests at harbour seal haul-out sites, consisted of regular (every three days) disturbance through direct approaches by vessel and effectively 'chasing' the seals into the water. The seal behaviour was recorded via GPS tags, and found that even intense levels of disturbance did not cause seals to abandon their haul-out sites more than would be considered normal (for example seals travelling between sites) and the seals were found to haul-out at nearby sites or to undertake a foraging trip in response to the disturbance (but would later return).

17.8.133 Further studies on the effects of vessel disturbance on harbour seals when they are hauled out, suggest that even with repeated disturbance events that are severe enough to cause individuals to flee into the water, the likelihood of harbour seals moving to a different haul-out site would not increase. Furthermore, this appeared to have little effect on their movements and foraging behaviour (Paterson *et al*., 2019).

17.8.134 A study of the reactions of harbour seal from cruise ships found that, if a cruise ship was less than 100 m from a harbour seal haul-out site, individuals were 25 times more likely to flee into the water than if the cruise ship was at a distance of 500 m from the haul-out site (Jansen *et al.,* 2010). At distances of less than 100 m, 89 % of individuals would flee into the water, at 300 m this would fall to 44 % of individuals, and at 500 m, only 6 % of individuals would flee into the water (Jansen *et al.,* 2010). Beyond 600 m, there was no discernible effect on the behaviour of harbour seal. As a precautionary approach, any harbour seal haul-out sites within 500 m of the shipping channel and anchorage location will be considered to have the potential to disturb harbour seal while they are hauled out.

17.8.135 Within The Wash, there are a number of different harbour seal haul-out and pupping sites (a total of 50 sites within The Wash; **Figure 17.6** (SCOS, 2018)). Of these sites, none are located within 500 m of the anchorage location and shipping channel to be used for the proposed Boston project, with the closest site being the Friskney South site, at approximately 840 m from the shipping channel (**Figure 17.6**).

17.8.136 The 2018 count of harbour seals of the three closest sites to the shipping channel and anchorage location (**Figure 17.6**) recorded a total of 38 adults and 16 pups at Friskney South, seven adults and no pups at the Rodger site, and one adult and one pup at the Ants site. This equates to a very small proportion (up to 1.2 % of all adults, and 1.1 % of all pups) of the total harbour seal count, of 3,747 adults and 1,498 pups in 2018 (Thompson, 2019).

17.8.137 In the vicinity of the three sites located closest to the shipping channel and anchorage location there are a further 47 haul-out locations to which seals could move if disturbed, without having to move too far. The increased shipping levels would be present year-round, therefore, any potential pupping sites along the route could be exposed to disturbance, meaning that any harbour seal looking for a pupping site could be exposed to the potential for increased disturbance prior to the birth of any pups each season, allowing individuals to choose a nearby site with no increased shipping levels (as a result of the Facility), if required. Harbour seal pups are born having pre-shed their white coat in utero and are able to swim almost immediately (SCOS, 2018); they would therefore not be confined to the site at which they were born if they were exposed to any disturbance effects due to the increased vessel movements.

17.8.138 The harbour seal haul-out sites within The Wash are submerged at high tide due to being situated on tidally submerged mudflats. The tidal nature of The Haven means that ships will only be able to travel up the shipping channel at or near high tide, commencing from the anchor point a maximum of two hours before high tide, and ending a maximum of 1.5 hours after high tide. As a result, the harbour seal haul-out sites would be submerged and inaccessible to seals when vessels would be able to travel along the shipping channel. There would therefore be no potential for harbour seal at haul-out sites to be disturbed when the vessels are using the shipping channel. The closest haul-out site is 2.2 km from the anchorage site, therefore there is no potential disturbance at harbour seal haul-out sites from vessels located in the anchorage area.

17.8.139 Due to the distance of these sites to the shipping channel and anchorage location, the low number of harbour seal (and pups) present at the nearest sites, and the ability of harbour seals and pups to move to any one of the other suitable sites nearby, the magnitude of impact would be negligible. With a high sensitivity, the overall effect significance of disturbance of harbour seals at haul-out sites due to vessels is **minor adverse**.

17.8.140 **Table** 17-24 below summarises the impacts of disturbance to harbour seal haul-out sites as a result of increased vessel presence in the construction phase.

Table 17-23 Summary of Impact Assessment

Impact: Increased disturbance at seal haul-out sites (Construction)	Magnitude	Sensitivity	Significance
Disturbance at harbour seal haul-out sites	Negligible	High	Minor adverse

Potential for effects on harbour seal as a result of increased collision risk

17.8.141 As outlined above, during the construction phase of the Facility, it is expected that there will be an increase in vessel traffic, with an additional maximum of 89 vessels, or 178 movements, per year, over the current vessel numbers currently using the shipping channel. As indicated above, this is a small increase of vessel numbers through the existing shipping channel, with a 0.8 % increase over annual vessel numbers within this channel during the construction.

17.8.142 As outlined above, the existing levels of shipping traffic around the facility shipping corridor is high and harbour seals are therefore habituated to the presence of vessels and would be able to detect and avoid vessels. Although marine mammals are able to detect and avoid vessels, vessel strikes are known to occur, possibly due to distraction whilst foraging and socially interacting, or due to the marine mammals' inquisitive nature (Wilson *et al.,* 2007). Therefore, increased vessel movements can pose an increased risk of vessel collision to harbour seals, although are considered to have a low sensitivity to the increased risk of collision.

17.8.143 Studies have shown that larger vessels are more likely to cause the most severe or lethal injuries, with vessels over 80 m in length causing the most damage to marine mammals (Laist *et al.,* 2001). The vessels for the proposed Facility are expected to be 100 m in length. Vessels travelling at high speeds are considered to be more likely to collide with marine mammals, and those travelling at speeds below 10 knots would rarely cause any serious injury (Laist *et al.,* 2001). The vessels moving to and from the Facility would be restricted to a speed of 4 knots within The Haven, and 6 knots through the shipping channel and anchorage area within The Wash, and therefore reducing the risk to cause any serious injury.

17.8.144 Although the risk of collision related to the operation of the Facility is likely to be low given the low speed of the vessels and restricted area in The Wash, as a precautionary scenario, the number of harbour seals that could be at increased collision risk with vessels during the operation of the Facility has been assessed based on a very worst-case of 5 % of the number of individuals that could be present in the shipping channel and anchorage location.

17.8.145 In total, the area that has been defined as having the potential for an increase in collision risk for harbour seal is 10.46 km^2, with an estimated density of 3.189 harbour seals per km^2 within this area (as calculated from the Russel *et al*., 2017 data).

17.8.146 A total of 1.7 harbour seals (0.03 % of the SE England MU; or 0.5 % of the most recent count of adult seals in The Wash (Thompson, 2019)) could be at increased risk of collision. The magnitude of impact is therefore medium, with the impact being permanent. This results in an effect significance of **minor adverse**.

17.8.147 **Table 17-24** below summarises the impacts of increased risk of collision, from the increased vessel presence in the construction phase.

Table 17-24 Summary of Impact Assessment

Impact: Increased risk of collision (Construction)	Magnitude	Sensitivity	Significance
Increased risk of collisions for marine mammals (impact zone includes the Wash as a transit area)	Medium	Low	Minor adverse

Impact 5 - Increased emissions to air and deposition on marine and estuarine habitats

17.8.148 The following designated sites (with a marine and coastal interest) are located within the distance criteria specified in Defra Environment Agency guidance as requiring consideration for potential impacts of air emissions (Defra and Environment Agency, 2016):

- The Wash and North Norfolk Coast SAC.
- The Wash SPA.
- The Wash Ramsar site.
- Havenside LNR.

17.8.149 The potential for nitrogen oxides (NO_x), sulphur dioxide (SO_2), nitrogen, acid and ammonia deposition on these sites during the construction of the Facility was assessed as a result of air quality dispersion modelling, carried out in **Chapter 14 Air Quality.** This did not identify any significant levels of deposition on these sites; therefore, this will have **no significant effect**.

Potential Impacts during Operation

Impact 1 - Habitat alteration due to hydrodynamic changes

17.8.150 During the operational phase, there is a potential for indirect impact on

estuarine habitats within The Haven due to the following potential effects on the hydrodynamic and sedimentary regime:

- Changes to the tidal current regime and erosion/accretion patterns due to the presence of the wharf and berthing areas.
- Changes to the wave regime (ship wash) due to the increase in vessel traffic.
- Changes in suspended sediment concentrations due to maintenance dredging of the berthing areas.
- Changes in estuary-bed level due to maintenance dredging of the berthing areas.

17.8.151 The above potential effects are assessed in **Chapter 16 Estuarine Processes**, which concludes that all effects will be of negligible magnitude.

17.8.152 However, an additional impact could occur from a marine and coastal ecological perspective, the vessels that will be berthed at the wharf during the operation of the Facility are likely to be grounded on the mudflats during low tide until the next high tide floods the berthing pocket to allow the vessel to leave the Facility. This is likely to cause permanent habitat disturbance and continual fluxes of possibly contaminated sediment as the vessel is lifted on and off the mudflats with the flooding and ebbing tides because the vessels are likely berthed in the same locations each time. However, to prevent this, a campshed will be placed on top of the sediment, which will routinely be topped up. This campshed will be gravel or chalk, which could act as a new area of colonisation for opportunistic species such as brown algae (fucoids), bryozoans and potentially ascidians. As the area where the campshed will be placed will constitute ‘new habitat’ and will not be mudflat, it is not expected for this area to support any recolonization by species that prefer mudflat.

17.8.153 The grounding of one vessel at the same location at the wharf will occur at a maximum of five times per week. Although there are no ground vessels currently at the Application Site, the Port of Boston does have some NAABSA (not always afloat but safely aground) berths further upstream in the River Witham. However, the grounding of vessels during the operation of the Facility will result in less intertidal areas being available at certain states of the tide and result in a loss of feeding area for birds. As such, this impact is considered to be of medium magnitude.

17.8.154 The mudflat habitat will be replaced with a hard substrate habitat, which will likely support new kinds of species colonisation. This area will be approximately equivalent to 3 vessels of approximately 100 m length each. The area is very

localised and small in relation to the total of the similar habitat available in The Haven, the sensitivity for the benthic mudflat populations that will be lost in this section of The Haven is therefore considered to be low. This results in a **minor adverse** effect significance.

Table 17-25 Summary of Impact Assessment

Impact: Habitat alteration due to hydrodynamic changes (Operation)	Magnitude	Sensitivity	Significance
Habitat alteration	Medium	Low	Minor adverse

Impact 2 - Increased vessel traffic and movement

17.8.155 The number of large vessels that will be arriving and leaving The Haven will increase from 420/year (visiting the Port of Boston in 2019) to approximately 1000/year navigating along The Haven, due to the 580 vessels required per annum during operation of the Facility. This equates to approximately 1.6 extra vessels per day which is a significant increase for The Haven area. No seasonal changes in the number of operation-related vessels are anticipated throughout the year. Each vessel will be 90-100 m long and will be travelling at a maximum speed of 4 knots. This increased vessel traffic has the potential to result in increased risk of invasive species with ballast water or hull fouling, increased ship wash, disturbance to birds and marine mammals, underwater noise and increased risk of collisions for marine mammals.

17.8.156 To put this in context of the wider area of The Wash, there are approximately 77,441 vessels entering the whole of The Wash annually, or 212 movements per day, as shown by the Vessel Density Grid Data 2015 from the MMO (MMO, 2017). Additionally, the proposed shipping channel to be used by the operational Facility is currently being used by approximately 11,000 vessels annually (approx. 30 vessels per day) (www.marinetraffic.com, 2017). The increase of 580 large vessels per year through the operational period of the Facility is a small increase compared to the number already present when taken in context with vessel movements within The Wash and the shipping channel (equating to an additional 0.8 % and 5.27 % vessels, respectively).

Increased risk of invasive species with ballast water or hull fouling

17.8.157 There is anticipated to be a negligible risk of invasive species being introduced to The Haven with the daily delivery vessels visiting the Facility. Any vessels that do take on or discharge ballast should be covered by the IMO Ballast Water Management Convention and as such would have to ensure that the risk of introducing non-native invasive species is very low or they reach specified

treatment requirements to reduce risks of introductions. In any case, vessels delivering RDF to the Facility will arrive fully-laden and depart empty. Advice from the proposed shipping and logistics handler for the proposed wharf has indicated that the ships used to deliver material to the Facility will not require to take on ballast water when leaving empty. Vessels delivering clay to the Facility as binder in the aggregates process, will arrive full, the hold will be emptied of the clay and washed out (with the wash water retained on-site in sealed sumps prior to being used in the aggregate manufacture process. These vessels will then leave full of aggregate. As such, a **negligible** effect from the introduction of invasive species through ballast water can be concluded.

17.8.158 Vessels can also introduce species via hull fouling whereby species that adhere to the hull of a vessel release and settle in a new location once a vessel reaches another port or berthing area. The potential for this is likely to be increased due to the vessel grounding on the intertidal zone. Although the vessels are only transiting within the UK there is still potential for introducing non-native invasive species from such locations as there are many species even in the UK, that are only local to certain areas. In addition, a lot of the ports that the vessels are transiting from will also have vessels from overseas visiting the port which could introduce species from other regions which subsequently settle on the vessels delivering to The Haven. The impact of introducing non-native invasive species can be high as once a species is introduced, they can potentially outcompete native species and reduce biodiversity and affect infrastructure through excessive growth, amongst other risks. The ongoing vessel movements on a daily basis increase the likelihood of invasive species and as the risk is high management is recommended. With an impact such as invasive species, it is not possible to predict the magnitude of the impact or the sensitivity of the native species as the introduced species is not known and its translocation is reliant on many factors. Given the number of vessels visiting such a relatively narrow inlet the potential for recolonisation potential is high if non-native invasive species are released from vessel hulls. The risks are considered to be high and therefore management is recommended. Management measures involve undertaking a biosecurity plan to ensure that users are aware of the risks and undertake risk reduction measures when necessary. It is recommended that such a plan is developed in conjunction with the Port of Boston to cover all major vessels entering and leaving The Haven. This plan will form part of the NMP as secured Requirement 14 of the DCO.

17.8.159 **Table 17-26** below summarises the potential for an increased risk of invasive species through the operational phase.

Table 17-26 Summary of Impact Assessment

Impact: Increased risk of invasive species (Operation)	Magnitude	Sensitivity	Significance
Increased risk of invasive species with ballast water	Negligible	Not known due to many influential factors	Negligible
Increased risk of invasive species with hull fouling	-	-	Potential for high risk therefore management recommended

Increased ship wash

17.8.160 On the site visit on the 8th October 2018, erosion of the saltmarsh was observed further upstream from the Principal Application Site, most likely caused by the tidal patterns and natural waves (**Plate 17-5**). However, there is also existing ship wash occurring in The Haven from the vessels which transit to the Port of Boston, which differs from natural wind-born waves, which are typically higher (likely to be up to 0.4 m in The Haven) and longer period (potentially up to eight seconds) but are short duration. . From the data provided in **Chapter 16 Estuarine Processes** of this report which investigates the potential for ship wash waves, given the heights and periods of anticipated ship wash waves, they would potentially exceed the threshold values above which erosion could occur in The Haven.

17.8.161 Hence, as a worst-case scenario, it is assumed that the heights and periods of waves created by an individual vessel in The Haven are above the threshold for the erosion of mud from the intertidal areas and that the increase in the shipping traffic would result in an increase in erosion.

Plate 17-5 Erosion of the saltmarshes upstream of the location of the Principal Application Site.

17.8.162 The increased vessel movements would mean increased wave movements, which would impinge on the intertidal mudflats and saltmarsh. However, as stated in **Chapter 16 Estuarine Processes** (**Section 16.7**), the natural wind-caused wave conditions would not change. Although the magnitude of the ship waves would be larger than that of the natural wind-generated waves, the frequency that the natural waves occur will be much higher, as they can occur all year round, any time of the day.

17.8.163 Additionally, the flood-tide dominance of The Haven results in a long-term net transport of suspended sediment into The Haven and net accretion of mud on the channel margins and estuary bed. **Chapter 16 Estuarine Processes** concludes that accretion has taken place in The Haven despite the short-term erosional events caused by ship wash. This would indicate that the annual net deposition of mud on the intertidal areas during natural wind-wave conditions exceeds the short-term erosion of mud during 840 vessel movements (420 upstream and 420 downstream) along the channel.

17.8.164 Given the relatively small amount of time that ship wash would be active on the intertidal mudflats (increasing from 0.15 % to 0.4 % of a year) compared to the relatively large amount of time that wind-waves are active (from 99.85 % to 99.60 % of a year), the annual effect on erosion/deposition of wind waves (and

tidal currents) would continue to significantly exceed the erosion caused by ship waves. This means that The Haven mudflats and saltmarsh are likely to continue to be accretionary because the proportional increase in erosion through ship wash would be small.

17.8.165 It is concluded that the increase in vessel traffic is unlikely to affect the intertidal mudflats and saltmarsh as the contribution to the overall accretion of these areas by locally-generated wind waves and tidal currents would significantly exceed the contribution to erosion from ship waves.

17.8.166 Saltmarsh and mudflat are both BAP priority habitats and represent supporting habitat for fish and birds, as well as the invertebrates and vegetation that colonise these habitats. These habitats provide an important habitat for birds in particular, as birds are known to use these areas for feeding and roosting in particular and likely to use them more in extreme weather events (i.e. when a winter is colder than normal in The Wash) (personal communication, RSPB).

17.8.167 As these habitats are not designated as national or international habitats of importance at this location, they are considered to have a value of regional importance. Therefore, overall, these receptors can be considered of medium sensitivity.

17.8.168 The increase in vessel traffic is unlikely to cause a significant increase in the erosion of the intertidal habitats and the potential magnitude is therefore considered to be low. This is because the predicted change to waves generated by extra ship wash is very small compared to the effect of natural wind-waves. Therefore, a **minor adverse** effect is predicted.

17.8.169 **Table 17-27** below summarises the habitat loss from increased ship wash associated with an increase in vessel presence during the operational phase.

Table 17-27 Summary of Impact Assessment

Impact: Increased vessel traffic and movement (Operation)	Magnitude	Sensitivity	Significance
Loss of habitat (increased ship wash)	Low	Medium	Minor adverse

Increased disturbance (visual and airborne noise)

17.8.170 Increased vessel movements can result in visual disturbance effects to bird species including those mentioned in **Section 17.6**, namely the dark-bellied Brent goose, shelduck, lapwing, dunlin, black-tailed godwit, redshank and turnstone, all

of which are sensitive to airborne noise. All these species are also considered to be sensitive to visual disturbance (Woodward, *et al*., 2015). Marine mammals are also sensitive to visual disturbance from increased vessel movements

17.8.171 Similar to the construction phase, the bird species mentioned in the paragraph above (and also the species that are qualifying interest features of The Wash SPA and Ramsar site) are sensitive to such disturbance because they use the mudflats in The Haven and The Wash as feeding and roosting areas. There is no evidence that the saltmarsh and mudflat areas are used significantly for breeding birds. It is noted that birds supported by habitats within the boundaries of The Wash SPA and Ramsar site are likely to be affected by the increases in vessel movements too as the vessels will be transiting via this site.

17.8.172 As outlined in the construction impacts above, the presence of vessels around high water (the period when the vessels can enter The Haven), particularly of large vessels, cause an impact on birds roosting, and sometimes feeding on areas close to the water's edge. It causes them to take flight and eventually to leave a roost area.

17.8.173 The effect of an increase in the number of vessel movements is not likely to affect the feeding usage of the intertidal mudflats as the vessels will only be entering the Haven and berthing to unload around high water due to the restricted depth of water. Around high tide, however, the proposed increase in vessel movements may increase the frequency of disturbances to roosting birds. This effect is likely to occur all the way along The Haven to the Principal Application Site, although most of the effect will be in and around the mouth of The Haven where roosting sites are more numerous.

17.8.174 The monitoring that was undertaken at the mouth of The Haven found that, overall, 24 bird species altered their behaviour due to boat presence or wash. Most bird disturbance occurred in small numbers, but disturbance to black-tailed godwit, redshank, oystercatcher, shelduck, turnstone, dark-bellied Brent goose, golden plover and lapwing occurred in significant numbers (i.e. more than 1 % of the Wash population, based on the WeBS 5-year average from The Wash at the time of the survey (between 2013/14 and 2017/18)).

17.8.175 The following summarises the peak numbers of birds disturbed by the baseline situation, expressed as a percentage of The Wash population (based on 5-year average for 2013/2018): 220 redshank (3.9 %); c.700 oystercatchers (3.6 %); 36 shelduck (1.1 %); c. 250 dark-bellied Brent geese (1.7 %); 18 turnstone (2 %); c1,100 lapwing (7.53 %); c. 3,000 golden plover (21.2 %) and c. 2000 black-tailed godwit (23.8 %), which is also over double the count required to identify a

site holding internationally important numbers.

17.8.176 Changes in bird behaviour varied depending on the type of river traffic. The vast majority of birds that displayed a change in behaviour were disturbed due to river traffic presence, with fewer affected instead by ship wash. The larger counts of birds disturbed were caused by the large cargo ships, although smaller vessels did also cause disturbance. Wash caused by small boats varied; most fishing/private vessels caused very little wash on the mudflats, whereas the pilot boat caused a much higher wash on some occasions, similar to that of the large cargo ships, likely due to the speed at which it was travelling.

17.8.177 As pilots will be accompanying the large vessels associated with the Facility into The Haven, there is also a requirement for a higher number of pilots to be transported out to the larger vessels. As each pilot vessel can transport up to 6 pilots, it should therefore be possible that only one pilot boat is required (as at present on the majority of occasions). However, there will be occasions when two pilot boats are required to transport the pilots to the vessels. The movements of the pilot boat generally do not cause disturbance as they are of smaller size, although, it is recognised that some of the pilot boat movements do cause disturbance through the wash that they create. Discussions with the Boston Harbour Master have revealed that in the past it was not uncommon to be using two pilot vessels operating at the same time. There are also occasions when the pilots travel out of The Haven on a departing vessel and return on an incoming vessel without the need for the pilot boat. The planning of such will be highly dependent on the timings, water levels and ships draughts.).

17.8.178 At the river mouth, following disturbance due to vessel presence, all birds either returned to the same area or found another roosting/feeding location close by. The alternative roosting sites were between 125 and 800 m from the original roost site. Once at the alternative roost locations the birds did not appear to be disturbed again. Some species however do return to the same roost location and for these species repeated flights as a result of disturbance would cause the birds to deplete important energy reserves. There were also occasions where the birds were having to fly some distance to avoid the vessel, having been disturbed.

17.8.179 The increase in the number of vessels during operation could increase the frequency of occurrence of these disturbance effects. Given that the total number of commercial vessels is currently in the order of 420 per year through The Haven (between 2014 and 2019 ship numbers varied between 371 and 524 per year as discussed in **Chapter 18 (Navigational Issues)**. The port of Boston has also indicated that there were years when there were higher numbers of vessels, including 1986/87 which were bumper years with large number of grain exports

which would have pushed vessel numbers up higher, although they do not have the logs for this), an increase of 580 vessels during the operational phase of the proposed Facility is considered to be high. Currently, large vessels transit on average once per day but anecdotal evidence from the Boston Harbour Master indicates that there are approximately 20-25 % of days per year when large vessels do not transit The Haven and clearly days when more than one large vessel transits, as seen during the behavioural monitoring of birds at the mouth of The Haven. It is generally the larger vessels that cause the disturbance to birds, as discussed further below.

17.8.180 However, it is important to note that all of the large vessels (those that cause the most disturbance) arriving into/departing from The Haven will be travelling at the same time of day to take advantage of the high tide window, which (as a worst case) during a spring tide would be approximately 3.5 hours, including a transit period of approximately one hour from the mouth of The Haven to the proposed development site. The observations of bird behaviour at the mouth of The Haven showed that vessels appear to transit through the mouth of The Haven during a 60-minute window. As such, the period during which the frequency of disturbance events will be increased is limited over each tidal cycle. After the commercial vessels have passed and the tidal window has closed, those birds that may be displaced from the site would be able to return to the grounds undisturbed by such shipping movements. The short tidal window also means that the risk of repeated flights by species exhibiting a flight and return response to disturbance is minimised.

17.8.181 A detailed analysis of the bird data collated for disturbance events (Bentley, 2020) is provided within **Appendix 17.1**. This analysis shows that the baseline situation where vessels currently travel through The Haven (and will continue to do so) has occurred for many years, and the number of birds that utilise The Haven (and The Wash SPA) do not appear to have been affected overall. The number of birds present at the time of designation in 1988 and subsequent periods shows that for most species the numbers fluctuate but have generally increased since designation.

17.8.182 Based on the behavioural responses exhibited by bird species in response to vessel disturbance events during the bird survey (Bentley, 2020), many of the species affected by disturbance at the roosting sites around the mouth of The Haven were observed to fly to an alternative roosting site after one disturbance episode and therefore did not display repeated disturbance responses. The bird species utilising this area generally fly off to alternative roost sites where they appear to be outside of the range of disturbance for subsequent vessel

movements. Although this is not a desired outcome, it does show that they are not subjected to repeated disturbance events which could have a detrimental effect on energy reserves. The species that do seem to be affected by repeated disturbance events are lapwing and golden plover, which regularly returned to the same roosting site following disturbance events.

17.8.183 The large cargo vessels were observed during the surveys to enter and leave The Haven within a time period of up to 60 minutes around high water. After this, it appeared that any disturbance is mainly due to smaller vessels travelling relatively fast and causing disturbance through presence of the vessel or the wash created.

17.8.184 The survey data showed that the following species (which are also qualifying species for The Wash SPA / Ramsar) were affected by disturbance during the baseline survey (Bentley, 2020), but in numbers that are not significant in the context of The Wash population (i.e. less than 1 % of the total population recorded from the 5-year WeBS average):

- Dunlin;
- Knot;
- Eider;
- Wigeon;
- Black-headed gull;
- Curlew; and
- Grey plover.

17.8.185 Additional surveys undertaken during January and February 2021 showed consistent results albeit with lower numbers of waders present at the mouth of The Haven and higher numbers of gulls during the January counts. The largest quantity of birds that changed their behaviour in the latest counts (January and February 2021) were c. 425 lapwing as a result of disturbance by the pilot boat during the February count.

17.8.186 Of the species that were disturbed to a greater degree (ringed plover, lapwing, turnstone, golden plover, black-tailed godwit, redshank, cormorant, mallard, oystercatcher, Brent goose, shelduck and teal), the data has shown that some species generally fly off to alternative roosts after just one disturbance event. These species are redshank, oystercatcher and, to an extent, black-tailed godwit. It is not expected therefore that the proposed increase in vessel numbers transiting through The Haven would result in significant disturbance to these

species (i.e. birds displaced by an initial disturbance event would not be affected by subsequent vessel transits through the Haven, regardless of frequency).

17.8.187 Species that were affected by repeated disturbance events (notably lapwing and golden plover, and on one occasion, 5 black-tailed godwit) were due to the fact that they displayed a tendency to return to roost sites at the mouth of The Haven once initial disturbances had passed. These species are more likely to be affected by increased frequency of vessel traffic during high tide windows since an increase in the number of disturbances over a set period of time would increase the energy expenditure from repeated flight and return responses. Further information on the observed responses by lapwings and golden plover are provided below.

17.8.188 Both lapwing and golden plover will frequently roost together in large groups. Both species displayed a preference during the survey to return to roosting sites following disturbance, usually after a period of flight of around 60-90 seconds (as a worst case up to 120 seconds), although repeated disturbances did on occasion lead to displacement, indicating that a displacement response is viable and there is suitable alternative habitat locally.

17.8.189 In terms of foraging, lapwings and golden plovers preferentially feed on grazing fields, cultivated land and coastal fields/saltmarsh, often inland, and would not be affected by changing vessel traffic in the Haven at high tide. Where feeding on intertidal habitats is necessitated, this would be optimal at low tide when mud/sand is exposed, during which times there would be no change in the baseline vessel traffic.

17.8.190 Energy cost per flight have been calculated for lapwing and golden plover due to these repeat disturbance events. Energy cost per flight can be calculated using an equation from Kvist *et al.*, 2001 (as used in Collop *et al.*, 2016, regarding energy costs of wintering waders responding to disturbance in the Wash), where the *Cost (kJ)* = $(10^{0.39} \times M^{0.35}\text{-}0.95)/1000 \times S$; (where *M* = body mass (g) and *S* = flight time (s)).

17.8.191 The body mass of lapwing is 140 to 320 g, and the body mass of golden plover is 160 to 280g (taken from RSPB website). The flight time is considered to be the worst case recorded in the surveys (i.e. 120 seconds). With this in mind, the energy cost per flight for lapwing is between 1.546 and 2.104 kJ, and the energy cost per flight for golden plover is between 1.626 and 2.003 kJ.

17.8.192 The thermal neutral requirements for wading birds has been calculated using Nagy et al., 1999 (again as used in Collop *et al.*, 2016): where the *Energy*

requirement (kJ) = 10.5 x $M^{0.681}$; (where *M* = body mass (g)). Using this calculation, the daily energy requirement for lapwing is between 303.88 and 533.58 kJ, and the daily energy requirement for golden plover is between 332.81 and 487.20 kJ. As such, the cost per flight as a percentage of the daily intake requirement for each species can be calculated. For a lapwing, each 120-second flight response would represent around 0.39 % to 0.51 % of its daily energy intake requirements. For a golden plover, each flight would represent around 0.41 % to 0.48 % of its daily energy intake.

17.8.193 As an example, an additional (theoretical) four vessel transits per day would result in an increase in daily energy requirements of up to 2 % for lapwing and golden plover. As such, the predicted impacts of additional energy expenditure on these species when responding to an increase in vessel disturbance is therefore very low. These calculations are based on an assumption of 120-second flights (longest flight time observed), although it should be noted that in most instances flight times were considerably shorter than 120 seconds (in most cases half of this), therefore energy costs are likely to be lower than 2 %.

17.8.194 There was also a disturbance event to black-tailed godwit on the 17th January 2020 where a pilot vessel disturbed c.200 individuals, which circled for 90 seconds before returning to their roost site. This would have expended energy for these individuals who could then have potentially been further disturbed by subsequent events. However, as mentioned previously, displacement from the site is an equally viable response for this species.

17.8.195 It is important to consider the effects of disturbance on the waterbird assemblage as a whole, as well as considering individual component species. The peak number of birds that responded to a single vessel disturbance event was in December 2019, when a total of 6,980 individuals (largely from roosting flocks of golden plover, black-tailed godwit and lapwing) took flight. This represents around 1.8 % of the most recent WeBS 5-year average in The Wash and suggests that significant numbers may be affected by initial disturbance from the passage of large cargo ships. However, far fewer birds took flight as a consequence of subsequent disturbance events (i.e. less than 1 % of The Wash SPA population) each time. This indicates that most birds affected were displaced elsewhere following the first event, indicating that an increase in the frequency of vessel transits over the high tide period would not significantly increase the risk of disturbance-related effects such as excess energy exertion – most birds would already have been displaced by those initial vessel movements.

17.8.196 Again, it is worth noting that the main foraging activity, when birds replenish their energy reserves, is likely to take place at low tide, when vessel traffic would

be unchanged from the existing situation. As such, it is mostly roosting birds that would be affected.

17.8.197 The monitoring has shown that although the sensitivity of the birds is high to an initial disturbance, most of the birds fly off to alternative roost sites and are not disturbed again. As the baseline situation includes large vessels transiting regularly through The Haven, the sensitivity for most species to repeat disturbances is low or negligible. For those birds that habitually return to the same roosting site and are disturbed again on subsequent visits (primarily lapwing and golden plover), the energy usage for the additional flights seems to only represent a small percentage of additional usage, mostly thought to be due to the short flights that arise as a result of disturbance. For the SPA/Ramsar site waterbird assemblage as a whole, although the initial disturbance event showed high levels of disturbance, any subsequent events were below 1 % in terms of the assemblage disturbed.

17.8.198 The disturbance monitoring covered the area of marsh habitat at the mouth of The Haven. In terms of any disturbance occurring elsewhere along the shipping channel and along The Haven itself, it is expected that these areas are already subjected to the same baseline levels of disturbance as at the mouth of The Haven and therefore any additional vessel traffic as a result of the proposed facility would equally not have a significant additional effect on birds.

17.8.199 Vessel movements have been taking place through The Haven for at least the last 100 years, certainly since the designation of the SPA in 1988, with numbers varying over the years. The fact that high bird numbers are still observed at the mouth of The Haven shows that the roost site is still used despite the baseline level of disturbance that this creates.

17.8.200 The disturbance events only happen around the high water period within a possible maximum tidal window around the mouth of The Haven of up to 3.5 hours as a worst case during spring tides, but in reality, this appears to be a window of approximately 60 minutes given the observations of vessel movements during the surveys. It is estimated to take the larger vessels approximately 60 minutes to transit from the Port of Boston to The Wash. The Haven is largely a one-way channel for large vessels but passing is possible in localised areas of the channel. The disturbance only therefore occurs for a maximum of 7 hours in any 24-hour period, with 3.5 of those hours happening at night-time when visual disturbance is expected to be less, particularly in the winter period.

17.8.201 There are no large vessel movements outside of these periods so the remaining low tide feeding areas are not affected by such movements. These

areas are therefore expected to provide a good foraging resource for birds at all times when the mudflats are exposed. It seems likely that the birds use the areas at all other states of the tide and use alternative nearby roosting sites during the periods when the larger vessels transit through The Haven.

17.8.202 It is recognised that there are currently approximately 840 large vessel movements (420 vessels) per year and that there will be some days when there are no large vessels currently transiting The Haven. Anecdotal evidence from the Boston Harbour Master indicates that there were around 20-25 % of days with no throughput of larger vessels during 2020. During the predicted operation of the proposed facility there would be vessels transiting through The Haven every day. An increase of 46 days (from 137 days to 183 days of the total overwintering period) disturbance results from the predicted increase in larger vessels due to the Boston Alternative Energy Facility. Given that the birds appear to have adapted to the long-term baseline disturbance by flying to alternative nearby roost locations then it is reasonable to assume that they would continue to do this. The alternative roost sites are obviously providing enough roosting areas to sustain these populations over the long term, with the baseline levels of disturbance and are at such close distances to ensure minimal additional energy usage**. Figure 17.10** shows the location of alternative habitats in the area around the mouth of The Haven and shows that there are many areas of habitat that could still be available for roosting, particularly along the Freiston Shore. It is therefore expected that the same behavioural response would occur for the disturbance in the days when previously no large vessels came through The Haven.

17.8.203 In light of the assessment above, it is not considered that birds would experience significant disturbance effects due to the increase in vessel numbers using The Haven.

Noise levels and visual disturbance at the facility during operation

17.8.204 For operational noise levels at the facility, the information presented in the previous section of construction-phase impacts highlights that below 50 dBA, no behavioural effect would be expected, but when noise levels increase, particularly approaching 70 dBA, there is a range of bird responses, with the potential for birds to experience significant effects. The operational noise modelling carried out for the Facility (**Chapter 10 Noise and Vibration**) identified no impact to the two sites on the shores of the Haven (including the bank opposite to the Principal Application Site), in relation to background noise levels. The predicted noise levels ranged from 34 to 42 dBA, which accounted for operation of the Facility, as well as the increased vessel movements.

17.8.205 Based on previous studies and the operational noise modelling, a noise level of <50 dBA for operational vessel noise is considered to be a suitable threshold to indicate a level of effect where disturbance due to noise would not cause a behavioural response. It is expected that the vessel movements will cause short-lived increases in noise as the vessel berths and unloads/loads cargo. As such, only a temporary effect on the bird populations are expected at the development site for the remaining areas of roosting and feeding habitat.

17.8.206 There is also potential for visual disturbance due to operational activities. The aggregate wharf is the part of the facility closest to Area B and the Habitat Mitigation Area. This will be used for loading aggregate and it is expected that there would be an average of 2 vessels per week. Whilst these vessels are present there could be disturbance to roosting and feeding birds. For redshank, which are the birds present in highest numbers, the visual alert distances (according to the data in the toolkit (IECS, 2013)) are given as 250 m for unhabituated birds. This is where species show behavioural changes and most species will take flight or walk away moving to another area close by. It is expected that the birds using this area are habituated to vessel presence, given the number of vessels using The Haven and the narrow width of The Haven, and that they would habituate to some extent to the presence of the vessel and movements around the vessel. However, initially, until the birds habituate to the noise, during aggregate loading operations (twice a week) there could be some disturbance whereby redshank, and other waterbirds would relocate up to a worst case (given that the birds using this area will be habituated to some level of disturbance already) of 250 m away on the saltmarsh habitat within Area B. The marsh within Area B stretches for 665 m so there is still a high proportion of Area B left that would support the roosting birds at levels observed during the high-water counts. The proposed features within the Habitat Mitigation Area providing roosting opportunities would be located outside of this 250 m zone.

Summary

17.8.207 Overall, disturbance from both vessel activity and noise levels have the potential to affect populations of birds that utilise The Haven. Within Area B at the proposed development site there is considered to be enough space for roosting birds to relocate a very short distance on the occasions when vessels are using the closest wharf area (the aggregate wharf) which is used on average by 2 vessels a week at high water periods. At the mouth of the Haven and within The Haven, the magnitude of the impact (i.e. the effect on the receptor – birds) is low because most of the birds are either habituated to baseline levels of disturbance or fly off to alternative roost sites from the baseline disturbance caused by existing

vessel movements. Because of this, there is a limited number of birds remaining, and those that do remain are considered to be of lower sensitivity, although they do appear to relocate after approximately three vessel disturbances and although each disturbance flight is short, they do use energy reserves during each flight. At the proposed development site, the birds may have a higher sensitivity to disturbance from the vessels unloading, although this is only expected to be two vessels a week. The sensitivity of birds to disturbance is therefore considered to be medium.

17.8.208 The overall effect significance would therefore be one of **minor adverse** significance.

17.8.209 **Table 17-28** below summarises the impacts to bird species as a result of visual and noise disturbance from increased vessel presence in the operational phase.

Table 17-28 Summary of Impact Assessment

Impact: Visual and noise disturbance impacts on birds from increased vessel traffic (Operation)	Magnitude	Sensitivity	Significance
Increased visual and noise disturbance to bird species	Low	Medium	Minor adverse

17.8.210 As discussed in the construction impacts there is a loss of habitat at the development site and as a result there is a proposal to provide enhancement in the Habitat Mitigation Area to ensure no net loss of roosting and foraging opportunities in this localised area. There is also a biodiversity net gain proposal for the project to be achieved through habitat creation works to provide alternative feeding and roosting areas within the Frampton Marsh and Freiston Shore RSPB reserves.

17.8.211 The proposed habitat net gain measures are currently under discussion with the Royal Society for the Protection of Birds, Natural England and Lincolnshire Wildlife Trust. An agreed package will be developed with the relevant stakeholders during the DCO process and will be detailed in the Landscape and Ecological Mitigation Strategy (LEMP), which is secured by a requirement of the DCO.

Increased underwater noise impacts to fish species

17.8.212 The potential impacts on marine and coastal ecological receptors from underwater noise during operation are limited, and significantly lower than during

the construction phase. There will be no piling during the operational phase, the only underwater noise that will be generated will be the noise from the increased vessel movements. The maintenance dredging that will be carried out will be temporary and intermittent.

17.8.213 Other than the information presented in **Table 17-14**, there is insufficient data from shipping operations to define accurate exposure criteria for fish. However, **Table 17-14** shows that fish have low sensitivity to noise generated by shipping. All fish species in categories 1-3, however, have high sensitivity to masking (interference with the fish hearing ability), but this is not a fatal impact.

17.8.214 The potential for underwater noise impacts to fish species would be the same (or lower) as those assessed for dredging during the construction phase. Therefore, the effect is assessed as **minor adverse**.

17.8.215 **Table 17-29** below summarises the impact of underwater noise on fish species due to increased vessel presence during the operational phase.

Table 17-29 Summary of Impact Assessment

Impact: Underwater noise impacts from increased vessel traffic (Operation)	Magnitude	Sensitivity	Significance
Disturbance from vessels – fish species	Low	Medium	Minor adverse

Potential for effects on harbour seal due to vessel disturbance (presence and noise)

17.8.216 As stated above, there will be an increase in the number of vessels through the operational phase of the Facility, with 580 vessels above the existing levels per year, (averaging 12 per week), representing an increase of 0.8 % above baseline levels (of 11,000 vessels per year in the shipping channel). However, it is unlikely that vessel noise would be sufficient to cause the onset of either a permanent auditory injury (PTS) or a temporary auditory injury (TTS) in harbour seals.

17.8.217 As outlined in the above sections, the vessels related to the proposed Facility will be slow moving, and the noise emitted is likely to be of low frequency. Noise levels reported by Malme *et al*. (1989) and Richardson *et al*. (1995) for large surface vessels indicate that physiological damage to auditory sensitive marine mammals is unlikely. However, the levels could be sufficient to cause local disturbance to sensitive marine mammals in the immediate vicinity of the vessel, depending on ambient noise levels.

17.8.218 Best practice measures will be put in place in order to minimise the disturbance that is caused to marine mammals from the vessel traffic. This will mainly be in the form of an observer on board each vessel, looking out for marine mammals as the vessel makes its way through The Wash and up The Haven.

17.8.219 The potential for disturbance from vessels during the operational phase would be the same as within the construction period, with up to 33.4 harbour seals (or 0.7 % of SE England MU population; or 0.9 % of the most recent count of adult seals in The Wash (Thompson, 2019)) based on the harbour seal density within the shipping corridor and anchorage area of 3.189 harbour seals per km^2 (Russel *et al.*, 2017). This equates to a negligible magnitude of impact. Taking into account the low sensitivity of harbour seal to disturbance from vessels at sea, the overall effect significance is **negligible**.

17.8.220 **Table 17-30** below summarises the potential for disturbance as a result of impacts of increased vessel presence through the operational phase.

Table 17-30 Summary of Impact Assessment

Impact: Disturbance from an increased vessel traffic (Operation)	Magnitude	Sensitivity	Significance
Disturbance from vessels – harbour seal	Negligible	Low	Negligible

Potential disturbance at harbour seal haul-out sites

17.8.221 As outlined in the construction impacts section, harbour seal may become disturbed from haul-out sites due to the presence of vessels, which, if occurring in the breeding season, can result in the abandonment of pups.

A1.1.1 Best practice measures will be put in place in order to minimise the disturbance that is caused to marine mammals from the vessel traffic. This will mainly be in the form of an observer on board each vessel, looking out for marine mammals as the vessel makes its way through The Wash and up The Haven. This requirement will form part of the NMP which is secured by Requirement 14 of the DCO.

17.8.222 The potential for impact would be the same as for the construction phase. Due to the distance of haul-out sites to the shipping channel and anchorage location, the low number of harbour seal (and pups) present at the nearest sites, and the ability of harbour seals and pups to move to any one of the other suitable sites nearby, the magnitude of impact would be negligible. With a high sensitivity, the overall effect significance of harbour seal to vessel disturbance is **minor**

adverse.

17.8.223 **Table 17-31** below summarises the potential for disturbance at harbour seal haul-out sites due to an increase in vessels during the operational phase.

Table 17-31 Summary of Impact Assessment

Impact: Disturbance at harbour seal haul-out sites from increased vessel traffic (Operation)	Magnitude	Sensitivity	Significance
Disturbance at harbour seal haul-out sites	Negligible	High	Minor adverse

Potential for effects on harbour seal as a result of increased collision risk

17.8.224 As discussed above, during the operational phase of the Facility, it is expected that there will be an increase in vessel traffic, with an additional 580 vessels expected per year, averaging 12 per week, through the operational period, over the current vessel numbers currently using the shipping channel. As outlined above, this is a small increase of vessel numbers through the existing shipping channel in The Wash, with a 5.27 % increase over annual vessel numbers within this channel during the operational phase.

17.8.225 The potential for increased risk of collision from vessels during the operational phase would be the same as for the construction phase, with a total of 1.7 harbour seals (0.03 % of the SE England MU; or 0.5 % of the most recent count of adult seals in The Wash (Thompson, 2019)) could be at increased risk of collision if it is considered that 5 % would be at risk, and a total of 3.3 harbour seals (0.06 % of the SE England MU; or 0.9 % of the most recent count of adult seals in The Wash (Thompson, 2019)) may be at risk of collision with vessels if it is considered that up to 10 % could be at risk. The magnitude of impact is therefore medium, with the impact being permanent. As outlined in **Section 17.8.132** the sensitivity of seals to collision risk is considered to be low. This results in an effect significance of **minor adverse**.

17.8.226 **Table 17-32** below summarises the potential for increased risk of collision due to increased vessel presence through the operational phase.

Table 17-32 Summary of Impact Assessment

Impact: Increased risk of collisions from increased vessel traffic (Operation)	Magnitude	Sensitivity	Significance
Increased risk of collisions for marine mammals (impact zone	Medium	Low	Minor adverse

Impact: Increased risk of collisions from increased vessel traffic (Operation)	Magnitude	Sensitivity	Significance
includes the Wash as a transit area)			

Mitigation

17.8.227 It is recommended (as also specified in **Chapter 16 Estuarine Processes**, **Section 16.8**) that bathymetric surveys be undertaken every six months to monitor any potential erosion of the intertidal habitats. These surveys will form part of the monitoring measures required under condition 13 of the DML.

17.8.228 Vessel movements will be incorporated into recognised vessel routes where marine mammals are accustomed to vessel presence, to reduce any disturbance and any increased collision risk. An observer would also be on board either the pilot vessel or the Facility-related vessel to watch for any marine mammals. These measures will be secured within the NMP which will be produced in conjunction with the Port of Boston as a requirement of the DCO.

Impact 3 - Increased levels of suspended sediments and loss of benthic habitat due to maintenance dredging

Increased levels of suspended sediments

17.8.229 Similar to the construction phase, there is a potential impact to the fish and benthic communities of The Haven to be affected by the maintenance dredging regime and the resulting increase in suspended sediments. The annual volume of sediment that would deposit in the berthing areas has calculated to be approximately 1,643 m^3. This has therefore been assumed to be the same as the volume of maintenance dredging (**Chapter 16 Estuarine Processes**).

17.8.230 Any sediment recovered from the maintenance dredge of the wharf area will be lifted directly on to the wharf for subsequent draining in a settling pond, where the drained water will be used for the on-site aggregate production. A small volume of the dredged sediment would naturally be lost from the excavator during the dredging process and would enter the water column.

17.8.231 The berthing areas would also potentially create a sink for deposition of fine sediment, which will require maintenance dredging during the operational phase. On any one occasion, the volume of maintenance dredging would be significantly less than the capital dredge and, therefore, the loss of sediment during dredging would be less than during the capital dredging. As such, the effects on both the

fish and benthic communities are expected to be lower magnitude, with the sensitivities of these receptors being as described for the construction phase. The effect is considered to be of **minor adverse** significance (fish) and **negligible** (benthic communities).

Loss of benthic habitat

17.8.232 Similar to the impacts from capital dredging, there will be a small amount of seabed permanently lost due to the regular maintenance dredging of the wharf area.

17.8.233 The seabed in this area is already affected through the presence of boats beached on it during low tide as they wait for higher water to re-float and exit The Haven. The wharf is an open structure and as such the habitats beneath it will still be subject to tidal influence. The specific permanent habitat loss will be in front of the footprint of the wharf where the vessels will need to beach. This area of habitat has already been included in the loss calculation undertaken for the initial dredging works and wharf construction and so is not recalculated again.

Table 17-33 Summary of Impact Assessment

Impact: Increased levels of suspended sediments (Operation)	Magnitude	Sensitivity	Significance
Effects on fish migration and behaviour	Negligible	Medium	Minor adverse
Smothering of benthic communities	Negligible	Low	Negligible

Mitigation

17.8.234 Given that the maintenance dredging will form part of the existing wider maintenance programme, and the nature of the predicted impacts, no specific measures are considered necessary.

17.8.235 The volume of maintenance dredging required will be set to minimise impacts and also allow a safe clearance between a berthed vessel and others passing through the channel.

Impact 4 - Beaching of vessels at low tide

17.8.236 Vessels that will be berthed at the wharf during the operation of the Facility will to be grounded on the campshed which will be placed on the mudflats (see **Figure 5.2**). Vessels would be grounded on the campshed during low tide until the tide floods when the vessel will be able to leave the Facility. The habitat loss

from the installation of the campshed has been built into the assessment of habitat loss during operation as outlined above. This impact refers to the effect on any benthic species that recolonise the hard substrata of the campshed.

17.8.237 The grounding of vessels at the same locations at the wharf will occur at a maximum of five times a week.

17.8.238 The grounding of the vessels are unlikely to mobilise contaminants given the hard substrate nature of the campshed. Nonetheless, the vessel movements in this area may have a low risk of mobilising contaminants from any sediment that settles on the hard substrate between tide cycles. Benthic communities are considered to be of low sensitivity to resuspended contaminants, as they are largely sediment dwelling organisms, accustomed to the level of contamination existent in the sediment. Levels of contaminants are not considered to be high enough to have a probable effect. However, there is potential for spillages to occur (including oily waste) which could increase the level of contaminants. Good practices, effective maintenance and the development of effective contingency planning and monitoring should be able to reduce the likelihood of such impacts.

17.8.239 The benthic communities in this area that do colonise the campshed area, would be at risk of being compressed with the grounded vessel. The affected area will only be the size of three vessels (assuming all three are berthed at the same time) and is considered relatively small in terms of the total available mudflat habitat within The Haven. As such, this impact, in relation to the benthic invertebrates, is classed as low magnitude, where the benthic communities can be classed of low sensitivity. This results in a **minor adverse** impact significance.

Table 17-34 Summary of Impact Assessment

Impact: Beaching of vessels at low tide (Operation)	Magnitude	Sensitivity	Significance
Compressing of benthic communities	Low	Low	Minor adverse

Impact 5 - Increased emissions to air and deposition on marine and estuarine habitats

17.8.240 The following designated sites (with a marine and coastal interest) are located within the distance criteria specified in Defra Environment Agency guidance as requiring consideration for potential impacts of air emissions (Defra and Environment Agency, 2016):

- The Wash and North Norfolk Coast SAC.
- The Wash SPA.
- The Wash Ramsar site.

- Havenside LNR.

17.8.241 The potential for nitrogen oxides (NO_x), sulphur dioxide (SO_2), nitrogen, acid and ammonia deposition on these sites during the operation of the Facility was assessed as a result of air quality dispersion modelling, carried out in **Chapter 14 Air Quality.** As was assessed in **Chapter 14 Air Quality**, the operational impacts of deposition can be considered to be insignificant in the short term. For the longer term however (based on annual mean levels), these cannot be considered insignificant as the contribution of all pollutants to the background levels were above 1 % of the relevant annual mean Critical Levels or Loads.

17.8.242 The air quality modelling critical loads were based on the conservative estimate range for saltmarsh, given by the Air Pollution Information System (APIS).

17.8.243 For the saltmarshes linked to The Wash and Havenside LNR, the predicted project-alone impact was greater than 1 % of the Critical Load, specifically given the LNR's location immediately downwind of the Principal Application Site. This exceedance prediction was typically lower for The Wash. However, overall deposition of contaminants (specifically nitrogen) is generally of low importance for saltmarshes as the inputs are generally significantly below the large nutrient loadings from riverine and tidal inputs. Mature, upper areas of saltmarsh (like those found along The Haven) are also likely to be subject to direct run-off from the surrounding catchment. Biogeochemical cycling of nutrients through microbial activity is quite rapid in this open system and nitrogen losses via denitrification may be considerable (Barnes & Owen, 1998).

17.8.244 Although there is limited information on the specific types of saltmarsh that are designated under The Wash and North Norfolk Coast SAC, the sensitivity review on MarLIN for pioneer saltmarsh and *Puccinellia maritima* saltmarsh community habitats for the pressure 'changes in nutrient levels', which also addresses aerial deposition, states that moderate enrichment may be beneficial to plant communities within a saltmarsh. Nitrogen is typically a limiting nutrient in saltmarsh ecosystems and added nitrogen resulted in increased primary production and decomposition (Valiela & Teal, 1974; Long & Mason, 1983). At a benchmark level, an increase in nutrients was concluded unlikely to have a significant effect on communities (Tyler-Walters, 2001; Tyler-Walters, 2004). Natural England's Advice on Operations also states that the saltmarsh habitats of The Wash and North Norfolk Coast SAC are not sensitive at the pressure benchmark for 'nutrient enrichment', stating that "…*The benchmark for this pressure indicates that nutrient enrichment levels will be within acceptable levels, therefore it is unlikely that this habitat would be significantly affected by*

contamination at this magnitude" (Natural England, 2020). However, it is not clear what this magnitude/benchmark is (in a quantitative sense), and there is limited information other available on the effect of other nutrients/pollutants on saltmarsh habitats.

17.8.245 Based on the above information, as a conservative estimate it is considered that saltmarshes are of medium sensitivity to deposition. Based on the modelling results of the air quality modelling, and that there are no exceedances of the Critical Load (except for 1 % exceedance for Havenside LNR, based on the most stringent of the Critical Load range), this impact is considered to be of low magnitude, resulting in an overall **minor adverse** significance. Continuous monitoring of the emissions from the stack will be secured as a condition of the environmental permit.

17.8.246 With regards to deposition on to intertidal habitats (such as mudflats and shellfish beds that are exposed and covered at every state of the tide), where although deposition may occur in-between tides, this would be washed away with the tide; although there is the potential for this to contribute to a change in water quality, in the context of the wider water column, this is not considered to be significant. This is further supported by the fact that APIS does not identify deposition as a main input of pollutants to the marine system, compared to other sources of pollutant inputs (such as discharge pipes etc.). As such, the modelled deposition is not expected to have a wider impact on intertidal habitats or water quality.

17.9 Cumulative Impacts

Screening of Cumulative Projects

17.9.1 **Table 17-35** presents projects that have the potential to have cumulative impacts when considered alongside the Facility. Other potential cumulative schemes have been identified by Boston Borough Council; however, these are not considered in this chapter because they are all land based with no potential for causing an impact on marine ecology.

17.9.2 Due to the wide ranging nature of the harbour seal, and that they may forage a considerable distance from their principal haul-out site, there is the potential for cumulative impacts from projects at distance from the Facility. Therefore, for harbour seal, projects that are within the same reference population (the south-east England MU; SCOS, 2018) as the Facility, and that have the potential to overlap temporally, have been screened in for further assessment.

Table 17-35 Projects in the Vicinity of the Facility with the Potential to have Cumulative Impacts

Project	Status	Development Period	Distance from Application Site	Project Definition	Project Data Status	Included in CIA	Rationale
Boston Barrier Flood Defence	Transport and Works Act Order consented	2017 – ongoing (completed August 2021)	Boston Barrier at closest point to the Application Site is 500 m.	Environmental Statement	Complete / high	Yes	Potential for cumulative impacts for capital and maintenance dredging is unlikely because the timescale for this project will not overlap with the Facility – however, it is considered as a worst-case.
Port of Boston Maintenance Dredging	Ongoing maintenance	Ongoing	Approximately 400 m average distance from the Application Site	Maintenance dredging to maintain navigation	Ongoing	Yes	Potential for cumulative impacts for capital and maintenance dredging.
Triton Knoll Offshore Wind Farm	DCO consented	2008 - ongoing	Onshore cable corridor and Construction compound at Langrick 9.7 km from the Application Site	Environmental Statement	Complete/ high	Yes	Potential for cumulative impacts from the operational phase only.
Viking Link Interconnector B/17/0340	Application approved	2014 - 2023	Bicker Fen substation 14.4 km from the Application Site	Environmental Statement	Incomplete / low	Yes	Potential for overlap in construction phases.

17.9.3 It is likely that only Boston Barrier and the maintenance dredging for the Port of Boston are close enough to the Application Site to have the potential to result in significant cumulative impacts for most marine ecology receptors. Cumulative impacts may arise due to simultaneous operation. Other projects that are significant distances from the proposed project may have the potential to have cumulative impacts because of the wide-ranging nature of marine mammals.

17.9.4 The maintenance dredging undertaken for the Port of Boston removes an average of 24,000 tonnes of sediment per year from the Port and various locations along The Haven (Marine Management Organisation, 2015) and this is disposed offshore although no maintenance dredging takes place at the wharf site of the Facility (*pers. Comm, Port of Boston)*. The capital dredging for the proposed scheme is a much larger volume (estimated at 225,000 m^3) but will mostly be undertaken using land-based plant and none will be disposed offshore. All of the dredging would be undertaken using mechanical dredging techniques which reduce the concentration of plumes when compared to hydraulic methods of dredging.

17.9.5 The maintenance dredged material from the berthing pocket at the Principal Application Site will be used within the Facility as part of the lightweight aggregate manufacture process. It is acknowledged that some water will drain out of the material as it is transported to land, but this is expected to be a relatively small volume which would soon be dispersed in the water column and onto the intertidal areas.

17.9.6 The potential impacts from capital and maintenance dredging were considered to be minor for both fish and benthic species and it is not expected that cumulatively the impacts would be significant for benthos as different areas are likely to be affected. However, for fish, the impact significance could increase considering they are more sensitive to increased suspended sediment concentrations. It is therefore recommended that the dredging programme for the proposed Facility is co-ordinated with any other dredging that is being carried out in The Haven to ensure there is no overlap of timings for both capital and maintenance dredging activities.

17.9.7 A summary of the potential cumulative impacts with the Port of Boston Maintenance Dredging is set out in **Table 17-36**.

Table 17-36 Potential Cumulative Impacts with the Port of Boston Maintenance Dredging activity

Impact	Potential for cumulative impact	Data confidence	Rationale
Construction phase			
Increased suspended sediment from the capital dredge activities	Yes	Medium	Potential for impact where dredging windows overlap
Operational phase			
Increased suspended sediment concentrations due to maintenance dredging	Yes	Medium	Where the maintenance dredging windows overlap for both projects, there could be potential for cumulative impact.

17.9.8 Operation of the Boston Barrier will coincide with the construction of the Facility (including capital dredge) and maintenance dredging for the wharf so there is potential for cumulative impacts.

17.9.9 The worst case scenario from a marine and coastal ecology perspective would be for the operation of the Boston Barrier and capital dredging for the Facility to occur at the same time. This would represent the greatest risk of a cumulative increase in suspended sediment concentrations leading to cumulative impacts on fish and benthic ecology. This is highly unlikely as the barrier would only be operational during a flood event when capital dredging is unlikely to be taking place. The combined change in suspended sediment concentrations could affect a greater spatial area.

17.9.10 A summary of the potential cumulative impacts with the Boston Barrier is set out in **Table 17-37.**

Table 17-37 Potential Cumulative Impacts with the Boston Barrier

Impact	Potential for cumulative impact	Data confidence	Rationale
Construction phase			
None	N/A	N/A	N/A
Operational phase			
Habitat alteration due to hydrodynamic changes	Yes	High	Where the maintenance dredging windows overlap for both projects, there could be
Changes in vessel traffic and movement leading to increased ship wash,	Yes	High	

Impact	Potential for cumulative impact	Data confidence	Rationale
underwater noise, disturbance and collision risk			potential for cumulative impact.
Increased suspended sediment concentrations due to maintenance dredging	Yes	High	
Increased emissions to air and deposition on marine and estuarine habitats	Yes	High	

17.9.11 With regards to marine mammals, there is the potential for cumulative impacts with other projects, including the Triton Knoll Offshore Wind Farm (OWF), during its operational phase only (as is due to be fully operational by 2021, prior to the Facility commencing construction), and the VikingLink project, which is currently under construction and due to be completed in 2022, resulting in the potential for overlapping construction periods.

17.9.12 A summary of the potential cumulative impacts with both Triton Knoll OWF and the VikingLink project are set out below in **Table 17-38** and **Table 17-39**.

Table 17-38 Potential Cumulative Impacts with Triton Knoll OWF

Impact	Potential for cumulative impact	Data confidence	Rationale
Construction phase			
Increase in vessel traffic leading to increased underwater noise impacts to harbour seal	No	High	Overlap of the Facility construction phase will overlap with the operational period of Triton Knoll only.
Increased risk of collision due to increased number of vessels	No	High	
Operational phase			
Increase in vessel traffic leading to increased underwater noise impacts to harbour seal	Yes	High	Overlap of the Facility operational phase with the operational period of Triton Knoll, both of which include the increase of vessel numbers and associated impacts to harbour seal
Increased risk of collision due to increased number of vessels	Yes	High	

Table 17-39 Potential Cumulative Impacts with the VikingLink project

Impact	Potential for cumulative impact	Data confidence	Rationale
Construction phase			
Increase in vessel traffic leading to increased underwater noise impacts to harbour seal	Yes	High	Overlap of the Facility construction phase with the construction of the VikingLink project, both of which include the increase of vessel numbers and associated impacts to harbour seal
Increased risk of collision due to increased number of vessels	Yes	High	
Operational phase			
Increase in vessel traffic leading to increased underwater noise impacts to harbour seal	Yes	High	Overlap of the Facility construction phase with the operational phase of the VikingLink project, both of which include the increase of vessel numbers and associated impacts to harbour seal
Increased risk of collision due to increased number of vessels	Yes	High	

Cumulative Impact Assessment: Harbour seal

17.9.13 As outlined above, there are three projects with the potential for cumulative impacts on Harbour Seal. There are;

- Triton Knoll OWF:
  - Operational impacts of Triton Knoll OWF with the construction and operational phases of the Facility.
- VikingLink:
  - Construction phase of VikingLink with construction phase of the Facility.
  - Operation phase of VikingLink with both the construction and operation phase of the Facility.

17.9.14 **Table 17-40** below includes the cumulative impact assessment of these projects.

Table 17-40 Cumulative Impact Assessment for Harbour Seal

Project (and phase)	Phase of the Facility	Potential Cumulative Impact	Assessment for other Project	Assessment for the Facility	Cumulative Impact Assessment
Triton Knoll OWF (operation)	Construction	Underwater noise impacts	The ES for Triton Knoll OWF states that an increase in noise associated with the operational vessels should be set against the already high level of background noise levels from commercial shipping activity in the area. It was concluded that the impact significance of any increase in operational noise (including vessels) would be negligible (Triton Knoll Offshore Wind Farm Limited, 2012).	Less than one harbour seal will be at risk from PTS from piling activities at the Principal Application Site (0.008), and less than one would be at risk of PTS from dredging activities (0.0002). Less than one seal would also be at risk of TTS from piling (0.37), or from dredging activities (0.0002). The very small number of harbour seal potentially at risk of PTS or TTS onset results in a negligible magnitude, and minor impact overall (when taking into account sensitivity to noise). Mitigation put in place would further reduce the potential for impact to harbour seal. Disturbance from vessels, based on very worst-case and precautionary assessment, could impact up to 33.4 harbour seals. Any such disturbance would be localised and temporary, and result in a very small proportion of the population potentially being impacted. Harbour seals have a low sensitivity to vessel disturbance, and the very low number of individuals potentially	Taking into account the very low number of harbour seal potentially at risk of PTS, TTS, or disturbance as a result of piling or dredging activities at the Principal Application Site, or the increase in vessels, and the low likelihood of impact from the Triton Knoll OWF during operation, it is concluded that there is **no risk of significant cumulative impacts** from the two projects together, with a very low number of individuals potentially impacted.

Project (and phase)	Phase of the Facility	Potential Cumulative Impact	Assessment for other Project	Assessment for the Facility	Cumulative Impact Assessment
				impacted temporarily results in a negligible impact.	
		Increased risk of collision	The ES for Triton Knoll OWF states given the high numbers of vessels in the area already, marine mammals are likely to be habituated, and the low level of increase in vessel numbers mean that there would be minor impact to marine mammal populations overall (Triton Knoll Offshore Wind Farm Limited, 2012).	The increase in vessel numbers could, based on very worst-case and precautionary assessment, increase the risk of collision to up to two harbour seals (1.7). The sensitivity of harbour seal to an increase in collision is low, and with the very small number of seal potentially impacted, there would be a minor adverse impact.	The very small number of harbour seal at increased risk of collision from the Facility and Triton Knoll OWF together is **unlikely to result in a significant cumulative impact** to the harbour seal population.
	Operation	Underwater noise impacts	The ES for Triton Knoll OWF states that an increase in noise associated with the operational vessels should be set against the already high level of background noise levels from commercial shipping activity in the area. It was concluded that the impact significance of any increase in operational noise (including vessels) would be negligible (Triton Knoll Offshore Wind Farm Limited, 2012).	Disturbance from vessels, based on very worst-case and precautionary assessment, could impact up to 33.4 harbour seals. Any such disturbance would be localised and temporary, and result in a very small proportion of the population potentially being impacted. Harbour seals have a low sensitivity to vessel disturbance, and the very low number of individuals potentially impacted temporarily results in a negligible impact.	Taking into account the very low number of harbour seal potentially at risk disturbance as a result of the increase in vessels, and the low likelihood of impact from the Triton Knoll OWF during operation, it is concluded that there is **no risk of significant cumulative impacts** from the two projects together, with a very low number of individuals potentially impacted.
		Increased risk of collision	The ES for Triton Knoll OWF states given the high numbers of	The increase in vessel numbers could, based on very worst-case and	The very small number of harbour seal at increased risk

Project (and phase)	Phase of the Facility	Potential Cumulative Impact	Assessment for other Project	Assessment for the Facility	Cumulative Impact Assessment
			vessels in the area already, marine mammals are likely to be habituated, and the low level of increase in vessel numbers mean that there would be minor impact to marine mammal populations overall (Triton Knoll Offshore Wind Farm Limited, 2012).	precautionary assessment, increase the risk of collision to up to two harbour seals (1.7). The sensitivity of harbour seal to an increase in collision is low, and with the very small number of seal potentially impacted, there would be a minor adverse impact.	of collision from the Facility and Triton Knoll OWF together is **unlikely to result in a significant cumulative impact** to the harbour seal population.
VikingLink (construction)	Construction	Underwater noise impacts	Underwater noise sources with the potential for PTS and TTS during construction of the VikingLink project include Side Scan Sonar (SSS) and Multi-Beam Echosounder (MBES). Disturbance impacts were predicted to occur from all potential construction activities, including SSS and MBES, Pingers, vessel noise, cable trenching and rock placement (National Grid Viking Link Ltd. and Energinet.dk, 2017). The assessment found that seals are at risk of either PTS or TTS onset from SSS, MBES and pingers, and TTS onset from vessels, with the worst-case injury	Less than one harbour seal will be at risk from PTS from piling activities at the Principal Application Site (0.008), and less than one would be at risk of PTS from dredging activities (0.0002). Less than one seal would also be at risk of TTS from piling (0.37), or from dredging activities (0.0002). The very small number of harbour seal potentially at risk of PTS or TTS onset results in a negligible magnitude, and minor impact overall (when taking into account sensitivity to noise). Mitigation put in place would further reduce the potential for impact to harbour seal. Disturbance from vessels, based on very worst-case and precautionary assessment, could impact up to 33.4	Mitigation on the VikingLink project would ensure that any potential impact of PTS or TTS to harbour seal would be at a negligible level. Taking this into account with the very low number of harbour seal potentially at risk of PTS, TTS, or disturbance as a result of piling or dredging activities at the Principal Application Site, or the increase in vessels, it is concluded that there is **no risk of significant cumulative impacts** from the two projects together, with a very low number of individuals potentially impacted, and no

Project (and phase)	Phase of the Facility	Potential Cumulative Impact	Assessment for other Project	Assessment for the Facility	Cumulative Impact Assessment
			zone predicted from the MBES (with an impact range of 50 m for TTS onset, and 15 m for PTS). For disturbance impacts to seals, the SBP and vessels have the largest impact ranges, with 16 km and 2.8 km respectively. The potential for PTS and / or TTS onset was assessed as moderate adverse, due to the potential for injury to highly protected species. With mitigation, the impact was assessed as negligible for PTS and / or TTS onset (National Grid Viking Link Ltd. and Energinet.dk, 2017). The assessment of disturbance of seals for SBP and vessels resulted in an impact assessment of minor, due to the short-term and localised nature of the activities. The potential for disturbance for other activities was assessed as negligible for seal species due to the short term nature, and smaller impact ranges	harbour seals. Any such disturbance would be localised and temporary, and result in a very small proportion of the population potentially being impacted. Harbour seals have a low sensitivity to vessel disturbance, and the very low number of individuals potentially impacted temporarily results in a negligible impact.	risk of impact to the harbour seal population.

Project (and phase)	Phase of the Facility	Potential Cumulative Impact	Assessment for other Project	Assessment for the Facility	Cumulative Impact Assessment
			(National Grid Viking Link Ltd. and Energinet.dk, 2017).		
		Increased risk of collision	The ES for VikingLink states that as the vessels associated with the project will be travelling relatively slowly, the likelihood of collision is very low, and therefore assessed to be a negligible impact (National Grid Viking Link Ltd. and Energinet.dk, 2017).	The increase in vessel numbers could, based on very worst-case and precautionary assessment, increase the risk of collision to up to two harbour seals (1.7). The sensitivity of harbour seal to an increase in collision is low, and with the very small number of seal potentially impacted, there would be a minor adverse impact.	The very small number of harbour seal at increased risk of collision from vessels using the Facility and the VikingLink project together is **unlikely to result in a significant cumulative impact** to the harbour seal population.
VikingLink (operation)	Construction and operation	Underwater noise impacts	During operation, maintenance surveys may be carried out, including the use if SSS, MBES, and pingers. Therefore, the same impacts are predicted as those for the same activities during construction (National Grid Viking Link Ltd. and Energinet.dk, 2017). The potential for PTS and / or TTS onset was assessed as moderate adverse, due to the potential for injury to highly protected species. With mitigation, the impact was assessed as negligible for PTS	Less than one harbour seal will be at risk from PTS from piling activities at the Principal Application Site (0.008), and less than one would be at risk of PTS from dredging activities (0.0002). Less than one seal would also be at risk of TTS from piling (0.37), or from dredging activities (0.0002). The very small number of harbour seal potentially at risk of PTS or TTS onset results in a negligible magnitude, and minor impact overall (when taking into account sensitivity to noise). Mitigation	Mitigation on the VikingLink project would ensure that any potential impact of PTS or TTS to harbour seal would be at a negligible level. Taking into account the very low number of harbour seal potentially at risk of PTS, TTS, or disturbance as a result of piling or dredging activities at the Principal Application Site, or the increase in vessels, it is concluded that there is **no**

Project (and phase)	Phase of the Facility	Potential Cumulative Impact	Assessment for other Project	Assessment for the Facility	Cumulative Impact Assessment
			and / or TTS onset (National Grid Viking Link Ltd. and Energinet.dk, 2017). The assessment of disturbance of seals for SBP and vessels resulted in an impact assessment of minor, due to the short-term and localised nature of the activities. The potential for disturbance for other activities was assessed as negligible for seal species due to the short term nature, and smaller impact ranges (National Grid Viking Link Ltd. and Energinet.dk, 2017).	put in place would further reduce the potential for impact to harbour seal. Disturbance from vessels, based on very worst-case and precautionary assessment, could impact up to 33.4 harbour seals. Any such disturbance would be localised and temporary, and result in a very small proportion of the population potentially being impacted. Harbour seals have a low sensitivity to vessel disturbance, and the very low number of individuals potentially impacted temporarily results in a negligible impact.	**risk of significant cumulative impacts** from the two projects together, with a very low number of individuals potentially impacted, and no risk of impact to the harbour seal population.
		Increased risk of collision	The ES for VikingLink states that as the vessels associated with the project will be travelling relatively slowly, the likelihood of collision is very low, and therefore assessed to be a negligible impact (National Grid Viking Link Ltd. and Energinet.dk, 2017).	The increase in vessel numbers could, based on very worst-case and precautionary assessment, increase the risk of collision to up to two harbour seals (1.7). The sensitivity of harbour seal to an increase in collision is low, and with the very small number of seal potentially impacted, there would be a minor adverse impact.	The very small number of harbour seal at increased risk of collision from vessels using the Facility and the VikingLink project together is **unlikely to result in a significant cumulative impact** to the harbour seal population.
Overall Cumulative Impact Assessment					

Project (and phase)	Phase of the Facility	Potential Cumulative Impact	Assessment for other Project	Assessment for the Facility	Cumulative Impact Assessment
Triton Knoll OWF (operation) And VikingLink (construction – as the worst-case)	Construction (as the worst-case)	Underwater noise impacts	Taking into account the very low number of harbour seal potentially at risk of PTS, TTS, or disturbance as a result of piling or dredging activities at the Principal Application Site, or the increase in vessels, and the low likelihood of impact from the Triton Knoll OWF during operation, and the potential for impact to harbour seal (after mitigation) on the VikingLink project, it is concluded that there is **unlikely to be a risk of significant cumulative impacts** from the two projects together, with a very low number of individuals potentially impacted, and **no risk of impact to the harbour seal population**.		
		Increased risk of collision	The very small number of harbour seal at increased risk of collision from vessels using the Facility, Triton Knoll OWF and the VikingLink project together is **unlikely to result in a significant cumulative impact** to the harbour seal population.		

17.10 Inter-Relationships with Other Topics

17.10.1 The potential impacts on marine and coastal ecology as assessed in this chapter have inter-relationships with other chapters. **Table 17-41** presents the impacts considered in this chapter and highlights that the chapter has been informed by the assessments described in **Chapter 10 Noise and Vibration, Chapter 14 Air Quality, Chapter 16 Estuarine Processes** and **Chapter 15 Marine Water and Sediment Quality**.

Table 17-41 Chapter Topic Inter-Relationships

Topic and description	Related Chapter	Where addressed in this Chapter
Airborne and underwater noise (piling and vessel movements)	**Chapter 10 Noise and Vibration**	**Section 17.8**
Effects on water column (suspended sediment concentrations and water quality)	**Chapter 16 Estuarine Processes** **Chapter 15 Marine Water and Sediment Quality**	**Section 17.8**
Changes in vessel traffic and movement leading to increased ship wash, underwater noise, disturbance and collision risk	**Chapter 10 Noise and Vibration** **Chapter 16 Estuarine Processes**	**Section 17.8**
Increased levels of contaminants in water column	**Chapter 16 Estuarine Processes** **Chapter 15 Marine Water and Sediment Quality**	**Section 17.8**
Increased emissions to air and deposition on marine and estuarine habitats	**Chapter 14 Air Quality**	**Section 17.8**

17.11 Interactions

17.11.1 The potential impacts identified and assessed in this chapter have the potential to interact with each other, which could give rise to synergistic impacts because of that interaction. The worst case impacts assessed within the chapter take these interactions into account and for the impact assessments are considered conservative and robust.

17.11.2 For clarity, the areas of interaction between impacts are presented in **Table 17-42**, along with an indication as to whether the interaction may give rise to synergistic impacts.

Table 17-42 Interaction Between Impacts

Potential interaction between impacts				
Construction				
	Loss of and/or change to estuarine habitats due to capital dredging	**Increased suspended sediment concentrations from capital dredging, with potential for sediment-bound contaminants to be released**	**Disturbance due to construction activity / increased vessel presence (excluding underwater noise but including airborne noise)**	**Underwater noise (piling and vessel movements)**
Loss of and/or change to estuarine habitats due to capital dredging and reclamation due to quay construction	-	No	No	No
Increased suspended sediment concentrations from capital dredging, with potential for sediment-bound contaminants to be released	No	-	Yes, but the disturbance issue is included in the general construction disturbance	No
Disturbance due to construction activity/increased vessel presence (excluding underwater noise but including airborne noise)	No	Yes, but the disturbance issues is covered under general construction noise and visual disturbance.	-	No as different species affected.
Underwater noise (piling and dredging)	No	No	No	-

Potential interaction between impacts				
Operation				
	Habitat alteration due to hydrodynamic changes	**Changes in vessel traffic and movement leading to increased underwater noise, disturbance and collision risk**	**Increased suspended sediment concentrations due to maintenance dredging**	**Increased emissions to air and deposition on marine and estuarine habitats**
Habitat alteration due to hydrodynamic changes	-	No	No	No
Changes in vessel traffic and movement leading to increased ship wash, underwater noise, disturbance at seal haul-out sites and collision risk	No	-	Yes, but increases in suspended sediment highly localised impact and as species affected are highly mobile this is not considered to be an issue.	No
Increased suspended sediment concentrations due to maintenance dredging	No	Yes, but increases in suspended sediment highly localised impact and as species affected are highly mobile this is not considered to be an issue.	-	No
Increased emissions to air and deposition on marine and estuarine habitats	No	No	No	-
Decommissioning				
No impacts on marine and coastal ecology are anticipated during the decommissioning phase.				

17.12 Summary

17.12.1 The significance of potential impacts on the marine and coastal ecological receptors arising from the construction and operation of the Facility have been assessed. No impact is predicted for the decommissioning phase as it is planned that the wharf will be left in place.

17.12.2 The main potential impacts arising from the proposed scheme are habitat loss/alteration, increased suspended sediment concentrations and increased noise and visual disturbance caused by piling and ship movements. The sensitive receptors include fish species, benthic communities, birds, marine mammals, saltmarsh and mudflats.

17.12.3 A summary of all effects, associated mitigation and residual effect has been included in **Table 17-43**.

17.12.4 Potential impacts of the proposed Facility during the construction and operational phases have also been assessed in the HRA (**Appendix 17.1**), which covers the following sites:

- The Wash SPA.
- The Wash Ramsar site.
- The Wash and North Norfolk Coast SAC.

Table 17-43 Impact Summary

Potential Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Mitigation	Residual Effect
Construction						
Impact 1: Loss of and/or change to estuarine habitats and associated species within the footprint of the wharf and dredging area	Mudflats	Low	Medium	Minor adverse	Material removed to be restricted to a minimum. The design of the quay wall and wharf has been set to minimise the volume of capital dredging required. Habitat mitigation through enhancement of roosting and foraging area in a Habitat Mitigation Area. Biodiversity net gain measures in place to create habitat which would offset the loss of habitat.	Minor adverse
	Saltmarshes	Medium	Medium	Moderate adverse		Minor adverse
Impact 2: Increased suspended sediment concentrations from capital dredging, with potential for sediment-bound contaminants to be released	Fish	Medium	Medium	Moderate adverse	For fish, dredging will be limited to being undertaken during non-sensitive periods this reduces significance. No mitigation for benthic receptors is necessary.	Minor adverse
	Benthic fauna	Low	Low	Minor adverse		Minor adverse
Impact 3: Disturbance due to human activity/increased human presence (excluding	Birds	Medium	Low to Medium	Moderate adverse	The noisiest activities to be undertaken during non-sensitive	Minor adverse

Potential Impact		Receptor	Value/ Sensitivity	Magnitude	Significance	Mitigation	Residual Effect
underwater noise, but including airborne noise)						periods (May-Sep). Monitoring of bird numbers and adherence to thresholds during construction to be undertaken.	
Impact 4: Underwater noise (piling and dredging)	Underwater noise from piling and dredging works (permanent auditory injury and temporary auditory injury; PTS and TTS).	Fish	Medium	Negligible to Low	Minor adverse	Marine mammal watcher and soft-start procedures for piling undertaken in high tides.	Minor adverse
	Underwater noise from piling and dredging works (permanent auditory injury; PTS).	Harbour seal	High	Negligible	Minor adverse		Minor adverse
	Underwater noise from piling and dredging works (temporary auditory injury; TTS).	Harbour seal	Medium	Negligible	Minor adverse		Minor adverse

Potential Impact		Receptor	Value/ Sensitivity	Magnitude	Significance	Mitigation	Residual Effect
	Underwater noise from an increase in vessels	Harbour seal	Low	Negligible	Negligible	Slow speed (max. 4 knots) to be kept for all vessels. Vessel movements to be incorporated in to recognised vessel routes. Best practice measures to minimise the disturbance (such as an observer on board each vessel, looking out for marine mammals as the vessel makes its way through The Wash and up The Haven).	Negligible
	Disturbance at harbour seal haul-out sites	Harbour seal	High	Negligible	Minor adverse		Minor adverse
	Increased collision risk (impact zone includes The Wash as a transit area)	Harbour seal	Low	Medium	Minor adverse		Minor adverse
Impact 5: Increased emissions to air and deposition on marine and estuarine habitats		Marine and coastal habitats	Medium	Negligible	Negligible	N/A	Negligible
Operation							
Impact 1: Habitat alteration due to hydrodynamic changes		Intertidal and subtidal habitats	Low	Medium	Minor adverse	Dredging works to be minimised according to best practice and monitor the seabed and habitat level through regular bathymetric and habitat surveys.	Minor adverse
Impact 2: Changes in vessel traffic and movement leading to increased ship wash,		Increased risk of invasive species with ballast water	Negligible	Negligible	Negligible	Shipping to be kept to a minimum, as necessary.	Negligible

Potential Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Mitigation	Residual Effect
underwater noise, disturbance and collision risk	Intertidal habitats (increased ship wash)	Medium	Low	Minor adverse	Risk of invasive species to be managed through the NMP. Best practice measures to minimise the disturbance (such as an observer on board each vessel, looking out for marine mammals as the vessel makes its way through The Wash and up The Haven). Slow speed (max. 4 knots) to be kept for all vessels. Vessel movements to be incorporated in to recognised vessel routes.	Minor adverse
	Birds (visual disturbance)	Medium	Low	Minor adverse		Minor adverse
	Disturbance from vessels – fish species	Medium	Low	Minor adverse		Minor adverse
	Disturbance from vessels – harbour seal	Low	Negligible	Negligible		Negligible
	Disturbance at harbour seal haul-out sites	High	Negligible	Minor adverse		Minor adverse
	Increased risk of collisions for marine mammals (impact zone includes the Wash as a transit area)	Low	Medium	Minor adverse		Minor adverse
Impact 3: Increased levels of suspended sediments due to maintenance dredging	Fish (migration and behaviour)	Medium	Negligible	Minor adverse	Given that the maintenance dredging will form part of the existing wider maintenance programme, and the nature of the predicted impacts, no specific measures are considered necessary.	Minor adverse
	Benthic fauna	Low	Negligible	Negligible		Negligible

Potential Impact	Receptor	Value/ Sensitivity	Magnitude	Significance	Mitigation	Residual Effect
Impact 4: Beaching of vessels at low tide	Benthic fauna	Low	Low	Minor adverse	No mitigation was deemed necessary	Minor adverse
Impact 5: Increased emissions to air and deposition on marine and estuarine habitats	Marine and coastal habitats	Medium	Low	Minor adverse	Continuous monitoring of emissions from the stack	Negligible
Decommissioning						
No impacts on marine and coastal ecology are anticipated during the decommissioning phase.						

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