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Immingham Green Energy Terminal

Development Consent Order 2023

7.6 Shadow Habitats Regulations Assessment

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Executive Summary

This report provides information for the Secretary of State, as the relevant Competent Authority for the DCO application, to undertake the first two stages of a Habitats Regulations Assessment as required under Regulation 63 of the Conservation of Habitats and Species Regulations 2017 (as amended).

The Stage one (Screening) assessment has considered how the Project might affect five European sites. This screening stage concluded that Likely Significant Effects could not be discounted with respect to the Humber Estuary SAC, Humber Estuary SPA, Humber Estuary Ramsar site and The Wash and North Norfolk Coast.

The impact pathways screened into stage 2 (AA) covered a range of pathways including habitat loss, changes to habitats, water quality changes, airborne noise and visual disturbance, underwater noise and vibration and the introduction and spread of non-native species.

At Stage two AA, further information has been collated to examine the potential for changes in the baseline conditions as a result of the Project with reference to the conservation objectives for each site. Where relevant, mitigation measures have been proposed to reduce the potential for adverse effects.

The assessment has concluded that for the majority of pathways there is no potential for an adverse effect on site integrity or any potential for the predicted effects to compromise any of the conservation objectives with no mitigation required. However, mitigation has been identified in relation to the effects of airborne noise and visual disturbance during construction which includes restrictions on working over winter in certain locations, acoustic barriers and visual screens, soft-start marine piling and cold weather restrictions. In addition, due to the uncertainty associated with the techniques that will be used to remove the pipe racks within Work Area 2 (the jetty access road) and plant and equipment on the approach jetty topside associated with hydrogen production (within Work Area 1), a commitment has been made to undertake these works outside of the overwintering period.

Based on the distribution of birds, the likely level of disturbance and the Applicant's commitment to mitigation, it is considered that there will be no adverse effects on the integrity of either the Humber Estuary SPA or Ramsar from the effects of airborne noise and visual disturbance.

Mitigation has ~~alsobeen~~also been identified in relation to the effects of underwater noise and vibration during marine piling which includes soft-start marine piling, vibro marine piling where possible, seasonal marine piling restrictions, night-time marine piling restrictions and use of Marine Mammal Observers. Based on the assessment of effects on qualifying species (river and sea lamprey and grey seal), the likely level of disturbance and the Applicant's commitment to mitigation, it is considered that there will be no adverse effects on the integrity of the Humber Estuary SAC or Ramsar from the effects of underwater noise and vibration during marine piling. There is also considered to be no adverse effects on the integrity of The Wash and North Norfolk Coast SAC (as a result of

underwater noise and vibration during marine piling on the common seal qualifying feature), based on the Applicant's commitment to mitigation.

A review of other plans and projects that could contribute to effects has established that no significant adverse in-combination effects on site integrity with other plans and projects will occur.

In conclusion, based on best available scientific information and professional judgement, it is considered that the construction and consequent operation of the Project (alone or in combination with other plans or projects) will not have an adverse effect on the integrity of any European designated sites in view of that sites conservation objectives.

1. Introduction

1.1. Overview

1.1.1. The Immingham Green Energy Terminal ("IGET") (hereafter 'the Project') is a proposal by Associated British Ports ('ABP') (hereafter 'the Applicant') to construct and facilitate the operation by multiple users of a multi-user liquid bulk terminal, which would be located on the eastern side of the Port of Immingham (hereafter 'the Port). The Project is a Nationally Significant Infrastructure Project ("NSIP") and will therefore require submission of an application for a Development Consent Order ("DCO").

1.1.2. This Shadow Habitats Regulations Assessment ("HRA") presents Stages 1 (Screening) and 2 (Appropriate Assessment) and has been prepared to support the DCO application for the Project.

1.1.3. The land on which the Project is to be constructed (the "Site") is located in North East Lincolnshire on the south bank of the Humber Estuary to the east of the Port. The boundary of the Project is shown in **Plate 1** and is approximately centred on National Grid Reference (NGR) E520783 N415271.

1.2. Project Background

1.2.1. The Project would comprise the alteration of a harbour facility for the construction, operation and maintenance of a multi-user green energy terminal to facilitate the import and export of bulk liquids associated with the energy sector, together with associated development. The terminal would consist of a jetty and associated loading/ unloading infrastructure and pipelines.

1.2.2. Initially, the terminal would be used for the import and export of green ammonia to be converted to green hydrogen. To facilitate this, a hydrogen production facility, comprising associated ammonia handling equipment, storage and processing units would be constructed as part of the Project. Other proposed uses for the green energy terminal will come forward in due course and separate applications submitted as required. It is anticipated that a future use of the terminal will be the import of liquefied carbon dioxide to connect to adjacent carbon transport and storage networks for sequestration in the North Sea.

1.2.3. The Site is located in North East Lincolnshire on the south bank of the Humber Estuary to the east of the Port. A detailed description of the works is provided in the parameters section of **Chapter 2: The Project [TR030008/APP/6.2]**.

1.2.4. The following is a summary of the main elements of each of Work Nos 1-10:

a. The Nationally Significant Infrastructure project ("NSIP"), **Work No. 1**, comprising:

   i. On the marine side, a terminal for liquid bulks: comprising:

      A. A jetty (defined by **Work No. 1a**) including a loading platform, associated dolphins, fenders and walkways, topside infrastructure but not limited to control rooms, marine loading arms, pipe-racks, pipelines and other infrastructure.

B. A single berth, with a berthing pocket with a depth of up to 14.5m below chart datum.

ii. related landside infrastructure including, but not limited to, a jetty access ramp, a flood defence access ramp and works to raise the seawall locally under the jetty access ramp.

b. Associated Development on the landside, comprising:

i. A corridor between the new jetty and Laporte Road which would support a private road (the ‘jetty access road’), pipe-racks, pipelines to enable the ammonia import to the East Site, as well as security gates, a security building, a power distribution building and associated utilities – (**Work No. 2**).

ii. ‘East Site - Ammonia Storage’ (**Work No. 3**) on which an ammonia storage tank and related plant including an ammonia tank flare stack would be constructed (**Work No. 3a**) as well as additional buildings (including welfare building, power distribution building and a process instrumentation building), pipe-racks, pipelines, pipes, cable-racks, utilities and other infrastructure.

iii. Construction of a culvert (**Work No. 4**) under Laporte Road for pipelines, pipes and cables and other conducting media linking the two parts of the East Site.

iv. ‘East Site – Hydrogen Production Facility’ (**Work No. 5**) on which up to three hydrogen production units and associated plant including flue gas stacks and flare stacks would be constructed (**Work No. 5a**) together with additional buildings (including process control building, power distribution buildings, process instrumentation buildings, analyser shelters), pipe-racks, pipelines, pipes, utilities and other infrastructure.

v. Underground pipelines, pipes, cables and other conducting media (**Work No. 6**), between the East and West Sites, for the transfer of ammonia, hydrogen, nitrogen and utilities, with cathodic protection against saline corrosion.

vi. ‘West Site’ (**Work No. 7**) involving the construction of up to three hydrogen production units with associated flue gas stacks and flare stacks and up to four liquefier units (**Work No. 7a** and **Work No. 7b** combined); hydrogen storage tanks, hydrogen trailer filling stations, a hydrogen vent stack and associated process equipment (**Work No. 7c**); and hydrogen vehicle and trailer filling stations, hydrogen compressors and associated process equipment (**Work No. 7d**). Also additional buildings (including but not limited to control room and workshop building, security and visitor building, contractor building, warehouse, driver administration building, safe haven building, electrical substation and metering station, power distribution buildings, process instrumentation buildings, analyser buildings and additional temporary buildings during construction), process and utility plant including cooling towers and pumps, fire water tank, instrument air equipment, pipe-racks, pipelines, pipes, cable-racks, utilities and other infrastructure;

vii. Formation of temporary construction and laydown areas on Queens Road (**Work No. 8**) and off Laporte Road (**Work No. 9**).

viii. Temporary removal of street furniture and modification of overhead cables on Kings Road (**Work No. 10**) associated with the transport of large construction components from the Port to the Site.

c. Appropriate topside infrastructure installed on the jetty to load and unload vessels.

d. A small capital dredge (approximately 4000 m^3).

e. Disposal of dredged material at sea at licensed disposal sites.

~~f. Potential limited maintenance dredging during operation.~~

1.2.5. The hydrogen production facility is intended to be a continuous operation, although this would be dependent upon shipping frequency. The intention is therefore that the facility will operate 24 hours a day, seven days a week and 365 day a year. The facility would have a planned preventive maintenance programme during the operational phase. The flare stacks proposed as part of the Project are relatively small in scale (as compared to those associated with offshore oil and gas platforms or refineries), with the flame largely enclosed as a result of shrouding. Furthermore, they are only required to be used during start up, shut down and emergency use (typically less than 5% of the time annually).

1.2.6. During operation, the Terminal will operate 24 hours a day, seven days a week and 365 days a year and would be able to accommodate up to 292 vessel calls per year. Heavy Goods Vehicles (HGVs) would use the A1173 to access the Site. Operational traffic movements are detailed in **Chapter 11: Traffic and Transport [TR030008/APP/6.2**]. In summary, it is anticipated that during the operational phase of the Project, total HGV movements at the Site would be approximately 96 movements (48 in and 48 out) per day. These figures include movements associated with the delivery of consumables and removal of waste products.

1.2.7. During operation of the Project, maintenance dredging will potentially be required in the same way as currently occurs at the Port. The modelling of the scheme (as reported in **Chapter 16: Physical Processes [TR/030008/APP/6.2])** indicates that the berth pocket, once dredged, will remain swept clear of deposited material by the flood and ebb tidal flows (in much the same way the existing Immingham Oil Terminal berths are). Consequently, the need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all). Should maintenance dredging be required, it is proposed to be incorporated within the maintenance dredge licence for Immingham (L/2014/00429/1) as part of the renewal of the licence at the end of 2025.

1.2.8. Regarding engineering and maintenance works in Work No. 1, this activity is expected to be limited and only required occasionally.

1.2.9. Further information on the operational phase is provided in **Section 2.6** of **Chapter 2: The Project [TR030008/APP/6.2**].

1.2.10. No provision has been made for the decommissioning of the jetty, jetty head, jetty access ramp and the jetty access road. This is because these elements would, once constructed, become part of the fabric of the Immingham port estate and would, in simple terms, continue to be maintained so that they can be used for port-related activities to meet a long-term need. On this basis decommissioning of these elements is not considered within the Shadow HRA as no pathways exist that would cause potential effects on features of the Humber Estuary European Marine Site.

1.2.11. When appropriate, the infrastructure associated with the hydrogen production facility may be decommissioned. The majority of the proposed landside decommissioning works are well in excess of 200 m from the foreshore (located within Work Area 5). Similarly, there are no areas of terrestrial habitat within or adjacent to the Project boundary that are considered functionally linked land (and as such do not provide important habitat for SPA species). On this basis, marine ornithology receptors (i.e. coastal waterbirds) are considered to be out of the zone of potential effects associated with most decommissioning elements. The exception to this will be the removal of pipe racks within Work Area 2 (the jetty access road) and plant and equipment on the approach jetty topside associated with hydrogen production (within Work Area 1) which have been considered in the Shadow HRA.

1.2.12. ~~1.2.5.~~ **The consenting route** – given the effect of the proposed alteration to the existing harbour facility is to increase by at least the relevant quantity per year (5 million tonnes) the quantity of material the embarkation or disembarkation of which the facilities are capable of handling, the Project has been taken forward as an NSIP. In light of this, ABP are submitting a DCO application for authorisation for the Project and has prepared an Environmental Statement ("ES") as part of the DCO application process. Ultimately the DCO application will be submitted to the Secretary of State for Transport (the "Secretary of State") for authority to construct and then operate the Project. Additional consents and approvals that are required for the construction and operation of the Project will, with the agreement of the appropriate consenting bodies, be incorporated within the final DCO. This includes a deemed marine licence, in consultation with the Marine Management Organisation ("MMO"), as part of the DCO.

1.2.13. ~~1.2.6.~~ A single Shadow Habitat Regulations Assessment ("HRA") has been produced for the entirety of the Project. The information within this report will assist the Competent Authority (in this case the Secretary of State in respect of the determination of the DCO application) with their review under Regulation 63 of the Conservation of Habitats and Species Regulations 2017 (as amended) (the 'Habitats Regulations')[1] in determining the need for Appropriate Assessment ("AA").

1.2.14. ~~1.2.7.~~ This report has been informed by the assessments undertaken in Chapter 6: Air Quality [TR030008/APP/6.2], Chapter 9: Nature Conservation (Marine Ecology) [TR030008/APP/6.2], Chapter 10: Ornithology [TR030008/APP/6.2],

1 Following the UK leaving the EU, these have been modified by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019.

Chapter 16: Physical Processes [TR030008/APP/6.2] and Chapter 17: Marine Water and Sediment Quality [TR030008/APP/6.2] of the ES. A description of the Project and details on construction and operational methodologies are provided in Chapter 2: The Project [TR030008/APP/6.2] of the ES.

Plate 1: Location of the Project


AECOM
PROJECT
Immingham Green Energy Terminal
CLIENT
Associated British Ports
LEGEND
Site Boundary
Immingham
Environmental Statement
Location of the proposed development
Figure 01

1.3. The Habitats Regulations Assessment Process

1.3.1. The 'Habitats Regulations') (Ref 1-1) transposed the requirements of Council Directive 92/43/EEC (as amended) (Ref 1-2) on the conservation of natural habitats and of wild fauna and flora (the 'Habitats Directive') and Council Directive 2009/147/EC on the conservation of wild birds (the 'Birds Directive') (Ref 1-3) into UK law. Following the UK leaving the EU, the Habitats Regulations have been amended by the Conservation of Habitats and Species (Amendment) (EU Exit) Regulations 2019 (Ref 1-4). The only material modification of relevance to this ~~assessments~~assessment is how the protected site network is referred to (see **Paragraph 1.3.2**).

1.3.2. The Habitats Regulations as amended Ref 1-4 refers to a National Site Network within the UK which comprises the protected sites already designated under the Habitats Regulations (Ref 1-1). In this report the sites within the National Site Network have been referred to either by their designation (e.g. Special Area of Conservation ("SAC")) or collectively as 'European sites'.

1.3.3. The European sites protected under the Habitats Regulations include SACs, Sites of Community Importance ("SCIs"), candidate SACs ("cSACs") and Special Protection Areas ("SPAs"). According to Paragraph 181 of the National Planning Policy Framework ("NPPF") (Ref 1-5), in England equivalent protection also applies to Ramsar sites (designated under the 1971 Ramsar Convention (Ref 1-6) for their internationally important wetlands), possible SACs ("pSAC"), potential Special Protection Areas ("pSPA"), and proposed Ramsar sites and any sites identified, or required, as compensatory measures for adverse effects on any of the aforementioned sites.

1.3.4. As Competent Authority for the DCO application, the Secretary of State is required to take account of the Habitats Regulations and undertake an AA of the Project where a conclusion is reached that the Project (either on its own or in combination with other plans or projects) would be likely to have a significant effect, directly and/or indirectly, on the European/Ramsar sites. As summarised above, Regulation 63(1) of the Habitats Regulations states that:

> *"A competent authority, before deciding to undertake, or give any consent, permission, or other authorisation for a plan or project which:*
>
> *a) is likely to have a significant effect on a European site or a European offshore marine site (either alone or ~~in combination~~in-combination with other plans or projects); and*
>
> *b) is not directly connected with or necessary to the management of the site*
>
> *must make an appropriate assessment of the implications for the site in view of that site's conservation objectives".*

1.3.5. The decision as to whether an AA is required is based on an assessment of likely significant effect ("LSE"). LSE is recognised as being an objective judgement or a statement that the anticipated effects of the proposal will be more than trivial (i.e., that the anticipated changes resulting from a proposal have the potential to impact on an interest feature of a European/Ramsar site). If a project (or plan) could have an LSE on a European/Ramsar site, it does not automatically follow that an impact will occur. The decision of LSE is purely an indication of the need for an AA (Ref 1-7).

1.3.6. In an AA, it is necessary to determine whether the project or plan would result in an adverse effect on the integrity ("AEOI") of the European/Ramsar site(s) in view of the site's conservation objectives. The integrity of a site has been defined as the "coherence of its ecological structure and function, across its whole area that enables it to sustain the habitat, complex of habitats and/or the levels of populations of the species for which it was designated" (Ref 1-8).

1.3.7. Subject to the provisions of Regulation 64 and 68 of the Habitat Regulations, the competent authority may only agree to the plan or project after having ascertained that it will not adversely affect the integrity of the European sites.

1.3.8. Where it cannot be demonstrated that a project will not have an AEOI of the European sites, or there is insufficient certainty of an avoidance of an adverse effect, the activities can only proceed where the requirements of the derogation process under Regulations 64 and 68 of the Habitats Regulations is satisfied. In this case it must be demonstrated that there are no alternative solutions which achieve the project objectives and would avoid or have a lesser effect on the European sites. It must then be demonstrated that the Project is necessary for Imperative Reasons of Overriding Public Interest ("IROPI") and to ensure that adequate compensation, usually in the form of replacement habitat, has been secured to protect the overall coherence of the UK National Site Network (i.e., European/Ramsar sites) (Ref 1-9).

1.3.9. The decision as to whether the integrity of the European sites is adversely affected will be made by the Secretary of State as Competent Authority for the DCO application, in consultation with Natural England.

1.3.10. The Shadow HRA process for NSIPs comprises a three stage process, as detailed in the Planning Inspectorate ("PINS") Advice Note 10 (Ref 1-9):

- **Stage 1. Screening** – check if the proposal is likely to have a significant effect on the qualifying features of European site(s)'s , both alone or in combination with other plans or projects. At this stage, and in light of the decision of the Court in the case of (People Over Wind and Sweetman v Coillte Teoranta (Case C-323/17)), mitigation measures proposed for the purpose of avoiding or minimising risk to a European site may not be taken into account. If a conclusion of no LSE is reached for all/the European site(s), their qualifying features having been fully taken into account, it is not necessary to proceed to the next stage of HRA.

- **Stage 2. Appropriate assessment** – assess the implications of the proposal for the qualifying features of the European site(s), in view of the site(s)' conservation objectives and identify ways to avoid or minimise any effects. Where there is a negative assessment, either because an AEOI is found to be likely or cannot be excluded, consent must be refused unless an exemption (Stage 3 (Derogation)) is justified.

- **Stage 3. Derogation** – following a negative assessment, consider if proposals qualify for an exemption. There are three tests to this stage to be followed in order: demonstrating that there are no alternative solutions to deliver the project objectives demonstrating that there are IROPI; and demonstrating that satisfactory compensatory measures been secured which ensure that the coherence of the European Sites is protected. Each test must be passed in sequence for a derogation to be granted.

1.4. Report Structure

1.4.1. This report has been structured as follows:

a. **Section 1: Introduction** provides a brief description of the Project and an overview of the need for an HRA.

b. **Section 2: Consultation** presents the outcome of the consultation that has been undertaken to date, along with how it has influenced the Shadow HRA.

c. **Section 3: Stage 1 - Screening** reviews the location of the Project in relation to European/Ramsar sites and the potential for it to result in an LSE on the interest features of these sites.

d. **Section 4: Stage 2 – Appropriate Assessment** reviews the potential for the Project to result in an AEOI on the interest features of European/ Ramsar sites, including in-combination effects.

e. **Section 5: Conclusions** presents a brief summary of the findings of this report.

2. Consultation

2.1. Introduction

2.1.1. A scoping exercise was undertaken in August 2022 to establish the form and nature of the Shadow HRA, and the approach and methods to be followed. The Scoping Report **(Appendix 1.A [TR030008/APP/6.4])** records the findings of the scoping exercise and details the technical guidance, standards, best practice and criteria being applied in the assessment to identify and evaluate the likely significant effects of the Project on designated sites. A Scoping Opinion was adopted by the Secretary of State on 10 October 2022 **[TR030008/APP/6.4].**

2.1.2. Statutory Consultation took place between 9 January and 20 February 2023 in accordance with the Planning Act 2008. The Applicant prepared a Preliminary Environmental Information Report ("PEI" Report), which was publicised at the consultation stage.

2.1.3. As a result of consideration of the responses to the first Statutory Consultation, the developing environmental assessments and through ongoing design-development and assessment, a series of changes within the Project were identified. A second Statutory Consultation took place between 24 May and 20 July in accordance with the Planning Act 2008 and a PEI Report Addendum was publicised to support the consultation.

2.1.4. The consultation undertaken with statutory consultees to inform this Shadow HRA, including a summary of comments raised via the formal scoping opinion **(Appendix 1.A [TR030008/APP/6.4])** and in response to the formal consultation and other pre-application engagement is summarised in **Table 1**.

2.1.5. Other topic-specific comments are included in the individual ES chapters (e.g. Chapter 9: Nature Conservation (Marine Ecology) [TR030008/APP/6.2] and Chapter 10: Ornithology [TR030008/APP/6.2]).

Table 1: Summary of consultation responses relating to Shadow HRA.

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
Natural England	Scoping opinion, Chapter 5: Air Quality 10 October 2022	We note and welcome the report's reference to the assessment of air quality issues arising from traffic generation during the construction and operational lifetime of the scheme (para 5.2.1). Natural England has produced guidance for public bodies to help assess the impacts of road traffic emissions to air quality capable of affecting European Sites. Natural England's approach to advising competent authorities on the assessment of road traffic emissions under the Habitats Regulations -NEA001	The air quality assessment does quantify the impact of onsite emissions, including those from docked vessels, on air quality sensitive habitats, including nearby saltmarsh habitat within the SAC.
Natural England	Scoping opinion, Chapter 5: Air Quality 10 October 2022	With regard to the construction phase the focus on PM10, set out in this para (5.6.2) should be reviewed with regard to its suitability for ecological receptors including designated sites in the context of the APIS information (site relevant critical loads).NO2 and PM2.5 should also be included in this assessment.	The construction phase assessment on air quality reported in the ES **(Chapter 9: Nature Conservation (Marine Ecology) [TR030008/APP/6.2])** has been undertaken in line with relevant Institute of Air Quality Management ("IAQM") guidance and includes consideration of relevant impacts at sensitive habitats.
Planning Inspectorate	Scoping opinion, Chapter 7: Nature Conservation (Terrestrial Ecology) 10 October 2022	Impacts on designated marine ecology features would be assessed in accordance with ES Chapter 8 and impacts on designated ornithology features would be assessed in accordance with Chapter 9. The Inspectorate agrees that this matter can be scoped from terrestrial ecology assessment on the basis that no impacts are anticipated on the Humber Estuary Special Area of Conservation (SAC), Special Protection Area (SPA), Ramsar and Site of Special Scientific Interest (SSSI), collectively referred to as the Humber EMS, and as impacts on marine ecology and ornithology for these designated sites will be assessed	Scoping opinion noted. The effects on European designated sites are considered in **Chapters 9: Nature Conservation (Marine Ecology) [TR030008/APP/6.2], Chapter 10: Ornithology [TR030008/APP/6.2]** and in the Shadow HRA (this report).

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
		elsewhere in the ES.	
Natural England	Scoping opinion, Chapter 9: Nature Conservation (Marine Ecology) 10 October 2022	" The development site is within or may impact on the following European/internationally designated nature conservation site(s): •Humber Estuary Special Area of Conservation (SAC) •Humber Estuary Special Protection Area (SPA); •Humber Estuary Ramsar site. •Greater Wash Special Protection Area (SPA) Natural England broadly agrees with this section of the Scoping Report which detail the potential impact pathways on the designated sites during both construction and operation phases of the proposed development.	Scoping opinion noted. These sites are considered within the Shadow HRA (this report).
Planning Inspectorate	Scoping opinion, Chapter 9: Nature Conservation (Marine Ecology) 10 October 2022	In addition to the Humber Estuary European sites, the Proposed Development may also impact on the Greater Wash SPA and this should be considered within the ES.	Noted. The SPA is considered in the Shadow HRA (this report) in **Section 3** (Stage 1-Screening).
Natural England	Statutory Consultation January 2023	**Internationally and nationally designated sites** The application site is in close proximity to European designated sites (also referred to as Habitat sites), and therefore has the potential to affect their interest features. European sites are afforded protection under the Conservation of Habitats and Species Regulations 2017, as amended (the 'Habitats Regulations'). The application site is within and adjacent to the Humber Estuary	Stage 1 (Screening) and Stage 2 (Appropriate Assessment) of this Shadow HRA considers potential impacts on international designations with respect to LSE and the potential for AEOI.

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
		Special Area of Conservation (SAC) and Special Protection Area (SPA) which are European sites. The site is also listed as Humber Estuary Ramsar Site 1 and notified at a national level as Humber Estuary Site of Special Scientific Interest (SSSI). The consultation documents provide some screening information for the Habitats Regulations Assessment (HRA). It is Natural England's advice that the proposal is not directly connected with or necessary for the management of the European site. You should therefore determine whether the proposal is likely to have a significant effect on any European site, proceeding to the Appropriate Assessment stage where significant effects cannot be ruled out.	
Natural England	Statutory Consultation January 2023	**PEIR Appendix 9.C HRA screening** Natural England has reviewed PEIR Appendix 9C which provides the results of a preliminary screening exercise identifying the potential impact pathways. Natural England is broadly in agreement with the high-level impact pathways set out in **Table 3**: Potential effects on the European sites, however future iterations will need to drill down further into the impacts on the individual qualifying features of the designated sites and demonstrate a much greater level of detail of when these impacts may arise. The summary of preliminary conclusions at 3.4 presents a list of features that have been screened in for further assessment, but where features have been screened out there is no explanation provided. Natural England considers that it is important to provide justification related to the screening of features, particularly where an impact pathway has been screened out. We appreciate that this information may be within other chapters of the PEIR, if so, there should be clear links to the relevant sections.	Noted. Stage 1 of the full Shadow HRA includes further detail on the rationale for screening out features **(Section 3**).

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
Natural England	Statutory Consultation January 2023	**Chapter 6: Air Quality** 1) Potential air quality impacts from traffic during construction and operation phases Paragraph 6.3.13 states that Institute of Air Quality Management (IAQM) and Environmental Protection UK (EPUK) guidance has been used to inform the assessment. Natural England guidance NEA0012 should also be followed when undertaking the assessment. 2) Ammonia (NH3), along with nitrous oxides (NOx), can contribute to N-deposition in the soil and potential eutrophication of habitats. Whereas background levels of nitrous oxides have shown a steady decline over time due to reduced emissions from vehicles and other sources, levels of ammonia have remained relatively stable over the last 30 years. Ammonia can be emitted from vehicle exhaust emissions as a by-product of the catalytic conversion process designed to reduce emissions of nitrogen oxide. 3) Ammonia emissions from road traffic could make a significant difference to nitrogen deposition close to roads. As traffic composition transitions toward more petrol and electric cars (i.e., fewer diesel cars on the road), catalytic converters may aid in reducing NOx emissions but result in increased ammonia emissions (see https://www.aqconsultants.co.uk/news/february-2020-(1)/ammonia-emissions-from-roads-for-assessing-impacts). Therefore, we advise that further consideration is needed within the air quality assessment. 4) There are currently two models which can be used to calculate the ammonia concentration and contribution to total N deposition from road sources. One of these models is publicly available and called CREAM (Air Quality Consultants - News - Ammonia Emissions from Roads for Assessing Impacts on Nitrogen-Sensitive Habitats (aqconsultants.co.uk), and there is another	1) The method of assessment of road traffic emissions impacts has been set out in **Section 6.4** of **Chapter 6: Air Quality [TR030008/APP/6.2]**. The assessment presented in Section 4.7 of this document has been undertaken in line with relevant and appropriate guidance. This includes reference to Natural England guidance, where there is the potential for road traffic emissions to impact on a relevant and sensitive habitat. 2) Noted. 3) The assessment reported in **Section 6.8** of **Chapter 6: Air Quality [TR030008/APP/6.2]** and **Section 4.7** of this document has included consideration of NH_3 emissions on relevant and sensitive habitat. 4) Noted. 5) Noted. Operational traffic numbers have been revised since the first Statutory Consultation and therefore this pathway has been scoped into both the impact assessment and HRA (see **Section 4.7** of this document).

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
		produced by National Highways. 5) Paragraph 6.8.47 states that it is likely that during operation the traffic movements will equal approximately 96 two-way movements per day, which is below the significance threshold identified in Natural England guidance NEA001. We recommend that this is still considered within the Shadow HRA, particularly if these numbers are subject to change.	
Natural England	Statutory Consultation January 2023	Potential air quality impacts from marine vessels during construction phase Paragraph 6.8.32 states that although the construction vessel working area is adjacent to the SAC, receptors sensitive to air pollution impacts are not present in the vicinity of the vessels, and the nearest sensitive receptor (saltmarsh) is 3km from the location. Natural England advises that this should be clearly explained within the Shadow HRA.	Air quality sensitive receptors within the SAC that are included in the air quality assessment are illustrated on **Figure 6.3 [TR030008/APP/6.3]** and are included in this Shadow HRA as summarised below. **Table 3**of this HRA sets out the rationale for excluding construction vessel emissions as a pathway for LSE on the Humber Estuary SPA, and **Table 5** of this HRA for the Humber Estuary Ramsar. In summary, this is because none of the habitats within the zone of influence of the construction vessel working area support vegetation that could be sensitive to vessel emissions (intertidal mudflats and subtidal estuarine habitats).
Natural England	Statutory Consultation January 2023	Potential dust emissions during construction phase. We note that at 6.8.7 a 50m buffer for ecological receptors within nature conservation sites has been used. Natural England advises that designated site ecological receptors within 200m should be assessed for potential impacts from	Noted. The construction dust assessment that has been reported in **Section 6.8** of **Chapter 6: Air Quality [TR030008/APP/6.2]** has followed the methodology based on relevant guidance, . Designated habitats within 200m of landside

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
		dust emissions. However, we agree with paragraph 6.8.19 which states that tidal mudflat has been identified as not being sensitive to dust impacts, therefore we advise that if all ecological receptors within 200m are mudflat then this impact pathway can be screened out.	construction activities are intertidal mudflats, which are not sensitive to dust emissions. All other construction activities are greater than 200 m from the designated habitats.
Natural England	Statutory Consultation January 2023	<u>Potential air quality impacts from marine vessel emissions and landside plant emissions during operation phase</u> Natural England notes that paragraphs 6.8.38 – 6.1.2 consider the combined emissions from both the marine vessel emissions and the landside plant emissions together, it would be useful to understand the contributions from each of these impact pathways, as this will be useful to inform the effectiveness of any mitigation put in place.	**Section 6.8** of **Chapter 6: Air Quality [TR030008/APP/6.2]** has reported the air quality impact assessment, including the contribution from vessel emissions and landside plant. These sources of emissions are not modelled separately within the air quality modelling. Changes in air quality during construction and operation could not be screened out of LSE for some Humber Estuary SAC/Ramsar habitat features, and therefore have been subject to appropriate assessment within this Shadow HRA (See **Section 4.7**). However, the assessment has not identified any requirements for mitigation.
Natural England	Statutory Consultation January 2023	Paragraph 6.3.21 states that “NO2 and NH3 also contribute to nitrogen deposition, which is another pollutant that is harmful to nature conservation sites. Flares on site will be required to operate in an emergency or during plant start-up to burn off the release of NH3, which will therefore also be a source of NOx emissions”. We advise that as well as contributing to N-deposition, the release of NH3 may also lead to direct damage to vegetation, and it is not clear if there is potential for release of unreacted ammonia through this process.	**Chapter 6: Air Quality [TR030008/APP/6.2]** (Section 6.8) has set out and considered all emissions sources and pollutants with the potential to contribute to a significant effect, with reference to applicable guidance. This includes NH3 emissions alone, and the contribution of NH3 emissions to N-deposition Paragraphs 6.4.29 and 6.4.33 discuss the sources of nitrogen emissions included within the air quality

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
			modelling. Changes in air quality during operation could not be screened out of LSE for some Humber Estuary SAC/Ramsar habitat features, and therefore have been subject to appropriate assessment within this Shadow HRA (see **Section 4.7**).
Natural England	Statutory Consultation January 2023	We note that PEIR Figures 6.3c and 6.3d include the ecological receptors used as part of the air quality assessment, however, we cannot find any explanation of the reasons for picking these receptors and the habitat types represented at each receptor.	The selection of air quality sensitive receptors has been reported in **Section 6.4** of **Chapter 6: Air Quality [TR030008/APP/6.2]** and **Appendix 6.B [TR030008/APP/6.4]** of the ES. This includes the selection criteria, in line with appropriate guidance. The study area for assessment of air quality effects is 10km for ecologically sensitive sites in respect of onsite point source emissions and vessels in berth. The Air Pollution Information System ("APIS") website has been used to identify habitats within the statutory designated sites (Humber Estuary SAC/Ramsar) that are sensitive to changes in air quality, and to determine the relevant Critical Levels and Critical Loads for each habitat and pollutant to inform the assessment.
Natural	Statutory Consultation	The PEIR Figures 6.3c and 6.3d indicate that the process contributions exceed 1% of the environmental benchmarks for annual mean NOx and N-deposition at	Noted.

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
England	January 2023	several of the ecological receptors. There does not appear to be figures for annual mean NH3 and sulphur dioxide. At this stage, the assessment provided is very preliminary and therefore Natural England will review in further detail once we are consulted on the ES and HRA.	
Natural England	Statutory Consultation January 2023	Natural England notes at paragraph 6.8.45 that it concludes that "the additional predicted contribution from nitrogen emissions from the Project does not result in any exceedance of the Critical Load range for saltmarsh, and it is concluded that there will be no adverse effect on the Humber Estuary designated site." However, we consider that detailed ecological justification would be required to understand the reasoning for not using the lower critical load range for upper saltmarsh. This should be based on habitat surveys and frequency of tidal inundation. We would find it useful for the Shadow HRA to refer to the notified habitat features of the SAC. Even using the higher critical load, we note that the process contribution for annual mean NOx is predicted to be 11% of the critical load, at ecological receptor (E11) defined as worst affected. E11 receptor is also adjacent to the Able Marine Energy Compensation site (Cherry Cobb Sands Tidal Exchange/ managed realignment site), which is due to be constructed. Saltmarsh surveys have been undertaken recently as part of this project.	Air quality modelling for construction and operational emissions has been undertaken as reported in **Section 6.8** of ES **Chapter 6: Air Quality [TR030008/APP/6.2.** Changes in air quality during construction and operation could not be screened out of LSE for some Humber Estuary SAC/Ramsar habitat features, and therefore have been subject to appropriate assessment within this Shadow HRA. Further information has been included within the assessment to justify the relevant critical loads used, and to refer to the notified habitat features of the SAC (see **Section 4.7**).
Natural England	Statutory Consultation January 2023	<u>Assessment of impacts on benthic habitats and species</u> At this time, Natural England have not fully considered the potential impacts on benthic habitats and species, and we will provide detailed comments on the ES. However, we have some initial comments below.	Noted
Natural England	Statutory Consultation	<u>Potential effects from permanent direct loss of intertidal and subtidal habitat during construction and operation phases</u>	Habitat loss values have been updated to reflect the latest scheme design. The assessment has

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
	January 2023	Natural England notes that the proposed development will result in loss of 0.017 ha of intertidal habitat as a result of the proposed jetty piles. In addition, it is noted that piling activities will result in a direct loss of 0.035 ha of subtidal habitat. Natural England advises that the assessment considers the potential for adverse effects as a result of loss of both intertidal and subtidal habitat. This should include the combined loss of SAC habitat (i.e., Estuaries and Mudflats and sandflats not covered by seawater at low tide) as well as the loss of supporting habitat for SPA bird species. Natural England considers that any credible risk of a measurable loss of marine or terrestrial habitat, no matter how small, from within a European site is a 'likely significant effect' and the full significance of its impact on site integrity should be screened-in and further tested by an Appropriate Assessment. It is Natural England's advice that a lasting and irreparable loss of European Site habitat will prevent a conclusion of no adverse effect on site integrity being reached, unless an Appropriate Assessment can clearly demonstrate it is ecologically inconsequential. Furthermore, the appropriate assessment should be made in view of the European sites' conservation objectives, which provides a list of attributes contributing to site integrity that can provide a checklist for the assessment process, the detailed supplementary advice and advice on operations should also inform the conclusion.	considered the potential for adverse effects as a result of loss of both intertidal and subtidal habitat including supporting habitat for SPA bird species. Noted. Loss of marine and terrestrial habitat from within a European site has been screened-in for further assessment in the Appropriate Assessment. The Shadow information to support an Appropriate Assessment has been prepared in view of the European sites' conservation objectives which has been used as a basis for the assessment. The supplementary advice and advice on operations has also been used to inform the conclusion.
Natural England	Statutory Consultation January 2023	Assessment of impacts on Sea and River Lamprey (migratory fish) during the construction phase The following advice is provided on the assumption that the underwater noise	

Con s u l t e e	Reference , Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
		modelling used in the assessment in Appendix 9B is correct and we defer to Cefas advice as to the accuracy of the modelling. NE note in paragraph 9.8.1, that there are a number of mitigation measures being considered for fish and marine mammals including "the use of soft start procedures, the use of vibro piling where possible with seasonal/night time piling restrictions specifically for migratory fish species and JNCC piling protocols for marine mammals" it also states that these mitigation measures would be further developed, if required, through ongoing engagement with statutory authorities as part of the statutory consultation process and taking into account the final scheme design information and latest understanding of potential effects. We agree that the mitigation set out would be effective in reducing impacts to migratory fish and should be considered within the assessment. The outcome of the Shadow HRA will identify the mitigation required. We welcome the commitment to engage with Natural England to further develop mitigation measures considering the final design and understanding of potential effects.	Noted. Noted. Mitigation requirements for fish have been developed as part of the assessment process (including the Shadow HRA) and through engagement with statutory authorities (detailed below in table).
Natural England	Statutory Consultation January 2023	<u>Assessment of impacts on marine mammals during construction and operation phases</u> As above, the following advice is provided on the assumption that the modelling used in the underwater noise assessment in Appendix 9B is correct and we defer to Cefas advice as to the accuracy of the modelling. NE broadly agrees with the scope of the assessment during the construction phase of the project. Nonetheless, we advise that the assessment should reflect the key impact parameters including hammer energy, pile diameter, timing, and duration. An assessment based on these parameters should present the ranges/zones of injury and disturbance to marine mammals. The number of	Noted The assessment has been based on the results of the underwater noise modelling and has taken into account factors such as marine piling method, pile diameter, duration. Mitigation has been developed based on an understanding of

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
		animals predicted to be within the impact zones should be determined and presented as a proportion of the relevant reference population (e.g., Management Unit population for EIA purposes). Note that we consider it likely that marine mammals could be within the construction impact zones, based on their highly mobile nature and the evidence presented by the Application such as the sightings of harbour porpoise approximately 2km from the project area and grey seals are regularly recorded foraging in the Immingham area. Once the risk of exposure is identified, appropriate mitigation should be considered. The outcome of the Shadow HRA will identify the mitigation required. We welcome the commitment to engage with Natural England to further develop mitigation measures considering the final design and understanding of potential effects.	the population ecology of the marine mammal species in the area. Where possible an estimation of the number of animals predicted to be within the potential zone of effect of marine piling has been determined and presented as a proportion of the relevant reference population (e.g., Management Unit population). Mitigation requirements for marine mammals have been developed as part of the assessment process (including the Shadow HRA) and through engagement with statutory authorities (detailed below in table).
Natural England	Statutory Consultation January 2023	**Chapter 10: Ornithology** **Potential Impacts on Greater Wash SPA** Your assessment concludes that the proposal can be screened out from further stages of assessment because significant effects are unlikely to occur, either alone or in combination. On the basis of the information provided, Natural England concurs with this view.	Noted
Natural England	Statutory Consultation January 2023	**Key points in relation to Humber Estuary SPA/ Ramsar birds** Associated British Ports (ABP) has collected bird data for bird survey Sector C of Immingham frontage for October to March inclusive for several years. In relation to this development, data has been collected for August and September 2021 and April to August 2022. Natural England advises that the data for winter and summer bird counts for 2021 and 2022 should be combined to give a complete picture of bird activity throughout these years. We understand that bird	1). Noted.

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
		data is being collected for terrestrial fields adjacent to the Humber Estuary to assess their value as functionally linked land. • Once the additional bird data is available, the relevant tables and figures (including figures 10.3 and 10.4 which relate to bird data within bird survey sector C of Immingham frontage) need to be updated so that we have a more complete picture of bird use on the site. Please also indicate clearly the sources of data for each figure/ table, whether it is Wetland Bird Survey (WeBS) or ABP's own data. • Once additional data is available, more detailed assessment of the data is needed, including identification of the months that have significant numbers of SPA/ Ramsar species (over 1% of the latest WeBS five-year mean peak) and identification of the key species. This information is currently presented as data for October to March winter period (**Table 10**.7) and data for months outside October to March winter period (**Table 10**.8) • More information about mitigation measures will be required if significant numbers of birds are recorded. The Shadow HRA should also explain how the mitigation measures proposed will avoid or reduce the effect and the level of certainty that mitigation measures will be effective. • The intertidal areas adjacent to proposed jetty and the terrestrial habitat are likely to be the areas with the highest potential for impacts on SPA/Ramsar birds.	2). Relevant tables and figures have been updated (including winter 2022/23 data) within **Appendix A and Chapter 10: Ornithology [TR030008/APP/6.2]**. The source of the data has been highlighted in the respective tables or figures. 3). More detailed assessment based on the data has been undertaken including identifying those months that have numbers of SPA/ Ramsar species (over 1% of the latest estuary-wide WeBS five-year mean peak). 4). Mitigation requirements for coastal waterbirds have been developed based on the bird survey results and as part of the assessment process (including the Shadow HRA) and through engagement with statutory authorities**.** 5). Noted
Natural England	Statutory Consultation	**Natural England's response refers to the following tables:** **Table 10.10 Potential effects during construction scoped in/ out of further**	Noted

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
	January 2023	**detailed assessment** In terms of construction impacts, we consider that this table equates to the likely significant effect test in the Shadow HRA for effects on SPA/ Ramsar birds during the construction period. Natural England agrees that maintenance dredging and dredge disposal is unlikely to impact SPA/ Ramsar birds due to the distance of the berth from any intertidal habitat. The assessment of impacts on SPA/ Ramsar birds during the construction period will be informed by the additional bird data and analysis of this data. Natural England will provide advice on the outputs of the assessments once the additional information is available.	
Natural England	Statutory Consultation January 2023	**Table 10.11 Potential effects during operation scoped in/ out of further detailed assessment (berth operations during operation phase)** The following impacts have been screened in for further assessment and Natural England supports this approach. • Direct changes to intertidal foraging and roosting habitat as a result of marine infrastructure footprint. • Airborne noise and visual disturbance to coastal waterbirds using intertidal habitats. • Airborne noise and visual disturbance to waterbirds using terrestrial habitats. The assessment of impacts on SPA/ Ramsar birds during the operational period will be informed by the additional bird data and analysis of this data. Natural England will provide advice on the outputs of the assessments once the additional information is available.	Noted
Natural	Statutory	**Table 10.12 Summary of potential impact, mitigation, and residual effects**	Noted

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
England	Consultation January 2023	We cannot comment on this table until all the bird data is available, the Shadow HRA has been carried out and we better understand the expected impacts and what mitigation measures are required.	
Natural England	Statutory Consultation January 2023	Below is a summary of the expected scenarios/ locations for disturbance of SPA/ Ramsar birds during construction and operation phases. We have highlighted any additional issues that we advise should be considered in the assessment: 1) Disturbance to birds during construction in the marine environment (**Table 10**.10) Natural England supports the use of the 300m disturbance zone for birds. Mitigation measures such as soft start piling, and cold weather restrictions have been mentioned. However, the Shadow HRA should look in detail at the impacts of the development on SPA/ Ramsar birds and identify what/why mitigation measures will be required. The Environment Agency has implemented seasonal working restrictions for the Stallingborough 3 flood alleviation scheme (avoiding working during the winter months), so this will be a consideration.	Based on a detailed review (presented **Section 4.10**), the assessment has been based on the application of a 200m disturbance zone rather than 300m as the evidence suggests the response of waterbirds to disturbance stimuli is relatively limited at distances over 200m, particularly in areas subject to already high levels of existing anthropogenic activity (as found in the Port of Immingham area). The assessment has also been based on advice provided by Natural England as part of the consultation for the nearby proposed Immingham Eastern Ro-Ro Terminal ("IERRT") project which stated that '*peak levels below 55 dBA can be regarded as not significant, while peak noise levels approaching 70 dBA and greater are most likely to cause an adverse effect.' Therefore, levels over 65.5 dBA may cause disturbance to SPA birds. Birds may habituate to regular noise below 70 dBA, but irregular above 50 dBA should be avoided*'. It should be noted that noise modelling of marine piling predicts that noise levels will be lower than 70 dBA at distances of more than 200 m away with the use of a noise suppression system and

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
			in the range of background noise levels that can occur on the foreshore in the Port of Immingham area. Mitigation requirements for coastal waterbirds have been developed based on the bird survey results and as part of the assessment process (including the Shadow HRA) and through engagement with statutory authorities.
Natural England	Statutory Consultation January 2023	2) Disturbance to birds during construction in the terrestrial environment (**Table 10**.10) Currently the assessment only considers the field adjacent to the estuary where the construction compound will be temporarily located. There may be other terrestrial areas which are within the red line boundary which could be used by SPA/ Ramsar birds, so this also requires consideration. It is stated that the flood bank and the Long Strip plantation will provide screening for the construction works in the estuary, which is relevant. However, as tree works are proposed in Long Strip plantation, an assessment is needed to explain whether these works will impact on birds using the adjacent fields (if this field is still being used by birds during the tree works).	There are no areas of terrestrial habitat within or adjacent to the Project boundary that are functionally linked to the Humber Estuary SPA/ Ramsar **(Section 1.4 of Appendix A).** This pathway has therefore been scoped out of the impact assessment and screened out of the Shadow HRA at Task 1 LSE screening (**Table 4**). This pathway is also screened out of the cumulative and in-combination effects assessment.
Natural England	Statutory Consultation January 2023	3) Disturbance to birds during operation in the marine environment (**Table 10**.11) Most impacts on birds in the marine environment during operation have been screened out and given the distance of the berthing operations for the intertidal area, Natural England agrees with this assessment. However, further information is needed about the impact on birds using the intertidal areas within 300m of the new port infrastructure (jetty).	Noted. Further more detailed information has been provided on bird numbers in proximity to the new port infrastructure in **Section 4.3**

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
Natural England	Statutory Consultation January 2023	4) Disturbance to birds during operation in terrestrial environment (**Table 10**.11) The fields adjacent to the estuary where the site compounds will be temporarily located have been scoped into the assessment, this is supported by Natural England. Natural England has based its advice on the fact that the construction compounds will have been removed by the start of the operational phase, however clarity about this and the expected length of the construction period will be important. There may be other fields that will be part of the development that could be used by SPA/ Ramsar birds and should also be included in the assessment. It is stated that the flood bank and the Long Strip plantation will both have a screening effect for birds using the fields adjacent to the estuary. However, as works are proposed on the plantation as part of the development, the effect of the tree works on the screening function needs to be considered.	There are no areas of terrestrial habitat within or adjacent to the Project boundary that are functionally linked to the Humber Estuary SPA/ Ramsar **(Section 1.4 of Appendix A).** This pathway has therefore been scoped out of the impact assessment and screened out of the Shadow HRA at Task 1 LSE screening (**Table 4**). This pathway is also screened out of the cumulative and in-combination effects assessment.
Natural England	Statutory Consultation January 2023	5) Loss of supporting marine habitat for SPA/ Ramsar birds (**Table 10**.10) Natural England agrees that the impacts from capital dredge and dredge disposal and indirect effects on estuarine processes can be screened out of further assessment within the ES, but they should be considered in the Shadow HRA. Changes to intertidal habitat from berth operation and infrastructure effects have been screened in for further assessment, Natural England supports this approach. The Shadow HRA should consider whether the same numbers and species of SPA/ Ramsar waterbirds are likely to use the site post construction. No mitigation measures have been proposed so far, however the requirement for mitigation measures will be determined through the Shadow HRA process.	Stage 1 (Screening) of the Shadow HRA considers capital dredge and dredge disposal. Indirect effects on estuarine processes has been screened in to Stage 2 (Appropriate Assessment) and assessed in **Section 4.5.** Potential changes to waterbird habitat as a result of infrastructure has been screened in to Stage 2 (Appropriate Assessment) and assessed in **Section 4.3** Direct and indirect effects of dredging on supporting habitat for SPA/ Ramsar birds have been screened into the Shadow HRA.

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
Natural England	Statutory Consultation January 2023	6) Loss of supporting terrestrial habitat for SPA/ Ramsar birds (**Table 10**.10) Loss of habitat is screened in for further assessment, which Natural England supports. The bird data that is currently being gathered will inform the detailed assessment. The Shadow HRA should indicate the period over which the terrestrial habitat will be unavailable due to construction compounds and other uses. Natural England has been working with North East Lincolnshire Council and other estuary stakeholders for many years to deliver a strategic approach to mitigation within the South Humber Gateway (for impacts associated with the loss of land functionally linked to the Humber Estuary SPA/Ramsar site). Natural England believes this is the most effective way to mitigate for impacts on functionally linked land. We therefore support the commitment to further discussion with North East Lincolnshire Council with respect to the South Humber Gateway Mitigation scheme. As the proposed development site falls within the South Humber Bank mitigation zone, you should liaise with North East Lincolnshire Council regarding how you should contribute to the strategic approach. This forms a key policy in the North East Lincolnshire local plan (see policy 9 https://www.nelincs.gov.uk/assets/uploads/2020/10/The-NEL-Local-Plan-adopted-2018.pdf). (Ref 1-10)	There are no areas of terrestrial habitat within or adjacent to the Project boundary that are functionally linked to the Humber Estuary SPA/ Ramsar **(Section 1.4 of Appendix A).** This pathway has therefore been scoped out of the impact assessment and screened out of the Shadow HRA at Task 1 LSE screening. As no functionally linked land is present within the Project Boundary, there is no requirement for mitigation to be delivered via the South Humber Gateway Scheme (Policy 9).
Natural England	Statutory Consultation January 2023	**Chapter 25: In-Combination Screening Assessment** The Shadow HRA will need to consider in-combination effects from other relevant projects and plans. The in-combination requirement makes sure that the effects of numerous small proposals, which alone would not result in a significant effect, are assessed to determine whether their combined effect	Noted. The Shadow HRA considers in-combination impacts (**Section 4.14**) based on the criteria highlighted by NE.

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
		would be significant enough to require more detailed assessment. Plans or projects that should be considered in the in-combination assessment include the following: i. The incomplete or non-implemented parts of plans or projects that have already commenced; ii. Plans or projects given consent or given effect but not yet started; iii. Plans or projects currently subject to an application for consent or proposed to be given effect; iv. Projects that are the subject of an outstanding appeal; v. Ongoing plans or projects that are the subject of regular review; vi. Any draft plans being prepared by any public body; vii. Any proposed plans or projects published for consultation prior to application. Natural England has no specific comments to make on this Chapter but will provide further detailed advice on the in-combination assessments undertaken as part of the Shadow HRA. These will need to consider all of the impact pathways that has been discussed within this letter.	
Pre-application meeting, 23 November 2022.	Natural England	The meeting provided an update of the IGET project, a summary of the site-specific surveys and a high-level discussion of potential effects.	The Shadow HRA has been completed taking on board consultee comments from the meeting.
Pre-application meeting, 11 January	Natural England	The meeting provided a further update of the IGET project as well as a discussion on potential effects, HRA, stakeholder engagement and project programme.	The Shadow HRA has been completed taking on board consultee comments from the meeting.

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
2023			
Pre-application meeting, 1 August 2023.	Natural England	The meeting provided a further update of the Project as well as a discussion on potential effects, HRA, stakeholder engagement and project programme.	The **Shadow HRA [TR030008/APP/7.6]** has been completed taking on board consultee comments from the meeting.
Second Statutory Consultation	Natural England	**Internationally and nationally designated sites** Natural England notes there have been no amendments to the PEIR Appendix 9C which was provided in the first S42 consultation. The application site is in close proximity to European designated sites (also referred to as Habitat sites), and therefore has the potential to affect their interest features. European sites are afforded protection under the Conservation of Habitats and Species Regulations 2017, as amended (the 'Habitats Regulations'). The application site is within and adjacent to the Humber Estuary Special Area of Conservation (SAC) and Special Protection Area (SPA) which are European sites. The site is also listed as Humber Estuary Ramsar site and notified at a national level as Humber Estuary Site of Special Scientific Interest (SSSI). Our advice regarding the potential impacts upon the Humber Estuary SSSI coincides with our advice regarding potential impacts upon the Humber Estuary SAC/SPA/Ramsar as detailed above. Natural England notes that the application site is in close proximity to the Humber Estuary SSSI and North Killingholme Haven Pits SSSI. Based on the plans submitted, Natural England considers that the proposed development	Potential effects on the Humber Estuary SAC, SPA and Ramsar site are considered in this Shadow HRA report.

Consultee	Reference, Date	Summary of Response	How Comments Have been Addressed in this shadow HRA
		could have potential significant effects on the interest features for which the sites have been notified. The consultation documents provide some screening information for the Habitats Regulations Assessment (HRA). It is Natural England's advice that the proposal is not directly connected with or necessary for the management of the European site. You should therefore determine whether the proposal is likely to have a significant effect on any European site, proceeding to the Appropriate Assessment stage where significant effects cannot be ruled out.	

3. Stage 1 - Screening

3.1. Identification of Sites and Features screened into the Assessment

3.1.1. In accordance with PINS Advice Note 10 (Ref 1-9), the first stage of the Shadow HRA involves considering if the plan or project is likely to have a significant effect on interest features of a European/Ramsar site either alone or in-combination with other plans or projects.

3.1.2. The entire Humber Estuary is designated as a SAC and a SPA under the Habitats and Birds Directives. It is also classified as a 'Ramsar site' under the Ramsar Convention due to the presence of internationally important wetlands. These designated sites together form the Humber Estuary European Marine Site ("EMS"). In addition, following advice from Natural England (**Table 1**), there is the potential for the Greater Wash SPA, which is located approximately 20km from the Project, to be affected as it is designated for a range of seabird and diving bird species. The Wash and North Norfolk Coast SAC, which has common seals as a qualifying feature, also has the potential to be affected by the Project. The location of these sites in relation to the Project is shown on **Plate 2** of this Shadow HRA.

3.1.3. The qualifying interest features and justification as to their inclusion or exclusion from the Stage 1 screening assessment is provided in **Table 2**. The judgement as to whether a site or feature needs to be considered is based on the available baseline information of the location, ecology and/or behaviour of interest features provided in **Appendix A** and the detailed description of the Project provided in **Chapter 2: The Project of the ES [TR030008/APP/6.2]**. In the specific context of SPA/Ramsar waterbird features, advice provided by Natural England that birds exceeding 1 % of the estuary-wide WeBS five-year mean peak should be viewed as significant numbers has also been applied. This is a threshold commonly applied by Natural England on the Humber Estuary, and one which has been specifically requested by Natural England to be applied for the Project, to determine whether there is the potential to adversely effect individual species. Some species were also screened in on a precautionary basis when numbers

Plate 2: Location of designated sites

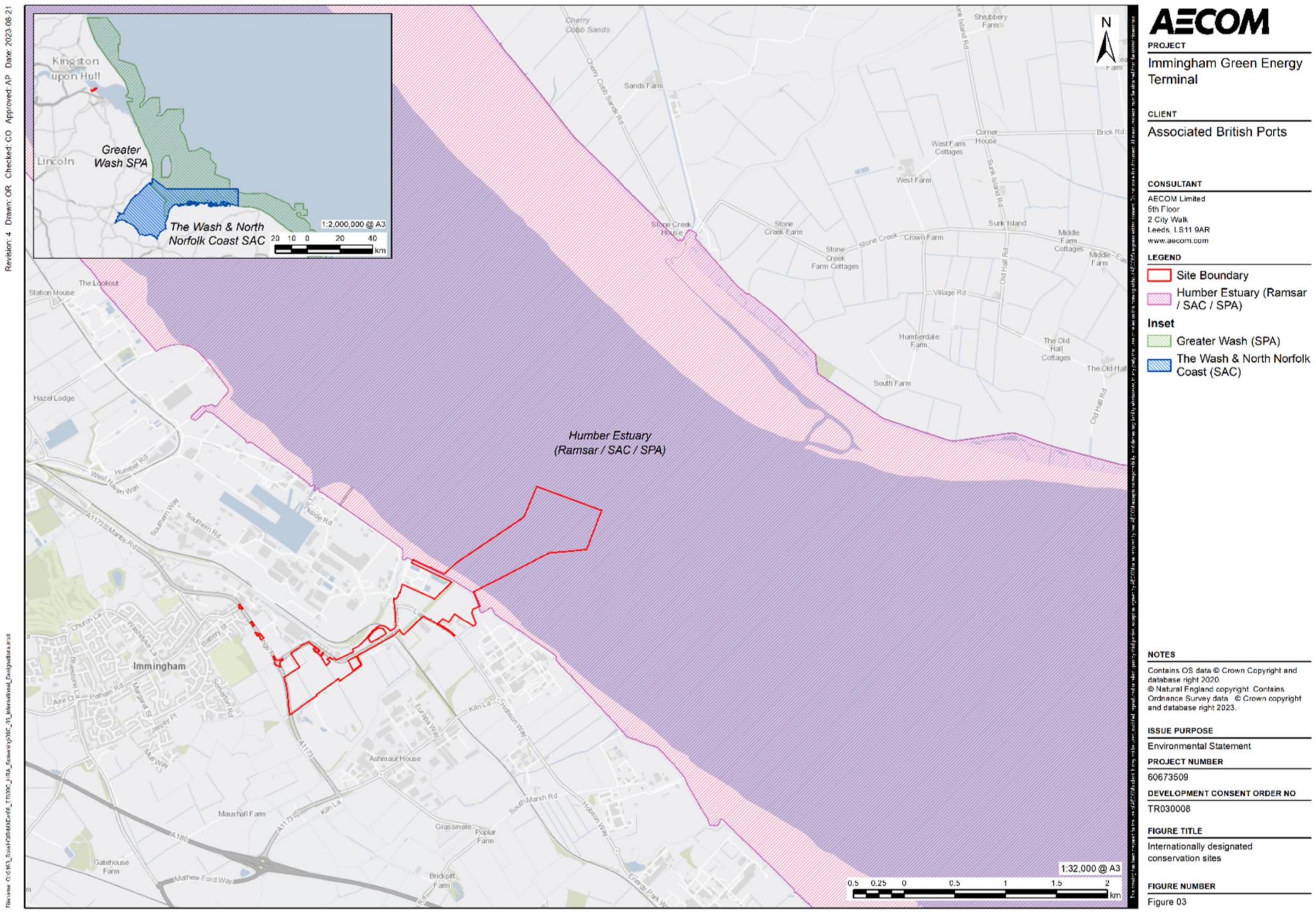

AECOM
PROJECT
Immingham Green Energy Terminal
CLIENT
Associated British Ports
CONSULTANT
AECOM Limited
5th Floor
2 City Walk
Leeds, LS11 9AR
www.aecom.com
LEGEND
Site Boundary
Humber Estuary (Ramsar / SAC / SPA)
Inset
Greater Wash (SPA)
The Wash & North Norfolk Coast (SAC)
NOTES
Contains OS data © Crown Copyright and database right 2020. © Natural England copyright. Contains Ordnance Survey data. © Crown copyright and database right 2023.
ISSUE PURPOSE
Environmental Statement
PROJECT NUMBER
60673509
DEVELOPMENT CONSENT ORDER NO
TR030008
FIGURE TITLE
Internationally designated conservation sites
FIGURE NUMBER
Figure 03
Humber Estuary (Ramsar / SAC / SPA)
Immingham
Greater Wash SPA
The Wash & North Norfolk Coast SAC
Kingston upon Hull
Lincoln
1:2,000,000 @ A3
1:32,000 @ A3
N
Revision: 4 Drawn: OR Checked: CO Approved: AP Date: 2023-08-21

Table 2: Identification of European/Ramsar sites and qualifying features relevant to the Screen

Site	Qualifying features	Justification (✓ requires consideration, x not relevan	
Humber Estuary SAC	H1110. Sandbanks which are slightly covered by sea water all the time; Subtidal sandbanks	✓	Feature is present in the vicinity of the dredge disposal
	H1130. Estuaries	✓	Feature is present within the footprint of the Project.
	H1140. Mudflats and sandflats not covered by seawater at low tide; Intertidal mudflats and sandflats	✓	Feature is present within the footprint of the Project.
	H1150. Coastal lagoons	x	Two qualifying coastal lagoons areas are present withi (Humberston Fitties and Northcoates Lagoon which are from the proposed Project). These sites lie beyond the direct or indirect changes resulting from the constructio the Project which are limited to within the vicinity of the
	H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	✓	Based on the current geographic extent and location of Communities Act (2006) Section 41 habitats of principa saltmarsh habitat is located over 3km to the northwest Humber Estuary Site of Special Scientific Interest ("SSS outside any potential direct or indirect marine changes operational activities associated with the Project which Immingham. However pioneer saltmarsh is moderately from operational marine vessel/road vehicle emissions pathway only.
	H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	✓	As described above the nearest saltmarsh habitat is loc ~~northwest~~northeast of the Project and outside of any po resulting from the construction and operational activitie (*Glauco-Puccinellietalia maritimae*) is sensitive to N dep

Site	Qualifying features		Justification (✓ requires consideration, x not relevant to the screening assessment)
			marine vessel/road vehicle emissions and requires consideration in relation to this pathway only.
	H2110. Embryonic shifting dunes	**x**	Based on the current geographic extent and location of Natural Environment and Rural Communities Act (2006) Section 41 habitats of principal importance (Ref 1-11), the nearest coastal sand dunes within the Humber SAC are located more than 12km southwest of the Project at Cleethorpes and therefore outside the 10km study area for the air quality impact assessment . This is outside any potential direct or indirect changes resulting from the construction and operational activities associated with the Project which are limited to within the vicinity of the Port of Immingham.
	H2120. Shifting dunes along the shoreline with *Ammophila arenaria* ("white dunes"); Shifting dunes with Marram	**x**	
	H2130. Fixed dunes with herbaceous vegetation ("grey dunes"); Dune grassland	**x**	
	H2160. Dunes with *Hippophae rhamnoides*; Dunes with sea-buckthorn	**x**	
	S1095. *Petromyzon marinus*; Sea lamprey	✓	Sea lamprey are recorded in the estuary and are known to also move through the estuary during spawning migrations (as summarised in **Section 1.3 of Appendix A**). This species may be present in the vicinity of the Project.
	S1099. *Lampetra fluviatilis*; River lamprey	✓	River lamprey are recorded in the estuary and are known to also move through the estuary during spawning migrations (as summarised in **Section 1.3 of Appendix A**). Their growth phase is primarily restricted to estuarine waters. This species may be present in the vicinity of the Project.
	S1364. *Halichoerus grypus*; Grey seal	✓	The nearest established breeding colony for grey seals is located over 25km away at Donna Nook. In addition, small numbers have been observed hauling out on mudflat at Sunk Island (on the north bank of the Humber Estuary) which is located approximately 4km north east from the Project and around 3-4km from the dredge disposal site (including transit routes). Whilst not sensitive at their haul out sites, grey seals may be present in the estuary in the vicinity of the Port of Immingham.
Humber Estuary SPA	A021 *Botaurus stellaris*; Great Bittern (Non-breeding)	**x**	The Humber region supports both breeding and wintering Great Bittern. Based on the extensive bird data available for the Humber Estuary, Great Bittern is recorded within reedbed habitats such as around Blacktoft Sands, Far Ings and North Killingholme Haven clay pits. This species does not normally occur on open mudflat habitat and has not been recorded in the Immingham Outer

Site	Qualifying features	Justification (✓ requires consideration, x not relevant to the screening assessment)	
	A021 *Botaurus stellaris*; Great Bittern (Breeding)	x	Harbour ("IOH") bird monitoring that has been undertaken in the Immingham area (**Section 1.4 of Appendix A**).
	A048 *Tadorna tadorna*; Common Shelduck (Non-breeding)	✓	Low numbers (< 10-20 individuals feeding during the winter months and <10 individuals feeding outside the winter months and roosting year-round), representing < 1% of the estuary wide WeBS five year mean peak) have been recorded in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C between the Immingham Oil Terminal ("IOT") Jetty and the mudflat fronting North Beck drain (within approximately 400-500m of the Project) (**Section 1.4 of Appendix A**). While this species has only been recorded in relatively low numbers in the context of estuary-wide populations (and below the 1 % threshold used by Natural England to determine potentially significant numbers), given this species is regularly recorded, the feature has been screened in on a precautionary basis.
	A081 *Circus aeruginosus*; Eurasian Marsh Harrier (Breeding)	x	Marsh Harriers breed in the Humber region and are also recorded during passage periods and the winter. Marsh Harrier primarily forage around reed beds and marshes in coastal areas as well as farmland near wetland and are recorded relatively frequently in the Immingham region. However, the species is not recorded hunting over mudflats for prey species and, therefore, does not overlap with any potential direct or indirect changes resulting from the construction and operational activities associated with the Project, which are limited to within the vicinity of the Port of Immingham
	A082 *Circus cyaneus*; Hen Harrier (Non-breeding)	x	Hen Harrier is a winter visitor and passage migrant on the Humber. This species roosts and forages primarily in areas of saltmarsh and reedbed as well as open habitats such as arable fields and grassland. This species is only rarely recorded in the Immingham area.
	A132 *Recurvirostra avosetta*; Pied Avocet (Non-breeding)	x	Wintering populations of Pied Avocet are typically recorded in the inner estuary in the largest numbers (**Section 1.4 of Appendix A**). This species is recorded in the Immingham region but is considered rare in the vicinity of the Project with no Avocet recorded in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within approximately 400-500m of the Project). The area is, therefore, considered to be of very limited functional value for the species and has been screened out.
	A132 *Recurvirostra avosetta*; Pied	x	Pied Avocet are not known to breed on the foreshore in the Immingham area. This species is

Site	Qualifying features	Justification (✓ requires consideration, x not relevant to the screening assessment)	
	Avocet (Breeding)		recorded in the Immingham region but is considered rare in the vicinity of the Project with no Avocet recorded in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within approximately 400-500m of the Project). The area is, therefore, considered to be of very limited functional value for the species and has been screened out.
	A140 *Pluvialis apricaria*; European Golden Plover (Non-breeding)	x	The Humber Estuary is one of the most important sites in the UK for Golden Plover with the species primary recorded roosting on mudflats and other intertidal habitats in the region (**Section 1.4 of Appendix A**). While this species is widely distributed through the estuary, the species is considered rare in the vicinity of the Project with no Golden Plover recorded in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within approximately 400-500m of the Project). The area is, therefore, considered to be of very limited functional value for the species and has been screened out.
	A143 *Calidris canutus*; Red Knot (Non-breeding)	x	While this species is recorded on the foreshore in the Immingham area, the species is considered rare in the vicinity of the Project with no Knot recorded in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within approximately 400-500m of the Project). The area is, therefore, considered to be of very limited functional value for the species and has been screened out.
	A149 *Calidris alpina*; Dunlin (Non-breeding)	✓	Low numbers (<100 individuals~~,~~ feeding during the winter months and <10 individuals feeding outside the winter months and roosting year-round) representing < 1% of the estuary wide WeBS five year mean peak) have been regularly recorded in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within approximately 400-500m of the Project) (**Section 1.4 of Appendix A**). While this species has only been recorded in low numbers in the context of estuary-wide populations (and below the 1 % threshold used by Natural England to determine potentially significant numbers), given this species is regularly recorded, the feature has been screened in on a precautionary basis.
	A151 *Philomachus pugnax*; Ruff (Non-breeding)	x	The Humber Estuary is considered an important site for passage Ruff. Important areas of the Humber for Ruff are the intertidal mudflats and adjacent lagoons of Alkborough Flats and Blacktoft Sand (**Section 1.4 of Appendix A**). This species is more rarely recorded in the outer Humber Estuary and typically shows a preference for more sheltered sections of the inner Humber Estuary.

Site	Qualifying features	Justification (✓ requires consideration, x not relevant to the screening assessment)	
			This species is rarely recorded on mudflat habitat in the Immingham area with no records of the species occurring in Sector C over the last five years of IOH monitoring (2018/19 to 2022/23).
	A156 *Limosa limosa islandica*; Black-tailed godwit (Non-breeding)	✓	Black-tailed Godwit have been regularly observed on the foreshore in the area of the Project with abundances < 100 individuals recorded feeding (representing up to 2% of the estuary wide WeBS five year mean peak) in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within approximately 400-500m of the Project) (**Section 1.4 of Appendix A**). On this basis, this feature has been screened into the assessment. Numbers recorded feeding outside the winter months and roosting (year-round) have been lower than recorded feeding in the winter months (<10 individuals) representing < 1% of the estuary wide WeBS five year mean peak).
	A157 *Limosa lapponica*; Bar-tailed Godwit (Non-breeding)	x	Very low numbers (< 5 individuals, representing < 1% of the estuary wide WeBS five year mean peak) have been recorded relatively infrequently in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within approximately 400-500 of the Project) (**Section 1.4 of Appendix A**). The area is, therefore, considered to be of very limited functional value for the species and has been screened out.
	A162 *Tringa totanus*; Common Redshank (Non-breeding)	✓	Low numbers (<10-20 individuals~~,~~ feeding during the winter months and <5-10 individuals feeding outside the winter months and <10 individual roosting) representing < 1% of the estuary wide WeBS five year mean peak) have been regularly recorded in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within approximately 400-500m of the Project) (**Section 1.4 of Appendix A**). While this species has only been recorded in low numbers in the context of estuary-wide populations (and below the 1 % threshold used by Natural England to determine potentially significant numbers), given this species is regularly recorded, the feature has been screened in on a precautionary basis.
	A195 *Sterna albifrons*; Little Tern (Breeding)	x	Little Tern breed at Easington Lagoon, which is located approximately 20km from the Project, with data suggesting this species forages within 5km of nesting sites (Ref 1-12). This species is considered very rare within the Immingham area.
	Waterbird assemblage	✓	As well as the qualifying species listed above in this table, the foreshore in the vicinity of the Project also supports a range of other assemblage species with the following bird species regularly recorded in in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within

Site	Qualifying features		Justification (✓ requires consideration, x not relevant to the screening assessment)
			approximately 400-500m of the Project) (**Section 1.4 of Appendix A**): • Turnstone: <20-30 birds feeding and roosting year-round (representing up to 10% of the estuary wide WeBS five year mean peak); • Teal: <20-30 birds feeding during the winter months, <5-10 individuals feeding outside the winter months and <10 individual roosting (representing <1% of the estuary wide WeBS five year mean peak); • Curlew: <10-20 birds feeding during the winter months and <5-10 individuals feeding outside the winter months and <10 individual roosting (representing <1% of the estuary wide WeBS five year mean peak); and • Oystercatcher: <10-20 birds ~~(~~feeding during the winter months, <5-10 individuals feeding outside the winter months and <10 individual roosting representing <1% of the estuary wide WeBS ~~five year~~five-year mean peak). All these species have been screened into the assessment (noting with specific respect to Teal, Oystercatcher and Curlew that it is acknowledged that they have only been recorded in low numbers in the context of estuary-wide populations (and below the 1 % threshold used by Natural England to determine potentially significant numbers), but given these species are regularly recorded, they have been screened in on a precautionary basis). All other assemblage species have been screened out as they are considered rare or only occur infrequently and in low numbers in this area (representing <1% of the estuary wide WeBS five year mean peak). The rationale for screening in individual assemblage species is provided in **Appendix B** of this HRA.
Humber Estuary Ramsar	Criterion 1 – natural wetland habitats that are of international importance: Near-natural estuary with component habitats, specifically dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	✓	The Criterion 1 interest feature includes habitats which are present within the footprint of the Project (estuarine waters, intertidal mud and sandflats) and saltmarsh which is sensitive to N deposition or NOx/ammonia from operational marine vessel/ road vehicle emissions.
	Criterion 3 – supports populations of plants and/or animal species of	✓	The nearest established breeding colony for grey seals is located over 25km away at Donna Nook. In addition, small numbers have been observed hauling out on mudflat at Sunk Island (on the north

Site	Qualifying features		Justification (✓ requires consideration, x not relevant to the screening assessment)
	international importance: Breeding colony of grey seals *Halichoerus grypus* at Donna Nook.		bank of the Humber Estuary) which is located approximately 4km north east from the Project and around 3-4 m from the dredge disposal site (including transit routes). Whilst not sensitive at their haul out sites, grey seals may be present in the estuary in the vicinity of the Port of Immingham.
	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl.	✓	As well as the qualifying species listed above in this table, the foreshore in the vicinity of the Project also supports a range of other assemblage species with the following bird species regularly recorded in in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within approximately 400-500m of the Project) (**Section 1.4 of Appendix A**): • Turnstone: <20-30 birds feeding and roosting year-round (representing up to 10% of the estuary wide WeBS five year mean peak); • Teal: <20-30 birds feeding during the winter months, <5-10 individuals feeding outside the winter months and <10 individual roosting (representing <1% of the estuary wide WeBS five year mean peak); • Curlew: <10-20 birds feeding during the winter months and <5-10 individuals feeding outside the winter months and <10 individual roosting (representing <1% of the estuary wide WeBS five year mean peak); and • Oystercatcher: <10-20 birds feeding during the winter months, <5-10 individuals feeding outside the winter months and <10 individual roosting (representing <1% of the estuary wide WeBS five year mean peak). All these species have been screened into the assessment (noting with specific respect to Teal, Oystercatcher and Curlew that it is acknowledged that they have only been recorded in low numbers in the context of estuary-wide populations (and below the 1 % threshold used by Natural England to determine potentially significant numbers), but given these species are regularly recorded, they have been screened in on a precautionary basis). All other assemblage species have been screened out as they are considered rare or only occur infrequently and in low numbers in this area (representing <1% of the estuary wide WeBS five year mean peak). The rationale for screening in individual assemblage species is provided in **Appendix B** of this Shadow HRA.
	Criterion 6 – Bird Species/Populations Occurring at	✓	Species that form part of Criterion 6 of the Humber Ramsar site, specifically Dunlin, Black-tailed Godwit, Redshank and Shelduck have been screened into the assessment. The rationale for

Site	Qualifying features	Justification (✓ requires consideration, x not relevant to the screening assessment)	
	Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering).		screening in individual species can be seen above in the Humber Estuary SPA section of this ~~Table~~table.
	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: River lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus*.	✓	River and sea lamprey are recorded in the estuary and are known to also move through the estuary during spawning migrations (as summarised in **Section 1.3 of Appendix A**). River lamprey growth phase is primarily restricted to estuarine waters. This species may be present in the vicinity of the Project.
Greater Wash SPA	A001 *Gavia stellata*; Red-throated Diver (Non-breeding)	**x**	The Humber Estuary supports relatively low numbers of wintering Red-throated Diver although it is acknowledged these could form part of the population occurring in the Greater Wash SPA. However, data suggests that Red-throated Diver are rarely recorded inshore in the Port of Immingham area with this species considered to be highly sensitive to vessel movements and typically avoid areas with high shipping intensity (Ref 1-13). On that basis, it is considered that this interest feature of the Greater Wash SPA will not overlap with any potential direct or indirect changes resulting from the construction and operational activities associated with the proposed development which are limited to within the vicinity of the Port of Immingham.
	A065 *Melanitta nigra*; Common Scoter (Non-breeding)	**x**	The Humber Estuary supports passage and wintering Common Scoter and it is acknowledged these could form part of the population occurring in the Greater Wash SPA. However, data suggests that Common Scoter are rarely recorded inshore in the Port of Immingham area with this species considered to be highly sensitive to vessel movements and typically avoid areas with high shipping intensity (Ref 1-13). Therefore, this interest feature of the Greater Wash SPA will not overlap with any potential direct or indirect changes resulting from the construction and operational activities associated with the Project which are limited to within the vicinity of the Port of Immingham.

Site	Qualifying features	Justification (✓ requires consideration, x not relevant to the screening assessment)	
	A177 *Hydrocoloeus minutus*; Little Gull (Non-breeding)	**x**	Little Gull are rarely recorded in the Port of Immingham area (Ref 1-13) and, therefore, this interest feature of the Greater Wash SPA will not overlap with any potential direct or indirect changes resulting from the construction and operational activities associated with the Project which are limited to within the vicinity of the Port of Immingham.
	A191 *Sterna sandvicensis*; Sandwich Tern (Breeding)	**x**	The Humber Estuary does not overlap with the foraging ranges of nesting Sandwich Terns from the breeding colonies of the Greater Wash SPA (the maximum foraging range of Sandwich Tern recorded is 80km with the breeding colonies located over 90km away on the North Norfolk coast). Most foraging activity also occurs much closer to the nesting colonies (Ref 1-12; Ref 1-13). Therefore, it is highly unlikely this interest feature will overlap with any potential direct or indirect changes resulting from the construction and operational activities associated with the Project which are limited to within the vicinity of the Port of Immingham
	A193 *Sterna hirundo*; Common Tern (Breeding)	**x**	The Humber Estuary does not overlap with the foraging ranges of nesting Common Terns from the breeding colonies of the Greater Wash SPA (the maximum foraging range of Common Tern recorded is 30km with the breeding colonies located over 90km away on the North Norfolk coast). Most foraging activity also occurs much closer to the nesting colonies (Ref 1-12; Ref 1-13). Therefore, it is highly unlikely this interest feature will overlap with any potential direct or indirect changes resulting from the construction and operational activities associated with the Project which are limited to within the vicinity of the Port of Immingham.
	A195 *Sternula albifrons*; Little Tern (Breeding)	**x**	Little Tern forages within 5km of nesting sites (Ref 1-14) and, therefore, this interest feature of the Greater Wash SPA will not overlap with any potential direct or indirect changes resulting from the construction and operational activities associated with the Project which are limited to within the vicinity of the Port of Immingham.
The Wash and North Norfolk Coast SAC*	S1365 Harbour seal *Phoca vitulina**	✓	It is acknowledged that there could be potentially connectivity between the Wash and North Norfolk Coast SAC and the Humber Estuary with respect to common seal movements. Common seals have been recorded foraging over 200km from haul out sites outs including from sites in the Wash (Ref 1-15; Ref 1-16; Ref 1-17). The Wash and North Norfolk Coast SAC is located over 75km from the Project. However, evidence suggest that harbour seals typically forage within 40-50km of their haul out sites (Ref 1-18) which is reflected in high predicted at-sea densities of common seals in the Wash and along the North Norfolk and Lincolnshire coasts and much lower predicted densities in the Humber Estuary or north of Spurn Point (Ref 1-19). On this basis, the Immingham area is not considered to be key foraging habitat for common seals of the Wash and North Norfolk Coast SAC population although it is acknowledged that it is possible that individuals from this population

Site	Qualifying features	Justification (✓ requires consideration, x not relevant to the screening assessment)	
			could infrequently forage in this area.

- *The Wash and North Norfolk Coast SAC also supports a range intertidal and subtidal qualifying habitat features but given that these features are located over 75km from the Project they are not within the zone of influence of potential effects and therefore has no potential to cause LSE.

Table 3: Potential impacts that could result in LSE on features of the Humber Estuary SAC and the Wash and North Norfolk Coast SAC

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
Humber Estuary SAC	Construction	Direct loss of qualifying intertidal habitat	Marine piling	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries	Yes	Marine piling will result in the small loss of intertidal.
		Direct loss of qualifying subtidal habitat	Marine piling	H1130: Estuaries	Yes	Marine piling will result in the small loss of subtidal.
		Changes to qualifying habitats as result of the removal of seabed material during capital dredging	Capital dredge	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries	Yes	Capital dredging causes the direct physical removal of marine sediments from the dredge footprint, resulting in the modification of existing marine habitats. The impacts to benthic fauna associated with the dredged material include changes to abundance and distribution through damage, mortality or relocation to a disposal site.
		Direct changes to qualifying habitats as a result of sediment	Marine piling	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries	No	Marine piling has the potential to result in the localised resuspension of sediment as a result of seabed disturbance. Sediment that settles out of suspension back onto the seabed as result of marine piling is expected

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
		deposition				to be negligible and benthic habitats and species are not expected to be sensitive to this level of change. This impact pathway is therefore, not considered further in the Shadow HRA. alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE
			Capital dredge	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries	Yes	Capital dredging has the potential to result in localised physical disturbance and smothering of seabed habitats and species (where the sediment settles out of suspension back onto the seabed).
			Dredge disposal	H1110. Sandbanks which are slightly covered by sea water all the time H1130: Estuaries	Yes	Dredge disposal will result in the deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats.
		Indirect loss or change to qualifying habitats as a result of changes to hydrodynamic and sedimentary processes	Marine works (jetty structure and capital dredging)	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries	Yes	The jetty structure and capital dredge have the potential to result in changes to hydrodynamic and sedimentary processes (e.g., flow rates, accretion and erosion patterns). Marine invertebrates inhabiting sand and mud habitat show different tolerance ranges to physiological stresses caused by tidal exposure and tidal elevation and, therefore, hydrodynamic and bathymetric changes caused by the dredging

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						could affect the quality of marine habitats and change the distribution of marine species.
			Dredge disposal	H1110. Sandbanks which are slightly covered by sea water all the time H1130: Estuaries	Yes	The disposal of dredged material at the marine disposal site has the potential to result in changes to hydrodynamic and sedimentary processes (e.g., water levels, flow rates, changes to tidal prism, accretion and erosion patterns). Marine invertebrates inhabiting sand and mud habitat show different tolerance ranges to physiological stresses caused by tidal exposure and tidal elevation and, therefore, hydrodynamic and bathymetric changes caused by the disposal could affect the quality of marine habitats and change the distribution of marine species.
		Changes in water and sediment quality on benthic habitats and species	Marine piling	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries	No	The negligible, highly localised and temporary changes in suspended sediment levels (and related changes in sediment bound contaminants and dissolved oxygen) associated with bed disturbance during marine piling is considered will not result in significant effects in any species and habitats. The potential for accidental spillages will also be negligible during construction through following established industry guidance and protocols. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition,

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
			Capital dredge	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries	Yes	Changes in water quality during capital dredging could impact benthic habitats and species through an increase in suspended sediment concentrations ("SSC") and the release of toxic contaminants bound in sediments.
			Dredge disposal	H1110. Sandbanks which are slightly covered by sea water all the time H1130: Estuaries	Yes	Changes in water quality could occur during dredged material disposal through the deposition of material causing elevated SSC and contaminant levels. This could potentially impact on benthic habitats and species.
			Surface water drainage	H1140: Mudflats and sandflats not covered by seawater at low tide H1110. Sandbanks which are slightly covered by sea water all the time H1130: Estuaries	No	Standard measures to control surface water run-off during construction are embedded within the Project design to ensure legislative compliance, and therefore it is very unlikely that contaminated run-off would enter the Humber Estuary. This impact pathway is therefore, not considered further in the Shadow HRA.
		The potential introduction and spread of non-native species	Construction, dredging and dredge disposal	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries	Yes	Non-native species have the potential to be transported into the local area as a result of construction, dredging and dredge disposal activity. Potential effects alone are considered in Section 4.12 although

	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
				H1110. Sandbanks which are slightly covered by sea water all the time		in-combination effects are assumed to be negligible and not of a magnitude to cause a LSE assuming that standard biosecurity measures are implemented for the Project and also for other projects.
		Physical change to habitats resulting from the deposition of airborne pollutants	Construction marine vessel and road vehicle emissions	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries H1110. Sandbanks which are slightly covered by sea water all the time H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand H1330: Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	No	The assessment has considered a scenario of peak construction vessel operation (see **Chapter 6: Air Quality** of the ES **[TR030008/APP/6.2]**). Given the limited number of construction vessel emissions sources, the frequency of operation and distance between source and sensitive receptors (over 3km away from the nearest saltmarsh habitat), it is considered highly unlikely that this source could contribute to a significant effect on local air quality. Transport emissions have a much smaller dispersal distance than energy from waste facilities and other significant emitters for which a 10km zone of influence would be more appropriate. While the zone of influence for ship exhaust stacks will be greater than that for vehicle exhausts (where the zone of influence is 200m) this has been allowed for in the precautionary use of a 3km zone of influence. The SAC habitats closest to the construction site are ~~marine~~intertidal habitats and are

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						therefore not sensitive to changes in air quality due to dust smothering or marine vessel/ road vehicle emissions during construction. Although there are areas of designated habitat within the Humber Estuary SAC that are nearer to the source of vessel emissions, these are intertidal mudflats (H1140) and subtidal estuarine habitats (H1130, H1110) that do not support any rooted plants that could be sensitive to construction vessel emissions. All available critical loads (and levels) are based on research into impacts on 'rooted macrophytes' (i.e. conventional plants) or (for ammonia) lichens & bryophytes. In other words, they have all been based on impacts on plant communities which obtain their nutrients either through their roots or directly from atmosphere. Unvegetated intertidal mudflat has no such vegetation communities and therefore it would be completely inappropriate to use the available critical loads. While intertidal mudflats supporting pioneer saltmarsh (H1310) can be sensitive to nutrients in some circumstances, where they cause excessive macroalgal (seaweed) growth, the APIS notes that even for

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						saltmarsh *'Overall N deposition [from atmosphere] is likely to be of low importance for these systems as the inputs are probably significantly below the large nutrient loadings from river and tidal inputs'*. It is also considered that the Humber Estuary is likely to be at relatively low risk of smothering from macroalgae, given the role of high sediment load in limiting sunlight penetration and strong wave action in breaking up macroalgae mats. The nearest saltmarsh habitat (H1330) is approximately 3km ~~north-west~~north-east of the site. The assessment has concluded that due to the transient, intermittent and temporary nature of construction marine vessel emissions, and the distance from the nearest sensitive habitat, there will be no likely significant effects on SAC habitats (see **Chapter 9: Nature Conservation (Marine Ecology) [TR030008/APP/6.2]**). There are no designated nature conservation receptors within 200m of a road that exceeds the IAQM and EPUK screening guidance on local roads (see **Chapter 6: Air Quality** of the ES **[TR030008/APP/6.2]**), below which a road traffic impact is unlikely to contribute to a significant effect on local air quality. There

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						are also no roads that exceed the National Highways DMRB screening criteria on the Strategic Road Network (see **Chapter 6: Air Quality** of the ES **[TR030008/APP/6.2]**). There is therefore no potential for construction road vehicle emissions to give rise to LSEs on designated habitats. This impact pathway is, therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Direct loss or changes to migratory fish habitat	Marine piling	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*	No	There is the potential for impacts to fish as a result of habitat loss due to installation of piles and the footprint of the Project. However, the direct footprint of the marine piling only covers a highly localised area with the mobile nature of lamprey allowing them to utilise nearby areas. ~~There is therefore considered to be no potential for LSE and this~~This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
			Capital dredge	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra*	No	Backhoe dredging can directly remove fish and fish eggs in the bucket. Capital dredging also has the potential to result in seabed

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
				fluviatilis		disturbance and smothering of seabed habitats and species. However, the capital dredge will not overlap with the spawning grounds of lamprey which are further upstream in freshwater habitat. Both species are recorded in the estuary at other life stages with the growth phase of river lamprey primarily restricted to estuaries and both species also move through the estuary during spawning migrations. Given the very small dredge footprint in the context of the entire Humber Estuary (and small amount of material that needs to be dredged), the probability that lamprey species will be removed into the bucket during backhoe dredging while passing through the estuary on migration is considered to be low. In addition, given the high mobility of both river and sea lamprey, lamprey will easily be able to avoid the zone of influence of the dredging and utilise other nearby areas with the footprint of dredging only representing a small proportion of the ranges of lamprey. ~~There is therefore considered to be no potential for LSE and this~~This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						LSE.
			Dredge disposal	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*	No	Disposal at the marine disposal site will result in the deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats. However, the capital dredge will not overlap with the spawning grounds of lamprey which are further upstream in freshwater habitat. Both species are recorded in the estuary at other life stages with the growth phase of river lamprey primarily restricted to estuaries and both species also move through the estuary during spawning migrations. Therefore, given the high mobility of both river and sea lamprey (and also the parasitic fish prey of these species), lamprey will easily be able to avoid the zone of influence of the dredging and utilise other nearby areas with the footprint of dredging only represent a small proportion of the ranges of lamprey. ~~There is therefore considered to be no potential for LSE and this~~This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Changes in water	Marine piling	S1095: Sea lamprey	No	The expected highly localised and temporary

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
		and sediment quality on migratory fish species		*Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*		changes in suspended sediment levels and related changes in sediment bound contaminants and dissolved oxygen associated with bed disturbance during marine piling will not result in significant effects in any fish species. The potential for accidental spillages will also be negligible during construction through following established industry guidance and protocols. This impact pathway is, therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
			Capital dredge	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*	Yes	Changes in water quality during capital dredging could impact migratory fish species through an increase in SSC and the release of toxic contaminants bound in sediments.
			Dredge disposal	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*	Yes	Changes in water quality could occur during dredged material disposal through the deposition of material causing elevated SSC and contaminant levels. This could potentially impact on migratory fish species.
		Underwater noise effects on migratory fish species	Marine piling	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra*	Yes	During marine piling, there is the potential for noise disturbance to fish. Percussive (impact) and vibro marine piling will produce underwater noise above background

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
				fluviatilis		conditions and at a level that may cause a risk of injury and behavioural changes to migratory fish in the vicinity of the Project.
			Capital dredge	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*	Yes	Elevated underwater noise and vibration levels caused by the action of the dredger could potentially affect migratory fish.
			Dredge disposal	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*	Yes	Underwater noise and vibration levels caused by the movement of the dredger to and from the disposal site could potentially affect migratory fish.
		Lighting effects on migratory fish and seals	Construction	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis* S1364: Grey seal *Halichoerus grypus*	No	With respect to potential lighting effects during construction, equipment such as marine piling rigs, cranes etc. will be lit for safety reasons. Beams of light from construction lighting will largely be restricted to the surface waters as light is unlikely to penetrate far into the water column given the high turbidity of the Humber Estuary. Furthermore, evidence suggests that lamprey are not considered to be particularly sensitive to lighting and will often be attracted to lighting rather than causing a barrier to movements (Ref 1-20 and Ref 1-21. Therefore, such localised changes would not

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						cause disruption or blocking of migratory routes for these species. Seals are also known to forage in areas with artificial lighting (such as harbours, offshore wind farms and fish farms) with lighting not known to cause adverse effects in this species. Rather than disrupting any foraging movements, lighting might also have some minor and localised beneficial effects given that lighting has been shown to aggregate fish shoals and will also potentially improve foraging efficiency through enhancing vision of this predator near the surface. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Direct loss or changes in marine mammal foraging habitat	Construction (marine piling, capital dredge and dredge disposal)	S1364: Grey seal *Halichoerus grypus*	No	There is the potential for impacts to marine mammals as a result of changes to marine mammal foraging habitat and prey resources. However, the footprint of the Project only covers a highly localised area that constitutes a negligible fraction of the known ranges of local marine mammal populations. This impact pathway is ~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						LSE.
		Changes in water and sediment quality on marine mammals	Marine piling	S1364: Grey seal *Halichoerus grypus*	No	The negligible, highly localised and temporary changes in suspended sediment levels and related changes in sediment bound contaminants and dissolved oxygen associated with bed disturbance during marine piling will not result in significant effects in any marine mammal species. The potential for accidental spillages will also be negligible during construction through following established industry guidance and protocols. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
			Capital dredge	S1364: Grey seal *Halichoerus grypus*	No	The plumes resulting from dredging are expected to have a minimal and local effect on SSC in the vicinity of the Project (as described in more detail in **Chapter 16: Physical Processes [TR030008/APP/6.2]**). Marine mammals are well adapted to turbid conditions and, therefore, not sensitive to the scale of changes in SSC predicted during capital dredging (Ref 1-22). Given the limited extent of sediment dispersal significant elevations in water column contamination are unlikely. In addition, the temporary and

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						localised changes in water column contamination levels are considered unlikely to produce any lethal and sub-lethal effects in these highly mobile species (the concentrations required to produce these effects are generally acquired through long-term, chronic exposure to prey species in which contaminants have bioaccumulated) (Ref 1-22). Furthermore, potential for accidental spillages will also be negligible during all phases through the application of established industry guidance and protocols. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
			Dredge disposal	S1364: Grey seal *Halichoerus grypus*	No	The plumes resulting from dredge disposal are expected to have a minimal and local effect on SSC (as described in more detail in **Chapter 16: Physical Processes [TE030008/APP/6.2]**). Marine mammals are well adapted to turbid conditions and, therefore, not sensitive to the scale of changes in SSC predicted during disposal (Ref 1-22). Given the limited extent of sediment dispersal significant elevations in water column contamination are unlikely. In addition, the temporary and localised

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						changes in water column contamination levels are considered unlikely to produce any lethal and sub-lethal effects in these highly mobile species (the concentrations required to produce these effects are generally acquired through long-term, chronic exposure to prey species in which contaminants have bioaccumulated) (Ref 1-22). Furthermore, potential for accidental spillages will also be negligible during construction through the application of established industry guidance and protocols. ~~The potential for water quality impacts to marine mammal has therefore been scoped out of the assessment.~~ This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Collision risk to marine mammals	Construction, dredging and dredge disposal	S1364: Grey seal *Halichoerus grypus*	No	Vessels involved in construction and dredging/dredge disposal will be mainly stationary or travelling at low speeds (2-6 knots), making the risk of collision very low. Although all types of vessels may collide with marine mammals, vessels traveling at speeds over ten knots are considered to have a much higher probability of causing lethal injury (Ref 1-23). Furthermore, the region is already characterised by heavy shipping

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						traffic. The additional movements due to construction activity (including capital dredging) will only constitute a small increase in vessel traffic in the area which will also be temporary in nature. In general, incidents of mortality or injury of marine mammals caused by vessels remain a relatively rare occurrence in UK waters (Ref 1-24; Ref 1-25). For example, out of 144 post mortem examinations carried out on cetaceans in 2018, only two (1.4%) were attributed to boat collision with the biggest causes of mortality including starvation and by-catch, although some incidents are likely to remain unreported (Ref 1-25). In addition, marine mammals foraging within the Humber Estuary region will routinely need to avoid collision with vessels and are, therefore, considered adapted to living in an environment with high levels of vessel activity. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Underwater noise effects on marine mammals	Marine piling	S1364: Grey seal *Halichoerus grypus*	Yes	Percussive (impact) and vibro marine piling will produce underwater noise above background conditions and at a level that

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						may cause a risk of injury and behavioural changes to marine mammals if they are present in the vicinity of the Project.
			Capital dredge	S1364: Grey seal *Halichoerus grypus*	Yes	Elevated noise and vibration levels caused by the action of the dredger could potentially affect marine mammals by inducing adverse behavioural reactions.
			Dredge disposal	S1364: Grey seal *Halichoerus grypus*	Yes	Elevated noise and vibration levels caused by dredge disposal including the movement of the dredger to and from the disposal site) could potentially affect marine mammals by inducing adverse behavioural reactions.
		Visual disturbance of hauled out seals	Construction, dredging and dredge disposal	S1364: Grey seal *Halichoerus grypus*	No	The nearest established breeding colony for grey seals is located over 25km away at Donna Nook. Approximately ten to 15 grey seals were also observed hauling out on mudflat at Sunk Island (on the north bank of the Humber Estuary) during recent benthic surveys as detailed in Ref 1-26. This haul out site is located approximately 4km north east from the Project and around 3-4km from the dredge disposal sites (including transit routes). No seal haul out sites are known to occur nearer to the Project. Seals which are hauled out on land, either resting or breeding, are considered particularly sensitive to visual disturbance

	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						(Ref 1-27). The level of response of seals is dependent on a range of factors, such as the species at risk, age, weather conditions and the degree of habituation to the disturbance source. Hauled out seals have been recorded becoming alert to powered craft at distances of up to 800 m although seals generally only disperse into the water at distances <150-200 m (Ref 1-28; Ref 1-29; Ref 1-30; Ref 1-31). For example, in a study focusing on a colony of grey seals on the South Devon coast, vessels approaching at distances between 5m and 25m resulted in over 64% of seals entering the water, but at distances of between 50m and 100m only 1% entered the water (~~Ref 1-38~~Ref 1-32). Recent disturbance research has also found no large-scale redistribution of seals after disturbance with most seals returning to the same haul out site within a tidal cycle (~~Ref 1-32~~Ref 1-33). Based on this evidence, seals hauled out on the intertidal habitats of Sunk Island (located on the opposite bank to the Project) are out of the zone of influence of any potential visual disturbance effects as a result of dredging, dredge disposal or construction activity. This

	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						impact pathway is, therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Operation	Direct changes to qualifying habitats beneath marine infrastructure due to shading	Operation	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries	Yes	Changes in sunlight levels as a result of shading due to marine infrastructure has the potential, albeit minimal, to cause changes to the benthic community occurring in an area.
		Changes to qualifying habitats as result of seabed removal during dredging	Maintenance dredging	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries	Yes	Maintenance dredging causes the direct physical removal of marine sediments from the dredge footprint, resulting in the modification of existing marine habitats. The impacts to benthic fauna associated with the dredged material include changes to abundance and distribution through damage, mortality or relocation to a disposal site. Given that the dredge footprint has not previously been subject to any maintenance dredging, there is, therefore, considered to be a potential, albeit minimal, for LSE.
		Changes to qualifying habitats as a result of sediment deposition	Maintenance dredging and disposal	H1130: Estuaries H1140: Mudflats and sandflats not covered by seawater at low tide	No	Maintenance dredge and dredge disposal will result in the deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats.

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
				H1110. Sandbanks which are slightly covered by sea water all the time		As a result of the expected limited maintenance dredging requirements, smaller changes in SSC and sedimentation (within the dredge plumes and at the disposal site) as compared to the capital dredge will occur. Deposition of sediment as a result of dredging will be highly localised and similar to background variability. The benthic species occurring within and near to the dredge area typically consist of burrowing infauna (such as polychaetes and oligochaetes), which are considered tolerant to some sediment deposition. Based on evidence provided in relevant Marine Evidence based Sensitivity Assessment (MarESA) assessments, the characterising species recorded in the project-specific subtidal survey are considered tolerant to deposition of at least 50 mm with many species considered capable of burrowing through much greater levels of sediment deposition. The predicted millimetric changes in deposition are, therefore, considered unlikely to cause smothering effects. In addition, the species recorded in the benthic invertebrate surveys are fast growing and/or have rapid reproductive rates which allow populations to typically rapidly recolonise disturbed habitats, many within a few months following the

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						disturbance events (~~Ref 1-33~~ Ref 1-34~~;~~ Ref 1-35; Ref 1-36; Ref 1-37). Clay Huts licensed disposal site (HU060) will be used for maintenance disposal (if required) as per the existing maintenance dredge licence. The disposal site is located in the mid channel and is subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows. This disposal site is already used for the disposal of maintenance dredge arisings (millions of wet tonnes of dredge sediment are disposed of at HU060 annually) which will also cause some disturbance due to sediment deposition. This is reflected in a generally impoverished assemblage at the disposal site. The benthic species recorded include mobile infauna (such as errant polychaetes e.g., *Arenicola* spp. And amphipods) which are able to burrow through sediment. They are, therefore, considered tolerant to some sediment deposition. In addition, characterising species typically have opportunistic life history strategies, with short life histories (typically two years or less), rapid maturation and the production of large

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						numbers of small propagules which makes them capable of rapid recoverability should mortality as a result of smothering occur (~~Ref 1-33;~~ Ref 1-34; Ref 1-35; Ref 1-36; Ref 1-37; Ref 1-38). On this basis, any effects are considered to be temporary and short term. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Indirect changes to qualifying habitats as a result of changes to hydrodynamic and sedimentary processes	Maintenance dredging and disposal	H1130: Estuaries H1140: Mudflats and sandflats not covered by seawater at low tide H1110. Sandbanks which are slightly covered by sea water all the time	No	The predicted physical processes impacts from future maintenance dredging, if required, will be similar to that which already arises from the ongoing maintenance of the existing Immingham berths. Maintenance dredging has the potential to result in changes to hydrodynamic and sedimentary processes (e.g., water levels, flow rates, changes to tidal prism, accretion and erosion patterns). However, as described in more detail in **Chapter 16: Physical Processes [TR030008/APP/6.2]** only changes in hydrodynamic and sedimentary processes that are of a negligible magnitude are predicted. These changes will not be discernible against natural processes at nearby intertidal habitats. Furthermore, the

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						predicted changes are not expected to modify existing subtidal habitat types found in the area. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Changes in water and sediment quality on benthic habitats and species	Maintenance dredge and dredge disposal	H1130: Estuaries H1140: Mudflats and sandflats not covered by seawater at low tide H1110. Sandbanks which are slightly covered by sea water all the time	No	The need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all). Consequently, changes in water quality lower than for the capital dredge and at worst similar to the changes arising from existing maintenance dredging are expected. Elevated SSCs due to maintenance dredging (if required) and dredge disposal are considered to be of a magnitude that can occur naturally or as a result of existing maintenance dredging/disposal. Sediment plumes resulting from dredging are also considered to dissipate rapidly and be immeasurable against background levels within a short duration of time. Naturally very high SSCs typically occur year-round in the Humber Estuary, particularly during the winter months when storm events disturb the seabed and on spring tides. The estuarine benthic

	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						communities recorded in the region are considered tolerant to this highly turbid environment (~~Ref 1-34;~~ Ref 1-35; Ref 1-36; Ref 1-37). Magnitude of change in water quality is therefore assessed as negligible. The results of the sediment contamination sampling are summarised in the Water and Sediment Quality assessment (**Chapter 17: Marine Water and Sediment Quality [TR030008/APP/6.2]**). In summary, low levels of contamination were found in the samples and there is no reason to believe the sediment will be unsuitable for disposal in the marine environment. During maintenance dredging and dredge disposal, sediment will be rapidly dispersed in the water column. Therefore, the already low levels of contaminants in the dredged sediments will be dispersed further. The probability of changes in water quality occurring at the disposal site is considered to be low and the overall exposure to change is considered to be negligible. The sensitivity of subtidal habitats and species to contaminants is assessed as low to moderate because, although contaminants can cause toxicity in subtidal communities, the concentrations of

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						contaminants required to produce both lethal and sub-lethal effects are generally high (although responses vary considerably between species). This impact pathway is, therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Non-native species transfer during vessel operations	Vessel operations	H1130: Estuaries H1140: Mudflats and sandflats not covered by seawater at low tide H1110. Sandbanks which are slightly covered by sea water all the time	Yes	Non-native species have the potential to be transported into the local area on the hulls of vessels during operation. Non-native invasive species also have the potential to be transported via vessel ballast water. Potential effects alone are considered in Section 4.12 although in-combination effects are assumed to be negligible and not of a magnitude to cause a LSE assuming that standard biosecurity measures are implemented for the Project development and also for other projects.
		Physical change to habitats resulting from the deposition of airborne pollutants	Operational marine vessel emissions	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries H1110. Sandbanks which are slightly covered by sea water all	Yes	Emissions from docked marine vessels and landside plant during operation have been modelled in **Chapter 6: Air Quality** of the ES **[TR030008/APP/6.2]**. The potential for NO_x, NH_3, SO_2 and N deposition to affect designated habitats that are sensitive to these emission sources within the Humber

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
				the time H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand H1330: Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)		Estuary EMS has been identified, as at some locations the 1% thresholds for the relevant Critical Levels/ Loads are exceeded.
			Operational road vehicle emissions	H1140: Mudflats and sandflats not covered by seawater at low tide H1130: Estuaries H1110. Sandbanks which are slightly covered by sea water all the time H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand H1330: Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	No	There are no designated nature conservation receptors within 200m of a road that exceeds the IAQM and EPUK screening guidance on local roads (see **Chapter 6: Air Quality** of the ES **[TR030008/APP/6.2]**), below which a road traffic impact is unlikely to contribute to a significant effect on local air quality. ~~Likely Significant Effects are therefore screened out of this pathway~~This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
		Changes to migratory fish habitat	Maintenance dredge and dredge disposal	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*	No	The need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all). Maintenance dredging and dredge disposal will result in the highly localised deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats. However, the maintenance dredge will not overlap with the spawning grounds of lamprey which are further upstream in freshwater habitat. Both species are recorded in the estuary at other life stages with the growth phase of river lamprey primarily restricted to estuaries and both species also move through the estuary during spawning migrations. Therefore, given the high mobility of both river and sea lamprey (and also the parasitic fish prey of these species), lamprey will easily be able to avoid the zone of influence of the dredging and utilise other nearby areas with the footprint of dredging only represent a small proportion of the ranges of lamprey. This impact pathway is ~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
		Changes in water and sediment quality on migratory fish	Maintenance dredge and dredge disposal	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*	No	Changes in water quality are also expected to be lower than for the capital dredge and at worst similar to changes arising from existing maintenance dredging. With specific respect to lamprey, these species are known to migrate through estuaries with high SSC (including the Humber Estuary). Elevated SSCs due to dredging are considered to be of a magnitude that can occur naturally or as a result of ongoing maintenance dredging/disposal. Sediment plumes resulting from dredging and dredge disposal are also considered to dissipate rapidly and be immeasurable against background levels within a short duration of time. Therefore, lamprey would also be able to avoid any temporary sediment plumes. Based on these factors there is therefore considered limited potential for migrating fish to be adversely affected by the predicted changes in SSC. With respect to sediment contamination, generally low levels of contamination were found in the sediment contamination samples as presented in the Water and Sediment Quality assessment in **Chapter 17: Marine Water and Sediment Quality**

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						[TR030008/APP/6.2]). Based on this sampling data, the overall level of contamination in the proposed dredge area is considered to be low and the sediment plume would be expected to rapidly dissipate by the strong tidal currents in the area. Significant elevations in the concentrations of contaminants within the water column are not anticipated. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Underwater noise effects on migratory fish	Vessel operations including maintenance dredge and dredge disposal	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*	No	During the operational phase there is the potential for noise disturbance to lamprey species as a result of vessel movements. The worst-case source level associated with vessels during operation is the same as for dredging activity. The need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all). Only mild behavioural responses for lamprey species in relative proximity to operational vessels are anticipated with noise levels unlikely to be discernible above ambient levels in the wider Humber Estuary area given the high levels of

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						existing background vessel noise in the area. Furthermore, the additional operational vessel movements resulting from the Project will only constitute a small increase in vessel traffic in the area (approximately a 3% increase alone and 6% with the IERRT project). This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Lighting effects on migratory fish and seals	Vessel and berth operations	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis* S1364: Grey seal *Halichoerus grypus*	No	With respect to potential lighting effects, the jetty will be lit for safety and operational purposes. Beams of light from operational lighting will largely be restricted to the surface waters as light is unlikely to penetrate far into the water column given the high turbidity of the Humber Estuary. Furthermore, evidence suggest that lamprey are not considered to be particularly sensitive to lighting and will often be attracted to lighting rather than causing a barrier to movements (Ref 1-20 and Ref 1-21). Therefore, such localised changes would not cause disruption or blocking of migratory routes for these species. Seals are also known to forage in areas with artificial lighting (such as harbours, offshore wind farms and

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						fish farms) with lighting not known to cause adverse effects in this species. Rather than disrupting any foraging movements, lighting might also have some minor and localised beneficial effects given that lighting has been shown to aggregate fish shoals and will also potentially improve foraging efficiency through enhancing vision of this predator near the surface. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Underwater noise effects on marine mammals	Maintenance ~~dredge and~~dredg, dredge disposal and vessel operations	S1364: Grey seal *Halichoerus grypus*	No	During the operational phase there is the potential for noise disturbance to grey seal species as a result of vessel movements. The worst-case source level associated with vessels during operation is the same as for dredging activity. The need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all). Only mild behavioural responses for seals in relative proximity to operational vessels are anticipated with noise levels unlikely to be discernible above ambient levels in the wider Humber Estuary

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						area given the high levels of existing background vessel noise in the area. Furthermore, the additional operational vessel movements resulting from the Project will only constitute a small increase in vessel traffic in the area (approximately a 3% increase alone and 6% with the IERRT project). This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Visual disturbance of hauled out seals	Vessel operations, maintenance dredge and dredge disposal	S1364: Grey seal *Halichoerus grypus*	No	The nearest established breeding colony for grey seals is located over 25km away at Donna Nook. Approximately ten to 15 grey seals were also observed hauling out on mudflat at Sunk Island (on the north bank of the Humber Estuary) during recent benthic surveys as detailed in Ref 1-26. This haul out site is located approximately 4km north east from the Project. No seal haul out sites are known to occur nearer to the Project. Seals which are hauled out on land, either resting or breeding, are considered particularly sensitive to visual disturbance (Ref 1-27). The level of response of seals is dependent on a range of factors, such as the species at

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						risk, age, weather conditions and the degree of habituation to the disturbance source. Hauled out seals have been recorded becoming alert to powered craft at distances of up to 800 m although seals generally only disperse into the water at distances <150-200 m (Ref 1-28; Ref 1-29; Ref 1-30; Ref 1-31). For example, in a study focusing on a colony of grey seals on the South Devon coast, vessels approaching at distances between 5m and 25m resulted in over 64% of seals entering the water, but at distances of between 50m and 100m only 1% entered the water (~~Ref 1-38~~Ref 1-32). Recent disturbance research has also found no large-scale redistribution of seals after disturbance with most seals returning to the same haul out site within a tidal cycle (~~Ref 1-32~~Ref 1-33). Based on this evidence, seals hauled out on the intertidal habitats of Sunk Island (located on the opposite bank to the Project) are out of the zone of influence of any potential visual disturbance effects as a result of maintenance dredging and vessel operations. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
		Collision risk to marine mammals	Vessel operations	S1364: Grey seal *Halichoerus grypus*	No	Vessels using the berths during operation will be typically approaching at slow speeds (2-4 knots) and maintenance dredging/dredge disposal will be mainly stationary or travelling at low speeds (2-6 knots), making the risk of collision very low. Although all types of vessels may collide with marine mammals, vessels traveling at speeds over ten knots are considered to have a much higher probability of causing lethal injury (Ref 1-23). Furthermore, the region is already characterised by heavy shipping traffic. The additional operational vessel movements resulting from the Project will only constitute a small increase in vessel traffic in the area on a typical day. There will also be periodic maintenance dredger and barge movements. In general, incidents of mortality or injury of marine mammals caused by vessels remain a relatively rare occurrence in UK waters (Ref 1-24; Ref 1-25). For example, out of 144 post mortem examinations carried out on cetaceans in 2018, only two (1.4%) were attributed to boat collision with the biggest causes of mortality including starvation and by-catch, although some incidents are likely to remain unreported (Ref 1-25). In addition, marine mammals frequently foraging within

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						the region will routinely need to avoid collision with vessels and are, therefore, considered adapted to living in an environment with high levels of vessel activity. This impact pathway is, therefore, not considered further in the Shadow HRA.
The Wash and North Norfolk Coast	Construction	Direct loss or changes in marine mammal foraging habitat	Construction (marine piling, capital dredge and dredge disposal)	S1365: Harbour seal *Phoca vitulina*	No	There is the potential for impacts to marine mammals as a result of changes to marine mammal foraging habitat and prey resources. However, the footprint of the Project only covers a highly localised area that constitutes a negligible fraction of the known ranges of local marine mammal populations. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Changes in water and sediment quality on marine mammals	Marine piling		No	The negligible, highly localised and temporary changes in suspended sediment levels and related changes in sediment bound contaminants and dissolved oxygen associated with bed disturbance during marine piling will not result in significant effects in any marine mammal species. The potential for accidental spillages will also be negligible during construction through following established industry guidance and

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						protocols. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
			Capital dredge	S1365: Harbour seal *Phoca vitulina*	No	The plumes resulting from dredging are expected to have a minimal and local effect on SSC in the vicinity of the Project (as described in more detail in **Chapter 16: Physical Processes [TR030008/APP/6.2]**). Marine mammals are well adapted to turbid conditions and, therefore, not sensitive to the scale of changes in SSC predicted during capital dredging (Ref 1-22). Given the limited extent of sediment dispersal significant elevations in water column contamination are unlikely. In addition, the temporary and localised changes in water column contamination levels are considered unlikely to produce any lethal and sub-lethal effects in these highly mobile species (the concentrations required to produce these effects are generally acquired through long-term, chronic exposure to prey species in which contaminants have bioaccumulated) (Ref 1-22). Furthermore, potential for accidental spillages will also be negligible during all phases through the application of established industry guidance and protocols.

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
			Dredge disposal	S1365: Harbour seal *Phoca vitulina*	No	The plumes resulting from dredge disposal are expected to have a minimal and local effect on SSC (as described in more detail in **Chapter 16: Physical Processes [TR030008/APP/6.2]**). Marine mammals are well adapted to turbid conditions and, therefore, not sensitive to the scale of changes in SSC predicted during disposal (Ref 1-22). Given the limited extent of sediment dispersal significant elevations in water column contamination are unlikely. In addition, the temporary and localised changes in water column contamination levels are considered unlikely to produce any lethal and sub-lethal effects in these highly mobile species (the concentrations required to produce these effects are generally acquired through long-term, chronic exposure to prey species in which contaminants have bioaccumulated) (Ref 1-22). Furthermore, potential for accidental spillages will also be negligible during construction through the application of established industry guidance and protocols. The potential for water quality

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination LSE	Justification
						impacts to marine mammal has therefore been scoped out of the assessment. This impact pathway is, therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Collision risk to marine mammals	Construction, dredging and dredge disposal	S1365: Harbour seal *Phoca vitulina*	No	Vessels involved in construction and dredging/dredge disposal will be mainly stationary or travelling at low speeds (2-6 knots), making the risk of collision very low. Although all types of vessels may collide with marine mammals, vessels traveling at speeds over ten knots are considered to have a much higher probability of causing lethal injury (Ref 1-23). Furthermore, the region is already characterised by heavy shipping traffic. The additional movements due to construction activity (including capital dredging) will only constitute a small increase in vessel traffic in the area which will also be temporary in nature. In general, incidents of mortality or injury of marine mammals caused by vessels remain a relatively rare occurrence in UK waters (Ref 1-24; Ref 1-25). For example, out of 144 post mortem examinations carried out on cetaceans in 2018, only two (1.4%) were

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						attributed to boat collision with the biggest causes of mortality including starvation and by-catch, although some incidents are likely to remain unreported (Ref 1-25). In addition, marine mammals foraging within the Humber Estuary region will routinely need to avoid collision with vessels and are, therefore, considered adapted to living in an environment with high levels of vessel activity. This impact pathway is ~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Lighting effects on marine mammals	Construction	S1365: Harbour seal *Phoca vitulina*	No	With respect to potential lighting effects during construction, equipment such as piling rigs, cranes etc. will be lit for safety reasons. Beams of light from construction lighting will largely be restricted to the surface waters as light is unlikely to penetrate far into the water column given the high turbidity of the Humber Estuary. Seals are also known to forage in areas with artificial lighting (such as harbours, offshore wind farms and fish farms) with lighting not known to cause adverse effects in this species. Rather than disrupting any foraging movements, lighting might also have some minor and localised beneficial effects

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						given that lighting has been shown to aggregate fish shoals and will also potentially improve foraging efficiency through enhancing vision of this predator near the surface. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Underwater noise effects on marine mammals	Marine piling	S1365: Harbour seal *Phoca vitulina*	Yes	Percussive (impact) and vibro marine piling will produce underwater noise above background conditions and at a level that may cause a risk of injury and behavioural changes to marine mammals if they are present in the vicinity of the Project.
			Capital dredge	S1365: Harbour seal *Phoca vitulina*	Yes	Elevated noise and vibration levels caused by the action of the dredger could potentially affect marine mammals by inducing adverse behavioural reactions.
			Dredge disposal	S1365: Harbour seal *Phoca vitulina*	Yes	Elevated noise and vibration levels caused by the movement of the dredger to and from the disposal site could potentially affect marine mammals by inducing adverse behavioural reactions.

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
		Visual disturbance of hauled out seals	Construction, dredging and dredge disposal	S1365: Harbour seal *Phoca vitulina*	No	The nearest known haul out site for common seals is located over 25km away at Donna Nook (which could potentially have connectivity to the Wash and North Norfolk Coast SAC). Seals hauled out at Donna Nook are out of the zone of influence of any potential visual disturbance effects as a result of dredging, dredge disposal or construction activity. This impact pathway is, therefore, not considered further in the Shadow HRA.
	Operation	Underwater noise effects on marine mammals	Maintenance dredge ~~and~~ ,dredge disposal and vessel operations	S1365: Harbour seal *Phoca vitulina*	No	During the operational phase there is the potential for noise disturbance to common seal species as a result of vessel movements. The worst-case source level associated with vessels during operation is the same as for dredging activity. The need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all). Only mild behavioural responses for seals in relative proximity to operational vessels are anticipated with noise levels unlikely to be discernible above ambient levels in the wider Humber Estuary area given the high levels of existing background vessel noise in the area. Furthermore, the additional operational vessel movements resulting from the Project will only constitute a small increase in vessel

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						traffic in the area (approximately a 3% increase alone and 6% with the IERRT project). This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Visual disturbance of hauled out seals	Vessel operations, maintenance dredge and dredge disposal	S1365: Harbour seal *Phoca vitulina*	No	The nearest known haul out site for common seals is located over 25km away at Donna Nook (which could potentially have connectivity to the Wash and North Norfolk Coast SAC). Seals hauled out at Donna Nook are out of the zone of influence of any potential visual disturbance effects as a result of maintenance dredging and vessel operations. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Lighting effects on marine mammals	Operation	S1365: Harbour seal *Phoca vitulina*	No	With respect to potential lighting effects, the jetty will be lit for safety and operational purposes. Beams of light from operational lighting will largely be restricted to the surface waters as light is unlikely to penetrate far into the water column given the high turbidity of the Humber Estuary. Seals are also known to

Site	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						forage in areas with artificial lighting (such as harbours, offshore wind farms and fish farms) with lighting not known to cause adverse effects in this species. Rather than disrupting any foraging movements, lighting might also have some minor and localised beneficial effects given that lighting has been shown to aggregate fish shoals and will also potentially improve foraging efficiency through enhancing vision of this predator near the surface. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Collision risk to marine mammals	Vessel operations	S1365: Harbour seal *Phoca vitulina*	No	Vessels using the berths during operation will be typically approaching at slow speeds (2-4 knots) and maintenance dredging/dredge disposal will be mainly stationary or travelling at low speeds (2-6 knots), making the risk of collision very low. Although all types of vessels may collide with marine mammals, vessels traveling at speeds over ten knots are considered to have a much higher probability of causing lethal injury (Ref 1-23). Furthermore, the region is already

S	Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
						characterised by heavy shipping traffic. The additional operational vessel movements resulting from the Project will only constitute a small increase in vessel traffic in the area on a typical day. There will also be periodic maintenance dredger and barge movements. In general, incidents of mortality or injury of marine mammals caused by vessels remain a relatively rare occurrence in UK waters (Ref 1-24; Ref 1-25). For example, out of 144 post mortem examinations carried out on cetaceans in 2018, only two (1.4%) were attributed to boat collision with the biggest causes of mortality including starvation and by-catch, although some incidents are likely to remain unreported (Ref 1-25). In addition, marine mammals frequently foraging within the region will routinely need to avoid collision with vessels and are, therefore, considered adapted to living in an environment with high levels of vessel activity. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Table 4: Potential impacts that could result in LSE on features of the Humber Estuary SPA

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
Construction	Direct loss of supporting intertidal habitat	Marine piling	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage	Yes	Marine piling will cause a direct loss of a small area of intertidal habitat. This loss will be highly localised. However, given the protection afforded to the mudflat that is utilised by feeding waterbirds in this area, there is considered to be a potential for LSE on the waterbird features screened into the assessment (~~Table 2~~Table 2).
	Direct loss of terrestrial habitat outside the SPA boundary supporting feeding, roosting and loafing waterbirds ('functionally linked land').	Construction of landside infrastructure	Waterbird assemblage	No	There is no functionally linked land within the Project boundary. Surveys of the West Site in winter 2022 found the habitats to be unsuitable for feeding, roosting and foraging SPA waterbirds due

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
					to the presence of tall-swarded grassland and areas of scrub. No SPA waterbird species were recorded during the surveys **(Section 1.4 of Appendix A)**. The only SPA waterbird species recorded in the arable field within the temporary compound area in winter 2022/ 23 recorded was curlew; with only three records of single or low numbers (<5) birds **(Section 1.4 of Appendix A)** during the winter survey period. The five year mean peak count for this species within the Humber Estuary is 2,544, and therefore the 1% Humber Estuary threshold for this species that would indicate that an area of terrestrial habitat was important for the species within the estuary is 25 birds. The curlew counts within the temporary compound area are therefore significantly below this threshold, and therefore it is

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
					concluded that this is not functionally linked land to the SPA. No other habitats within the terrestrial part of the Site boundary are suitable for feeding, roosting and loafing waterbirds. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Capital dredge and dredge disposal	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding)	No	The footprint of the capital dredge and dredge disposal sites do not overlap with the intertidal and would not cause any direct changes to intertidal feeding and roosting habitat used by qualifying SPA species screened into the assessment (**~~Table 2~~Table 2**). This impact pathway is therefore,

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
			A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage		not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Indirect loss of supporting intertidal habitat as a result of changes to hydrodynamic and sedimentary processes	Marine works (jetty structure and capital dredging)	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage	Yes	The jetty structure and capital dredge has the potential to result in changes to hydrodynamic and sedimentary processes (e.g. water levels, flow rates, changes to tidal prism, accretion and erosion patterns) which could cause erosion to intertidal mudflat used by feeding birds. There is, therefore, considered to be a potential for LSE on the waterbird features screened into the assessment (~~Table 2~~Table 2).
	Changes in water or sediment	Capital dredging	A048; Common Shelduck (Non-breeding) *Tadorna*	No	All SPA features screened into the Shadow HRA (~~Table 2~~Table

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
	quality		*tadorna* A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage		**2**) are coastal waterbirds that feed on intertidal invertebrates by using the beak to capture prey on intertidal habitats (either when exposed to air or when covered in very shallow water). Therefore, they are not considered sensitive to the directs effects of elevated suspended sediment plumes (unlike diving birds which use pursuit or plunge diving to capture prey underwater). It is considered possible that SPA features could be sensitive to indirect effects resulting from changes to intertidal benthic habitats and species due to suspended sediment concentrations (i.e. changes to invertebrate prey resources on supporting mudflat). However, given estuarine benthic communities recorded on mudflats and the shallow mud in the region are considered tolerant to this highly turbid environment

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
					and the predicted SSCs are within the range that can frequently occur naturally and also as a result of ongoing dredge activity, potential effects of elevated SSC on prey resources are considered to be negligible **(Section 4.8)**. With respect to sediment contamination during construction, potential effects on intertidal benthic habitats and species are considered to be insignificant **(Section 4.9**). On this basis, potential effects on waterbirds as a result of bioaccumulation through consuming prey (i.e. intertidal benthos) will be negligible. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
	Airborne noise and visual disturbance to coastal waterbirds within the SPA boundary.	Construction activity (including capital dredging)	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage	Yes (marine construction activity) No (landside piling)	During marine activity construction, there is the potential for airborne noise and visual disturbance to affect coastal waterbirds. There is, therefore, considered to be a potential for LSE on the waterbird features screened into the assessment (~~Table 2~~**Table 2**) both alone and in-combination with other plans and projects. There is the potential for landside piling to cause potential noise disturbance to coastal waterbirds on the adjacent foreshore. However, terrestrial noise modelling has predicted that the nearest landside piling to the foreshore (within Work Area No. 5. associated with piling of the foundations of the ammonia storage tanks) is predicted to cause noise levels <55 dB $L_{Aeq,1hr}$ and <65 dB L_{Amax} on the

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
					foreshore. This is lower than the 70 dB criteria applied in the assessment and also in the range of background noise in the local Port of Immingham area. The terrestrial piling is also more than 300 m from the foreshore (which is greater than the 200 m disturbance buffer applied in the assessment). On this basis, SPA waterbird features on the foreshore are predicted to be out of the zone of potential disturbance effects arising from terrestrial piling noise during construction. On this basis, terrestrial noise due to landside piling is not considered to result in an LSE.
	Airborne noise and visual disturbance to coastal waterbirds using functionally linked land outside the SPA boundary.	Construction	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A156: Black-tailed Godwit	No	There is no functionally linked land within or adjacent to the Project boundary. This impact pathway is therefore, not

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
			Limosa limosa islandica (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage		considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Lighting effects on coastal waterbirds during construction	Construction	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage	No	With respect to potential lighting effects, construction equipment such as marine piling rigs, cranes etc. will be lit for safety reasons. Waders and other waterbirds feeding on intertidal mudflats are known to feed nocturnally. Evidence suggests that artificial illumination can improve foraging (through increasing prey intake rate) and can, therefore, lighting can have a positive effect on the nocturnal foraging of waterbirds (Ref 1-39). Artificial lighting has also been found in some

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
					situations to increase potential perceived predation risk in waders which can cause increased behavioural responses in areas with higher intensity illumination (Ref 1-40). The majority of construction activities are planned to occur in daylight hours. Where construction is required at night on the approach jetty, effects will be localised. Temporary lighting during construction will be arranged so that glare is minimised outside the construction areas with a Lighting Management Plan (LMP) incorporated into the Final CEMP that addresses the use of lighting around potentially sensitive areas including the Humber Estuary. On this basis, potential

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
					construction lighting effects are considered to be highly localised and of a negligible magnitude, and as such are not considered to result in a LSE to any waterbird features alone or in-combination.
Operation	Potential mortality or injury to coastal waterbirds as a result of flare stacks	Flare stack operation	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage	No	Flare stacks have the potential to cause incidental mortality to birds during nocturnal periods with the flame emitted during a flaring event known to attract birds in some situations. Most incidents reported have been as a result of birds using the structures as a nocturnal roosting perch and/or birds attracted to the illumination of the flare during migratory movements. It should be noted that evidence suggests that effects on birds have been recorded as a result of

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
					flare stacks associated with offshore oil and gas platforms or refineries (Ref 1-41). These structures have very large open flames that are active as part of normal operations. In contrast, the flare stacks proposed as part of the Project will be much smaller in comparison, with the flame largely enclosed as a result of shrouding. Furthermore, they are only required to be used during start up, shut down and emergency use (typically less than 5 % of the time annually). In addition, no supporting terrestrial habitat for SPA species occurs within the Project boundary. Furthermore, the SPA waterbird species screened in **(Table 2)** are not known to use

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
					stacks or other similar structures in industrial areas of the Humber Estuary for roosting. In addition, the locations where the flare stacks will be installed (in the East Site-Ammonia Storage, East Site-Hydrogen Production Facility and West Site) are not in a known flight path route between the foreshore and nearby functionally linked land areas with flight path survey data suggesting only very limited flights occur (during winter, migratory passage and summer months) (Ref 1-42). Flare stacks are also a feature of the industrial landscape in the local area with local populations of SPA birds considered accustomed to these features with no evidence to suggest that local populations have been affected by flare stacks from nearby refineries.

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
					Based on all these considerations, the risk of flare stacks causing injury or morality is considered to be negligible and will not result in a LSE to any waterbird features alone or in-combination.
~~Operation~~	Changes to coastal waterbird foraging and roosting habitat as a result of marine infrastructure	Berth operations	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage	Yes	Marine infrastructure associated with the Project (raised jetty structure etc.) could potentially cause direct damage or reduced functionality to waterbird feeding and roosting habitat. There is, therefore, considered to be a potential for LSE on the waterbird features screened into the assessment (~~Table 2~~Table 2).
	Airborne noise and visual	Berth operations	A048; Common Shelduck	Yes	During operation, there is the

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
	disturbance to coastal waterbirds within the SPA boundary		(Non-breeding) *Tadorna tadorna* A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage		potential for airborne noise and visual disturbance to affect coastal waterbirds within the SPA boundary. There is, therefore, considered to be a potential for LSE on the waterbird features screened into the assessment (**~~Table 2~~Table 2**).
	Lighting effects on coastal waterbirds during operation	Berth operations	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding)	No	With respect to potential lighting effects, ~~the jetty~~construction equipment such as marine piling rigs, cranes etc. will be lit for safety ~~and operational purposes.~~ reasons. Waders and other waterbirds feeding on intertidal mudflats are known to feed nocturnally. Evidence suggests that artificial illumination can improve foraging (through increasing prey intake

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
			Waterbird assemblage		rate) and can, therefore, lighting can have a positive effect on the nocturnal foraging of waterbirds (Ref 1-39). Artificial lighting has also been found in some situations to increase potential perceived predation risk in waders which can cause increased behavioural responses in areas with higher intensity illumination (Ref 1-40). Further analysis suggests that operational lighting effects on the foreshore and Humber Estuary will be highly localised to the immediate vicinity of the jetty with light spill falling to 2 lux[2] within 7.5 m of the jetty and reaching levels

[2] 1. For context, moonlight on a full moon can be up to 1-2 lux with direct sunlight over 100,000 lux (https://www.seratechnologies.com/what-is-lux-and-what-level-should-it-be).

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
					consistent with current background illumination within 15 –20 m of the jetty. On this basis, potential operational lighting effects are considered to be highly localised and of negligible magnitude not considered to result in a LSE to any waterbird features alone or in-combination.
Decommissioning	Airborne noise and visual disturbance to coastal waterbirds within the Ramsar boundary	Landside decommissioning of the removal of pipe racks within Work Area 2 (the jetty access road) and plant and equipment on the approach jetty topside associated with hydrogen production (within Work Area 1).	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A149: Dunlin *Calidris alpina alpina* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding)	Yes	During decommissioning, there is the potential for airborne noise and visual disturbance to affect coastal waterbirds. There is, therefore, considered to be a potential for LSE on the waterbird features screened into the assessment **(Table 2)**.

Phase	Impact Pathways/ Potential Effects	Project activity	Feature	Potential for LSE alone and In-combination	Justification
			Waterbird assemblage		

Table 5: Potential impacts that could result in LSE on features of the Humber Estuary Ramsar

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
Construction	Direct loss of qualifying intertidal habitat	Marine piling	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and	Yes	Marine piling will result in the small loss of intertidal.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			coastal brackish/saline lagoons.		
	Direct loss of qualifying subtidal habitat	Marine piling	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal	Yes	Marine piling will also result in a loss, albeit minimal, of subtidal. This impact pathway has, therefore, been scoped into the assessment.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			brackish/saline lagoons.		
	Direct changes to qualifying intertidal as result of seabed removal during dredging	Capital dredge	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	Yes	Capital dredging causes the direct physical removal of marine sediments from the dredge footprint, resulting in the modification of existing marine habitats. The impacts to benthic fauna associated with the dredged material include changes to abundance and distribution through damage, mortality or relocation to a disposal site.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		
	Direct changes to qualifying habitats as a result of sediment deposition	Marine piling	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	No	Marine piling has the potential to result in the localised resuspension of sediment as a result of seabed disturbance. Sediment that settles out of suspension back onto the seabed as result of marine piling is expected to be negligible and benthic habitats and species are not expected to be sensitive to this level of change. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		
		Capital dredge	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	Yes	Capital dredging has the potential to result in localised physical disturbance and smothering of seabed habitats and species (where the sediment settles out of suspension back onto the seabed).

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		
		Dredge disposal	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	Yes	Dredge disposal will result in the deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		
	Indirect loss or change to qualifying habitats and species as a result of changes to hydrodynamic and sedimentary processes	Marine works (jetty structure and capital dredging)	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	Yes	The jetty structure and capital dredge have the potential to result in changes to hydrodynamic and sedimentary processes (e.g., flow rates, accretion and erosion patterns). Marine invertebrates inhabiting sand and mud habitat show different tolerance ranges to physiological stresses caused by tidal exposure and tidal elevation and, therefore, hydrodynamic and bathymetric changes caused by the dredging could affect the quality of marine habitats and change the distribution of marine species.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		
		Dredge disposal	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	Yes	The disposal of dredged material at the marine disposal site has the potential to result in changes to hydrodynamic and sedimentary processes (e.g., water levels, flow rates, changes to tidal prism, accretion and erosion patterns). Marine invertebrates inhabiting sand and mud habitat show different tolerance ranges to physiological stresses caused by tidal exposure and tidal elevation and, therefore, hydrodynamic and bathymetric changes caused by the disposal could affect the quality of marine habitats and change the distribution of marine species.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		
	Changes in water and sediment quality on benthic habitats and species	Marine piling	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	No	The negligible, highly localised and temporary changes in suspended sediment levels (and related changes in sediment bound contaminants and dissolved oxygen) associated with bed disturbance during marine piling is considered unlikely to produce adverse effects in any species. The potential for accidental spillages will also be negligible during construction through following established industry guidance and protocols. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		
		Capital dredge	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	Yes	Changes in water quality during capital dredging could impact benthic habitats and species through an increase in SSC and the release of toxic contaminants bound in sediments. with other plans and projects.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		
		Dredge disposal	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	Yes	Changes in water quality could occur during dredged material disposal through the deposition of material causing elevated SSC and contaminant levels. This could potentially impact on benthic habitats and species.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		
		Surface water drainage	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	No	Standard measures to control surface water run-off during construction are embedded within the Project design to ensure legislative compliance, and therefore it is very unlikely that contaminated run-off would enter the Humber Estuary. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		
	The potential introduction and spread of non-native species	Construction, dredging and dredge disposal	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	Yes	Non-native species have the potential to be transported into the local area as a result of construction, dredging and dredge disposal activity. Potential effects alone are considered in Section 4.12 although in-combination effects are assumed to be negligible and not of a magnitude to cause a LSE assuming that standard biosecurity measures are implemented for the Project and also for other projects.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		
	Physical change to habitats resulting from the deposition of airborne pollutants	Construction	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline	No	The assessment has considered a scenario of peak construction vessel operation (see **Chapter 6: Air Quality** of the ES **[TR030008/APP/6.2]**). Given the limited number of construction vessel emissions sources, the frequency of operation and distance between source and sensitive receptors (over 3km away from the nearest saltmarsh habitat), it is considered highly unlikely that this source could contribute to a significant effect on local air quality. Transport emissions have a much smaller dispersal distance than energy from waste facilities and other significant emitters for which a 10km zone of influence would be more appropriate. While the zone of influence for ship exhaust stacks will be greater than that for vehicle exhausts (where the zone of influence is 200m) this has been allowed for in the precautionary use of a 3km zone of influence. The designated habitats closest to the construction site are ~~marine~~intertidal habitats and are therefore not

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			lagoons.		sensitive to changes in air quality due to dust smothering or marine vessel/ road vehicle emissions during construction. Although there are areas of designated habitat within the Humber Estuary Ramsar that are nearer to the source of vessel emissions, these are intertidal mudflats and subtidal estuarine habitats that do not support any rooted plants that could be sensitive to vessel emissions. All available critical loads (and levels) are based on research into impacts on ‘rooted macrophytes’ (i.e. conventional plants) or (for ammonia) lichens & bryophytes. In other words, they have all been based on impacts on plant communities which obtain their nutrients either through their roots or directly from atmosphere. Unvegetated intertidal mudflat has no such vegetation communities and therefore it would be completely inappropriate to use the available critical loads. While intertidal mudflats supporting pioneer saltmarsh vegetation can be sensitive to nutrients in some

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					circumstances, where they cause excessive macroalgal (seaweed) growth, the APIS notes that even for saltmarsh *'Overall N deposition [from atmosphere] is likely to be of low importance for these systems as the inputs are probably significantly below the large nutrient loadings from river and tidal inputs'*. It is also considered that the Humber Estuary is likely to be at relatively low risk of smothering from macroalgae, given the role of high sediment load in limiting sunlight penetration and strong wave action in breaking up macroalgae mats. There are no designated nature conservation receptors within 200m of a road that exceeds the IAQM and EPUK screening guidance on local roads (see **Chapter 6: Air Quality** of the ES **[TR030008/APP/6.2]**), below which a road traffic impact is unlikely to contribute to a significant effect on local air quality. There are also no roads that exceed the National Highways DMRB screening criteria on the Strategic Road Network (see **Chapter 6: Air Quality** of the ES **[TR030008/APP/6.2]**). There is therefore no potential

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					for construction road vehicle emissions to give rise to LSEs on designated habitats. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Direct loss or changes to migratory fish habitat	Marine piling	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus*	No	There is the potential for impacts to fish as a result of habitat loss due to installation of piles and the footprint of the Project. However, the direct footprint of the marine piling only covers a highly localised area with the mobile nature of lamprey allowing them to utilise nearby areas. This impact pathway is ~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			between coastal waters and their spawning areas.		
		Capital dredge	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their	No	Backhoe dredging can directly remove fish and fish eggs in the bucket. In addition, capital dredging has the potential to result in seabed disturbance and smothering of seabed habitats and species. However, the capital dredge will not overlap with the spawning grounds of lamprey which are further upstream in freshwater habitat. Both species are recorded in the estuary at other life stages with the growth phase of river lamprey primarily restricted to estuaries and both species also move through the estuary during spawning migrations. Given the very small dredge footprint in the context of the entire Humber Estuary (and small amount of material that needs to be dredged), the probability that lamprey species will be removed into the bucket during backhoe dredging while passing through the estuary on migration is considered to be low. In addition, given the high mobility of both river and

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			spawning areas.		sea lamprey (and also the parasitic fish prey of these species), lamprey will easily be able to avoid the zone of influence of the dredging and utilise other nearby areas with the footprint of dredging only represent a small proportion of the ranges of lamprey. This impact pathway is, therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Dredge disposal	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey	No	Disposal at the marine disposal site will result in the deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats. However, the capital dredge will not overlap with the spawning grounds of lamprey which are further upstream in freshwater habitat. Both species are recorded in the estuary at other life stages with the growth phase of river lamprey primarily restricted to estuaries and both species also move through the estuary during spawning migrations. Therefore, given the high mobility of both river and sea lamprey (and also the parasitic fish prey of these species), lamprey

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			Lampetra fluviatilis and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.		will easily be able to avoid the zone of influence of the dredging and utilise other nearby areas with the footprint of dredging only represent a small proportion of the ranges of lamprey. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Changes in water and sediment quality on migratory fish species	Marine piling	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis*	No	The expected highly localised and temporary changes in suspended sediment levels and related changes in sediment bound contaminants and dissolved oxygen associated with bed disturbance during marine piling are considered highly unlikely to produce adverse effects in any fish species. The potential for accidental spillages will also be negligible during construction through following established industry guidance and protocols. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.		
		Capital dredge	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal	Yes	Changes in water quality during capital dredging could impact migratory fish species through an increase in SSC and the release of toxic contaminants bound in sediments.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			waters and their spawning areas.		
		Dredge disposal	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey Lampetra fluviatilis and sea lamprey Petromyzon marinus between coastal waters and their spawning areas.	Yes	Changes in water quality could occur during dredged material disposal through the deposition of material causing elevated SSC and contaminant levels. This could potentially impact on migratory fish species.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
	Underwater noise effects on migratory fish species	Marine piling	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	Yes	During marine piling, there is the potential for noise disturbance to fish. Percussive (impact) and vibro marine piling will produce underwater noise above background conditions and at a level that may cause a risk of injury and behavioural changes to fish in the vicinity of the Project.
		Capital dredge	Criterion 8 – Internationally	Yes	Elevated underwater noise and vibration levels caused by the action of the dredger could potentially affect

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.		migratory fish.
		Dredge disposal	Criterion 8 – Internationally important source of food for fishes, spawning grounds,	Yes	Underwater noise and vibration levels caused by the movement of the dredger to and from the disposal site could potentially affect migratory fish.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.		
	Lighting effects on migratory fish and seals	Construction	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path:	No	With respect to potential lighting effects during construction, equipment such as marine piling rigs, cranes etc. will be lit for safety reasons. Beams of light from construction lighting will largely be restricted to the surface waters as light is unlikely to penetrate far into the water column given the high turbidity of the Humber Estuary. Furthermore, evidence

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas. Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at		suggest that lamprey are not considered to be particularly sensitive to lighting and will often be attracted to lighting rather than causing a barrier to movements (Ref 1-20 and Ref 1-21). Therefore, such localised changes would not cause disruption or blocking of migratory routes for these species. Seals are also known to forage in areas with artificial lighting (such as harbours, offshore wind farms and fish farms) with lighting not known to cause adverse effects in this species. Rather than disrupting any foraging movements, lighting might also have some minor and localised beneficial effects given that lighting has been shown to aggregate fish shoals and will also potentially improve foraging efficiency through enhancing vision of this predator near the surface. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.		
	Direct loss or changes in marine mammal foraging habitat	Construction (marine piling, capital dredge and dredge disposal)	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey	No	There is the potential for impacts to marine mammals as a result of changes to marine mammal foraging habitat and prey resources. However, the footprint of the Project only covers a highly localised area that constitutes a negligible fraction of the known ranges of local marine mammal populations. This impact pathway is, therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			seal colony in England and the furthest south regular breeding site on the east coast.		
	Changes in water and sediment quality on marine mammals	Marine piling	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site	No	The negligible, highly localised and temporary changes in suspended sediment levels and related changes in sediment bound contaminants and dissolved oxygen associated with bed disturbance during marine piling, is considered highly unlikely to produce adverse effects in any marine mammal species. The potential for accidental spillages will also be negligible during construction through following established industry guidance and protocols. This impact pathway is, therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			on the east coast.		
		Capital dredge	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.	No	The plumes resulting from dredging are expected to have a minimal and local effect on SSC in the vicinity of the Project (as described in more detail in **Chapter 16: Physical Processes [TE030008/APP/6.2]**). Marine mammals are well adapted to turbid conditions and, therefore, not sensitive to the scale of changes in SSC predicted during capital dredging (Ref 1-22). Given the limited extent of sediment dispersal significant elevations in water column contamination are unlikely. In addition, the temporary and localised changes in water column contamination levels are considered unlikely to produce any lethal and sub-lethal effects in these highly mobile species (the concentrations required to produce these effects are generally acquired through long-term, chronic exposure to prey species in which contaminants have bioaccumulated) (Ref 1-22). Furthermore, potential for accidental spillages will also be negligible during all phases through the application of established industry guidance

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					and protocols. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
		Dredge disposal	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.	No	The plumes resulting from dredge disposal are expected to have a minimal and local effect on SSC (as described in more detail in **Chapter 16: Physical Processes [TR030008/APP/6.2]**). Marine mammals are well adapted to turbid conditions and, therefore, not sensitive to the scale of changes in SSC predicted during disposal (Ref 1-22). Given the limited extent of sediment dispersal significant elevations in water column contamination are unlikely. In addition, the temporary and localised changes in water column contamination levels are considered unlikely to produce any lethal and sub-lethal effects in these highly mobile species (the concentrations required to produce these effects are generally acquired through long-term, chronic exposure to prey species in which contaminants have bioaccumulated) (Ref 1-22). Furthermore, potential for accidental spillages will also

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					be negligible during construction through the application of established industry guidance and protocols. The potential for water quality impacts to marine mammal has therefore been scoped out of the assessment. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Collision risk to marine mammals	Construction, dredging and dredge disposal	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey	No	Vessels involved in construction and dredging/dredge disposal will be mainly stationary or travelling at low speeds (2-6 knots), making the risk of collision very low. Although all types of vessels may collide with marine mammals, vessels traveling at speeds over ten knots are considered to have a much higher probability of causing lethal injury (Ref 1-23). Furthermore, the region is already characterised by heavy shipping traffic. The additional movements due to construction activity (including capital dredging) will only constitute a small increase in vessel traffic in the area which will also be temporary in nature.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			seal colony in England and the furthest south regular breeding site on the east coast.		In general, incidents of mortality or injury of marine mammals caused by vessels remain a relatively rare occurrence in UK waters (Ref 1-24; Ref 1-25). For example, out of 144 post mortem examinations carried out on cetaceans in 2018, only two (1.4%) were attributed to boat collision with the biggest causes of mortality including starvation and by-catch, although some incidents are likely to remain unreported (Ref 1-25). In addition, marine mammals foraging within the Humber Estuary region will routinely need to avoid collision with vessels and are, therefore, considered adapted to living in an environment with high levels of vessel activity. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Underwater noise effects on marine mammals	Marine piling	Criterion 3 – supports populations of plants and/or animal species of international	Yes	Percussive (impact) and vibro marine piling will produce underwater noise above background conditions and at a level that may cause a risk of injury and behavioural changes to marine mammals in the

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.		vicinity of the proposed development.
		Capital dredge	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports	Yes	Elevated noise and vibration levels caused by the action of the dredger could potentially affect marine mammals by inducing adverse behavioural reactions.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.		
		Dredge disposal	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals Halichoerus grypus at Donna Nook. It is the	Yes	Elevated noise and vibration levels caused by the movement of the dredger to and from the disposal site could potentially affect marine mammals by inducing adverse behavioural reactions.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			second largest grey seal colony in England and the furthest south regular breeding site on the east coast.		
	Visual disturbance of hauled out seals	Construction, dredging and dredge disposal	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site	No	The nearest established breeding colony for grey seals is located over 25km away at Donna Nook. Approximately ten to 15 grey seals were also observed hauling out on mudflat at Sunk Island (on the north bank of the Humber Estuary) during recent benthic surveys as detailed in Ref 1-26. This haul out site is located approximately 4km north east from the Project and around 3-4km from the dredge disposal sites (including transit routes). No seal haul out sites are known to occur nearer to the Project. Seals which are hauled out on land, either resting or breeding, are considered particularly sensitive to visual disturbance (Ref 1-27). The level of response of seals is dependent on a range

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			on the east coast.		of factors, such as the species at risk, age, weather conditions and the degree of habituation to the disturbance source. Hauled out seals have been recorded becoming alert to powered craft at distances of up to 800 m although seals generally only disperse into the water at distances <150-200m (Ref 1-28; Ref 1-29; Ref 1-30; Ref 1-31). For example, in a study focusing on a colony of grey seals on the South Devon coast, vessels approaching at distances between 5m and 25m resulted in over 64% of seals entering the water, but at distances of between 50m and 100m only 1% entered the water (~~Ref 1-38~~Ref 1-32). Recent disturbance research has also found no large-scale redistribution of seals after disturbance with most seals returning to the same haul out site within a tidal cycle (~~Ref 1-32~~Ref 1-33). Based on this evidence, seals hauled out on the intertidal habitats of Sunk Island (located on the opposite bank to the Project) are out of the zone of influence of any potential visual disturbance effects as a result of dredging, dredge disposal or construction

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					activity. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Direct loss of supporting intertidal habitat	Marine piling	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin,	Yes	Marine piling will cause a direct loss of intertidal habitat. This loss will be highly localised. However, given the protection afforded to the mudflat that is utilised by feeding waterbirds in this area, there is, therefore, considered to be a potential for LSE on the waterbird features screened into the assessment (**~~Table 2~~Table 2**).

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		
		Capital dredge	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations	No	The footprint of the capital dredge and dredge disposal sites do not overlap with the intertidal and would not cause any direct changes to intertidal feeding and roosting habitat used by qualifying Ramsar species screened into the assessment **(~~Table 2)~~Table 2).** This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		
	Direct loss of terrestrial habitat outside the Ramsar boundary supporting feeding, roosting and loafing waterbirds ('functionally linked land').	Construction of landside infrastructure	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean	No	There is no functionally linked land within or adjacent to the Site Boundary. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		
	Indirect loss of supporting intertidal habitat as a result	Marine works	Criterion 5 – Bird Assemblages of	Yes	The jetty structure and capital dredge has the potential to result in changes to hydrodynamic and sedimentary

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
	of changes to hydrodynamic and sedimentary processes	(jetty structure and capital dredging)	International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed		processes (e.g. water levels, flow rates, changes to tidal prism, accretion and erosion patterns) which could cause erosion to intertidal mudflat used by feeding birds. There is, therefore, considered to be a potential for LSE on the waterbird features screened into the assessment (~~Table 2~~Table 2).

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			Godwit (overwintering)		
	Changes in water or sediment quality	Capital dredging	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit,	No	All Ramsar features screened into the Shadow HRA are coastal waterbirds that feed on intertidal invertebrates by using the beak to capture prey on intertidal habitats (either when exposed to air or when covered in very shallow water). Therefore, they are not considered sensitive to the directs effects of elevated suspended sediment plumes (unlike diving birds which use pursuit or plunge diving to capture prey underwater). It is considered possible that Ramsar features could be sensitive to indirect effects resulting from changes to intertidal benthic habitats and species due to suspended sediment concentrations (i.e. changes to invertebrate prey resources on supporting mudflat). However, given estuarine benthic communities recorded on mudflats and the shallow mud in the region are considered tolerant to this highly turbid environment and the predicted SSCs are within the range that can frequently occur naturally and also

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering		as a result of ongoing dredge activity, potential effects of elevated SSC on prey resources are considered to be negligible **(Section 4.8)**. With respect to sediment contamination during construction, potential effects on intertidal benthic habitats and species are considered to be insignificant **(Section 4.9).** On this basis, potential effects on waterbirds as a result of bioaccumulation through consuming prey (i.e. intertidal benthos) will be negligible. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Airborne noise and visual disturbance to coastal waterbirds within the Ramsar boundary.	Construction activity (including capital dredging)	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl -	Yes (marine construction activity) No (landside piling)	During marine construction, there is the potential for airborne noise and visual disturbance to affect coastal waterbirds. There is, therefore, considered to be a potential for LSE on the waterbird features screened into the assessment (~~Table 2~~**Table 2**).

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		There is the potential for landside piling to cause potential noise disturbance to coastal waterbirds on the adjacent foreshore. However, terrestrial noise modelling has predicted that the nearest landside piling to the foreshore (within Work Area No. 5. associated with piling of the foundations of the ammonia storage tanks) is predicted to cause noise levels <55 dB $L_{Aeq,1hr}$ and <65 dB L_{Amax} on the foreshore. This is lower than the 70 dB criteria applied in the assessment and also in the range of background noise in the local Port of Immingham area. The terrestrial piling is also more than 300 m from the foreshore (which is greater than the 200 m disturbance buffer applied in the assessment). On this basis, SPA waterbird features on the foreshore are predicted to be out of the zone of potential disturbance effects arising from terrestrial piling noise during construction. On this basis, terrestrial noise due to landside piling is not considered to result in an LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
	Airborne noise and visual disturbance to coastal waterbirds using functionally linked land outside the Ramsar boundary.	Construction	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage)	No	There is no functionally linked land within or adjacent to the Site Boundary. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		
	Lighting effects on coastal waterbirds during construction	Construction	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance:	No	With respect to potential lighting effects, construction equipment such as marine piling rigs, cranes etc. will be lit for safety reasons. Waders and other waterbirds feeding on intertidal mudflats are known to feed nocturnally. Evidence suggests that artificial illumination can improve foraging (through increasing prey intake rate) and can, therefore, lighting can have a positive effect on the nocturnal foraging of waterbirds (Ref 1-39). Artificial lighting has also been found in some situations to increase potential perceived predation risk in waders which can cause increased behavioural responses in areas with higher intensity illumination (Ref 1-40).

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		The majority of construction activities are planned to occur in daylight hours. Where construction is required at night on the approach jetty, effects will be localised. Temporary lighting during construction will be arranged so that glare is minimised outside the construction areas with a Lighting Management Plan (LMP) incorporated into the Final CEMP that addresses the use of lighting around potentially sensitive areas including the Humber Estuary. On this basis, potential construction lighting effects are considered to be highly localised and of a negligible magnitude, and as such are not considered to result in a LSE to any waterbird features alone or in-combination.
Operation	Direct changes to qualifying habitat beneath marine	Operation	Criterion 1 – natural wetland habitats that	Yes	Changes in sunlight levels as a result of shading due to marine infrastructure has the potential to cause

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
	infrastructure due to shading		are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		changes to the benthic community occurring in an area.
	Changes to qualifying habitat as result of seabed	Maintenance	Criterion 1 – natural wetland habitats that are of international	Yes	Maintenance dredging causes the direct physical removal of marine sediments from the dredge footprint, resulting in the modification of existing marine habitats.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
	removal during dredging	dredging	importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		The impacts to benthic fauna associated with the dredged material include changes to abundance and distribution through damage, mortality or relocation to a disposal site. Given that the dredge footprint has not previously been subject to any maintenance dredging, there is, therefore, considered to be a potential for LSE on this feature.
	Changes to qualifying habitat as a result of sediment deposition	Maintenance dredging and	Criterion 1 – natural wetland habitats that are of international importance:	No	Maintenance dredge and dredge disposal will result in the deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
		disposal	The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		As a result of the expected limited maintenance dredging requirements, smaller changes in SSC and sedimentation (within the dredge plumes and at the disposal site) as compared to the capital dredge will occur. Deposition of sediment as a result of dredging will be highly localised and similar to background variability. The benthic species occurring within and near to the dredge area typically consist of burrowing infauna (such as polychaetes and oligochaetes), which are considered tolerant to some sediment deposition. The predicted millimetric changes in deposition are, therefore, considered unlikely to cause smothering effects. In addition, the species recorded in the benthic invertebrate surveys are fast growing and/or have rapid reproductive rates which allow populations to typically rapidly recolonise disturbed habitats, many within a few months following the disturbance events (~~Ref 1-33;~~ Ref 1-34; Ref 1-35; Ref 1-36; Ref 1-37). Clay Huts licensed disposal site (HU060) will be used for maintenance disposal (if required) as per the

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					existing maintenance dredge licence. The disposal site is located in the mid channel and are subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows. This disposal site is already used for the disposal of maintenance dredge arisings (millions of wet tonnes of dredge sediment are disposed of at HU060 annually) which will also cause some disturbance due to sediment deposition. This is reflected in a generally impoverished assemblage at the disposal site. The benthic species recorded include mobile infauna (such as errant polychaetes e.g., *Arenicola* spp. and amphipods) which are able to burrow through sediment. They are, therefore, considered tolerant to some sediment deposition. In addition, characterising species typically have opportunistic life history strategies, with short life histories (typically two years or less), rapid maturation and the production of large numbers of small propagules which makes them capable of rapid recoverability should mortality as a

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					result of smothering occur (~~Ref 1-33;~~ Ref 1-34; ~~Ref 1-40; Ref 1-36~~Ref 1-35; Ref 1-43; Ref 1-37; Ref 1-38). On this basis, any effects are considered to be temporary and short term. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Indirect changes to qualifying habitats as a result of changes to hydrodynamic and sedimentary processes	Maintenance dredging and disposal	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks,	No	The predicted physical processes impacts from future maintenance dredging will be similar to those which already arise from the ongoing maintenance of the existing Immingham berths. Maintenance dredging has the potential to result in changes to hydrodynamic and sedimentary processes (e.g. water levels, flow rates, changes to tidal prism, accretion and erosion patterns). However, changes in hydrodynamic and sedimentary processes that are of a negligible magnitude are expected as a result of the expected limited maintenance dredging requirements. Such changes are unlikely to be discernible against

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		natural processes at nearby intertidal habitats. Furthermore, such changes are not expected to modify existing subtidal habitat types found in the area. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE..
	Changes in water and sediment quality on benthic habitats and species	Maintenance dredge and dredge disposal	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters,	No	The need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all). Consequently, changes in water quality lower than for the capital dredge and at worst similar to changes arising from existing maintenance dredging is expected. Elevated SSCs due to maintenance dredging and dredge disposal are anticipated to be of a magnitude that can occur naturally or as a result of existing maintenance dredging/disposal and sediment plumes resulting from dredging would also be expected to dissipate rapidly and be immeasurable against background levels within a short duration of time.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		Naturally very high SSCs typically occur year-round in the Humber Estuary, particularly during the winter months when storm events disturb the seabed and on spring tides. The estuarine benthic communities recorded in the region are considered tolerant to this highly turbid environment (~~Ref 1-34;~~ Ref 1-35; Ref 1-36; Ref 1-37). Magnitude of change is therefore assessed as negligible. The results of the sediment contamination sampling are summarised above and the Water and Sediment Quality assessment (**Chapter 17: Marine Water and Sediment Quality [TR030008/APP/6.2]**). In summary, low levels of contamination were found in the samples and there is no reason to believe the sediment will be unsuitable for disposal in the marine environment. During maintenance dredging and dredge disposal, sediment will be rapidly dispersed in the water column. Therefore, the already low levels of contaminants in the dredged sediments will be dispersed further. The

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					probability of changes in water quality occurring at the disposal site is considered to be low and the overall exposure to change is considered to be negligible. The sensitivity of subtidal habitats and species to contaminants is assessed as low to moderate because, although contaminants can cause toxicity in subtidal communities, the concentrations of contaminants required to produce both lethal and sub-lethal effects are generally high (although responses vary considerably between species). This impact pathway is, therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Non-native species transfer during vessel operations	Vessel operations	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative	Yes	Non-native species have the potential to be transported into the local area on the hulls of vessels during operation. Non-native invasive species also have the potential to be transported via vessel ballast water. Potential effects alone are considered in Section 4.12 although in-combination effects are assumed to be negligible and not of a magnitude to cause a LSE

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		assuming that standard biosecurity measures are implemented for the Project and also for other projects.
	Physical change to habitats resulting from the deposition of airborne pollutants.	Operational marine vessel emissions	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a	Yes (NOx and N deposition)	Emissions from docked marine vessels and landside plant during operation have been modelled in **Chapter 6: Air Quality** of the ES **[TR030008/APP/6.2]**. The potential for NO_x, NH_3, SO_2 and N deposition to affect designated habitats that are sensitive to these emission sources within the Humber Estuary EMS has been identified, as at some locations the 1% thresholds for

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		the relevant Critical Levels/ Loads are exceeded. The predicted NH_3 concentrations are below 1% of the Critical Level threshold at all receptors both alone and in-combination.
		Operational road vehicle emissions	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary	No	There are no designated nature conservation receptors within 200m of a road that exceeds the IAQM and EPUK screening guidance on local roads (see **Chapter 6: Air Quality** of the ES **[TR030008/APP/6.2]**), below which a road traffic impact is unlikely to contribute to a significant effect on local air quality. Likely Significant Effects are therefore screened out of this pathway. This impact pathway is therefore, not considered further in

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Changes to migratory fish habitat	Maintenance dredge and dredge disposal	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important	No	The need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all). Maintenance dredging and dredge disposal will result in the highly localised deposition of sediments which has the potential to cause physical disturbance and smothering of seabed habitats. However, the maintenance dredge will not overlap with the spawning grounds of lamprey which are further upstream in freshwater habitat. Both species are

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.		recorded in the estuary at other life stages with the growth phase of river lamprey primarily restricted to estuaries and both species also move through the estuary during spawning migrations. Therefore, given the high mobility of both river and sea lamprey (and also the parasitic fish prey of these species), lamprey will easily be able to avoid the zone of influence of the dredging and utilise other nearby areas with the footprint of dredging only represent a small proportion of the ranges of lamprey. This impact pathway is ~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Changes in water and sediment quality on migratory fish	Maintenance dredge and dredge disposal	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path:	No	Changes in water quality are also expected to be lower than for the capital dredge and at worst similar to existing maintenance dredging. Sediment plumes resulting from dredging and dredge disposal are also considered to dissipate rapidly and be immeasurable against background levels within a short

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.		duration of time. Therefore, lamprey would also be able to avoid the temporary sediment plumes. Based on these factors there is therefore considered limited potential for migrating fish to be adversely affected by the predicted changes in SSC. With respect to sediment contamination, generally low levels of contamination were found in the sediment contamination samples as presented in the Water and Sediment Quality assessment in **Chapter 17: Marine Water and Sediment Quality [TR030008/APP/6.2]**). Based on this sampling data, the overall level of contamination in the proposed dredge area is considered to be low and the sediment plume would be expected to rapidly dissipate by the strong tidal currents in the area. Significant elevations in the concentrations of contaminants within the water column are not anticipated. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					and not of a magnitude to cause a LSE.
	Underwater noise effects on migratory fish	Vessel operations including maintenance dredge and dredge disposal	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	No	During the operational phase there is the potential for noise disturbance to lamprey species as a result of vessel movements. The worst-case source level associated with vessels during operation is the same as for dredging activity. The need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all). Only mild behavioural responses for lamprey species in relative proximity to operational vessels are anticipated with noise levels unlikely to be discernible above ambient levels in the wider Humber Estuary area given the high levels of existing background vessel noise in the area. Furthermore, the additional operational vessel movements resulting from the Project will only constitute a small increase in vessel traffic in the area (approximately a 3% increase alone and 6% with the IERRT project). This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
	Lighting effects on migratory fish and seals	Vessel and berth operations	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas. Criterion 3 – supports populations of plants and/or animal species	No	With respect to potential lighting effects, the jetty will be lit for safety and operational purposes. Beams of light from operational lighting will largely be restricted to the surface waters as light is unlikely to penetrate far into the water column given the high turbidity of the Humber Estuary. Furthermore, evidence suggest that lamprey are not considered to be particularly sensitive to lighting and will often be attracted to lighting rather than causing a barrier to movements (Ref 1-20 and Ref 1-21). Therefore, such localised changes would not cause disruption or blocking of migratory routes for these species. Seals are also known to forage in areas with artificial lighting (such as harbours, offshore wind farms and fish farms) with lighting not known to cause adverse effects in this species. Rather than disrupting any foraging movements, lighting might also have some minor and localised beneficial effects given that lighting has been shown to aggregate fish shoals and will also potentially improve foraging efficiency through enhancing vision of

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast		this predator near the surface. This impact pathway is therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Underwater noise effects on marine mammals	Maintenance dredge ~~and~~, dredge disposal and vessel	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary	No	During the operational phase there is the potential for noise disturbance to grey seal species as a result of vessel movements. The worst-case source level associated with vessels during operation is the same as for dredging activity. The need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all). Only mild

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
		operations	Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.		behavioural responses for seals in relative proximity to operational vessels are anticipated with noise levels unlikely to be discernible above ambient levels in the wider Humber Estuary area given the high levels of existing background vessel noise in the area. Furthermore, the additional operational vessel movements resulting from the Project will only constitute a small increase in vessel traffic in the area (approximately a 3% increase alone and 6% with the IERRT project). This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Visual disturbance of hauled out seals	Vessel operations, maintenance dredge and dredge	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports	No	The nearest established breeding colony for grey seals is located over 25km away at Donna Nook. Approximately ten to 15 grey seals were also observed hauling out on mudflat at Sunk Island (on the north bank of the Humber Estuary) during recent benthic surveys as detailed in Ref 1-26. This haul out site is located approximately 4km north east from the Project. No seal haul out sites are known to occur nearer to the

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
		disposal	a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.		Project. Seals which are hauled out on land, either resting or breeding, are considered particularly sensitive to visual disturbance (Ref 1-27). The level of response of seals is dependent on a range of factors, such as the species at risk, age, weather conditions and the degree of habituation to the disturbance source. Hauled out seals have been recorded becoming alert to powered craft at distances of up to 800m although seals generally only disperse into the water at distances <150-200m (Ref 1-28; Ref 1-29; Ref 1-30; Ref 1-31). For example, in a study focusing on a colony of grey seals on the South Devon coast, vessels approaching at distances between 5m and 25m resulted in over 64% of seals entering the water, but at distances of between 50m and 100m only 1% entered the water (~~Ref 1-38~~Ref 1-32). Recent disturbance research has also found no large-scale redistribution of seals after disturbance with most seals returning to the same haul out site within a tidal cycle

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					(~~Ref 1-32~~Ref 1-33). Based on this evidence, seals hauled out on the intertidal habitats of Sunk Island (located on the opposite bank to the Project) are out of the zone of influence of any potential visual disturbance effects as a result of maintenance dredging and vessel operations. This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.
	Collision risk to marine mammals	Vessel operations	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at	No	Vessels using the berths during operation will be typically approaching at slow speeds (2-4 knots) and maintenance dredging/dredge disposal will be mainly stationary or travelling at low speeds (2-6 knots), making the risk of collision very low. Although all types of vessels may collide with marine mammals, vessels traveling at speeds over ten knots are considered to have a much higher probability of causing lethal injury (Ref 1-23). Furthermore, the region is already characterised by heavy shipping traffic. The additional

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.		operational vessel movements resulting from the Project will only constitute a small increase in vessel traffic in the area on a typical day. There will also be periodic maintenance dredger and barge movements. In general, incidents of mortality or injury of marine mammals caused by vessels remain a relatively rare occurrence in UK waters (Ref 1-24; Ref 1-25). For example, out of 144 post mortem examinations carried out on cetaceans in 2018, only two (1.4%) were attributed to boat collision with the biggest causes of mortality including starvation and by-catch, although some incidents are likely to remain unreported (Ref 1-25). In addition, marine mammals frequently foraging within the region will routinely need to avoid collision with vessels and are, therefore, considered adapted to living in an environment with high levels of vessel activity. T This impact pathway is~~,~~ therefore, not considered further in the Shadow HRA alone. In addition, in-combination effects are considered to be negligible and not of a magnitude to cause a LSE.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
	Potential mortality or injury to coastal waterbirds as a result of flare stacks	Flare stack operation	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage)	No	Flare stacks have the potential to cause incidental mortality to birds during nocturnal periods with the flame emitted during a flaring event known to attract birds in some situations. Most incidents reported have been as a result of birds using the structures as a nocturnal roosting perch and/or birds attracted to the illumination of the flare during migratory movements. It should be noted that evidence suggests that effects on birds have been recorded as a result of flare stacks associated with offshore oil and gas platforms or refineries (Ref 1-41). These structures have very large open flames that are active as part of normal operations. In contrast, the flare stacks proposed as part of the Project will be much smaller in comparison, with the flame largely enclosed as a result of shrouding. Furthermore, they are only required to be used during start up, shut down and emergency use (typically less

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					than 5 % of the time annually). In addition, no supporting terrestrial habitat for SPA species occurs within the Project boundary. Furthermore, the SPA waterbird species screened in **(Table 2)** are not known to use stacks or other similar structures in industrial areas of the Humber Estuary for roosting. In addition, the locations where the flare stacks will be installed (in the East Site-Ammonia Storage, East Site-Hydrogen Production Facility and West Site) are not in a known flight path route between the foreshore and nearby functionally linked land areas with flight path survey data suggesting only very limited flights occur (during winter, migratory passage and summer months) (Ref 1-42). Flare stacks are also a feature of the industrial landscape in the local area with local populations of SPA birds considered accustomed to these features with no evidence to suggest that local

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					populations have been affected by flare stacks from nearby refineries. Based on all these considerations, the risk of flare stacks causing injury or morality is considered to be negligible and will not result in a LSE to any waterbird features alone or in-combination.
	Direct changes to coastal waterbird foraging and roosting habitat as a result of marine infrastructure	Berth operations	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of	Yes	Marine infrastructure associated with the Project (raised jetty structure, linkspan etc.) could potentially cause direct damage or reduced functionality to waterbird feeding and roosting habitat. There is, therefore, considered to be a potential for LSE on the waterbird features screened into the assessment (~~Table 2~~**Table 2**).

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		
	Airborne noise and visual disturbance to coastal waterbirds within the Ramsar boundary	Berth operations	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3)	Yes	During operation, there is the potential for airborne noise and visual disturbance to affect coastal waterbirds. There is, therefore, considered to be a potential for LSE on the waterbird features screened into the assessment (~~Table 2~~Table 2).

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		
	Lighting effects on coastal waterbirds during operation	Berth operations	Criterion 5 – Bird Assemblages of International Importance:	No	With respect to potential lighting effects, ~~the jetty~~construction equipment such as marine piling rigs, cranes etc. will be lit for safety ~~and operational purposes.~~ reasons.

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
			Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		Waders and other waterbirds feeding on intertidal mudflats are known to feed nocturnally. Evidence suggests that artificial illumination can improve foraging (through increasing prey intake rate) and can, therefore, lighting can have a positive effect on the nocturnal foraging of waterbirds (Ref 1-39). Artificial lighting has also been found in some situations to increase potential perceived predation risk in waders which can cause increased behavioural responses in areas with higher intensity illumination (Jolkkonen *et al.*, 2023). Further analysis suggests that operational lighting effects on the foreshore and Humber Estuary will be highly localised to the immediate vicinity of the jetty with

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
					light spill falling to 2 lux[3] within 7.5 m of the jetty and reaching levels consistent with current background illumination within 15 –20 m of the jetty. On this basis, potential operational lighting effects are considered to be highly localised and of negligible magnitude not considered to result in a LSE to any waterbird features alone or in-combination.
Decommissioning	Airborne noise and visual disturbance to coastal waterbirds within the	Landside decommissioning of	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl	Yes	During decommissioning, there is the potential for airborne noise and visual disturbance to affect coastal waterbirds. There is, therefore, considered to be a potential for LSE on the waterbird features screened into the assessment **(Table 2)**.

[3] 1. For context, moonlight on a full moon can be up to 1-2 lux with direct sunlight over 100,000 lux (https://www.seratechnologies.com/what-is-lux-and-what-level-should-it-be).

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
	Ramsar boundary	the removal of pipe racks within Work Area 2 (the jetty access road) and plant and equipment on the approach jetty topside associated with hydrogen production (within Work	(five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		

Phase	Impact Pathways/ Potential Effects	Pr	Feature	Potential for LSE alone or in-combination	Justification
		Area 1).			

3.2. Transboundary Screening

3.2.1. Under Regulation 32 of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (the 2017 EIA Regulations) and based on the information that ABP provided in the Scoping Report (~~Ref 1-41~~Ref 1-44), PINS is of the view that the Project is likely to have a significant effect on the environment in a European Economic Area ("EEA") State (Ref 1-9).

3.2.2. In reaching this view, PINS has applied the precautionary approach as explained in PINS Advice Note 12 (Ref 1-9), and has taken into account the information supplied by ABP at the time of scoping.

3.2.3. In PINS' view, the trade routes associated with the Project, combined with the overlap of the Project with European/Ramsar sites, could lead to potential impacts on bird populations associated with EEA States (Ref 1-9).

3.2.4. The following species associated with populations in EEA states are interest features of the Humber Estuary SPA:

a. Red Knot (*Calidris canutus*) comprising 6.3% of the Northeastern Canada/Greenland/Iceland/North western Europe populations.

b. Black-tailed Godwit (*Limosa limosa*) comprising 2.6 to 3.2% of the Icelandic breeding population.

3.2.5. The following species associated with populations in EEA states are interest features of the Humber Estuary Ramsar:

a. Golden Plover representing 2.2% of the Iceland and Faroes/East Atlantic population

b. Black-tailed Godwit comprising 2.6 to 3.2% of the Iceland/West Europe populations.

3.2.6. On this basis, the EEA States of Iceland and Denmark have been notified of these potential transboundary issues by PINS.

3.2.7. While Knot is recorded on the foreshore in the Immingham area, the species is considered rare in the vicinity of the Project with no Knot recorded in the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C the last five years (2018/19 to 2022/23) during the IOH monitoring on the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within approximately 400-500m of the Project). The area is, therefore, considered to be of very limited functional value for the species. On this basis, there is considered to be no potential for an LSE on this interest feature either alone or in-combination with other plans and projects and, therefore, this interest feature is not considered further in the Shadow HRA.

3.3. Screening Conclusion

3.3.1. The screening review has determined that there are likely significant effects on European/Ramsar sites and qualifying features as a result of the Project, both alone or in combination with other plans or projects, and an AA by the Competent Authority is therefore likely to be required. There is a requirement to progress to the next stage of the Shadow HRA (**Section 4**).

3.3.2. Considering all sites and impact pathways as detailed in ~~**Table 2**~~**Table 2**, **Table 3**, **Table 4** and **Table 5** the Project has the potential to result in an LSE on the following European/Ramsar sites and features, and these have been taken forward into the Appropriate Assessment stage:

Humber Estuary SAC

a. H1110. Sandbanks which are slightly covered by sea water all the time; Subtidal sandbanks.

b. H1130. Estuaries.

c. H1140. Mudflats and sandflats not covered by seawater at low tide; Intertidal mudflats and sandflats.

d. H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand (air quality effects only).

e. H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) (air quality effects only).

f. S1095. *Petromyzon marinus*; Sea lamprey.

g. S1099. *Lampetra fluviatilis*; River lamprey.

h. S1364. *Halichoerus grypus*; Grey seal.

The Wash and North Norfolk Coast SAC

i. S1365. ~~Harbour seal~~Harbour seal *Phoca vitulina*.

Humber Estuary SPA:

j. A048 *Tadorna tadorna*; Common Shelduck (Non-breeding).

k. A149 *Calidris alpina alpina*; Dunlin (Non-breeding).

l. A156 *Limosa limosa islandica*; Black-tailed Godwit (Non-breeding).

m. A162 *Tringa totanus*; Common Redshank (Non-breeding).

n. Waterbird assemblage.

Humber Estuary Ramsar site:

o. Criterion 1 – natural wetland habitats that are of international importance.

p. Criterion 3 – supports populations of plants and/or animal species of international importance.

q. Criterion 5 – Bird Assemblages of International Importance.

r. Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance.

s. Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path.

3.3.3. The Greater Wash SPA was screened out of Stage 2 (Appropriate Assessment) as summarised in ~~**Table 2**~~**Table 2**.

3.3.4. It should be noted that with respect to maintenance dredging, this will only potentially be required in the same way as currently occurs at the Port of Immingham with the same dredging techniques used. The modelling of the scheme (as reported in **Chapter 16: Physical Processes [TR030008/APP/6.2])** indicates that the berth pocket, once dredged, will remain swept clear of deposited material by the flood and ebb tidal flows (in much the same way the existing Immingham Oil Terminal berths are). Consequently, the need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all).

3.3.5. Should maintenance dredging be required it is proposed to be incorporated within the maintenance dredge licence for Immingham (L/2014/00429/1) as part of the renewal of the licence at the end of 2025.

3.3.6. If maintenance dredging for the Project is required periodically this will be carried out in line with the existing regime. The frequency and volume of material deposited at the disposal site from each load (for maintenance dredging across the port) will not change compared with current maintenance dredging activities as the same plant and methods are proposed to be used. Furthermore, the volume of material that will need to be maintenance dredged from the berth pocket will be lower than the volumes of capital dredge material. Overall, the changes brought about as a result of the maintenance dredge and disposal of maintenance dredge material during operation will be comparable to those which already arise from the ongoing maintenance of the existing Port of Immingham berths. Therefore, it is considered that the likely impacts on marine receptors as a result of maintenance dredging will be comparable to the existing maintenance dredge regime. The magnitude of potential impacts are also considered to be lower than the capital dredge. There is, therefore, considered to be no potential for LSE to result on the interest feature either alone or in-combination with other plans and projects with respect to pathways relating to sediment deposition, water quality, changes to physical processes and underwater noise as summarised in **Table 3**, **Table 4** and **Table 5**. However, there is considered to be the potential for an LSE due to potential habitat changes resulting from the removal of seabed material during maintenance dredging (given that the dredge footprint has not previously been subject to maintenance dredging).

4. Stage 2 – Appropriate Assessment

4.1. Overview

4.1.1. In accordance with PINS Advice Note 10 (Ref 1-9), at Stage 1, ABP (as the applicant) has concluded that LSE on European site(s) and qualifying features are considered to exist, either alone or in combination with other plans or projects and an AA by the Competent Authority is likely to be required. In line with this guidance the assessment has documented Stage 1 (in **Section 3** above) and now moves to Stage 2 (AA) (this **Section 4**).

4.1.2. This second stage of the Shadow HRA involves undertaking an assessment of the potential effects on the integrity of the European/Ramsar sites and interest features that have been screened into the assessment in view of the site's conservation objectives (see **Table 6**). Where there are potential adverse effects, a review of mitigation options is carried out and mitigation measures are identified with a view to avoiding or minimising the effects. If, despite the identified measures of mitigation, there still remains a potential AEOI, the Shadow HRA must progress to Stage 3.

4.1.3. The potential effects on interest features of European/Ramsar sites that have been screened into the AA (see **Section 3.3**) have been reviewed and are presented in this section. This assessment has been carried out in the context of the nature and scale of the proposed Project, the geographic location relative to the interest features of European/Ramsar sites and the ecology, behaviour and sensitivities of the interest features to these environmental pressures/changes.

4.1.4. PINS Advice Note 10 (Ref 1-9) recommends that all relevant information is presented in a summary table which identifies all European sites and qualifying features and each pathway of effect which has been considered at each HRA Stage (screening, AA/IROPI and the derogations, as applicable). It is recommended that this exercise is undertaken for each phase of the Project (construction, operation, decommissioning, as relevant). A summary table containing this information is provided in **Appendix ~~C~~D** of this Shadow HRA.

Table 6: Qualifying interest features screened into the assessment and conservation objectives of European/Ramsar sites

Site	Features Screened In	Conservation Objectives
Humber Estuary SAC	• H1110. Sandbanks which are slightly covered by sea water all the time; Subtidal sandbanks; • H1130. Estuaries; • H1140. Mudflats and sandflats not covered by seawater at low tide; Intertidal mudflats and sandflats; • H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand • H1330. Atlantic salt meadows (Glauco-Puccinellietalia maritimae) (air quality effects only); • S1095. *Petromyzon marinus*; Sea lamprey; • S1099. *Lampetra fluviatilis;* River lamprey; and • S1364. *Halichoerus grypus*; Grey seal.	With regard to the natural habitats and/or species for which the site has been designated, and subject to natural change: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status[4] of its Qualifying Features, by maintaining or restoring; • The extent and distribution of qualifying natural habitats and habitats of qualifying species; • The structure and function (including typical species) of qualifying natural habitats; • The structure and function of the habitats of qualifying species; • The supporting processes on which qualifying natural habitats and habitats of qualifying species rely; • The populations of qualifying species; and • The distribution of qualifying species within the site.

4 Natural England has advised that they do not currently undertake a specific condition assessment of the Humber Estuary European sites. Instead, Natural England advised that the condition assessment for the Humber Estuary Site of Special Scientific Interest (SSSI) should be used where the SSSI features are the same as the European Marine Site features to give the conservation status. Habitat, lamprey and grey seal features of the SAC have not been recorded in the conservation status of the Humber Estuary SAC.

Site	Features Screened In	Conservation Objectives
The Wash and North Norfolk Coast	• 1365. Harbour seal *Phoca vitulina.*	With regard to the natural habitats and/or species for which the site has been designated, and subject to natural change: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the Favourable Conservation Status of its Qualifying Features, by maintaining or restoring; • The extent and distribution of qualifying natural habitats and habitats of qualifying species; • The structure and function (including typical species) of qualifying natural habitats; • The structure and function of the habitats of qualifying species; • The supporting processes on which qualifying natural habitats and habitats of qualifying species rely; • The populations of qualifying species; and • The distribution of qualifying species within the site.
Humber Estuary SPA	• A048 *Tadorna tadorna*; Common Shelduck (Non-breeding); • A149 *Calidris alpina alpina*; Dunlin (Non-breeding); • A156 *Limosa limosa islandica;* Black-tailed Godwit (Non-breeding); • A162 *Tringa totanus;* Common Redshank (Non-breeding); and • Waterbird assemblage.	With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified, and subject to natural change: Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring; • The extent and distribution of the habitats of the qualifying features; • The structure and function of the habitats of the qualifying features; • The supporting processes on which the habitats of the qualifying features rely; • The population of each of the qualifying features; and • The distribution of the qualifying features within the site.
Humber Estuary	• Criterion 1 – natural wetland habitats that are of international importance;	For Ramsar sites, a decision has been made by Defra and Natural England not to produce Conservation Advice packages, instead focussing on the production

Site	Features Screened In	Conservation Objectives
Ramsar site	• Criterion 3 – supports populations of plants and/or animal species of international importance; • Criterion 5 – Bird Assemblages of International Importance; • Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance; and • Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path.	of High Level Conservation Objectives. Regulations relating to HRAs extend to the Conservation Advice packages for designations to be, in most cases, suffi Ramsar interests. See the conservation objectives for Ra overlapping the Humber Estuary SAC a
* Denotes a priority natural habitat or species		

Source: JNCC (~~Ref 1-42, Ref 1-43~~Ref 1-45, Ref 1-46); Natural England (~~Ref 1-44; Ref 1-45; Ref 1-46~~Ref 1-47; Ref 1-48; R

4.2. Assessment of Effects

4.2.1. The assessment has been structured based on the following key impact pathways screened into the AA. The AA has taken a pathway approach to grouping potential effects but to provide clarity it should be noted that all pathways are construction related with the exception of the pathways in italics which are operational and in italics/underlined which are decommissioning:

a. Section 4.3: Physical loss of habitat and associated species:

   i. The potential effects of the direct loss of qualifying intertidal habitat.

   ii. The potential effects of the direct loss of supporting intertidal habitat on qualifying species.

   iii. The potential effects of the direct loss of qualifying subtidal habitat features.

   iv. The potential effects due to changes to waterbird foraging and roosting habitat as a result of the presence of marine infrastructure during operation on qualifying species.

b. Section 4.4: Physical damage through disturbance and/or smothering of habitat:

   i. The potential effects of changes to qualifying habitats as result of the removal of seabed material during capital dredging.

   ii. The potential effects of changes to qualifying habitats as a result of sediment deposition during capital dredging.

   iii. The potential effects of changes to qualifying habitats as a result of sediment deposition during capital dredge disposal.

   iv. The potential effects of changes to qualifying habitats as result of the removal of seabed material during maintenance dredging.

c. Section 4.5: Physical loss or damage of habitat through alterations in physical processes:

   i. Indirect loss or change to qualifying habitats (and supporting habitats) and qualifying species as a result of changes to hydrodynamic and sedimentary processes as a result of the marine works.

   ii. Indirect changes to qualifying habitats as a result of changes to hydrodynamic and sedimentary processes during capital dredge disposal.

d. Section 4.6: Direct changes to qualifying habitats beneath marine infrastructure due to shading:

   i. Direct changes to qualifying habitats beneath marine infrastructure due to shading.

e. Section 4.7: Physical change to habitats resulting from the deposition of airborne pollutants:

   i. *Physical change to qualifying habitats resulting from the deposition of N and NOx from marine vessel and landside plant emissions during operation*

f. Section 4.8: Non-toxic contamination through elevated SSC:

   i. The potential effects of elevated SSC during capital dredging on qualifying habitats and species.

   ii. The potential effects of elevated SSC during capital dredge disposal on qualifying habitats and species.

g. Section 4.9: Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases:

   i. The potential effects of the release of contaminants during capital dredging on qualifying habitats and species.

   ii. The potential effects of the release of contaminants during capital dredge disposal on qualifying habitats and species.

h. Section 4.10: Airborne noise and visual disturbance:

   i. The potential effects of airborne noise and visual disturbance during construction (including capital dredging) on qualifying species of coastal waterbird within the SPA/Ramsar boundary.

   ii. *The potential effects of airborne noise and visual disturbance during operation on qualifying species of coastal waterbird within the SPA/Ramsar boundary~~.~~*

   iii. *The potential effects of airborne noise and visual disturbance during decommissioning on qualifying species of coastal waterbird within the SPA/Ramsar boundary*

i. Section 4.11: Disturbance through underwater noise and vibration:

   i. The potential effects of underwater noise and vibration during marine piling on qualifying species of fish and marine mammals.

   ii. The potential effects of underwater noise and vibration during capital dredge and dredge disposal on qualifying species of fish and marine mammals.

j. Section 4.12: Biological disturbance due to potential introduction and spread of non-native species:

   i. The potential effects of the introduction and spread of non-native species during construction, capital dredging and dredge disposal on qualifying habitats.

   ii. *The potential effects of the introduction and spread of non-native species during operation on qualifying habitats.*

4.2.2. Each of the above pathways has then been structured based on the following sub-sections:

a. ***General scientific context:*** A review of the best available scientific evidence on the pathway to provide contextual information.

b. ***Summary of potential effects:*** This section provides a description of the potential effects on receptors relevant to the qualifying feature.

c. ***Mitigation:*** For those pathways for which mitigation is required a description of the measures will be provided.

d. ***Assessment of the potential for an AEOI:*** The potential residual effects will be considered in the context of relevant conservation objectives for the particular qualifying feature and the best scientific evidence on the pathway to reach a conclusion on the potential for an AEOI.

4.2.3. The information presented in this report relating to each pathway should also be reviewed in the context of the baseline information provided in **Appendix A**.

4.2.4. Consideration of intra-project combined effects is provided in **Section 4.13** of this Shadow HRA.

4.2.5. An in-combination assessment considering other relevant plans/projects is then provided in **Section 4.14** of this Shadow HRA.

4.3. Physical Loss of Habitat And Associated Species

The potential effects of the direct loss of qualifying intertidal habitat

General scientific context

4.3.1. The impact of direct habitat loss can involve building over marine habitats (such as reclamation) or the permanent physical removal of substratum and associated organisms from the seabed. Direct habitat loss can also occur due to deepening as a result of dredging causing a change from an intertidal to a subtidal environment.

4.3.2. Intertidal habitats are sensitive to physical loss at locations where new structures are introduced onto the seabed (i.e., within the development 'footprint' of these structures). The significance of such losses will vary on a site-by-site basis in response to differences in the extent and duration of the losses as well as the relative value of the habitats in question. The value of the habitats is, in turn, reflected by the species that are present and level of statutory and non-statutory protection afforded to them. As any effects are very much dependent upon site specific considerations, a generic scientific review is not appropriate in this case and the focus of the assessment is based on site-specific considerations.

Summary of effects

4.3.3. The maximum parameters for the piles will cause a direct loss of up to 0.00158 ha of intertidal mudflat habitat as a worst case assessment.

4.3.4. Intertidal habitat loss as a result of the marine piling represents approximately 0.000004% the Humber Estuary SAC and approximately 0.000018% of the 'mudflats and sandflats not covered by seawater at low tide' feature of the Humber Estuary SAC[25].

[25] Based on the extents given in the Standard Data Form on the JNCC website (~~Ref 1-42~~Ref 1-45))

4.3.5. This loss also represents 0.000004% of the Humber Estuary SPA/Ramsar[~~3~~6]. When considering this in the context of intertidal area, the area of loss represents approximately 0.000018% of intertidal foreshore habitats[~~4~~7] and approximately 0.000025% of mudflat[~~5~~8] within the SPA.

4.3.6. This habitat loss is therefore negligible in the context of the Humber Estuary SAC, SPA and Ramsar.

4.3.7. The loss of intertidal habitat due to marine piling will also be highly localised and considered *de minimis* in extent. The loss is considered to be a magnitude that will not change the overall structure or functioning of the nearby mudflats within the Port of Immingham area or more widely in the Humber Estuary. Potential effects of direct intertidal habitat loss on coastal waterbirds are considered in **paragraphs 4.3.10 to 4.3.18 of the Shadow HRA**.

Mitigation

4.3.8. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.3.9. As outlined above the loss of intertidal habitat due to marine piling will be highly localised and considered *de minimis* in extent in the context of the amount of similar habitat in the region (and as a proportion of the SAC/Ramsar site). On this basis any change to the '*extent and distribution of qualifying natural habitats*' is considered ecologically inconsequential **(**see **Table 7**), and the predicted effects are not considered to compromise any of the conservation objectives for the SAC/Ramsar Site. It is therefore concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

~~3~~6 Based on the extents given in the Standard Data Form on the JNCC website (~~Ref 1-43~~Ref 1-46)
~~4~~7 Based on using the 'Intertidal Substrate Foreshore (England and Scotland)' data layer (Ref 1-11).
~~5~~8 Based on using mudflat data layer of the Priority Habitat Inventory (England) (~~Ref 1-209~~Ref 1-50).

Table 7: The potential for an AEOI due to the direct loss of qualifying intertidal habitat

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1140: Mudflats and sandflats not covered by seawater at low tide	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	The potential effects have been considered in the context of the site's conservation objectives as well as the respective targets of these conservation objectives (as provided in the Supplementary Advice on Conservation Objectives (SACOs). ~~As discussed above, the~~The loss ~~in~~of intertidal habitat is de minimis in extent and considered negligible in the context of the amount of similar habitat in the region (and as a proportion of the SAC/Ramsar site). On this basis any change to the '*extent and distribution of qualifying natural habitats*' conservation objective and associated targets in terms of maintaining '*the presence and spatial distribution of mudflat and sandflat communities*' or restoring '*the total extent, spatial distribution and types of mudflats and sandflats*' is considered ecologically inconsequential~~.~~ both locally and more widely across the Humber Estuary site. A loss on this scale is also considered to be insignificant in terms of 'the structure and function (including typical species) of qualifying natural habitats' conservation objective. In this respect, the loss is considered to have no material consequences in terms of the '*presence and abundance of key structural and influential species*' target with the loss not considered to prevent key species from being a viable component of mudflat habitat in the local area. Furthermore, other targets relating to structure and function in terms of maintaining species composition, sediment composition and Total Organic Carbon (TOC) content in the local area or more widely across the Humber Estuary site will not be altered due habitat loss on this scale. Direct loss of intertidal due to the piles is considered to be insignificant in terms of '*supporting processes on which qualifying natural habitats rely*' conservation objective with any changes to associated targets relating to wave exposure, physico-chemical properties, sediment movement, hydrodynamic

Site	Features	Potential AEOI	Justification
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		regime, sediment quality and water quality parameters considered to be negligible and ecologically inconsequential on mudflat habitat in the Immingham area and more widely across the Humber Estuary site.

The potential effects of the direct loss of supporting intertidal habitat on qualifying species

General scientific context

4.3.10. The quality of intertidal habitat as a feeding resource for waterbirds can be highly variable both spatially and temporally (~~Ref 1-47~~Ref 1-51). Higher energetic costs for waterbirds could occur in areas where habitat change has caused a reduction in prey distribution and density. This may affect local populations in the long-term through impacts on individual fitness (survival, body condition and fecundity) (~~Ref 1-48~~Ref 1-52).

4.3.11. Habitat loss can also result in increased densities of birds already using a site, increasing the potential for interference competition (~~Ref 1-49; Ref 1-48~~Ref 1-53; Ref 1-52). Loss of intertidal habitat could displace birds and cause them to redistribute either locally or to neighbouring sites (~~Ref 1-50~~Ref 1-54). This in turn might affect the birds at those sites through competition and density-dependent mortality. Redshank displaced following the construction of an amenity barrage at Cardiff Bay (South Wales), for example, experienced a poorer body condition and had a lower survival rate after they moved (~~Ref 1-51~~Ref 1-55). Lambeck (~~Ref 1-52~~Ref 1-56) found that Oystercatchers displaced following large-scale habitat loss in the Delta region of The Netherlands experienced significantly higher mortality than those originally ringed elsewhere in the Delta, it is presumed as a result of the increased densities in recipient areas.

Summary of effects

4.3.12. The maximum parameters for the piles will cause a direct loss of up to 0.00158 ha of intertidal mudflat habitat as a worst case assessment.

4.3.13. The loss of habitat represents approximately 0.000004% of the Humber Estuary SPA/Ramsar[~~6~~9]. When considering this in the context of intertidal, the area of loss represents approximately 0.000018% of intertidal foreshore habitats[~~7~~10] and approximately 0.000025% of mudflat[~~8~~11] within the SPA/Ramsar.

4.3.14. This habitat loss is therefore clearly negligible in the context of the Humber SPA and Ramsar.

4.3.15. The loss of habitat due to marine piling will also be highly localised and considered *de minimis* in extent. The loss is also considered to be a magnitude that will not change the overall structure or functioning of the nearby mudflats within the Port of Immingham area or more widely in the Humber Estuary.

4.3.16. On this basis, any change to prey resources for birds feeding in the local area will be negligible. Individual survival rates or local population levels (either directly through mortality or due to birds dispersing to new feeding areas in other areas of the Humber Estuary) will not be affected.

[~~6~~9] Based on the extents given in the Standard Data Form on the JNCC website (~~Ref 1-43~~Ref 1-46)
[~~7~~10] Based on using the 'Intertidal Substrate Foreshore (England and Scotland)' data layer (Ref 1-11).
[~~8~~11] Based on using mudflat data layer of the Priority Habitat Inventory (England) (~~Ref 1-209~~Ref 1-50).

Mitigation

4.3.17. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.3.18. As outlined above the loss of intertidal habitat due to marine piling will be highly localised and considered *de minimis* in extent. On this basis, any resulting change to waterbird distribution or prey resources for birds feeding in the local area will be negligible. Individual survival rates or local population levels (either directly through mortality or due to birds dispersing to new feeding areas in other areas of the Humber Estuary) will not be affected. The predicted effects are not considered to compromise any of the conservation objectives (see **Table 8**) and it is therefore concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 8: The potential for an AEOI due to the direct loss of supporting intertidal habitat on qual

Site	Features	Potential AEOI	Justification
Humber Estuary SPA	A048; Common Shelduck (Non-breeding) *Tadorna tadorna*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	The potential effects have be conservation objectives. The predicted intertidal habit *populations of each of the qu* This is because the scale of magnitude that would cause of species so that individual (either directly through morta feeding areas in other areas The '*distribution of the qualit* objective will not be affected extent and of a scale that wo distribution. This loss is considered negli habitat even at a local scale The effects of the habitat los overall wider functionality of this basis, any change to the *the qualifying features'* conse ecologically inconsequential. The loss in intertidal habitat the amount of similar habitat SPA/Ramsar). On this basis *of the habitats of the qualifyi* considered ecologically inco
	A149: Dunlin *Calidris alpina alpina* (Non-breeding)		
	A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding)		
	A162: Common Redshank *Tringa totanus* (Non-breeding)		
	Waterbird assemblage		
Humber Estuary Ramsar site	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3)		
	Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		

The potential effects of the direct loss of qualifying subtidal habitat

General scientific context

4.3.19. The impact of direct habitat loss can involve building over marine habitats (such as reclamation) or the permanent physical removal of substratum and associated organisms from the seabed.

4.3.20. Subtidal habitats are sensitive to physical loss at locations where new structures are introduced onto the seabed (i.e., within the development 'footprint' of these structures). The significance of such losses will vary on a site-by-site basis in response to differences in the extent and duration of the losses as well as the relative value of the habitats in question. The value of the habitats is, in turn, reflected by the species that are present and level of statutory and non-statutory protection afforded to them. As any effects are very much dependent upon site specific considerations, a generic scientific review is not appropriate in this case and the focus of the assessment is based on site-specific considerations.

Summary of effects

4.3.21. Marine piling in the subtidal area (based on the maximum parameters assessed) will result in the direct loss of up to 0.051 ha of seabed habitat as a worst case assessment. This habitat represents approximately 0.00014% of the Humber Estuary SAC.

4.3.22. The project-specific subtidal survey (Section 1.3 of **Appendix A**) recorded a highly impoverished assemblage characterised by polychaetes (such *Nephtys* spp, *Streblospio shrubsolii* and *Scoloplos armiger*), nematodes, oligochaetes *Tubificoides* spp and crustacean *Diastylis rathkei)*.

4.3.23. The loss in subtidal habitat as a result of the piles is considered negligible in the context of extent of the overall amount of similar marine habitats found locally in the Humber Estuary. All the species recorded were considered commonly occurring and not protected. Furthermore, faunal assemblage recorded are also considered characteristic of subtidal habitats found more widely in this section of the Humber Estuary (~~Ref 1-53; Ref 1-54; Ref 1-55~~Ref 1-57; Ref 1-58; Ref 1-59).

4.3.24. The loss of subtidal habitats due to marine piling will be highly localised. The *de minimis* changes in subtidal habitat extent is of a magnitude which will not change the overall structure or functioning of the subtidal habitats within the Port of Immingham area or more widely in the Humber Estuary SAC.

Mitigation

4.3.25. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.3.26. As outlined above and within **Table 9**, the scale of predicted loss of subtidal habitat is considered inconsequential in the context of the amount of similar habitat in the region and as a proportion of the SAC/Ramsar**.** The predicted effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 9: The potential for an AEOI due to the direct loss of qualifying subtidal habitat

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1130: Estuaries	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	The potential effects have been considered in the context of the site's conservation objectives as well as the respective targets of these conservation objectives (as provided in the SACOs). ~~As discussed above, the~~The loss ~~in~~ of subtidal habitat ~~as a result of the piles is~~is de minimis in extent and considered ~~to be~~ negligible in the context of the amount of similar habitat in the region (and as a proportion of the SAC/Ramsar~~. As a consequence, this loss is inconsequential in terms of '*the*~~ site). On this basis any change to the '*extent and distribution of qualifying natural habitats*' conservation objective~~.~~ and associated targets in terms of maintaining '*the presence and spatial distribution of estuary communities*' or restoring '*the total extent, spatial distribution of the estuary to ensure no loss of integrity, while allowing for natural change and succession*' is considered ecologically inconsequential both locally and more widely across the Humber Estuary site. A loss on this scale is also considered to be insignificant in terms of ~~the~~ '*the structure and function (including typical species) of qualifying natural habitats*' conservation objective. In this respect, the loss is considered to have no material consequences in terms of targets associated with structure and function including restoring connectivity, the presence and abundance of key structural and influential species, maintaining freshwater flow, habitat zonation, estuary morphology, sediment regime, species composition of component communities, substrate composition/distribution, tidal regime, topography and water density. Direct loss of subtidal due to the piles is considered to be insignificant in terms of the '*supporting processes on which qualifying natural habitats rely*' conservation objective with any changes to associated targets relating to sediment contaminants and water quality parameters considered to be negligible and ecologically inconsequential on mudflat habitat in the Immingham area and more widely across the Humber Estuary

Site	Features	Potential AEOI	Justification
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		site.

The potential effects due to changes to waterbird foraging and roosting habitat as a result of the presence of marine infrastructure during operation on qualifying species

4.3.27. For clarity it should be noted that this pathway relates to potential changes to foraging and roosting habitat as a result of the physical presence of marine infrastructure during operation of the Project. The potential effects of the direct loss of intertidal habitat on qualifying species is assessed in **Paragraphs 4.3.10 to 4.3.18.**

4.3.28. It should also be noted that this pathway specifically relates to the structures themselves rather than human activity on the infrastructure which is assessed in **Section 4.10**. However, it is acknowledged that such effects are likely to some extent to be interrelated.

General scientific context

4.3.29. Any port and harbour development has the potential to cause reduced functionality to waterbird feeding and roosting habitat due to port infrastructure.

4.3.30. Waterbirds often show a preference for foraging in open spaces with clear sightlines when feeding so that scanning distances can be maximised. On this basis, certain species of coastal waterbirds might show a reluctance to approach tall anthropogenic structures or those that create enclosed spaces. One of the main reasons for not approaching a structure is thought to be the same as waders avoiding feeding near high banks, tall hedges/trees and in enclosed spaces (such as small fields surrounded by trees) (~~Ref 1-56~~Ref 1-60), i.e., they are trying to avoid any sudden attack by a predator that may be hiding in or behind the structure. Just as raptors often exploit tall structures to aid prey detection, species that may be targeted by raptors would naturally avoid tall structures to minimise predation risk. Many waders and waterfowl may avoid areas in which their sightlines are reduced, even though in certain circumstances this may reduce the quantity of high-quality foraging habitat available to them or access to important roosting sites. However, it is often difficult to separate the direct impact of the structure from other factors associated with development, such as human activity causing potential disturbance stimuli (see **Section 4.10**) (~~Ref 1-57~~Ref 1-61).

4.3.31. The addition of anthropogenic structures to coastal waters can also result in a new habitat for colonising epibiota (such as mussels, periwinkles, limpets and barnacles) which are considered prey items for certain wading birds such as Turnstone, Oystercatcher and Purple Sandpiper. Certain species (such as Turnstone) are also regularly recorded feeding on epifaunal species which have colonised anthropogenic structures in the intertidal such as jetties and coastal defences (~~Ref 1-58~~Ref 1-62).

4.3.32. Coastal waterbirds also regularly roost on a variety of artificial structures in harbours and ports including pontoons, platforms, sea walls and dolphins (mooring structures) (~~Ref 1-59; Ref 1-60; Ref 1-61~~Ref 1-63; Ref 1-64; Ref 1-65). Species commonly recorded in the UK using such structures include gulls, Cormorants and waders such as Dunlin, Turnstone and Oystercatchers. Factors that can influence the level of use by waterbirds of artificial roosting structures include the proximity to nearby feeding grounds, the level of human disturbance and perceived predator risk.

Summary of effects

4.3.33. Marine infrastructure associated with the Project (raised jetty structure etc.), will not prevent any direct access to established roosting habitat used by coastal waterbirds in the area. In addition, shading caused by the structures would not be expected to cause significant changes to benthic prey resources used by coastal waterbirds as considered further in **Section 4.6** of this assessment.

4.3.34. The approach jetty will be an open piled structure with large gaps between each of the piles and between the jetty deck and the foreshore seabed (i.e. the mudflat surface). This will minimise the enclosed feel and allow birds feeding near the structure to maintain sightlines. It should be noted that observations from the ornithology surveys in the area suggest that birds regularly feed in very close proximity to both the Eastern Jetty (approximately 1km from the Project) and the Immingham Oil Terminal approach jetty (approximately 500m from the Project) – which are both similar open piled structures - with species such as Redshank, Dunlin, Turnstone regularly recorded underneath jetties and Curlew, Shelduck and Black-tailed Godwit approaching them closely (<10-20m). On this basis, birds would be expected to show similar highly localised responses to structures associated with the Project with responses ranging from no avoidance for some species to potentially some local avoidance (i.e. directly underneath or in close proximity) for other species. However, a review of bird distribution data for Sector C (for the period 2018/19 to 2021/22) found that the densities of coastal waterbirds (including Black-tailed Godwit, Shelduck, Dunlin and Redshank) were typically either higher or broadly comparable on the foreshore near to the existing IOT jetty (<100-150m) compared to greater distances away (approximately 150m to 1km). There is therefore unlikely to be a change the overall distribution of waterbirds more widely along the foreshore fronting Immingham in this area.

4.3.35. Based on the above, birds would be expected to feed below or very close to the Project's approach jetty and indeed other infrastructure on the foreshore - none of which will prevent direct access to established roosting habitat. As a consequence, any avoidance of marine infrastructure is expected to be limited (and highly localised) and is unlikely to change the overall distribution of waterbird assemblages more widely on the foreshore in the local area.

Mitigation

4.3.36. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.3.37. Potential effects on qualifying species screened in to the assessment is expected to be limited (and highly localised) and is unlikely to change the overall distribution of waterbird assemblages more widely on the foreshore in the local area (see above and **Table 10**). The predicted effects are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 10: The potential for an AEOI on qualifying species due to changes to waterbird foraging of the presence of marine infrastructure

Site	Features	Potential AEOI	Justification
Humber Estuary SPA	A048; Common Shelduck (Non-breeding) *Tadorna tadorna*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Only very low numbers of Shelduck (winter months, and <10 individuals fe roosting, representing <1% of the est described in **Table 2**) have been reco in the vicinity of the Project (i.e. withir threshold used by Natural England to numbers. In addition, relatively low numbers of recorded (i.e. < 100 individuals, repre numbers as described in **Table 2**) on (i.e. within 400-500m) during the wint England advised that birds exceeding mean peak is viewed as significant n Godwit and numbers of Black-tailed G months in this area are lower (repres population numbers as described in T Based on the information provided ab feed close to the approach jetty and c (<10-20m). ~~As a consequence, direct will be neither impeded nor prevented~~ which are considered important even addition, the raised jetty structure is c distribution of waterbirds more widely

12 This species is typically recorded on the foreshore. Very low numbers (consisting of a few individuals) are also occasio the foreshore (< 50 m). This species is rarely recorded further offshore in this area.

Site	Features	Potential AEOI	Justification
	A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding)		in this area. It follows, therefore, that expected to be limited (and highly loc overall distribution of waterbird asser the local area. As a consequence, an *qualifying features within the site'* and *the qualifying features'* conservation inconsequential. The predicted effects are considered *population of each of the qualifying fe* the scale of change is not of a magni or prey consumption of species so th population levels (either directly throu new feeding areas in other areas of t
	A149: Dunlin *Calidris alpina alpina* (Non-breeding)	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Only very low numbers of Dunlin and Redshank feeding during the winter r outside the winter months and roostir population numbers as described in T foreshore in the vicinity of the Project 1% threshold used by Natural Englar numbers. Based on the information provided ab expected to feed under or very close infrastructure on the foreshore with n habitat ~~prevented.~~considered importa Furthermore, the raised jetty structure distribution of waterbirds more widely in this area. Therefore, any avoidance be limited (and highly localised) and i distribution of waterbird assemblages area. As a consequence, any change

Site	Features	Potential AEOI	Justification
	A162: Common Redshank *Tringa totanus* (Non-breeding)		*features within the site'* and '*structure and function of the habitats of the qualifying features*' conservation objectives are considered inconsequential. The predicted effects are considered unlikely to cause any changes to '*the population of each of the qualifying features'* conservation objective because the scale of change is not of a magnitude that would cause changes to the diet or prey consumption of species so that individual survival rates or local population levels (either directly through mortality or due to birds dispersing to new feeding areas in other areas of the Humber Estuary) are affected.
	Waterbird assemblage	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Turnstone is the only assemblage species known to feed and roost in numbers representing >1% of the estuary wide population numbers on the foreshore in the vicinity of the Project (i.e. within 400-500m) as described in **Table 2**. This species which feeds and roosts on upper shore boulders and sea defences is considered highly tolerant to disturbance and would be expected to continue roost and feed under the jetty. On this basis, no change to roosting or feeding habitat is anticipated for this species a result of the presence of marine infrastructure. All other SPA assemblage species screened into the assessment have only been recorded roosting and feeding in very low abundances on the foreshore[13] in the vicinity of the Project (i.e. within 400-500m) (representing <1% of the estuary wide population numbers as described in **Table 2**). This is below the 1% threshold used by Natural England to determine potentially significant numbers. Based on the information provided above, assemblage species would be expected to feed under or close to the approach jetty and other infrastructure on the foreshore (<10-20m) with no direct access to established roosting habitat ~~prevented.~~considered important even on a local scale impacted.

13 Very low numbers of Teal (<20-30 birds (representing <1% of the estuary wide WeBS five year mean peak)) are also occasionally recorded floating on the water near the foreshore (< 50 m). These birds are loafing rather than feeding. This species is rarely recorded further offshore in this area.

Site	Features	Potential AEOI	Justification
			Furthermore, the raised jetty structur distribution of waterbirds more widely in this area. Therefore, any avoidanc be limited (and highly localised) and i distribution of waterbird assemblages area. As a consequence, any change *features within the site'* and '*structure qualifying features*' conservation obje The predicted effects are considered *population of each of the qualifying fe* the scale of change is not of a magni or prey consumption of species so th population levels (either directly throu new feeding areas in other areas of t
Humber Estuary Ramsar site	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Based on the information provided ab expected to feed under or close to th on the foreshore (<10-20m) with no c habitat ~~prevented~~considered importa Furthermore, the raised jetty structur distribution of waterbirds more widely in this area. Therefore, any avoidanc be limited (and highly localised) and i distribution of waterbird assemblages area. As a consequence, any change *features within the site'* and '*structure qualifying features*' conservation obje The predicted effects are considered *population of each of the qualifying fe* the scale of change is not of a magni or prey consumption of species so th population levels (either directly throu new feeding areas in other areas of t

4.4. Physical Damage through Disturbance and/or Smothering off Habitat

The potential effects of changes to qualifying habitats as result of the removal of seabed material during capital dredging

4.4.1. For clarity it should be noted this pathway relates to potential changes to subtidal and intertidal habitat as a result of the physical removal of sediment material from the seabed. The potential effects of the direct loss of intertidal habitat are assessed in **Section 4.3.** It should also be noted that this assessment specifically relates to the effects of the capital dredge. The need for future maintenance dredging within the new berth pocket is expected to be very limited (if required at all). However, as this could cause disturbance to the seabed on a very periodic basis, changes to benthic habitats and species as result of the removal of seabed material during maintenance dredging is considered below in Paragraphs 4.4.29 to 4.4.35.

General scientific context

4.4.2. Dredging causes a direct physical removal of sediments, causing a modification to existing subtidal and intertidal habitats. This impacts benthic fauna associated with the dredged material including changes to abundance and distribution through damage, mortality or relocation to a disposal site, which may impact habitat quality.

4.4.3. The speed of recovery of the temporarily disturbed areas is dependent on the scale and timing of the disturbance, the life histories of species and the stability and diversity of the benthic community present. For example, while the opportunistic bivalve *Abra* spp. is vulnerable to physical disturbance (due to its fragile shell), the species is considered to have a high recoverability due to a high fecundity and larval dispersal rate (~~Ref 1-62; Ref 1-63~~Ref 1-66; Ref 1-67). Furthermore, a regularly disturbed sedimentary habitat with a low diversity benthic assemblage is likely to recover more quickly (i.e., return to its disturbed or 'environmentally-stressed' baseline condition) than a stable habitat with a pre-existing mature and diverse assemblage (~~Ref 1-64~~Ref 1-68).

4.4.4. In general, where studies have been undertaken to understand the effects of physical disturbance, they have shown recolonisation of deposited sediments by benthic species to be quite rapid. Sites are initially colonised by short lived, fast growing, opportunistic species ('r-selected') that are tolerant of high levels of disturbance; infaunal species dominate, particularly polychaetes worms. In time, these are succeeded by longer lived, slower growing species with a lower tolerance for disturbance (~~Ref 1-65; Ref 1-66~~Ref 1-69; Ref 1-70). Rates of recovery reported in reviewed literature suggest that a recovery time of six to 24 months is characteristic of many mobile sands and estuarine muds where frequent disturbance of the deposits precludes the establishment of long-lived communities (~~Ref 1-67; Ref 1-68~~Ref 1-71; Ref 1-72). In contrast, a community of sands and gravels may take two to three years to establish, depending on the proportion of sand and level of environmental disturbance by waves and currents (~~Ref 1-65;~~ Ref 1-69; Ref 1-73).

Summary of effects

4.4.5. The capital dredge will remove approximately 4,000m³ of material over a maximum area of approximately 10,000m². It is expected that the material will be removed with a backhoe dredger.

4.4.6. Following the capital dredge, the dredge pocket will provide a similar habitat to that occurring under pre-dredge conditions. The baseline benthic surveys predominantly recorded surface sediment within and near to the dredge footprints with a high silt content (i.e., mud and sandy mud) (**Section 1.3 of Appendix A)**. Sub surface sampling in the capital dredge footprint recorded sediments from most sampling locations dominated by silt material (**Chapter 17: Marine Water and Sediment Quality [TR030008/APP/6.2]** of the ES**).** This would provide a suitable substate for infaunal colonisation that is broadly comparable to existing sediment character which would then be expected to be recolonised by a similar assemblage to baseline conditions[~~9~~14].

4.4.7. The speed of recolonisation is expected to occur over a short period of time based on an understanding of the benthic community present in the area and the life history strategies of the species. The project-specific subtidal survey (**Section 1.3 of Appendix A**) recorded an impoverished benthic community which is likely to reflect the existing high levels of physical disturbance in the area due to strong tidal currents and sediment movement.

4.4.8. Samples were characterised by polychaetes (such *Nephtys* spp, *Streblospio shrubsolii* and *Scoloplos armiger*), nematodes, oligochaetes *Tubificoides* spp and crustacean *Diastylis rathkei.* These species are typically fast growing and/or have rapid reproductive rates which allow populations to fully re-establish in typically less than 1-2 years and for some species within a few months (~~Ref 1-34;~~ Ref 1-35; Ref 1-36; Ref 1-37). The benthic communities would, therefore, be expected to recolonise the dredge footprint relatively quickly. All the species recorded are commonly occurring and not protected. In addition, the faunal assemblage recorded is considered characteristic of subtidal habitats found more widely in this section of the Humber Estuary (~~Ref 1-53; Ref 1-54; Ref 1-55~~Ref 1-57; Ref 1-58; Ref 1-59).

Mitigation

4.4.9. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.4.10. Following the capital dredge, the dredge pocket will provide a similar habitat to that occurring under pre-dredge conditions. In addition, following dredging, the subtidal habitat would be expected to be recolonised rapidly by a broadly similar invertebrate assemblage to baseline conditions. (see above and **Table 11**). The predicted effects are therefore not considered to compromise any of the

[~~9~~14] The majority of marine infauna is known to occur in the upper few centimetres of sediment (~~Ref 1-210; Ref 1-211~~Ref 1-74;; Ref 1-75).

conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 11: The potential for an AEOI due to changes to qualifying habitats as result of the removal of seabed material during capital dredging

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1130: Estuaries	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	The capital dredge will not cause a change in habitat type (i.e., it will remain subtidal habitat with a similar substrate type) and therefore '*the extent and distribution of qualifying natural habitats*' conservation objective will not change. Following dredging, the subtidal habitat would be expected to be recolonised rapidly by a broadly similar invertebrate assemblage to baseline conditions. On this basis, the '*structure and function (including typical species) of qualifying natural habitats*' conservation objective would be expected not to change. Any '*Supporting processes on which qualifying natural habitats and habitats of qualifying species rely*' are also not expected to change as a direct result of sediment removal.
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	With respect to subtidal habitats, the capital dredge will not cause a change in habitat type (i.e., it will remain subtidal habitat with a similar substrate type) and therefore '*the extent and distribution of qualifying natural habitats*' conservation objective will not change. Following dredging, the subtidal habitat would be expected to be recolonised rapidly by a broadly similar invertebrate assemblage to baseline conditions. On this basis, the '*structure and function (including typical species) of qualifying natural habitats*' conservation objective would be expected not to change. Any '*Supporting processes on which qualifying natural habitats and habitats of qualifying species rely*' are also not expected to change as a direct result of sediment removal.

The potential effects of changes to qualifying habitats as a result of sediment deposition during capital dredging

General scientific context

4.4.11. Sediments suspended and dispersed during the marine works, dredging and disposal have the potential to resettle over the seabed. This potential blanketing or smothering of benthic species may cause stress, reduced rates of growth or reproduction and in the worst cases the effects may be fatal (~~Ref 1-70; Ref 1-71~~Ref 1-76; Ref 1-77).

4.4.12. Habitats within estuarine and coastal environments have highly fluctuating conditions including the resuspension and deposition of sediments on a daily basis (through tidal action), lunar cycles (due to the differing influences of spring and neap tides) and on a seasonal basis (due to storm activity and conditions of extreme waves). Subtidal and intertidal habitats are, therefore, characterised by such perturbations and the biological communities of these environments are well adapted to survival under fluctuating conditions.

4.4.13. If the amount of sediment deposited is too great to allow species to survive burial, then recovery occurs via re-colonisation and/or migration to the new sediment surface (~~Ref 1-72; Ref 1-73~~Ref 1-78; Ref 1-79). In general, the rate of recovery is dependent upon how stable and diverse the assemblage was in the first place. A regularly disturbed sedimentary habitat with a low diversity benthic assemblage is likely to recover more quickly (i.e., return to its disturbed or ‘environmentally-stressed’ baseline condition) than a stable habitat with a pre-existing mature and diverse assemblage. A study by Bolam *et al.* (~~Ref 1-74~~Ref 1-80), for instance, concluded that the relatively rapid recovery observed at a location on the Crouch Estuary was due to the opportunistic nature of the invertebrate assemblages and the dispersive behaviour of the dominant species that were present before the material was deposited. Furthermore, in cases where the quantity and type of sediment deposited does not differ greatly from natural sedimentation, e.g., of similar particle size, the effects are likely to be small as many of the species are capable of migrating up through the deposited sediments (~~Ref 1-75~~Ref 1-81).

4.4.14. The MarESA approach (~~Ref 1-76~~Ref 1-82) found that benthic communities in

Summary of effects

4.4.15. Sediment changes that are predicted to occur as a result of the capital dredge are presented in **Chapter 16: Physical Processes [TR030008/APP/6.2]**. In summary, maximum siltation as a result of the capital dredge within about 500m up and down the estuary from the edge of the dredge pocket is predicted to be around 1mm. Beyond this area, deposition levels are predicted to be negligible. Furthermore, once on the bed, the deposited material will return to the background system i.e. it will be put back into suspension on subsequent peak flood or ebb tides to be further dispersed.

4.4.16. The project-specific subtidal survey (**Section 1.3 of Appendix A**) recorded highly impoverished assemblage characterised polychaetes (such *Nephtys* spp, *Streblospio shrubsolii* and *Scoloplos armiger*), nematodes, oligochaetes *Tubificoides* spp and crustacean *Diastylis rathkei*. All the species recorded were considered commonly occurring and not protected.

4.4.17. The benthic species occurring within and near to the dredge area typically consist of burrowing infauna (such as polychaetes, oligochaetes or bivalves), which are considered tolerant to some sediment deposition. Based on evidence provided in relevant MarESA assessments, the characterising species recorded in the project-specific subtidal survey (described above) above are considered tolerant to deposition of at least 50mm with many species considered capable of burrowing through much greater levels of sediment deposition. The predicted millimetric changes in deposition are, therefore, considered unlikely to cause smothering effects as described above. In addition, the species recorded in the benthic invertebrate surveys are fast growing and/or have rapid reproductive rates which allow populations to fully re-establish in typically less than 1 to 2 years and for some species within a few months (Ref 1-59; Ref 1-191; Ref 1-15).

4.4.18. Deposition of sediment as a result of capital dredging will be highly localised and similar to background variability. Based on the evidence provided above the subtidal habitats within the vicinity of the proposed works are considered to have low sensitivity to smothering. The subtidal benthic communities present are also well adapted to survival under fluctuating sediment conditions and have high recoverability rates.

Mitigation

4.4.19. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.4.20. Deposition of sediment as a result of capital dredging will be highly localised and similar to background variability. This combined with the low sensitivity of species in the locality to such change (see above and **Table 12**), means the predicted effects are not considered to compromise any of the conservation objectives. It is therefore concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 12: The potential for an AEOI due to changes to qualifying habitats as a result of sedime dredging

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1130: Estuaries	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Based on the information providec capital dredging will be highly loca away from the direct vicinity of the considered commonly occurring a fluctuating sediment conditions. T high recoverability rates. On this b to cause a change to the '*the exte habitats and habitats of the qualify* Deposition will also, therefore, not *and function of qualifying natural h supporting processes on which qu* objectives.
	H1140: Mudflats and sandflats not covered by seawater at low tide		
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		

The potential effects of changes to qualifying habitats as a result of sediment deposition during capital dredge disposal

General scientific context

4.4.21. Scientific evidence on this impact pathway is provided in Paragraphs 4.4.11 to 4.4.14.

Summary of effects

4.4.22. The requirement for disposal of dredged material at sea associated with the Project would be fulfilled at licensed disposal sites HU056 and HU060 (see **Chapter 2: The Project**).

4.4.23. The assessment of the sediment changes that are predicted to occur as a result of the capital dredging disposal is presented in **Chapter 16: Physical Processes**. In summary, sedimentation resulting from the disposal plume is predicted to be generally in the range of 1 to 2mm at distances of up to around 1km from the disposal sites. Further up and down estuary, maximum sedimentation as a result of the disposal activities is generally predicted to be negligible.

4.4.24. The disposal sites are located in the mid channel and are subject to regular natural physical disturbance (and associated scouring) as a result of very strong tidal flows. This is reflected in a generally impoverished assemblage at both disposal sites. In addition, millions of wet tonnes of dredge sediment are disposed of at HU060 annually which will also cause some disturbance due to sediment deposition.

4.4.25. The benthic species recorded within and adjacent to the disposal sites include mobile infauna (such as errant polychaetes e.g., *Arenicola* spp. and amphipods) which are able to burrow through sediment. They are, therefore, considered tolerant to some sediment deposition. In addition, characterising species typically have opportunistic life history strategies, with short life histories (typically two years or less), rapid maturation and the production of large numbers of small propagules which makes them capable of rapid recoverability should mortality as a result of smothering occur (~~Ref 1-33;~~ Ref 1-34; Ref 1-35; Ref 1-36; Ref 1-37; Ref 1-38). On this basis, any effects are considered to be temporary and short term.

4.4.26. In summary, deposition in the wider area surrounding the disposal ground is expected to be in the order of millimetres. Sedimentation of this scale is unlikely to result in significant smothering effects to most faunal species with recoverability expected to be high.

Mitigation

4.4.27. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.4.28. Sedimentation of the scale predicted to arise from the disposal of dredge arisings is unlikely to result in significant smothering effects to most faunal species with recoverability expected to be high (see above and **Table 13**). The predicted effects are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 13: The potential for an AEOI due to changes to qualifying habitats as a result of sediment deposition during capital dredge disposal

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1110: Sandbanks which are slightly covered by sea water all the time	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Based on the information provided above, sediment deposition during dredge disposal will be highly localised and similar to background variability away from the direct vicinity of disposal. Benthic species in the area are considered commonly occurring and also well adapted to survival under fluctuating sediment conditions with have high recoverability rates. On this basis sediment deposition is not expected to cause a change to the '*the extent and distribution of qualifying natural habitats and habitats of the qualifying species*' conservation objective. Deposition will also, therefore, not cause any changes to the '*the structure and function of qualifying natural habitats*' or cause modifications to '*the supporting processes on which qualifying natural habitats rely*' conservation objectives.
	H1130: Estuaries		
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		

The potential effects of changes to qualifying habitats as result of the removal of seabed material during maintenance dredging

General scientific context

4.4.29. Scientific evidence on this impact pathway is provided in Paragraphs 4.4.2 to 4.4.4.

Summary of effects

4.4.30. Maintenance dredging causes the direct physical removal of marine sediments from the dredge footprint, resulting in the modification of existing marine habitats. The impacts to benthic fauna associated with the dredged material include changes to abundance and distribution through damage, mortality or relocation to a disposal site.

4.4.31. As summarised in the physical processes assessment **(Chapter 16: Physical Processes [TR030008/APP/6.2]),** maintenance dredging is expected to be to be very limited (if required at all). As a result, any dredging that is required will only be undertaken infrequently (frequency will be dictated by operational requirements but it is anticipated there could be several years or more between maintenance dredge campaigns).

4.4.32. Maintenance dredging will create similar seabed sedimentary conditions to that occurring following capital dredging[~~10~~15] with the surface layer of the seabed in the dredge footprint expected to be broadly comparable to the existing sediment character (i.e. sediment with a high silt content) following maintenance dredging.

4.4.33. On this basis, given the expected frequency of maintenance dredging, a comparable macrofaunal community to pre dredge conditions would be expected to occur over much of the maintenance dredging area between maintenance dredging campaigns[~~11~~16]. Furthermore, the highly impoverished benthic community recorded in the project-specific subtidal survey **(Section 1.3 of Appendix A)** (which is likely to reflect the existing high levels of physical disturbance in the area due to strong near bed tidal currents and sediment transport) is considered characteristic of subtidal habitats found more widely in this section of the Humber Estuary (~~Ref 1-53; Ref 1-54; Ref 1-55~~Ref 1-57; Ref 1-58; Ref 1-59). All of the species recorded are considered commonly occurring and not protected.

~~10~~15 The baseline benthic surveys predominantly recorded surface sediment within and near to the dredge footprints with a high silt content (i.e., mud and sandy mud) (Section 1.3 of Appendix A). Sub surface sampling in the capital dredge footprint recorded sediments from most sampling locations dominated by silt material (Appendix 2a: The Waste Hierarchy Assessment).

~~11~~16 The project-specific subtidal survey (Section 1.3 of Appendix A) recorded a benthic community characterised by polychaetes (such *Nephtys* spp, *Streblospio shrubsolii* and *Scoloplos armiger*), nematodes, oligochaetes *Tubificoides* spp and crustacean *Diastylis rathkei.* These species are typically fast growing and/or have rapid reproductive rates which allow populations to fully re-establish in typically less than 1-2 years and for some species within a few months (~~Ref 1-36, Ref 1-34~~Ref 1-37, Ref 1-35, Ref 1-36)

Mitigation

4.4.34. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.4.35. Maintenance dredging (if required) will not cause a change in habitat type and as such a comparable macrofaunal community to pre dredge conditions would be expected to occur over much of the area between maintenance dredging campaigns. Furthermore, the seabed in this area is generally considered to be highly impoverished and of limited ecological value (see above and **Table 14**). The predicted effects are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 14: The potential for an AEOI due to changes to qualifying habitats as a result of as resu material during maintenance dredging

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1130: Estuaries	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	The maintenance dredge will not c remain subtidal habitat with a simi *extent and distribution of qualifyin* will not change. Maintenance drec (if required at all). As a result, any undertaken infrequently and a cor dredge conditions would be expec maintenance dredging area betwe Furthermore, the seabed in this ar impoverished and of limited ecolo maintenance dredging as a result functioning of subtidal habitats in t the '*structure and function (includi habitats*' conservation objective w '*Supporting processes on which q qualifying species rely*' is not expe sediment removal.
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		

4.5. Physical Loss or Damage Of Habitat Through Alterations in Physical Processes

Indirect loss or change to qualifying habitats and species as a result of changes to hydrodynamic and sedimentary processes as a result of the marine works

General scientific context

4.5.1. Port or harbour structures (such as piles, breakwaters, coastal defences, jetties or quay walls) can cause changes to hydrodynamics (flow speeds, flow direction, waves, water levels) and seabed morphology (~~Ref 1-78; Ref 1-79; Ref 1-80~~Ref 1-84; Ref 1-85; Ref 1-86). Such changes have the potential to affect habitat quality and result in changes to the diversity, abundance and biomass of intertidal and subtidal species.

4.5.2. Dredging can cause direct habitat changes resulting from seabed removal and sediment deposition, as well as indirect habitat changes linked to hydrodynamic and sedimentary processes. Deepening or widening of channels during dredging can change seabed bathymetry and potentially alter flow patterns (speed/direction), wave exposure and cause tidal amplification (~~Ref 1-81; Ref 1-82; Ref 1-83~~Ref 1-87; Ref 1-88; Ref 1-89).

4.5.3. These hydrodynamic changes can lead to changes in sediment transport and also patterns of emersion/immersion as well as erosion/accretion of marine sedimentary habitats such as mudflats and sandbanks (~~Ref 1-81~~Ref 1-87). For example, ~~Ref 1-83~~Ref 1-89) found that saltmarsh retreat was related to an increase in the tidal prism brought about by dredging operations to maintain or increase the depth of the main navigable channel of the Westerschelde Estuary in the Netherlands. The consequent greater frequency with which the high tides reached the edge of the fringing marshes increased the risk of erosion.

4.5.4. Increased flow rates can also increase scouring and bed disturbance of subtidal and intertidal habitats which can cause a reduction in diversity and an increase in more opportunistic species. In addition, reductions in water flow could increase siltation levels which could change the habitat type of a seabed and lead to sedimentation (~~Ref 1-33~~Ref 1-34). Marine invertebrates inhabiting sand and mud

4.5.6. Slight increases to local peak ebb current speed landward of the berth pocket are predicted to cause a limited amount of erosion of the bed along part of the lower intertidal (at the elevation of Mean Low Water Springs ("MLWS")) beneath the landward ends of the proposed jetty. This will result in a potential indirect loss in the intertidal area (up to approximately 0.03 ha). The assessment indicates that once the softer upper layer is removed, the harder, more consolidated, underlayer of bed material is unlikely to erode further. This calculation represents a worst-case assessment of potential elevation changes and has been considered on a precautionary basis. The level of predicted change is at the limit of the accuracy of the modelled data and, in real terms, is likely to be immeasurable against the context of natural variability (as a result of storm events, for example).

4.5.7. This intertidal habitat loss represents approximately 0.00008% of the Humber Estuary SAC and approximately 0.00032% of the 'mudflats and sandflats not covered by seawater at low tide' feature of the Humber Estuary SAC[~~12~~17].

4.5.8. This loss also represents 0.00008% of the Humber Estuary SPA/Ramsar[~~13~~18]. When considering this in the context of intertidal area, the area of loss represents approximately 0.00034% of intertidal foreshore habitats[~~14~~19] and approximately 0.00047% of mudflat[~~15~~20] within the SPA.

4.5.9. The predicted intertidal loss, albeit assessed on a worst case basis, also consists of a very narrow strip on the lower shore around the sublittoral fringe. This predicted loss would be of a similar scale to that which can occur due to natural background changes in mudflat extent in the local region (e.g., due to seasonal patterns in accretion and erosion or following storm events). It is not considered that this *de minimis* change in mudflat extent will change the overall structure or functioning of the nearby mudflats within the Port of Immingham area or more widely in the Humber Estuary.

4.5.10. The predicted intertidal loss is also considered to have limited functional value to waterbirds which utilise the foreshore in this location (such as Black-tailed Godwit, Turnstone, Curlew, Dunlin, Oystercatcher, Redshank and Shelduck) (**Table A8 of Appendix A**). This is because while these species could, therefore, potentially be feeding in the predicted areas of habitat loss during low water periods, these very small areas remain largely inundated with water and are only uncovered for a very short duration.

4.5.11. To put this into context, consideration has been given to the proportion of time that the areas of loss are available to feed over the course of a year. Based on

~~12~~17 Based on the extents given in the Standard Data Form on the JNCC website (~~Ref 1-42~~**Ref 1-45**).
~~13~~18 Based on the extents given in the Standard Data Form on the JNCC website (~~Ref 1-43~~**Ref 1-46**).
~~14~~19 Based on using the 'Intertidal Substrate Foreshore (England and Scotland)' data layer (https://magic.defra.gov.uk/Metadata_for_MAGIC/SPIRE%20intertidal%20substrate%20foreshore.pdf. (Ref 1-11).
~~15~~20 Based on using mudflat data layer of the Priority Habitat Inventory (England) (https://data.gov.uk/dataset/4b6ddab7-6c0f-4407-946e-d6499f19fcde/priority-habitat-inventory-england). (~~Ref 1-209~~**Ref 1-50**).

tide gauge data at Immingham in 2020, the area of indirect loss was completely submerged for 99% of the time. The area of indirect loss, therefore, currently provides almost no feeding opportunities for coastal waterbirds. Furthermore, the spatial extent of loss represents a barely measurable and inconsequential reduction in available habitat for these mobile species even at a local scale.

4.5.12. On this basis, it can be concluded that any change to prey resources for birds feeding in the local area will be negligible and individual survival rates or local population levels (either directly through mortality or due to birds dispersing to new feeding areas in other areas of the Humber Estuary) will not be affected.

Mitigation

4.5.13. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.5.14. Effects on the hydrodynamic and sedimentary processes as a result of the Project are predicted to be small scale and highly localised. The predicted intertidal loss is also considered to be negligible in the context of the amount of similar habitat in the region and have limited functional value to waterbirds which utilise the foreshore in this location (see above and ~~**Table** 15:~~ **Table 15**). The predicted effects are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 15: The potential for an AEOI due to indirect changes to qualifying habitats (and supporting habitats) and qualifying species as a result of changes to hydrodynamic and sedimentary processes as a result of the marine works

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1130: Estuaries	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Magnitude of change on marine habitats and species from these highly localised and small scale predicted effects on the hydrodynamic and sedimentary processes is considered to be negligible in the context of natural background change. On this basis the potential effects are not expected to cause a change to '*the extent and distribution of qualifying natural habitats and* habitats of the qualifying species' conservation objective. The potential effects will also, therefore, not cause any changes to the '*the structure and function of qualifying natural habitats*' or cause modifications to '*the supporting processes on which qualifying natural habitats rely*' conservation objectives.
	H1140: Mudflats and sandflats not covered by seawater at low tide	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Magnitude of change on marine habitats and species from these highly localised and small scale predicted effects on the hydrodynamic and sedimentary processes is considered to be negligible including predicted erosion on nearby intertidal habitats in the context of natural background change. On this basis changes to hydrodynamic and sedimentary processes are not expected to cause a change to '*the extent and distribution of qualifying natural habitats*

Site	Features	Potential AEOI
Humber Estuary SPA	A048; Common Shelduck (Non-breeding) *Tadorna tadorna*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.

Site	Features	Potential AEOI
	A149: Dunlin *Calidris alpina alpina* (Non-breeding)	
	A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding)	
	A162: Common Redshank *Tringa totanus* (Non-breeding)	
	Waterbird assemblage	
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.

Site	Features	Potential AEOI	Justification
			cause modifications to '*the supporting processes on which qualifying natural habitats rely*' conservation objectives.
	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3)		The potential effects have been considered in the context of the site's conservation objectives. The predicted intertidal habitat loss will not cause changes to '*the populations of each of the qualifying features*' conservation objective. This is because the scale of loss is not considered to be of a magnitude that would cause changes to the diet or prey consumption of species so that individual survival rates or local population levels (either directly through mortality or due to birds dispersing to new feeding areas in other areas of the Humber Estuary) are affected. The '*distribution of the qualifying features within the site*' conservation objective will not be affected as the predicted loss is *de minimis* in extent and of a scale that would not cause changes in local distribution. The footprint of predicted habitat loss under baseline conditions already provides very limited feeding opportunities due to the low elevation on the shore and *de minimis* extent. This loss is considered negligible in the context of available feeding habitat even at a local scale along the eastern frontage of the port. The

Site	Features	Potential AEOI	
	Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		e h f f t *h* c i T r s p b *c* *f* c

Indirect changes to qualifying habitats as a result of changes to hydrodynamic and sedimentary processes during capital dredge disposal

General scientific context

4.5.15. Scientific evidence on this impact pathway is provided in Paragraphs 4.5.1 to 4.5.4.

Summary of effects

4.5.16. An assessment of the hydrodynamic and sediment regime changes that are predicted to occur as a result of the capital dredging disposal is presented in **Chapter 16: Physical Processes [TR030008/APP/6.2]**.

4.5.17. Local changes to the bathymetry (as a result of material disposal to the bed) within the disposal site will be small in the context of the existing depths. Disposal activity will be targeted to the deeper areas within the site, ensuring that bed level changes are not excessive in any one area, thus, minimising the overall change. As a result, associated changes to the local hydrodynamics (and sediment transport pathways) will be negligible.

4.5.18. These changes are not likely to result in any significant changes to local sediment transport in the region although some localised changes to seabed bathymetry and morphology could occur.

4.5.19. In addition, the predicted changes in flow rates and subtidal seabed morphology are not expected to modify existing subtidal habitat types found in the area (i.e., mobile sand habitats characterised by an impoverished infaunal assemblage).

4.5.20. The indirect loss and changes to subtidal habitats due to changes in hydrodynamic and sedimentary processes as a result of the capital dredge disposal are highly localised and small scale. The subtidal habitats which will be potentially affected are of low ecological value and are considered to be tolerant of the level of change in conditions expected and on this basis the effect is considered to be negligible.

Mitigation

4.5.21. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.5.22. The magnitude of change on marine habitats and species from the highly localised and small scale predicted effects on the hydrodynamic and sedimentary processes arising from the capital dredge disposal are considered to be negligible (see above and **Table 16**). The predicted effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 16: The potential for an AEOI due to indirect changes to qualifying habitats as a result of sedimentary processes during capital dredge disposal

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1110: Sandbanks which are slightly covered by sea water all the time	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Magnitude of change on marine h localised and small scale predicte sedimentary processes is conside in erosion and accretion are predi On this basis the potential effects '*the extent and distribution of qual qualifying species*' conservation o cause any changes to '*the structu habitats*' or cause modifications to *qualifying natural habitats rely'* co
	H1130: Estuaries		
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		

4.6. Direct Changes to Qualifying Habitats Beneath Marine Infrastructure Due to Shading

Direct changes to qualifying habitats beneath marine infrastructure due to shading

General scientific context

4.6.1. Artificial shading such as due to pontoons or jetty/pier decking has the potential to cause localised changes to the structure and functioning of biological communities in natural ecosystems (~~Ref 1-85; Ref 1-86; Ref 1-87~~Ref 1-91; Ref 1-92; Ref 1-93).

4.6.2. In sedimentary habitats microphytobenthos, macrofauna, sediment erodibility and biogeochemical sediment properties are often found to differ significantly between shaded and unshaded sediments (~~Ref 1-88; Ref 1-89; Ref 1-87~~Ref 1-94; Ref 1-95; Ref 1-93). Microphytobenthos are significant drivers of ecosystem functioning in benthic habitats influencing biogeochemical properties of sediment, food web dynamics (~~Ref 1-90~~Ref 1-96) and sediment erodibility (~~Ref 1-91~~Ref 1-97)). Heavy shading alters microphytobenthos assemblages causing a variety of responses, including changes in biomass, pigment ratios, species richness and diversity (~~Ref 1-88; Ref 1-87~~Ref 1-94; Ref 1-93). These changes can therefore have cascading effects on the sediments they inhabit and associated faunal assemblages (~~Ref 1-89; Ref 1-85; Ref 1-87~~Ref 1-95; Ref 1-91; Ref 1-93). For example, Tolhurst *et al*. (~~Ref 1-87~~Ref 1-93) found heavy shading of an intertidal mudflat caused directional responses in sediment properties, in line with a decrease in microphytobenthos, including reductions in chlorophyll *a*, colloidal carbohydrate, erosion threshold and total carbohydrate; and increased erosion rate and water retention. This resulted in significant changes in the faunal assemblage, driven by large decreases in oligochaetes and sabellid polychaetes – likely to be a direct response to the reduction of food; either the amount of microphytobenthos, or perhaps bacteria, or meiofauna (~~Ref 1-87~~Ref 1-93).

4.6.3. Shading of hard substrates, such as rocky shores and seawalls, can often alleviate stressful conditions associated with temperature and desiccation,

Summary of effects

4.6.4. Changes in sunlight levels as a result of shading have the potential to cause changes to the benthic communities leading to a change in habitat quality. In particular, shading can reduce the amount of light available for species that perform photosynthesis such as macroalgae species (seaweeds), macrophytes (such as saltmarsh plants) and microphytobenthos.

4.6.5. The open piled approach jetty could cause some shading to intertidal mudflat habitat. Given that these structures will be located several metres above the seabed, however, some natural light would be expected to reach the mudflat from either side of these structures at all times of the day with no habitat permanently shaded. Shading at the level predicted would only be expected to cause negligible changes to the growth rates of macroalgae species (seaweeds) and microphytobenthos occurring on the foreshore. Furthermore, no saltmarsh and only limited macroalgae occurs on mudflats in this area.

4.6.6. The subtidal and intertidal habitats and associated benthic communities are commonly occurring in the region and the effect of shading will be highly localised.

Mitigation

4.6.7. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.6.8. As outlined above and in **Table 17**, subtidal and intertidal habitats and associated benthic communities are commonly occurring in the region and the effect of shading will be highly localised and effects negligible. The predicted effects are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 17: The potential for an AEOI due to direct changes to qualifying habitats beneath marine infrastructure due to shading

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1130: Estuaries	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Based on the information provided above, potential shading effects are considered to be negligible. On this basis the potential effects are not expected to cause a change to '*the extent and distribution of qualifying natural habitats and habitats of the qualifying species*' conservation objective. Shading on this scale will also not cause any changes to the *'the structure and function of qualifying natural habitats'* or cause modifications to '*the supporting processes on which qualifying natural habitats rely'* conservation objectives.
	H1140: Mudflats and sandflats not covered by seawater at low tide		
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		

4.7. Physical Change to Habitats Resulting from the Deposition of Airborne Pollutants

Physical change to qualifying habitats resulting from the deposition of Nitrogen, NH3 and NOx from marine vessel and landside plant emissions during operation.

General scientific context

4.7.1. Exhaust emissions from marine vessels and landside ~~pant~~plant during the operational phase have the potential to impact on local air quality, with the emission of NO_X (mainly in the form of nitric oxide ("NO"), which is then converted to NO_2 in the atmosphere) and ammonia NH3 being the main pollutants of concern in relation to coastal saltmarsh.

4.7.2. Coastal saltmarsh is sensitive to effects from nitrogen deposition as vegetation is nitrogen limited (~~Ref 1-97~~Ref 1-103) and is therefore potentially vulnerable to eutrophication. Effects may be observed as increased graminoid (grasses) biomass, with potentially adverse effects on forbs (~~Ref 1-98~~Ref 1-104).

4.7.3. The Air Pollution Information System ("APIS") defines site-specific Critical Loads relevant to each European site for nitrogen deposition. The relevant nitrogen Critical Loads (which have recently been updated on the APIS website) are 10 - 20 kg N/ ha/ yr for 'low-mid and mid-upper saltmarshes' (H1330) and 20 – 30 kg N/ ha/ yr for 'pioneer saltmarshes' (H1310).

4.7.4. Environment Agency guidance (~~Ref 1-99~~Ref 1-105) states that impacts may be considered insignificant ('not significant') where:

a. The short-term impact is less than 10% of environmental assessment level for the nature conservation site.

b. The long-term impact is less than 1% of the long-term air quality objective or environmental assessment level for the nature conservation site.

4.7.5. Where the long-term impact at a nature conservation receptor exceeds these criteria, it may also be considered insignificant ('not significant') where:

4.7.6. The long-term total concentration after the impact lies below the air quality

If it does exceed 1% either alone or in combination with other projects or plans then further ecological interpretation has been undertaken. The assessment considered both onsite and offsite sources, however only the onsite operational emissions are relevant to coastal saltmarsh. The modelled emissions sources included marine vessel, land-tug and road traffic emissions. The modelling has taken into account The International Convention for the Prevention of Pollution from Ships (MARPOL) standards for marine vessel NOx emissions.

4.7.8. An in-combination air quality assessment for the Project with the adjacent IERRT project (~~currently going~~now passed through the DCO Examination phase) has also been undertaken, as given the proximity of the two projects to each other (they are at adjacent locations within the port of Immingham), there are clearly potential pathways by which operational marine vessel, road traffic and landside plant emissions from both projects could affect designated habitats in the same/similar locations. The air quality modelling has also taken into account any other relevant projects that could result in in-combination effects with the Project. This is considered in the in-combination effects section of the Shadow HRA (**Section 4.14**). No assessment in combination with the Viking CCS pipeline project was undertaken since no construction vehicles associated with that project will travel within 200m of any European site and there are no operational emissions.

Summary of effects

4.7.9. Emissions from docked marine vessels and landside plant during operation of the Project alone have been modelled in **Chapter 6: Air Quality [TR030008/APP/6.2]**. The potential for NOx, NH_3, SO_2 and N deposition to affect designated habitats that are sensitive to these emissions within the Humber Estuary EMS has been identified. The maximum forecast number of vessel calls during operation is 292 each year (average of 0.8 vessels per day); which is very small when considered in context with the baseline vessel movements within the Humber Estuary, which Department for Transport ("DfT") statistics indicate is one of the busiest waterways in the UK serving the main Humber Ports of Hull, Goole, Grimsby and Immingham. Analysis of marine traffic presented within **Chapter 12: Marine Transport & Navigation [TR030008/APP/6.2]** states that average daily vessel movements in this section of the Estuary (in the one year period between September 2021 and August 2022) were 78 per day. The majority of the vessels were cargo vessels (c. 47% of movements) followed by tugs (24%), tankers (15%) and passenger vessels (5%).

4.7.10. The assessment of air quality impacts on nature conservation receptors has been informed by modelling presented in Chapter 6: Air Quality and the following sections of that chapter are relevant to the assessment:

a. **Table 6**.19 – presents the outcome of air quality modelling on sensitive habitat receptors in the Humber Estuary assuming that all vessels calling at the Project will conform to the MARPOL Tier III NOx emissions standard.

b. **Table 6**.20 - presents the outcome of air quality modelling on sensitive habitat receptors in the Humber Estuary assuming that all vessels calling at the Project will conform to the MARPOL Tier II NOx emissions standard.

c. Figure 6.3 showing the locations of the modelled receptor locations within the Humber Estuary designated site.

4.7.11. MARPOL Tier III is more stringent than MARPOL Tier II; in order to go from the NOx Tier II limits to the NOx Tier III limits, NOx emissions must be cut by about 75%. The assessment of operational effects on air quality has been carried out in line with the IAQM 'Guide to the Assessment of Air Quality Impacts on Designated Nature Conservation Sites' (~~Ref 1-100~~Ref 1-106) and the methodology is detailed in **Chapter 6 :Air Quality [TR030008/APP/6.2]**. The assessment considered both onsite and offsite sources; however, only the onsite emissions are relevant to coastal saltmarsh. The emissions sources included vessel, land-tug and road traffic emissions.

4.7.12. While the '1% of the critical level/load' threshold is an important initial assessment threshold, it is not a damage threshold. Moreover, whether the critical level or load will be exceeded by total pollutant concentrations/deposition rates is also important. Modelling presented in **Table 6.19** in **Chapter 6: Air Quality**, which is reproduced as ~~**Table 18**~~**Table 18** below, demonstrates that with vessels complying with MARPOL Tier III emissions standards, modelled IGET sources account for 1% or less of the Critical Level for annual mean NOx at all but two receptor locations (O_E1 and O_E2). At these two locations, total NOx concentrations account for approximately 52% of the Critical Level (i.e. the critical level would not be exceeded). With MARPOL Tier III emissions standards, modelled IGET sources also account for 1% or less of the Critical Levels for SO_2 and NH_3 and of the Critical Load for nitrogen deposition, noting that the IAQM state that the 1% screening criteria should not be used rigidly and not to a numerical precision greater than the expression of the criteria themselves[~~16~~22].

4.7.13. Modelling presented in **Table 6.20** in **Chapter 6: Air Quality**, which is reproduced as ~~**Table 19**~~**Table 19** below, demonstrates that with vessels complying with MARPOL Tier II emissions standards (i.e. the less stringent standard), modelled IGET sources account for 1% or less of the Critical Level for annual mean NOx at all but three receptor locations (O_E1, O_E2 and O_E3). At these three locations, total NOx concentrations account for approximately 56% of the Critical Level (i.e. the critical level would not be exceeded). With MARPOL Tier II emissions standards, modelled IGET sources account for 1% or less of the Critical Levels for SO_2 and NH_3, and the Critical Levels are not exceeded for either pollutant. IGET sources account for 1% or less of the Critical Load for nitrogen deposition at all but two receptors (O_E1 and O_E2), with an impact equivalent to 1.7% and 1.9% of the critical load respectively. At these locations, the Critical Load for nitrogen deposition is already exceeded by the background contribution alone with the IGET contribution accounting for just 1.2% of the total nitrogen deposition rate predicted at these locations. Therefore, the impact of the Project on nitrogen deposition under a MARPOL Tier II emissions scenario is

~~16~~22 ' Whilst it is straightforward to generate model results for the PC to any level of precision required, the accuracy of the result is much less certain and it is unwise to place too much emphasis on whether the PC is 0.9% or 1.1%' source: air-quality-impacts-on-nature-sites-2019.pdf (iaqm.co.uk) greater than 1% of the critical load (being approximately 2% of the critical load) at two receptor locations, and therefore needs further consideration.

4.7.14. At the worst affected nature conservation receptors (O_E1 and O_E2), which relate to saltmarsh habitat on the northern shore of the Estuary) (**Figure 6.3** in **Chapter 6: Air Quality [TR030008/APP/6.3]**), the change in annual mean NH_3 and SO_2 can be screened as insignificant in line with Environment Agency guidance as the changes do not exceed 1% of the Critical Levels for NH_3 and SO_2. However, the annual mean NOx concentration and annual N deposition rate cannot be screened as insignificant as it exceeds the 1% screening threshold. The area of affected saltmarsh is shown on the isopleth Plate 3.

Table 18: Operational concentrations and deposition rates at selected nature conservation sen representing 2036) – Assuming MARPOL Tier III Emissions Standards (with SCR)

Rec. ID	Annual Mean Background Contribution ($\mu g/m^3$)[1]				Annual Mean Modelled Baseline Contribution ($\mu g/m^3$)[2]				Annual Mean Modelled IGET Contribution ($\mu g/m^3$)[3]			
	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-de
	$\mu g/m^3$			N/ ha/yr	$\mu g/m^3$			N/ ha/yr	$\mu g/m^3$			N/ h
O_E1	15.1	2.1	1.5	**14.6**	0.3	<0.1	<0.01	0.03	0.5	<0.1	0.01	0.
O_E2	15.1	2.1	1.5	**14.6**	0.3	<0.1	<0.01	0.02	0.5	<0.1	0.01	0.
O_E3	14.9	1.8	1.6	**13.9**	0.1	<0.1	<0.01	0.01	0.2	<0.1	<0.01	0.
O_E4	13.8	1.7	1.6	**13.9**	0.1	<0.1	<0.01	0.01	0.2	<0.1	<0.01	0.
O_E5	16.6	3.9	1.5	**14.7**	<0.1	<0.1	<0.01	<0.01	0.1	<0.1	<0.01	0.
O_E6	19.1	3.4	1.6	**16.0**	0.1	<0.1	<0.01	0.01	0.1	<0.1	<0.01	0.
O_E7	12.6	1.6	1.6	**13.9**	0.1	<0.1	<0.01	0.01	0.1	<0.1	<0.01	0.
O_E8	14.6	2.2	1.5	**14.7**	<0.1	<0.1	<0.01	<0.01	<0.1	<0.1	<0.01	0.
O_E9	15.8	1.9	1.5	**14.7**	<0.1	<0.1	<0.01	<0.01	<0.1	<0.1	<0.01	0.
O_E10	25.1	2.8	1.6	**13.5**	<0.1	<0.1	<0.01	<0.01	<0.1	<0.1	<0.01	0.
O_E11	21.1	3.4	1.6	**16.0**	<0.1	<0.1	<0.01	<0.01	<0.1	<0.1	<0.01	0.
O_E12	**36.5**	3.0	1.6	**16.0**	<0.1	<0.1	<0.01	<0.01	<0.1	<0.1	<0.01	0.

Rec. ID	Annual Mean Background Contribution (µg/m³)[1]				Annual Mean Modelled Baseline Contribution (µg/m³)[2]				Annual Mean Modelled IGET Contribution (µg/m³)[3]				Annual Mean Concentration/ Deposition Rate (µg/m³)[4]			
	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep
	µg/m³			N/ ha/yr	µg/m³			N/ ha/yr	µg/m³			N/ ha/yr	µg/m³			N/ ha/yr
O_E13	13.6	2.0	1.5	**14.6**	<0.1	<0.1	<0.01	<0.01	0.1	<0.1	<0.01	0.01	13.7	2.0	1.5	**14.6**
O_E14	11.6	1.7	2.1	**16.1**	<0.1	<0.1	<0.01	<0.01	<0.1	<0.1	<0.01	0.01	11.7	1.7	2.1	**16.1**
O_E15	11.6	1.7	2.1	**16.1**	<0.1	<0.1	<0.01	<0.01	<0.1	<0.1	<0.01	0.01	11.7	1.7	2.1	**16.1**

Notes:

[1] Background contribution of existing sources, minus the contribution from the sources specifically modelled.

[2] Model contribution, including the contribution from the IERRT project and other cumulative sources.

[3] Modelled contribution from IGET construction traffic emissions.

[4] Annual mean concentration is the combined contribution of background and modelled sources.

Table 19: Operational concentrations and deposition rates at selected nature conservation sensitive receptors for 2028 (also representing 2036) – Assuming MARPOL Tier II Emissions Standard (without SCR)

Rec. ID	Annual Mean Background Contribution (µg/m³)[1]				Annual Mean Modelled Baseline Contribution (µg/m³)[2]				Annual Mean Modelled IGET Contribution (µg/m³)[3]				Annual Mean Concentration/ Deposition Rate (µg/m³)[4]			
	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep
	µg/m³			N/ ha/yr	µg/m³			N/ ha/yr	µg/m³			N/ ha/yr	µg/m³			N/ ha/yr
O_E1	15.1	2.1	1.5	**14.6**	0.3	<0.1	<0.01	0.03	1.5	<0.1	0.01	0.17	17.0	2.1	1.5	**14.8**
O_E2	15.1	2.1	1.5	**14.6**	0.3	<0.1	<0.01	0.02	1.6	<0.1	0.01	0.19	17.0	2.1	1.5	**14.8**
O_E3	14.9	1.8	1.6	**13.9**	0.1	<0.1	<0.01	0.01	0.6	<0.1	<0.01	0.07	15.6	1.8	1.6	**14.0**
O_E4	13.8	1.7	1.6	**13.9**	0.1	<0.1	<0.01	0.01	0.4	<0.1	<0.01	0.05	14.3	1.7	1.6	**14.0**
O_E5	16.6	3.9	1.5	**14.7**	<0.1	<0.1	<0.01	<0.01	0.3	<0.1	<0.01	0.04	16.9	3.9	1.5	**14.7**
O_E6	19.1	3.4	1.6	**16.0**	0.1	<0.1	<0.01	0.01	0.2	<0.1	<0.01	0.03	19.4	3.4	1.6	**16.0**
O_E7	12.6	1.6	1.6	**13.9**	0.1	<0.1	<0.01	0.01	0.3	<0.1	<0.01	0.04	12.9	1.6	1.6	**13.9**
O_E8	14.6	2.2	1.5	**14.7**	<0.1	<0.1	<0.01	<0.01	0.1	<0.1	<0.01	0.02	14.7	2.2	1.5	**14.7**
O_E9	15.8	1.9	1.5	**14.7**	<0.1	<0.1	<0.01	<0.01	0.1	<0.1	<0.01	0.01	15.9	1.9	1.5	**14.7**
O_E10	25.1	2.8	1.6	**13.5**	<0.1	<0.1	<0.01	<0.01	0.1	<0.1	<0.01	0.01	25.3	2.8	1.6	**13.5**
O_E11	21.1	3.4	1.6	**16.0**	<0.1	<0.1	<0.01	<0.01	0.1	<0.1	<0.01	0.02	21.3	3.4	1.6	**16.0**
O_E12	**36.5**	3.0	1.6	**16.0**	<0.1	<0.1	<0.01	<0.01	0.1	<0.1	<0.01	0.01	**36.6**	3.0	1.6	**16.0**

Rec. ID	Annual Mean Background Contribution (µg/m³)[1]				Annual Mean Modelled Baseline Contribution (µg/m³)[2]				Annual Mean Modelled IGET Contribution (µg/m³)[3]				Annual Mean Concentration/ Deposition Rate (µg/m³)[4]			
	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep	NO_X	SO_2	NH_3	N-dep
	µg/m³			N/ ha/yr	µg/m³			N/ ha/yr	µg/m³			N/ ha/yr	µg/m³			N/ ha/yr
O_E13	13.6	2.0	1.5	**14.6**	<0.1	<0.1	<0.01	<0.01	0.1	<0.1	<0.01	0.02	13.8	2.0	1.5	**14.6**
O_E14	11.6	1.7	2.1	**16.1**	<0.1	<0.1	<0.01	<0.01	0.1	<0.1	<0.01	0.01	11.7	1.7	2.1	**16.1**
O_E15	11.6	1.7	2.1	**16.1**	<0.1	<0.1	<0.01	<0.01	0.1	<0.1	<0.01	0.01	11.7	1.7	2.1	**16.1**

Notes:

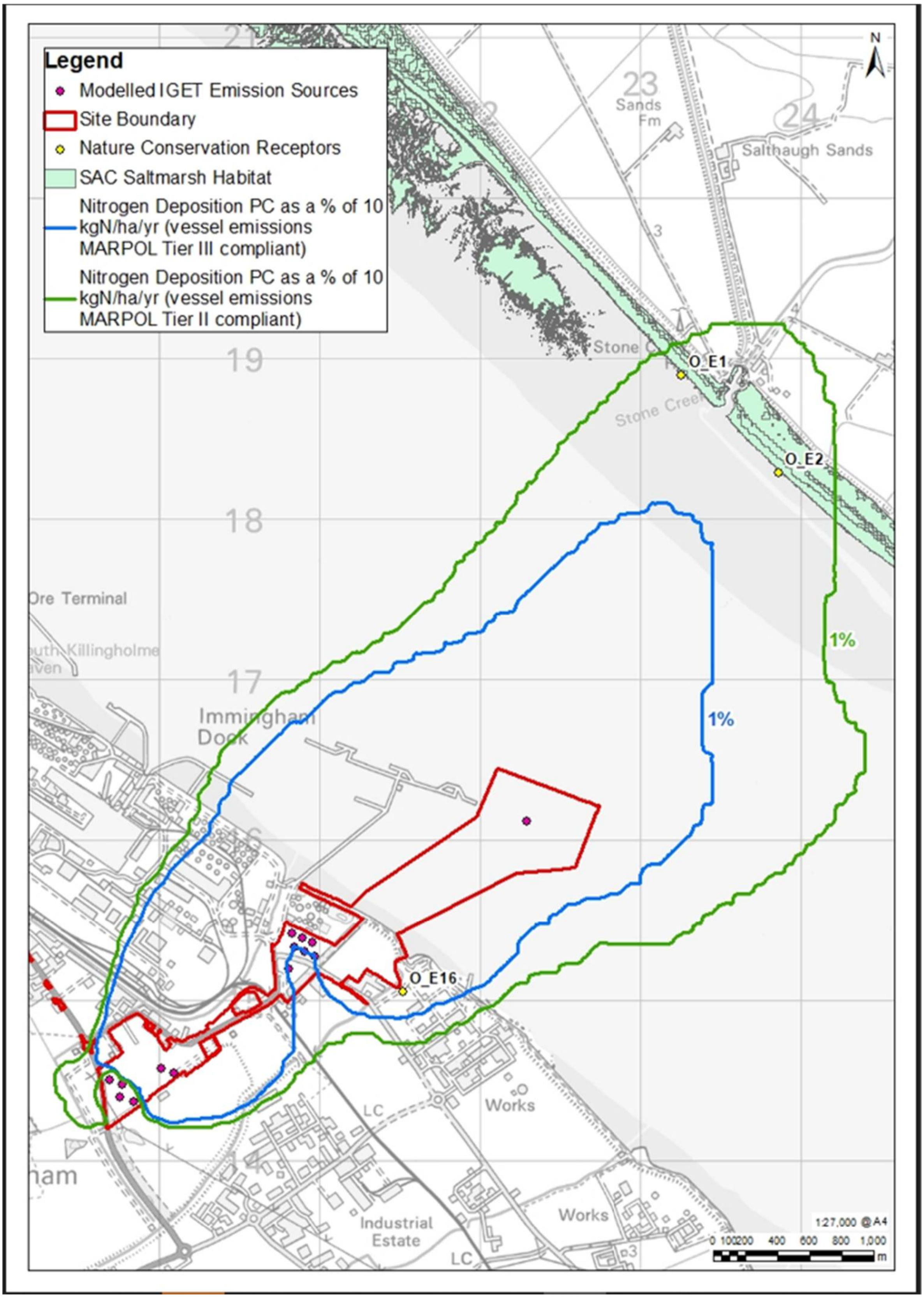
[1] Background contribution of existing sources, minus the contribution from the sources specifically modelled.

[2] Model contribution, including the contribution from the IERRT project and other cumulative sources.

[3] Modelled contribution from IGET construction traffic emissions.

[4] Annual mean concentration is the combined contribution of background and modelled sources.

Plate 3: Isopelth Diagram (operational N deposition assuming a precautionary 10 kgN/ha/yr as the suitable critical load)



4.7.15. In Plate 3, the lowest part of the critical load range, suitable for species-rich upper marsh (Atlantic salt meadow) has been used. However, for saltmarsh, APIS provides two Critical Load ranges, one of 10 - 20 kg/ha/yr suitable for upper saltmarsh (Atlantic salt meadows) and one of 20-30 kgN/ha/yr suitable for pioneer saltmarsh.

~~4.7.15. For saltmarsh, APIS provides a Critical Load range of 10 - 20 kg/ha/yr and nitrogen inputs have been experimentally demonstrated to have an effect on overall species composition of saltmarsh. However, the Critical Loads on APIS are relatively generic for each habitat type and cover a wide range of deposition rates. They do not (and are not intended to) take other influences (to which the habitat on a given site may be exposed) into consideration.~~

~~4.7.16. Moreover, it is important to note from APIS that the experimental studies which underlie conclusions regarding the sensitivity of saltmarsh have '… *neither used very realistic N doses nor input methods i.e. they have relied on a single large application more representative of agricultural discharge*', which is far in excess of anything that would be deposited from atmosphere. Therefore, APIS indicates that determining which part of the critical load range to use for saltmarsh requires expert judgment.~~

~~4.7.17. Generally, nitrogen inputs from the air are not as important to plants as nitrogen from other sources. Effects of nitrogen deposition from atmosphere are likely to be dominated by much greater impacts from marine or agricultural sources. This is reflected on APIS itself, which states regarding saltmarsh that '*Overall, N deposition [from atmosphere] is likely to be of low importance for these systems as the inputs are probably significantly below the large nutrient loadings from river and tidal inputs*'. Another mitigating factor is that the nature of intertidal saltmarsh in the Humber estuary means that there is daily flushing from tidal incursion. This is likely to further reduce the role of nitrogen from atmosphere in controlling botanical composition.~~

4.7.16. ~~4.7.18.~~ The change in threshold values for critical loads in APIS has been informed by recent studies in Ireland and the Netherlands, and a collaboration under the Working Group on Effects ("WGE") of the UNECE Convention on Long-Range Transboundary Air Pollution reported by the German Environment Agency (Ref 1)-. That research has shown that position of the saltmarsh in the tidal profile is relevant to which part of the critical load range is more appropriate. This is because the less the frequency or duration of inundation by seawater, the more important atmosphere becomes as a source of nitrogen. The APIS Site Relevant Critical Load app for the Humber Estuary SAC states that the lowest part of the new critical load range for upper saltmarsh (10 kg N/ha/yr) is most appropriate to the *'more densely vegetated upper marsh (e.g. EUNIS class MA223, MA224)'* with the highest part of the range being more appropriate for more frequently inundated marsh. Classes MA223 and MA224 are '*regularly but not daily flooded by seawater*' with a figure cited of 100-200 days/year[~~17~~23].

[~~17~~23] EUNIS -Factsheet for Atlantic upper-mid saltmarshes and saline and brackish reed, rush and sedge beds (europa.eu).

4.7.17. In 2023, Natural England provided AECOM with the unpublished 2019 document 'Humber Estuary SSSI: NFEU Saltmarsh Surveys 2018'. This contains the results of a survey of saltmarsh in the Humber Estuary SSSI. The areas of relevance to nitrogen deposition (air quality receptors O_E1 and O_E2 in Plate 3 above, these being the only locations where the PC due to the project is forecast to exceed 1% of the critical load if a critical load of 10 kgN/ha/yr is used) are coincident with survey locations 78 and 81 on Appendix 1 of the Natural England report. **Table 5** of the Natural England report identifies that the habitat present at survey locations 78 and 81 is primarily a species-poor stand of sea couch (*Elytrigia atherica*), NVC community SM24, with adjacent areas of NVC community SM6 (*Spartina anglica*) saltmarsh.

4.7.18. Sea couch is a common and widespread grass typical of higher saltmarshes but also found in many other circumstances including lower marsh and sand dunes. Section 2.3 of the Joint Nature Conservation Committee Common Standards Monitoring guidance for saltmarsh[24] thus classifies community SM24 as a 'drift line' community, rather than as 'pioneer saltmarsh', 'low-mid saltmarsh' or 'mid-upper saltmarsh'. Similarly, APIS does not identify community SM24 as an 'Atlantic salt meadow' community, which it restricts to communities SM10 to SM20, but rather classifies it more generally as an 'estuary' community. Sea couch grass has a high capacity for nitrogen assimilation such that nitrogen deposition will not adversely affect it. With regard to the adjacent areas of SM6, Section 2.3 of the JNCC Common Standards Monitoring guidance identifies community SM6 as 'pioneer saltmarsh'.

4.7.19. There is therefore good reason to conclude that the upper part (20 kgN/ha/yr) of the critical load range is appropriate for the affected areas of saltmarsh. Therefore, using a critical load of 20 kgN/ha/yr the additional predicted contribution from nitrogen emissions from the Project does not result in any exceedance of the Critical Load range for saltmarsh, ~~as~~even though the 1% of the critical load threshold is reached when new sources are considered 'in combination' under MARPOL II. **Table 19** shows that the modelled annual mean deposition rate at receptor O_E12 (the worst-case total deposition, not associated with an area of saltmarsh) will be 16.0 kg N/ha/yr, ~~which is well below the 20 kg N/ha/yr upper~~, while that at OE_1 and OE_2 will be 14.7 kgN/ha/yr, which are all well below the 20kgN/ha/yr critical load.

4.7.20. Moreover, guidance within the Highways Agency's Design Manual for Roads and Bridges (DMRB) in respect of Air Quality (Ref 1-238), identifies a threshold of 0.4 kg N/ ha/ yr as resulting in 'no significant effect' on all habitats based on Natural England Research Report NECR 210 (Ref 1-239), which collated dose response research and found that the lowest additional nitrogen deposition to reduce species richness in any habitat by one species was 0.4 kg/ N/ ha/ yr. The modelled cumulative Process Contribution from the Project at receptors OE_1 and OE_2 under the worst-case MARPOL Tier II Emissions Standards scenario

24 https://data.jncc.gov.uk/data/7607ac0b-f3d9-4660-9dda-0e538334ed86/CSM-SaltmarshHabitats-2004.pdf

is a maximum of 0.2 kg/ N/ ha/ yr ~~and~~according to **Table 19** (0.19 kgN/ha/yr from IGET and 0.02 kgN/ha/yr from other in combination sources). This is therefore ~~is~~ well under ~~this~~the DMRB threshold for effecting a measurable change in vegetated habitat species diversity. Although the emissions to air arising from the Project are mainly from marine vessels, as the pollutants are the same as those assessed for road vehicle engine emissions in the DMRB, it is considered appropriate to apply this threshold in the assessment for the Project.

4.7.21. Moreover, it is important to note from APIS that the experimental studies which underlie conclusions regarding the sensitivity of saltmarsh have '*… neither used very realistic N doses nor input methods i.e. they have relied on a single large application more representative of agricultural discharge'*, which is far in excess of anything that would be deposited from the atmosphere. Generally, nitrogen inputs from the air are not as important to plants as nitrogen from other sources. Effects of nitrogen deposition from the atmosphere are likely to be dominated by much greater impacts from marine or agricultural sources. This is reflected on APIS itself, which states regarding saltmarsh that '*Overall, N deposition [from atmosphere] is likely to be of low importance for these systems as the inputs are probably significantly below the large nutrient loadings from river and tidal inputs*'. Another mitigating factor is that the nature of intertidal saltmarsh in the Humber Estuary means that there is daily flushing from tidal incursion. This is likely to further reduce the role of nitrogen from atmosphere in controlling botanical composition.

4.7.22. ~~4.7.21.~~ In addition, Natural England's Supplementary Advice on Conservation Objectives for the Humber Estuary SAC states that the conservation objective for the 'Atlantic salt meadows *Glauco-Puccinellietalia maritimae*' and '*Salicornia* and other annuals colonising mud and sand' habitat features relevant to the assessment of air quality effects is to "*Maintain concentrations and deposition of air pollutants to below the site-relevant Critical Load or Level values given for this feature on the Air Pollution Information System*" (Ref 1-240). As set out above, the Process Contribution from the Project, which results in a mean deposition rate of 16 kg N/ ha/ yr on the nearest saltmarsh habitat does, not result in any exceedances of the Critical Load published on the APIS. Indeed, air quality modelling for this Project forecasts a slight improvement in nitrogen deposition between the base year and 2036 even when allowing for the Project. Therefore, the Project will not compromise the air quality 'maintain' target for the Humber Estuary SAC.

4.7.23. ~~4.7.22.~~ It is therefore concluded that operational emissions from marine vessels and landside plant will not adversely affect the integrity of designated habitats or undermine the conservation objectives within the Humber Estuary SAC.

Mitigation

4.7.24. ~~4.7.23.~~ Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.7.25. ~~**4.7.24.**~~ Based on the evidence and assessment provided above and the justification in ~~**Table 20**~~**Table 20**, operational vessel and landside plant emissions resulting in nitrogen deposition to saltmarsh habitat within the Humber

Estuary SAC/ Ramsar are not considered to compromise any of the conservation objectives of the Humber Estuary SAC/ Ramsar, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 20: The potential for an AEOI due to physical change to qualifying habitats resulting from the deposition of Nitrogen and NOx from marine vessel and landside plant emissions during operation.

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand H1330: Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Based on the information provided above, air quality effects are considered to be negligible. On this basis the potential effects are not expected to cause a change to '*the extent and distribution of qualifying natural habitats and habitats of the qualifying species*' conservation objective. Air quality effects on this scale will also not cause any changes to the *'the structure and function of qualifying natural habitats'* or cause modifications to '*the supporting processes on which qualifying natural habitats rely'* conservation objectives.
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		

4.8. Non-Toxic Contamination through Elevated Suspended Sediment Concentrations

The potential effects of elevated SSC during capital dredging on qualifying habitats and species

General scientific context

Elevated SSC: implications for benthic habitats and species

4.8.1. Dredging activities result in the suspension of disturbed sediment (~~Ref 1-65~~Ref 1-69). Macrofauna living in estuarine systems which are subject to naturally high levels of SSCs are considered well adapted to living in highly turbid conditions. An increased level of suspended sediments may result in an increase in food availability and therefore growth and reproduction for surface deposit feeders (such as certain polychaetes) within estuarine environments that rely on a supply of nutrients at the sediment surface. However, food availability would only increase if the additional suspended sediment contained a significant proportion of organic matter, and the population would only be enhanced if food was previously limiting (~~Ref 1-68~~Ref 1-72).

4.8.2. Greater energetic costs for benthic species could occur as a result of higher particle loads due to elevated suspended sediments stimulating the secretion of mucus to protect branchial or feeding structures of filter feeding organisms (~~Ref 1-101~~Ref 1-107). SSCs have been found to have a negative linear relationship with sub-surface light attenuation. Light availability and water turbidity are principal factors in determining depth range at which kelp and other algae are recorded. In addition, certain mobile epistrate feeders (such as the amphipod *Bathyporeia* spp.) feed on diatoms within the sand grains and an increase in suspended solids that consequently reduced light penetration could alter food supply (~~Ref 1-67~~Ref 1-71). However, longer-term changes in turbidity levels rather than temporary elevations are likely to be required to elicit any measurable changes in these species.

4.8.3. Elevated suspended sediment levels can also cause increased scouring and damage of epifaunal species due to the potentially abrasive action of the suspended sediment in flowing water.

a result of dredging are generally considered to be minimal and short-lived. However, potential effects can be more pronounced if dredging causes the disturbance of high levels of oxygen-depleting substances and nutrients present in some very fine-grained sediment deposits and where a great portion originate from waste water (~~Ref 1-103~~Ref 1-109).

4.8.6. Oxygen depletion in severe situations can lead to hypoxia with most research on the effects of reductions in dissolved oxygen on benthic fauna during hypoxic conditions. This occurs when oxygen is consumed (e.g., by decomposing organic matter, respiration and oxidation of reduced chemical species) faster than it is replenished (e.g., via air-water oxygen transfer, photosynthesis, and mixing) (~~Ref 1-104~~Ref 1-110). Coastal and estuarine waters can be particularly susceptible to low oxygen conditions as sediments are organic-rich and impose high sediment oxygen demands. Highly stratified estuaries, in which surface and bottom waters do not mix, are more prone to hypoxia (~~Ref 1-104~~Ref 1-110). Coastal areas are more likely to experience hypoxia during summer when high temperatures strengthen salinity stratification (~~Ref 1-105~~Ref 1-111). Severe anoxic events can deplete the benthic invertebrate communities and cause a shift in community composition, through attrition of intolerant species and elevated dominance, as well as reductions in body size (~~Ref 1-106~~Ref 1-112). In general, crustaceans and echinoderms are typically more sensitive to hypoxia, with lower oxygen thresholds, than annelids, molluscs and cnidarians (~~Ref 1-105~~Ref 1-111).

Elevated SSC: implications for fish

4.8.7. Increased suspended sediments can lead to physiological effects in adult finfish resulting from the abrasion of sediment particles on gill tissues, causing reduced gill function and possible mortality (~~Ref 1-107 Ref 1-108~~Ref 1-113 Ref 1-114). Such effects on fish are considered to occur at suspended sediment levels of around 10,000 mg/l (~~Ref 1-109~~Ref 1-115). High SSC levels may impact spawning and nursery grounds through damage to eggs and planktonic larvae, as well as causing abrasion or clogging of the fragile gills of larval and juvenile fish, resulting in mortality or reduced growth rates.

4.8.8. Because turbidity often impairs visual acuity, activities and processes that require vision can be inhibited, leading to behavioural responses. For example, foraging in both planktivorous and piscivorous fish can be negatively affected by suspended sediments. Piscivores are especially sensitive to increasing turbidity because many are visual hunters that detect prey from a distance. An increase in suspended sediment reduces both light and contrast, decreasing encounter distances between predator and prey (~~Ref 1-107~~Ref 1-113).

4.8.9. Elevated suspended sediments can also influence the movements and migration of fish with some species have been observed actively avoiding moving through areas with suspended sediment plumes (~~Ref 1-107; Ref 1-108~~Ref 1-113; Ref 1-114). However, such responses can cease if fish become acclimatised. Fish in high latitude coastal areas typically have to contend with variable turbidity and often poor visual conditions, resulting from fluctuations in ambient light levels, suspended sediments and in the light transmission properties of the water. For example, concentrations as high as 9,000 mg/l have been recorded in the path of salmon runs in the Usk Estuary (~~Ref 1-110~~Ref 1-116). Similarly, lamprey and shad species have been known to successfully pass through estuaries with extremely high suspended sediments and, therefore, can be considered tolerant of turbid conditions (~~Ref 1-111~~Ref 1-117). The mobile nature of fish species generally allows avoidance of areas of adverse conditions which are unlikely to significantly affect a population provided such conditions are temporary.

4.8.10. The resuspension of sediments containing organic material can cause oxygen depletion within the water column. The subsequent settling of this organic rich sediment can deplete the sediments of oxygen and affect benthic prey items used by fish. The response of fish to low concentrations of dissolved oxygen is determined by a range of factors, including the duration of exposure, water temperature and the presence of other pollutants (~~Ref 1-107~~Ref 1-113). The duration of any low dissolved oxygen event is a key factor in determining its effect. Most fish would survive an extremely low concentration of dissolved oxygen, such as 2 mg/l, for a few minutes, but a longer exposure would start to have sub-lethal and eventually lethal effects (~~Ref 1-112~~Ref 1-118).

Summary of effects

Effects on benthic habitats and species

4.8.11. The changes in SSC that are predicted to occur as a result of the capital dredge are presented in **Chapter 16: Physical Processes [TR030008/APP/6.2]**. In summary, the increased concentrations arising from the capital dredge will be of a lower magnitude and persist for a shorter distance (and time) than that from disposal activity which is summarised below.

4.8.12. Naturally very high SSC typically occur year-round in the Humber Estuary, particularly during the winter months when storm events disturb the seabed and on spring tides (~~Ref 1-113; Ref 1-114~~Ref 1-119; Ref 1-120). The estuarine benthic communities recorded on mudflats and the shallow mud occur commonly in this region and are considered tolerant to this highly turbid environment (~~Ref 1-34;~~ Ref 1-35; Ref 1-36; Ref 1-37). The predicted SSCs are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity (**Chapter 16: Physical Processes [TR030008/APP/6.2]**).

4.8.13. With respect to dissolved oxygen, increases in SSC will be brief and localised and there is not expected to be a significant reduction in dissolved oxygen nor therefore any implications for benthic species and habitats.

Effects on fish

4.8.14. As highlighted above, migratory fish including lamprey are known to migrate through estuaries with high SSC to reach spawning areas (including the Humber Estuary which is considered one of the estuaries in the UK with the highest levels of SSCs) (~~Ref 1-111; Ref 1-107; Ref 1-108~~Ref 1-117; Ref 1-113; Ref 1-114; Ref 1-119; Ref 1-120). Elevated SSCs due to dredging are expected to be of a magnitude that can occur naturally during migratory periods for lamprey or as a result of ongoing maintenance dredging/disposal.

4.8.15. Sediment plumes resulting from dredging will be localised (in the context of the entire width of the estuary). It is considered that they will dissipate rapidly and be immeasurable against background levels within a short duration of time (less than a single tidal cycle) as described in more detail in the Physical Processes assessment (**Chapter 16: Physical Processes [TR030008/APP/6.2]**). Therefore, lamprey will also be able to avoid the temporary sediment plumes. Based on these factors there is considered to be limited potential for migrating fish to be adversely affected by the predicted changes in SSC.

4.8.16. Given that elevated SSCs due to dredge are considered to be in the range of variability that can occur naturally in the Humber Estuary (which has very high SSCs year-round) as well as due to ongoing maintenance dredging/disposal and that plumes will be temporary in nature, sensitive life stages of fish occurring in the region such as larvae and juvenile fish are considered unlikely to be adversely affected by the dredging.

4.8.17. With respect to dissolved oxygen, increases in SSC will be brief and localised and there is not expected to be a reduction in dissolved oxygen and therefore a response by fish is not anticipated.

Mitigation

4.8.18. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.8.19. The predicted changes in SSCs during capital dredging are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity (see above and **Table 21**). The predicted effects on habitats and species are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 21: The potential for an AEOI on qualifying habitats and species due to elevated SSC dur

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1130: Estuaries	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Benthic habitats and species withi adapted to high suspended sedim dredging are predicted to be of a r result of ongoing maintenance dre localised and temporary effects ar '*the extent and distribution of qual qualifying species*' conservation o magnitude will also, therefore, not *and function of qualifying natural h supporting processes on which qu* objectives.
	H1140: Mudflats and sandflats not covered by seawater at low tide		
	S1095: Sea lamprey *Petromyzon marinus*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Lamprey regularly migrate through the Humber Estuary). In addition, predicted to be of a magnitude tha ongoing maintenance dredging/dis temporary effects are not conside *of each of the qualifying features' features within the site'* conservati This pathway would also not caus *distribution of the habitats of the q processes on which the habitats o* conservation objectives.
	S1099: River lamprey *Lampetra fluviatilis*		
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks,	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Benthic habitats and species withi adapted to high suspended sedim dredging are predicted to be of a r result of ongoing maintenance dre localised and temporary effects ar '*the extent and distribution of qual qualifying species*' conservation o

Site	Features	Potential AEOI	Justification
	estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		magnitude will also, therefore, not *and function of qualifying natural h* *supporting processes on which qu* objectives.
	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Lamprey regularly migrate through the Humber Estuary). In addition, predicted to be of a magnitude tha ongoing maintenance dredging/dis temporary effects are not conside *of each of the qualifying features'* *features within the site'* conservati This pathway would also not caus *distribution of the habitats of the q* *processes on which the habitats o* conservation objectives.

The potential effects of elevated SSC during capital dredge disposal on qualifying habitats and species

General scientific context

4.8.20. Scientific evidence on this impact pathway is provided in Paragraphs 4.8.1 to 4.8.10.

Summary of effects

Effects on benthic habitats and species

4.8.21. The changes in SSC that are predicted to occur as a result of the capital dredge disposal are presented in **Chapter 16: Physical Processes [TR030008/APP/6.2]**. In summary, the dredge disposal is predicted to produce peak SSC of around 600 to 800 mg/l above background at the disposal site, reducing to typically 100 to 200 mg/l within a distance of around 7km from the source. These peak increases are predicted to persist at any given location for a single modelled timestep (10 minutes) before the tidal forcing carries the plume further up or down estuary on the respective flood or ebb tide. SSCs of this magnitude are considered to regularly occur naturally or as a result of ongoing maintenance dredging/disposal. Upstream of Hull and downstream (within the outer estuary), maximum SSC levels are lower; generally, between 20 and 100 mg/l above background, as the tidal excursion from the disposal site limits the extent of the resultant plume. However, in reality due to the existing high SSC that typically occurs in the Humber Estuary, the predicted increase in concentrations resulting from the disposal is likely to become immeasurable (against background) within approximately 1km of the disposal site. The measurable plume from each disposal operation is also only likely to persist for a single tidal cycle (less than 6 hours from disposal) as after this time the dispersion under the peak flood or ebb tidal flows means concentrations will have reverted to background levels.

4.8.22. Naturally very high SSCs typically occur year-round in the Humber Estuary, particularly during the winter months when storm events disturb the seabed and on spring tides. The estuarine benthic communities recorded within the disposal ground and surrounding area were found to be of low ecological value but are considered characteristic of the ‘Sandbanks which are slightly covered by sea water all the time’ feature. The benthic communities have low sensitivity to increases in suspended sediments and are considered tolerant to this highly turbid environment (~~Ref 1-34;~~ Ref 1-35; Ref 1-36; Ref 1-37). The predicted SSCs are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity (**Chapter 16: Physical Processes [TR030008/APP/6.2**).

4.8.23. The disposal of sediment will temporarily increase SSC, however, due to the strong hydrodynamic conditions in the area, these temporary elevations in SSC are expected to dissipate rapidly to background concentrations. With respect to dissolved oxygen, increases in SSC will be brief and localised and there is not expected to be a significant reduction in dissolved oxygen nor therefore any implications for benthic species and habitats.

Effects on fish

4.8.24. The changes in SSC are described above in paragraph 4.8.21. Migratory species including lamprey are known to migrate through estuaries with high SSC (including the Humber Estuary which is considered one of the estuaries in the UK with the highest levels of SSC) (~~Ref 1-113~~Ref 1-119) and the predicted SSC are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity. Sediment plumes resulting from disposal will also be localised in the context of the entire width of the estuary. Therefore, salmonids and other migratory fish would also be able to avoid the temporary sediment plumes and sensitive life stages of fish occurring in the region such as larvae and juvenile fish are considered unlikely to be adversely affected by the dredging.

4.8.25. With respect to dissolved oxygen, increases in SSC will be brief and localised and there is not expected to be a significant reduction in dissolved oxygen as assessed in the Water and Sediment Quality assessment (**Chapter 17: Marine Water and Sediment Quality [TR030008/APP/6.2]**). Effects on lamprey are therefore considered to be negligible.

Mitigation

4.8.26. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.8.27. The predicted changes in SSCs during capital dredge disposal are within the range that can frequently occur naturally and also as a result of ongoing dredge and disposal activity (see above and **~~Table 21~~Table 22**). The predicted effects on habitats and species are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 22: The potential for an AEOI on qualifying habitats and species due to elevated SSC dur

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1110: Sandbanks which are slightly covered by sea water all the time	In the context of the site’s conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Benthic habitats and species withi adapted to high suspended sedim dredging are predicted to be of a r result of ongoing maintenance dre localised and temporary effects ar ‘*the extent and distribution of qual qualifying species*’ conservation o magnitude will also, therefore, not *and function of qualifying natural h supporting processes on which qu* objectives.
	H1130: Estuaries		
	S1095: Sea lamprey *Petromyzon marinus*	In the context of the site’s conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Lamprey regularly migrate through Humber Estuary). In addition, the are considered to be of a magnitu of ongoing maintenance dredging/ temporary effects are not conside *each of the qualifying features*’ or *within the site*’ conservation objec This pathway would also not caus *distribution of the habitats of the q processes on which the habitats c* conservation objectives.
	S1099: River lamprey *Lampetra fluviatilis*		
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and	In the context of the site’s conservation objectives, there is considered to be no potential AEOI on the qualifying interest	Benthic habitats and species withi adapted to high suspended sedim dredging are predicted to be of a r result of ongoing maintenance dre localised and temporary effects ar ‘*the extent and distribution of qual*

Site	Features	Potential AEOI	Justification
	humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	features.	*qualifying species*' conservation o magnitude will also, therefore, not *and function of qualifying natural h supporting processes on which qu* objectives.
	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Lamprey regularly migrate through Humber Estuary). In addition, the are considered to be of a magnitu of ongoing maintenance dredging temporary effects are not conside *each of the qualifying features*' or *within the site*' conservation objec This pathway would also not caus *distribution of the habitats of the q processes on which the habitats c* conservation objectives.

4.9. Toxic Contamination through Release of Toxic Contaminants Bound in Sediments, And Accidental Oil, Fuel or Chemical Releases

The potential effects of the release of contaminants during capital dredging on qualifying habitats and species

General scientific context

Release of contaminants: implications for benthic habitats and species

4.9.1. Benthic habitats and species are sensitive to toxic contamination (where concentrations of contaminants exceed sensitivity thresholds). Toxic contamination during construction can occur as a result of the release of synthetic contaminants such as fuels and oils or through the resuspension of sediment as a result of the disturbance of the seabed which can lead to the release and mobilisation of sediment-bound contaminants into the water column. These include both toxic contaminants, such as heavy metals, pesticides and hydrocarbons, and non-toxic contaminants, such as nutrients. In particular, there is a risk that any uncontrolled releases of materials or sediments into the water column could make contaminants temporarily available for uptake by marine organisms. Over the longer-term any such releases could also become stored in the surface sediments of benthic habitats for future benthic uptake.

4.9.2. Suspension-feeding organisms may be particularly vulnerable to pollutants in the water column due to their dependence on filtration (~~Ref 1-67~~Ref 1-71). High levels of chemical contaminants can potentially cause genetic, reproductive and morphological disorders in marine species. Contaminants may also have combined effects. Studies have suggested links between contamination with polycyclic aromatic hydrocarbons ("PAHs"), polychlorinated biphenyl ("PCBs"), amines and metals and a range of disorders (~~Ref 1-115~~Ref 1-121). Increased incidence of tumours, neoplasia, deoxyribonucleic acid ("DNA") damage, polyploidy, hypoploidy, hermaphroditism and reduced immune response have all been reported in marine invertebrates in areas of high levels of pollution (~~Ref 1-116; Ref 1-117; Ref 1-118; Ref 1-119; Ref 1-120; Ref 1-121~~Ref 1-122; Ref 1-123; Ref 1-124; Ref 1-125; Ref 1-126; Ref 1-127. Another highly researched pollutant is Tributyltin ("TBT"), which has toxic effects in a wide variety of biota, whereas inorganic tin is less toxic. TBT effects include lethal toxicity and effects on growth, reproduction, physiology, and behaviour. Several of the negative effects are due to interferences with the endocrine function, as occurs in the phenomenon imposex. Imposex is the superimposition of male organs onto females of gastropods, which are normally a dioecious species (~~Ref 1-122~~Ref 1-128).

4.9.3. Sub-lethal effects of chemical contamination on marine invertebrates can reduce the fitness of individual species. Lethal effects may allow a shift in community composition to one dominated by pollution-tolerant species such as oligochaete worms (~~Ref 1-123~~Ref 1-129). A reduction in community species richness is associated with elevated levels of pollutants. Contamination with PAHs, for example, leads to high levels of mortality in amphipod and shrimp species, and decreased benthic diversity (~~Ref 1-124~~Ref 1-130). Similar reductions in diversity are linked with heavy metal contamination (~~Ref 1-125~~Ref 1-131). Polychaete worms are thought to be quite tolerant of heavy metal contamination, whereas crustaceans and bivalves are considered to be intolerant (~~Ref 1-126~~Ref 1-132).

Release of contaminants: implications for fish

4.9.4. The potential release of contaminants during construction and dredging activities may result in those contaminants becoming available for uptake by any fish in the water column or on surface sediments. There is an indirect risk to some finfish species as sediment-bound contaminants may temporarily bioaccumulate in the tissues of certain fish prey, such as polychaete worms and marine bivalves, and made available for uptake by feeding fish.

4.9.5. The influence of contaminated sediments is considered to have a greater impact on fish than elevated SSC with a range of evidence suggesting that direct exposure to contaminants negatively effects fish (~~Ref 1-107~~Ref 1-113). Hydrophobic contaminants (such as legacy persistent organic pollutants including PCBs and organochlorine pesticides) as well as high-molecular weight polyaromatic and aliphatic hydrocarbons (such as PAHs), are closely associated with organic material in sediments. These contaminants have been linked to a range of potential reproductive impacts on adult fish (e.g., steroidogenesis, vitellogenesis, gamete production or spawning success) as well as lethal and non-lethal developmental (spinal and organ development, growth) impacts on embryos and larvae (~~Ref 1-127~~Ref 1-133).

4.9.6. Demersal fish species, such as dab and flounder, which remain close to the seabed and feed mainly on benthic organisms, would experience a higher exposure to contaminated sediments than pelagic fish such as herring.

Summary of effects

Effects on benthic habitats and species

4.9.7. The potential to impact the marine environment as a result of any sediment-bound contaminants arises primarily when the sediment that is released into the water column disperses and deposits elsewhere. However, it should be noted that the majority of material disturbed during capital dredging works will be lifted from the bed to the hopper/barge, with only a small proportion raised into suspension and remaining in the water column (i.e., through abrasion pressure from the draghead/bucket).

4.9.8. Sampling and subsequent chemical analysis has been undertaken in accordance with the agreed MMO sample plan. The results of this analysis are summarised in more detail in the Marine Water and Sediment Quality assessment (**Chapter 17: Marine Water and Sediment Quality [TR030008/APP/6.2]**) and show the majority of contaminants in the sediments of the proposed dredge area are at relatively low concentrations, mostly below, or marginally exceeding, Cefas Action Level 1 (AL1). There were no exceedances of Action level 2 (AL2) in any sediment samples analysed.

4.9.9. Based on the chemical analysis, there are low levels of contamination in sediments in the proposed dredge area. Only a small proportion of disturbed material is expected to be raised into suspension and this material will be rapidly dispersed by strong tidal currents in the area. Significant elevations in the water column contamination are, therefore, not anticipated. Based on these factors, the benthic communities would have no or very limited exposure to contaminants and not at concentrations of contaminants that would constitute a lethal or sub-lethal effect. The effects on subtidal and intertidal benthic communities from the release of contaminants during capital dredging is considered inconsequential.

Effects on fish

4.9.10. As described above in **Paragraph 4.9.8** low levels of contamination were found in the sediment contamination samples. Significant elevations in the concentrations of contaminants within the water column are not anticipated. Based on these factors, it is unlikely that fish including lamprey species would be exposed to elevated levels of contaminants during capital dredging and therefore effects on fish species are unlikely.

Mitigation

4.9.11. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.9.12. Significant elevations in the concentrations of contaminants are not anticipated during capital dredging based on the results of the site-specific sampling (see above and **Table 23**). The predicted effects on qualifying habitats and species are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 23: The potential for an AEOI on qualifying habitats and species the release of contaminants during capital dredging

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1130: Estuaries H1140: Mudflats and sandflats not covered by seawater at low tide	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Based on existing available information summarised above, the overall level of contamination in the proposed dredge area is considered to be low with only a small proportion of disturbed material expected to be raised into suspension. This material will be rapidly dispersed by strong tidal currents in the area. Significant elevations in the water column contamination are, therefore, not anticipated. Based on these factors, the magnitude of change to marine habitats and species is considered to be negligible. On this basis the localised and temporary effects are not considered to cause changes to '*the extent and distribution of qualifying natural habitats and habitats of the qualifying species*' conservation objective. Elevated contamination levels of this magnitude will also not cause any changes to the '*the structure and function of qualifying natural habitats*' or cause modifications to '*the supporting processes on which qualifying natural habitats rely*' conservation objectives.
	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Based on existing available information summarised above, the localised and temporary potential changes are considered to cause negligible effects in lamprey and will not cause changes to '*the population of each of the qualifying features*' or the '*distribution of the qualifying features within the site*' conservation objectives. This pathway would also not cause any changes to '*the extent and distribution of the habitats of the qualifying features*' or the '*supporting processes on which the habitats of the qualifying features rely*' conservation objectives.
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest	Based on existing available information summarised above, the overall level of contamination in the proposed dredge area is considered to be low with only a small proportion of disturbed material expected to be raised into suspension. This material will be rapidly dispersed by strong tidal currents in the area. Significant elevations in the water column contamination are, therefore, not anticipated. Based on these factors, the magnitude of change

Site	Features	Potential AEOI	Justification
	following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	features.	to marine habitats and species is co the localised and temporary effects ‘*the extent and distribution of qualify qualifying species*’ conservation obje this magnitude will also not cause a *function of qualifying natural habitat supporting processes on which qual* objectives.
	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	In the context of the site’s conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Based on existing available informat temporary potential changes are co lamprey and will not cause changes *qualifying features*’ or the ‘*distributio* conservation objectives. This pathway would also not cause *distribution of the habitats of the qua processes on which the habitats of t* objectives.

The potential effects of the release of contaminants during capital dredge disposal on qualifying habitats and species

General scientific context

4.9.13. Scientific evidence on this impact pathway is provided in Paragraphs 4.9.1 to 4.9.6.

Summary of effects

Effects on benthic habitats and species

4.9.14. The results of the sediment contamination sampling are summarised above and in the Water and Sediment Quality assessment (**Chapter 17: Marine Water and Sediment Quality [TR030008/APP/6.2])**. In summary, low levels of contamination were found in the samples and there is no reason to believe the sediment will be unsuitable for disposal in the marine environment.

4.9.15. During disposal, sediment will be rapidly dispersed in the water column. Therefore, the already low levels of contaminants in the dredged sediments will be dispersed further. The probability of changes in water quality occurring at the disposal site is considered to be low. The material will be rapidly dispersed by strong tidal currents in the area. Significant elevations in the water column contamination are, therefore, not anticipated. Based on these factors, the benthic communities at the disposal site would have no or very limited exposure to contaminants and not at concentrations of contaminants that would constitute a lethal or sub-lethal effect. The effects on subtidal and intertidal benthic communities from the release of contaminants during capital dredge disposal is considered inconsequential.

Effects on fish

4.9.16. Significant elevations in the concentrations of contaminants within the water column are not anticipated (**Paragraph 4.9.14**). Based on these factors, it is unlikely that fish would be exposed to elevated levels of contaminants during capital dredge disposal and therefore effects on fish species are unlikely.

Mitigation

4.9.17. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.9.18. Significant elevations in the concentrations of contaminants are not anticipated during capital dredge disposal based on the results of the site-specific sampling (see above and **Table 24**). The predicted effects on qualifying habitats and species are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 24: The potential for an AEOI on qualifying habitats and species the release of contaminants during capital dredging disposal

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1110: Sandbanks which are slightly covered by sea water all the time H1130: Estuaries	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Given the low levels of contamination found in the samples and the high level of dispersal expected as the disposal sites, subtidal habitats and species found in the vicinity of the disposal sites are not expected to be vulnerable to the potential release of sediment bound contaminants which could occur as a result of the disposal of the capital dredged arisings. On this basis the localised and temporary effects are not considered to cause changes to '*the extent and distribution of qualifying natural habitats and habitats of the qualifying species*' conservation objective. Elevated contamination levels of this magnitude will also not cause any changes to the '*the structure and function of qualifying natural habitats*' or cause modifications to 'the supporting processes on which qualifying natural habitats rely' conservation objectives.
	S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Based on existing available information summarised above, the localised and temporary potential changes are considered to cause negligible effects in lamprey and will not cause changes to '*the population of each of the qualifying features*' or the '*distribution of the qualifying features within the site*' conservation objectives. This pathway would also not cause any changes to '*the extent and distribution of the habitats of the qualifying features*' or the '*supporting processes on which the habitats of the qualifying features rely*' conservation objectives.
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the	Given the low levels of contamination found in the samples and the high level of dispersal expected as the disposal sites, subtidal habitats and species found in the vicinity of the disposal sites are not expected to be vulnerable to the potential release of sediment bound contaminants which could occur as a result of the disposal of the capital dredged arisings.

Site	Features	Potential AEOI	Justification
	humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	qualifying interest features.	On this basis the localised and temporary effects are not considered to cause changes to '*the extent and distribution of qualifying natural habitats and habitats of the qualifying species*' conservation objective. Elevated contamination levels of this magnitude will also not cause any changes to the '*the structure and function of qualifying natural habitats*' or cause modifications to 'the supporting processes on which qualifying natural habitats rely' conservation objectives.
	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Based on existing available information summarised above, the localised and temporary potential changes are considered to cause negligible effects in lamprey and will not cause changes to '*the population of each of the qualifying features*' or the '*distribution of the qualifying features within the site*' conservation objectives. This pathway would also not cause any changes to '*the extent and distribution of the habitats of the qualifying features*' or the '*supporting processes on which the habitats of the qualifying features rely*' conservation objectives.

4.10. Airborne Noise and Visual Disturbance

The potential effects of airborne noise and visual disturbance during construction on qualifying species of coastal waterbird within the SPA/Ramsar boundary

General scientific context

Introduction

4.10.1. Disturbance can cause birds to cease feeding, which can decrease the total amount of time available for feeding, as well as disrupting other behaviour such as breeding (~~Ref 1-128; Ref 1-129~~Ref 1-134; Ref 1-135). Where disturbance causes birds to take flight, it can increase energy demands and may increase food consumption by decreasing the available habitat area (~~Ref 1-130; Ref 1-131; Ref 1-132~~Ref 1-136; Ref 1-137; Ref 1-138. Repetitive disturbance events can result in possible long-term effects such as loss of weight, condition and a reduction in reproductive success, leading to population impacts (~~Ref 1-133; Ref 1-134; Ref 1-135~~Ref 1-139; Ref 1-140; Ref 1-141). Birds typically show a dispersive response to disturbance with prolonged disturbance causing displacement (~~Ref 1-130;~~ Ref 1-136; ~~Ref 1-137~~Ref 1-142; Ref 1-143).

4.10.2. Disturbance often occurs through a combination of simultaneous visual and noise stimuli, although some occurrences may be through separate visual or noise stimuli (Ref 1-14). Birds will also vary their response to human activities depending on the type of the activity, the noise produced, the speed and randomness of approach, the distance to which the disturbance factor approaches and the frequency of disturbance (~~Ref 1-138., Ref 1-139; Ref 1-140; Ref 1-128; Ref 1-141; Ref 1-142~~Ref 1-144., Ref 1-145; Ref 1-146; Ref 1-134; Ref 1-147; Ref 1-148).

Disturbance responses associated with construction activity

4.10.3. Construction activity in the coastal zone may lead to disturbance which has the potential to cause a reduction in foraging activity as well as temporary displacement from a localised area around the works (~~Ref 1-138~~Ref 1-144).

4.10.4. Overall, responses to construction noise and activity appear to initiate similar or less disturbance than that of human presence on the foreshore (e.g., recreation) (~~Ref 1-143; Ref 1-144; Ref 1-145; Ref 1-146~~Ref 1-149; Ref 1-150; Ref 1-151; Ref 1-152). For example, while some localised disturbance was caused as a result of piling activity as part of the construction work for ABB Power Generation Ltd (Pyewipe, Grimsby), this was not considered to have a major effect on surrounding bird populations and was found to be no greater than the effect arising from third party disturbance, including walkers and stopped cyclists, which were unrelated to the ABB works (~~Ref 1-143~~Ref 1-149). The greater effect of human presence as opposed to general construction works and machinery is also supported by Institute of Estuarine and Coastal Services ("IECS") (~~Ref 1-145~~Ref 1-151), in that a person approaching feeding birds on the mudflat caused birds to fly when the person was approximately 300m from the birds, whereas machinery could approach birds up to 50m before the birds moved away.

4.10.5. Lower levels of disturbance for construction activities compared with other nearby human activity was also observed during bird monitoring as part of the marine licensing consent for a quay wall construction development at the Port of Southampton. The study evaluated the disturbance effects of the extension work on waterbird species using the mudflat habitat on Bury Marsh opposite the Port of Southampton (approximately 100 to 200m away) during the overwinter period. No bird disturbance behaviour (such as startling, rapid flight or abruptly stopping foraging) was observed during periods of percussive piling activity. However, disturbance to waterbirds was observed on several occasions due to vessels and kayaks within 50m of Bury Marsh (~~Ref 1-144~~Ref 1-150).

4.10.6. Studies into the distances from activities that evoke a disturbance response (or flight initiation distance ("FID")) suggest that for most coastal works and other foreshore activity in areas where birds are likely to be habituated to some extent to disturbance due to existing anthropogenic activity, disturbance behaviour is not typically observed when activities occur more than some 200m away from a source with the reactions of many species occurring between 20 and 100m (Ref 1-153; Ref 1-147; ~~Ref 1-141; Ref 1-148; Ref 1-149; Ref 1-150; Ref 1-136; Ref 1-146; Ref 1-151 Ref 1-152; Ref 1-153;~~ Ref 1-154; ~~Ref 1-144~~Ref 1-155; Ref 1-156; Ref 1-142; Ref 1-152; Ref 1-157 Ref 1-158; Ref 1-159; Ref 1-160; Ref 1-150). This is discussed in more detail in **Table 25**.

4.10.7. Construction techniques which are known to cause loud source noise levels (such as piling) have been the subject of a number of disturbance monitoring studies which have investigated the relationship between activity source levels and the disturbance responses elicited by birds (~~Ref 1-148; Ref 1-155~~Ref 1-154; Ref 1-161; Ref 1-14; ~~Ref 1-147; Ref 1-146~~Ref 1-153; Ref 1-152). Research suggests that irregular construction noise at levels typically above 70 dB can cause behavioural responses in some waterbird species with flight responses generally occurring above 80 dB (**Table 25**). However, responses of birds will be dependent on a range of site-specific factors including ambient (background) noise levels, time of year, levels of existing activity and the species assemblage. In addition, visual disturbance associated with construction activity will often create a disturbance effect before any associated noise starts to have an effect (~~Ref 1-146~~Ref 1-152).

4.10.8. Birds generally appear to habituate to continuous noise as long as there is no large amplitude 'startling' component (~~Ref 1-156~~Ref 1-162). With specific respect to piling, it has been concluded that although piling has the potential to create the loudest noise during construction; it often consists of rhythmic "bangs", which birds might become accustomed to depending on the distance that birds are away from the piling (~~Ref 1-157~~Ref 1-163). For example, observations as part of the construction work for ABB Power Generation Ltd (Pyewipe) suggested that it was the initial sudden strikes during piling activities, which caused some localised disturbance, and that subsequent bangs typically resulted in reduced disturbance, demonstrating habituation (~~Ref 1-143~~Ref 1-149).

Table 25: Summary of noise and piling disturbance studies

Study	Summary
IECS, 2009a;~~Ref 1-148~~Ref 1-154 IECS, 2009b ~~Ref 1-150~~Ref 1-156	A study of coastal construction noise effects on the Humber Estuary was undertaken based around the measurement of noise levels while simultaneously monitoring the behavioural response by birds during flood defence works at Saltend. The defence works involved the use of a double hydraulic pile on site. The study noted a moderate to high behavioural response to irregular piling noise above 70 dB and a moderate response to regular piling noise below 70 dB. A flight response was noted to occur during works generating noise at between 80-85 dB. Behavioural responses, notably the down-shore movements of wildfowl were noted above 70 dB. Noise levels between 55 dB and 84 dB were generally accepted by birds. Other impacts associated with construction included a high response to personnel and plant equipment on the mudflat and a moderate to high response to personnel and plant equipment on the seaward toe and crest. Occasional movement of a crane jib and load resulted in a low to moderate response. Noises below 50 dB, long-term plant activities only on the crest and activity behind the flood bank elicited a low response.
Xodus, 2012 ~~Ref 1-155~~Ref 1-161	Monitoring of birds as part of the Grimsby River Terminal Project found that noise from construction (including piling) caused only 1% of the disturbance events observed, with large disturbances mainly caused by the presence of raptors, aircraft and helicopters. The study concluded that percussive piling noise less than 66 dB LAmax F gave rise to no disturbance, whilst a mild behavioural response (such as heads up alert, short walk or swimming) was observed to occur in the range of 73 to 81 dB LAmax F. Percussive piling noise over 83 dB LAmax F was considered likely to evoke a flight response.
Wright et al., 2013 Ref 1-14z	The experimental study intentionally disturbed birds at a high tide roost site, on the south bank of the Humber estuary using an impulsive sound similar to that associated with noise from port and power generation construction such as percussive piling and recorded the behavioural responses. Lapwing appeared to be the species most sensitive to intentional disturbance, while Curlew was the most tolerant. The study recommended that impulsive noise limits should be restricted to < 69.9 dB at the site.
ABPmer, 2002 ~~Ref 1-147~~ Ref 1-153	Disturbance monitoring of waterbirds in the vicinity of construction works (piling and dredging) at the ABP Teignmouth Quay Development concluded that sudden noise in the region of 80 dB appears to elicit a flight response in waders up to 250m from the source, with levels of approximately 70 dB causing flight or anxiety behaviour in some species.
Institute of Estuarine and Coastal Studies 2009a (Ref 1-154).	Disturbance monitoring along a 1.5km stretch of coastline near Pyewipe, Grimsby of piling works centred on the South Humber Bank Power Station found that birds appeared indifferent to the noise of piling from the landward side of the seawall, and the numbers and distribution of birds on the mudflat at low tides was similar during periods of piling and periods with no piling. Piling on the seaward side of the seawall only resulted in minor disturbance to birds immediately adjacent to the seawall, but feeding flocks appeared tolerant of piling noise at a distance of approximately 200 m (Ref 1-154).
Scott Wilson. (2009).Ref 1-155	Ornithological monitoring at Hartlepool found that birds feeding on mudflats at low tide were largely unaffected by marine piling activity to construct a new quay wall circa 200 m from the nearest mudflat, with only one significant disturbance event (causing a flock of gulls to leave the sector and not return) during the two month winter monitoring period (Ref 1-155). All marine piling at the Hartlepool site

Study	Summary
	employed a 'soft-start' procedure, where noise levels are gradually increased to minimise the impact of a sudden sharp increase in noise.
ABPmer. (2013). Ref 1-150	Bird monitoring as part of the marine licensing consent for a quay wall construction development at the Port of Southampton evaluated the disturbance effects of percussive piling on waterbird species using the mudflat habitat on Bury Marsh opposite the Port of Southampton (approximately 100 to 200 m away) during the overwinter period. No bird disturbance behaviour (such as startling, rapid flight or abruptly stopping foraging) was observed during monitoring periods of percussive piling activity. However, disturbance to waterbirds was observed on several occasions due to vessels and kayaks within 50 m of Bury Marsh (Ref 1-150).

Species sensitivity and responses

4.10.9. The level of response to potential disturbance stimuli also varies considerably between species with some ducks (such as Shelduck) and larger waders such as Curlew and godwits generally showing stronger responses to disturbance stimuli than smaller waders (such as Turnstone and Dunlin) (~~Ref 1-152; Ref 1-154;~~ Ref 1-158; ~~Ref 1-146; Ref 1-153~~Ref 1-160; Ref 1-164; Ref 1-152; Ref 1-159; Ref 1-165)). A detailed review of the responses and sensitivity of key waterbird species to noise and visual disturbance is presented in **Table 26**. This includes data on FID which is the distance at which a bird takes flight in response to a perceived danger and is used to help better understand the relative sensitivity of different species to disturbance.

4.10.10. The response to disturbance is also dependant on the previous experience of the birds to disturbance (i.e., level of habituation) as well as a range of other factors such as environmental conditions, their state at the time of the disturbance (e.g., hungry or satiated) and the quality of their alternative foraging sites (~~Ref 1-160; Ref 1-148 Ref 1-152~~Ref 1-166; Ref 1-154 Ref 1-158).

4.10.11. It is also important to understand potential behavioural responses of disturbance in the context of energetic costs, mortality and population consequences as some disturbance has been shown to have limited adverse effects on waterbirds. For example, Goss-Custard *et al*. (~~Ref 1-134~~Ref 1-140) used an individual-based behavioural model to establish critical thresholds for the frequency with which wading birds can be disturbed before they die of starvation. The model was concluded that the energetic costs of individual disturbance events were low relative to daily requirements and unlikely to be frequent enough to seriously limit foraging time.

Table 26: Summary of evidence of the sensitivity for different key species to noise and visual d

Species	Sensitivity to noise and visual disturbance Evidence on the sensitivity to disturbance stimuli
Shelduck	Shelduck are generally a wary species and are considered particularly sensitive to visual disturbance. Ty approach construction works no closer than 300m and can be affected by visual disturbance up to 500m (~~Ref 1-146~~Ref 1-152). Noise disturbance has been reported from 72 dB upwards for Shelduck. However, the species is subject habituation and further exposure to sounds of the same or greater level can lead to no response to stimu been recorded for noise levels as high as 88 dB but this is likely to be an extreme 'no response' level and exercised at receptor levels over 70 dB. Observation of disturbance responses from flood protection work that Shelduck react to noise in approximately 30% of exposure events to sudden noise above 60 dB or a dB (~~Ref 1-146~~Ref 1-152). Goodship and Furness ~~Ref 1-154~~Ref 1-160) assessed Shelduck as having a high sensitivity to human di range in mean FID from the literature reviewed of 36m to 250m as a result of the presence of people on foreshore although FIDs up to 700m have been recorded. Goodship and Furness (~~Ref 1-153~~Ref 1-159) undertook a disturbance literature review and assessed Sh species considered most sensitive to disturbance stimuli with the range in mean FID from the literature re 250m as a result of the presence of people on or near the foreshore.
Curlew	Research evidence indicates that Curlew are a cautious species that does not habituate to works rapidly particularly intolerant of people, allowing approach to a range of typically 120-300m before flushing (i.e. a (~~Ref 1-146; Ref 1-161~~Ref 1-152; Ref 1-167). Goodship and Furness ~~Ref 1-154~~Ref 1-160) assessed Curlew as having a high sensitivity to human distu the range in mean FID from the literature reviewed of 38m to 340m as a result of the presence of people foreshore with motorised vessels having a mean FID of 140m and motorised vehicles 188m. Collop et al., (~~Ref 1-152~~Ref 1-158) recorded a minimum FID of 88m and a maximum FID of 570m (with a this species through experimentally disturbing foraging birds (approaching a total of 39 times) as part of a Goodship and Furness (~~Ref 1-153~~Ref 1-159) undertook a disturbance literature review and assessed Cu

Species	Sensitivity to noise and visual disturbance Evidence on the sensitivity to disturbance stimuli
	species considered most sensitive to disturbance stimuli with the range in mean FID from the literature re 340m as a result of the presence of people on or near the foreshore with motorised vessels having a mea
Black-tailed Godwit	Disturbance responses have been recorded at distances over 100m from construction activity (~~Ref 1-146~~ Goodship and Furness (~~Ref 1-154~~Ref 1-160) found evidence of FIDs between 20 and 150m as a result o people on or near the foreshore from the literature reviewed in the study. This study also considered this relatively high tolerance towards human disturbance and appear to be able to habituate to human activiti concluded that a buffer zone of 100-200m was considered appropriate with respect to disturbance in the season. Burton *et al*. (~~Ref 1-162~~Ref 1-168 also considered overwintering Black-tailed Godwit to be one o species to potential disturbance with a 20m zone recommended to avoid disturbance to this species (and Gill *et al.* (~~Ref 1-163~~Ref 1-169) found no evidence that human presence reduced the number of Black-tai authors finding that the presence of infrastructure (as such as marinas/small ports or footpaths) did not i godwits supported by the food supply on the adjacent mudflats. This study compared marinas/ports agai that contained similar sediment type and fauna but was far enough away (> 200m) to be considered una activity at a marina. A study investigating human disturbance on Black-tailed Godwit, Curlew and Teal in found that out of the three species, Black-tailed Godwits were the least affected by disturbance events a move <50m from their original position when a disturbance event occurred (~~Ref 1-164~~Ref 1-170).Specific Estuary, Percival (~~Ref 1-165~~Ref 1-171) found that Black-tailed godwits in the Humber Estuary appear to relatively high disturbance environment. Black-tailed Godwits roost at high tide on the North Killingholme are located in an area adjacent to port infrastructure. There was no evidence found in this study that indu reduced the ability of the pits to support the godwit population.
Oystercatcher	Oystercatchers are relatively tolerant of disturbance stimuli and will habituate rapidly to ongoing activity. I they will often flush at great ranges but in more disturbed locations such as a typical estuary, this figure r between approximately 25 - 200m dependent upon the stimuli (with people causing the most extreme rea ~~1-146~~Ref 1-152). Collop *et al*., (~~Ref 1-152~~Ref 1-158) recorded a minimum FID of 30m and a maximum FID of 228m (with a this species through experimentally disturbing foraging birds (approaching a total of 147 times) as part of Goodship and Furness (~~Ref 1-153~~Ref 1-159) and Goodship and Furness (~~Ref 1-154~~Ref 1-160) undertoo literature reviews and assessed Oystercatcher as being of moderate sensitivity to disturbance stimuli wit FID from the literature reviewed of 26m to 136m as a result of the presence of people on or near the fore

Species	Sensitivity to noise and visual disturbance	
	Evidence on the sensitivity to disturbance stimuli	Sensitivity level[1]
	motorised vessels having a mean FID of 74m and motorised vehicles a mean FID of 106m.	
Teal	Bregnballe *et al.*, ~~Ref 1-166~~Ref 1-172 found most disturbance responses to this species were within 150m with limited responses at greater distances. Mayer *et al.,* (~~Ref 1-167~~Ref 1-173) recorded a mean FID of 169 m during an experimental disturbance study.	Moderate
Redshank	Redshank are considered a relatively tolerant species to visual stimuli (and will often approach much closer than 100m before flushing (sometimes as close as 30-50m)) but can be sensitive to noise stimuli, They are also considered to habituate to works rapidly (~~Ref 1-146~~Ref 1-152). Collop et al., (~~Ref 1-152~~Ref 1-158) recorded a minimum FID of 28 m and a maximum FID of 187 m (with a mean of 80m) for this species through experimentally disturbing foraging birds (approaching a total of 53 times) as part of a research study. Goodship and Furness (~~Ref 1-154~~Ref 1-160) assessed Redshank as having a moderate sensitivity to human disturbance with the range in mean FID from the literature reviewed of 4 to 150m as a result of the presence of people on or near the foreshore. Goodship and Furness (~~Ref 1-153~~Ref 1-159) undertook a disturbance literature review and assessed Redshank as being relatively sensitive to disturbance stimuli with the range in mean FID from the literature reviewed of 24m to 137m as a result of the presence of people on or near the foreshore.	Low to moderate
Dunlin	Dunlin appear to be a species tolerant to visual stimuli and are considered to habituate to people with most responses occurring in <75 - 100m of visual stimuli. Dunlin have been recorded foraging extremely closely to plant (<50m) and >75m from worker. When foraging, they can be initially disturbed by activity start-up, with a flight response, but will then forage back towards construction works, approaching to within 25m on occasion, before sometimes flushing and moving away again, to repeat the process (~~Ref 1-146~~Ref 1-152). Collop et al., (~~Ref 1-152~~Ref 1-158) recorded a minimum FID of 9 m and a maximum FID of 194m (with a mean of 44m) for this species through experimentally disturbing foraging birds (approaching a total of 117 times) as part of a research study (~~Ref 1-146~~Ref 1-152). Goodship and Furness (~~Ref 1-153~~Ref 1-159) and Goodship and Furness (~~Ref 1-154~~Ref 1-160 undertook disturbance literature reviews with the evidence reviewed suggesting that Dunlin is less sensitive to disturbance than many other waders with the range in mean FID from the literature reviewed of 39m to 163m as a result of the presence of people on or near the	Low

Species	Sensitivity to noise and visual disturbance Evidence on the sensitivity to disturbance stimuli
	foreshore.
Turnstone	Turnstone are considered not very sensitive to noise stimuli and habituate rapidly, especially in conjunctio stimuli. They are tolerant of people/workers and plant, allowing approach as close as 30-50m before flush observation of disturbance effects from works found Turnstone responses to be consistent with the expe with birds allowing approach to works to within 10m before reacting. This was in a highly disturbed area w of the foreshore and of 127 potential disturbance events observed, only 19 caused reaction of which only by the works with trucks flushing Turnstones at between 15 - 100m. Walkers (and dog walkers in particul greatest reactions. There was no evidence of reactions to noise, which reached levels above 90 dB due t ~~1-146~~Ref 1-152). Collop et al., (~~Ref 1-152~~Ref 1-158) recorded a minimum FID of 5m and a maximum FID of 75m (with a m species through experimentally disturbing foraging birds (approaching a total of 40 times) as part of a res Goodship and Furness (~~Ref 1-153~~Ref 1-159) undertook a disturbance literature review with the evidence Turnstone is less sensitive to disturbance than many other waders with the range in mean FID from the li 12.5m to 39m as a result of the presence of people on or near the foreshore.

1. The assigned sensitivity levels have been based on available evidence with respect to responses to disturbance st sensitivity has been presented where evidence suggests large variations in intraspecific responses due to various (such as the type of activity, site specific factors such as habituation, environmental conditions and site fidelity etc) precautionary sensitivity level has been assigned.

Review summary

4.10.13. Within a construction site, the level of disturbance stimuli is dependent on the type of activity being undertaken. In general, human presence on or near the foreshore (e.g., walking) is considered to cause greater disturbance than vehicles or watercraft and waterbirds are more easily disturbed by irregular movements than the regular and defined presence of machinery, vessels and other vehicles (~~Ref 1-145; Ref 1-144; Ref 1-168; Ref 1-169; Ref 1-170~~Ref 1-151; Ref 1-150; Ref 1-174; Ref 1-175; Ref 1-176). High level responses to noise (such as dispersal away from marine works) are typically associated with sudden or irregular noise over 70-80 dB (at the receiver (i.e., bird) location not the noise source) ~~Ref 1-148; Ref 1-155~~Ref 1-154; Ref 1-161; Ref 1-14; ~~Ref 1-147; Ref 1-146~~Ref 1-153; Ref 1-152).

4.10.14. The specific responses that waterbirds will have to disturbance varies between species as well as between birds of the same species due to a range of factors including the level of habituation and environmental conditions (~~Ref 1-160; Ref 1-148; Ref 1-152~~Ref 1-166; Ref 1-154; Ref 1-158).

4.10.15. Distances over 300 m have been recorded more occasionally for some sensitive species such as Curlew or Shelduck (~~Ref 1-146;~~ Ref 1-152; ~~Ref 1-153; Ref 1-154~~Ref 1-158; Ref 1-159; Ref 1-160). However, evidence from the detailed review above suggests that waterbirds generally show a flight response to anthropogenic activities such as construction and a presence of people (such as workers) on or near the foreshore at distances of typically less than 200m (and more typically between 20m and 100m for certain species such as Turnstone or Dunlin) in areas where birds are likely to be habituated to some extent to disturbance due to existing human activity (Ref 1-153; Ref 1-147~~; Ref 1-141; Ref 1-148; Ref 1-149; Ref 1-150; Ref 1-136; Ref 1-146; Ref 1-151~~; Ref 1-154; Ref 1-155; Ref 1-156; Ref 1-142; Ref 1-152; ~~Ref 1-153; Ref 1-144~~Ref 1-157; Ref 1-160; Ref 1-158; Ref 1-159; Ref 1-150).

Summary of effects (without mitigation)

4.10.16. The bird data suggest that the foreshore fronting the Project (i.e. the section of Sector C between the IOT Jetty and the mudflat fronting North Beck drain within approximately 400-500m of the Project) is regularly used by a variety of feeding and roosting waterbirds as summarised in **Section 1.4 and Table A8 of Appendix A)**. In an estuary wide context, numbers of most species recorded in this area were generally low. Natural England advised that birds exceeding 1% of the estuary-wide WeBS five year mean peak is viewed as significant numbers. When compared to estuary-wide numbers, feeding Black-tailed Godwit during the winter and Turnstone (both feeding and roosting) represent up to 2% and 10% respectively of the estuary-wide WeBS five year mean peak (2017/18 to 2020/21). Counts of other species represent <1 of the estuary-wide WeBS five year mean peak. During passage and summer months, only Turnstone was present in numbers exceeding 1% of estuary wide numbers.

4.10.17. Noise stimuli caused by the vibro and percussive marine piling activity and the presence of jack-up or crane barges (causing both potential noise and visual disturbance stimuli) as well as other construction machinery, construction workers and plant activity are all potential sources of disturbance associated with construction of the approach jetty.

4.10.18. The evidence reviewed above suggests that the response of waterbirds to disturbance stimuli is typically limited at distances over 200m (i.e. when birds are more than 200m away from disturbance stimuli) particularly in areas subject to already high levels of existing anthropogenic activity (as found in the Port of Immingham area). This detailed review has considered an extensive amount of research and reviews on FID – the distance at which a bird takes flight in response to disturbance stimuli – as well as studies that have investigated the distance that birds respond to construction activity including piling (or other analogous activities undertaken on the foreshore such as the construction of flood defence works). The use of a 200m buffer zone has been considered appropriate when considering disturbance effects for a number of assessments and research studies (such as Burton *et al.,* ~~Ref 1-162~~Ref 1-168 for waterbirds generally including sensitive species such as Shelduck and also Gill *et al.,* ~~Ref 1-163~~Ref 1-169 and Goodship and Furness (~~Ref 1-154~~Ref 1-160) with specific respect to Black-tailed Godwit). Specifically for the Humber Estuary, Ross and Liley (~~Ref 1-151~~Ref 1-157) stated that based on previous studies, a distance of 200m '*represents a distance well beyond the distance at which birds are likely to respond'*. This was considered applicable to both tolerant and sensitive species including Shelduck. The study also concluded that the probability of birds being flushed declined with distance (i.e. how far away the activity was from the bird), such that the probability of birds being flushed when activities are beyond 100m away is very low. The study was focused on recreational activity but also recorded disturbance associated with other activities including industry. As stated in in the review above, recreational disturbance (such as dog walking) is considered to cause greater or similar responses to that of port related disturbance.

4.10.19. The conclusions reached are supported by site specific evidence ~~which suggests that birds continue to feed in the Port of Immingham area within 200m of relatively noisy port activity and visual stimuli without being displaced~~ and direct observations of construction type activity occurring within the Immingham area. Recent (January to March 2023) disturbance monitoring of the IERRT Ground Investigation ("GI") works confirm that disturbance responses of waterbirds at distances of more than 200m are limited, specifically for waterbirds on the Immingham foreshore. Bird numbers and distribution on the local foreshore were also broadly comparable to what has been recorded in ongoing waterbird surveys in this area over the last five years. These birds appear to be tolerant of disturbance stimuli. A jack-up barge was used during the GI works which will also be used for the Project during construction; therefore, the construction plant will be similar in terms of visual presence. The suitability of a 200 m buffer has also been confirmed by the ornithologists who have undertaken the survey work in the Port of Immingham area which was used to inform the assessment. Their observations suggest that disturbance responses to human activity (including workers/plant on or near the foreshore, vehicles, vessels or port related noise) rarely occur when the source of disturbance is greater than 200 m from waterbirds. This includes species known to be more sensitive to disturbance such as Shelduck and Curlew. These findings are also consistent with data and observations by ABPmer ornithologists within other port environments including Southampton where waterbirds are regularly recorded within 200 m of human activity and continue feeding without eliciting any disturbance response (either dispersive or sub-dispersive) with disturbance responses typically occurring at distances of <100 m of stimuli including species considered more sensitive to disturbance such as Shelduck and Curlew.

4.10.20. With specific respect to noise stimuli, Natural England provided advice as part of the consultation for the proposed IERRT project which stated that '*peak levels below 55 dBA can be regarded as not significant, while peak noise levels approaching 70 dBA and greater are most likely to cause an adverse effect.' Therefore, levels over 65.5 dBA may cause disturbance to SPA birds. Birds may habituate to regular noise below 70 dBA, but irregular above 50 dBA should be avoided*'. It is also worth noting that visual disturbance associated with anthropogenic activity will in some situations create a disturbance effect before any associated noise starts to have an effect particularly in those species sensitive to visual stimuli (McLeod *et al.,* 2013; Smit and Visser, 1993; IECS, 2013).

4.10.21. On this basis the assessment has been based on consideration of a 200m potential disturbance zone and noise level guidance provided by Natural England described above.

4.10.22. The assessment focuses on potential disturbance to waterbirds on or near the foreshore due to approach jetty construction. It should be noted that construction of the Jetty Platform will occur at distances of more than 1km from the foreshore. In addition, capital dredging of the berths will also be undertaken at distances of more than 1km from the foreshore. On this basis, responses are considered unlikely even in more sensitive species on the foreshore and these elements of construction are not assessed further.

4.10.23. Ambient noise levels collected for the Applicant's separate 'IERRT' project (on the port land to the east and north of the Site Boundary) on the foreshore around the Port of Immingham have been used in this assessment. Unattended noise measurements over five days in July 2022 suggest a range of ambient noise levels between 42 to 58 dB LAeq, one hr and the existing range of Lmax noise levels is 48 to 84 dB Lmax. During percussive marine piling associated with the proposed development, noise levels above 70 dB *L*max are predicted within approximately 645m of the marine piling rigs and over 80 dB *L*max within approximately 205m in the absence of noise reducing controls (**Figures 10.5 of the ES [TR030008/APP/6.3**]).

4.10.24. In addition, in order to better understand potential zones of disturbance, **Figure 10.6 of the ES [TR030008/APP/6.3]** presents a 200m buffer zone. The figures also show MLWS and MLWN so that the extent of foreshore within and outside of these buffers under different tidal states can be better understood.

4.10.25. Waterbirds present in the area will be habituated to some extent to anthropogenic activities (due to existing port operations) near the foreshore such as vessel and vehicle movements, port related noise and human activity.

Nevertheless, avoidance responses or dispersive disturbance events (resulting in the redistribution of waterbird flocks to nearby areas) may occur during approach jetty construction on or near to the foreshore for any flocks present in this area.

4.10.26. Responses would be expected to be greatest for species considered more sensitive to bird disturbance such as Black-tailed Godwit, Redshank, Curlew and Shelduck (~~Table 26~~**Table 26**). Less sensitive species such as Dunlin~~,~~ and Turnstone ~~and gulls~~ would be expected to be disturbed to a lesser degree and feed closer to construction activity. It is known that sub-dispersive disturbance response (such as increased vigilance and corresponding reduced feeding rates or time spent roosting) can increase the stress response in birds in some situations. However, in areas such as Immingham where birds are relatively habituated to human activity, waterbirds perceive less risk associated with potential noise and visual disturbance stimuli so responses where birds stop feeding and increased stress levels are likely to be low compared to if new sources of human activity are introduced into more remote areas of coast (where birds are less habituated). It is also worth noting that sub-dispersive responses (such as increased alertness) typically have less energetic consequences per disturbance event than dispersive response (such as where birds stop feeding and take flight to another location). However, research also suggests that even when frequent dispersive flight response occur, energetic consequences and effects on overall foraging time can be limited (paragraph 4.10.12). Furthermore, there is no evidence to suggest that key SPA species occurring in the area such as Black-tailed Godwit or Turnstone are in poor condition with local Humber Estuary populations either increasing (Black-tailed Godwit) or remaining relatively stable (Turnstone), despite ongoing pressure from recreational disturbance and wildfowling along the South Bank of the Humber Estuary (Ref 1-177; Ref 1-178).

4.10.27. ~~It~~Should flight responses occur, it is not anticipated, however, that birds will be displaced from the local area completely, in that the birds would be expected to redistribute to nearby foreshore in the Immingham/Grimsby area and continue to feed and roost in these alternative locations following dispersal with the zone of potential disturbance very small in the context of the Humber Estuary SPA/Ramsar. The 200 buffer, for example only represents 0.023% of the SPA/Ramsar and 0.10% of intertidal foreshore habitats and specifically 0.14% of mudflat within the SPA. In addition, while energetic costs might be increased slightly due to disturbance, the research reviewed above suggests that the energetic costs of individual disturbance events would be expected to be relatively low and even relatively frequent disturbance could potentially only cause a small reduction in the time available in a day for feeding. In addition, birds are known to forage nocturnally and might potentially change foraging patterns to utilise the area during nocturnal periods when limited construction activity is occurring.

4.10.28. For all the construction activities, it is also recognised that during cold periods, coastal waterbirds are more susceptible to disturbance due to higher energetic costs and greater feeding requirements for thermoregulation. Furthermore, very cold winter weather can cause mudflats and adjacent functionally linked terrestrial habitats used for feeding (such as agricultural land and wet grassland) to freeze. In addition, cold conditions can cause an influx of waterbirds from continental Europe which have flown to Britain to escape from even colder conditions. This can further increase competition for feeding resources in an area. The increased difficulty obtaining enough food and greater energy required for thermoregulation can in some situations cause reduced survival rates and appear to make birds seem more tolerant to disturbance as birds avoid using excess energy reserves (~~Ref 1-134; Ref 1-171, Ref 1-172; Ref 1-152; Ref 1-159~~Ref 1-140; Ref 1-179, Ref 1-180; Ref 1-158; Ref 1-165).

4.10.29. In summary, the probability of noise and visual disturbance stimuli occurring during construction is likely to be high. As described above, disturbance at a level which could cause dispersive responses and relatively localised displacement of coastal waterbirds is likely with respect to construction activity associated with approach jetty. However, the foreshore in the vicinity of the approach jetty is used by generally relatively low numbers of waterbirds. Nevertheless, the potential for an AEOI cannot be ruled out, particularly for Black-tailed Godwit. On this basis mitigation has been included.

Mitigation

4.10.30. In order to reduce the level of impact associated with noise and visual disturbance during construction a number of mitigation measures will be implemented ~~which~~. The effectiveness of these measures is described in more detail in **Appendix E** and specifically with respect to minimising the potential for AEOI on qualifying features in **Table 27**. These measures will be secured through a condition on the deemed marine licence and include the following:

a. **Winter ~~marine~~ construction restriction from 1 October to 31 March (approach jetty, sea wall and landside jetty ramp):** In order to minimise potential disturbance effects on wintering populations of coastal waterbirds on the foreshore it is proposed that marine construction activity associated with the approach jetty can only be undertaken at distances greater than 200m of exposed intertidal foreshore during the period 1 October to 31 March inclusive. This restriction applies until an acoustic barrier/visual screen has been installed on both sides of the semi-completed structure jetty structure. Construction activity can then be undertaken on the approach jetty itself, behind the screens. The barrier/visual screen will only be required for the period 1 October to 31 March and for sections of the approach jetty within 200m of exposed intertidal foreshore. With the addition of acoustic barriers, noise levels on the intertidal mudflat will be less than 70 dB(A) which is within the range of existing background noise levels of operational port activities in the Port of Immingham area. No construction activity associated with the sea wall and landside jetty ramp (including piling) will also be undertaken between the 1 October and 31 March);

b. **Noise suppression system (approach jetty):** It is proposed that a noise suppression system (consisting of a piling sleeve with noise insulating properties) is used during all percussive piling activities associated with the approach jetty (during all periods of the year) to reduce noise levels on nearby foreshore areas. The noise suppression system is predicted to reduce noise levels to <70 dB Lmax at distances greater than approximately 200m from the marine piling and also in the range of existing background noise levels of operational port activities in the Port of Immingham area~~.~~;

c. **Soft starts:** Using soft starts (as outlined in the marine mammal and fish section above) will allow birds to become more tolerant to marine piling noise by allowing a more gradual increase in noise levels which will reduce the potential for birds to become startled. This will be applied to all marine piling activity ~~including the outer finger pier~~; and

d. **Cold weather construction restriction**: Coastal waterbirds are considered particularly vulnerable to bird disturbance during periods of extreme winter weather[~~18~~25]. On this basis, it is proposed that a temporary cessation of all construction activity within 200m of exposed intertidal foreshore is implemented following seven consecutive days of freezing (zero or sub-zero temperature) weather conditions. The restriction will not be lifted until after 24 hours of above freezing temperatures and also that Metrological Office weather forecasts indicate that freezing conditions will not return for the next five days. Similar measures have been implemented for other nearby developments and also as part of the Joint Nature Conservation Committee ("JNCC") scheme to reduce disturbance to waterfowl due to shooting activity during severe winter weather.

Assessment of the potential for an AEOI

4.10.31. The potential disturbance effects on qualifying species of coastal waterbird during construction and the effectiveness of the proposed mitigation measures is outlined above and in **Table 27.** On the basis of this evidence the predicted residual effects are not considered to compromise any of the conservation objectives, and as a consequence, this pathway will not result in an AEOI on the qualifying interest features as the mitigation will minimise exposure to potential disturbance during the overwintering period.

~~18~~25 It is recognised that during cold periods, coastal waterbirds are more susceptible to disturbance due to higher energetic costs and greater feeding requirements for thermoregulation. Furthermore, very cold winter weather can cause mudflats and adjacent functionally linked terrestrial habitats used for feeding (such as agricultural land and wet grassland) to freeze. In addition, cold conditions can also cause an influx of waterbirds from continental Europe which have flown to Britain to escape from even colder conditions in these areas. This can further increase competition for feeding resources in an area. The increased difficulty obtaining enough food and greater energy required for thermoregulation can in some situations cause reduced survival rates and appear to make birds seem more tolerant to disturbance as birds avoid using excess energy reserves (~~Ref 1-134; Ref 1-171, Ref 1-172; Ref 1-152; Ref 1-159~~Ref 1-140; Ref 1-179, Ref 1-180; Ref 1-158; Ref 1-165).

Table 27: The Potential for an AEOI on qualifying species due to potential airborne noise and visual disturbance during construction

Site	Features	Potential AEOI	Justification
Humber Estuary SPA	A048; Common Shelduck (Non-breeding) *Tadorna tadorna*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	Shelduck are known to be sensitive to anthropogenic disturbance. However, only very low numbers (< 10-20 individuals, representing <1% of the estuary wide population numbers as described in ~~Table 2~~**Table 2**) have been recorded on (or very close to [26]) the foreshore in the vicinity of the Project (i.e. within 400-500m). This is below the 1 % threshold used by Natural England to determine potentially significant numbers. Given the very low numbers of this species present feeding and roosting during the winter and outside the wintering period, potential effects on this species even without the proposed mitigation are considered to be limited in the context of local population numbers. Without mitigation, evidence suggests that regular disturbance and avoidance responses (i.e., temporary displacement) within a zone of approximately 200m around construction activities is considered possible for the very low numbers of Shelduck likely to be present in this area. Any responses at greater distances would be expected to only occur infrequently. However, with the application of the proposed mitigation measures, disturbance responses are expected to be very limited, both in terms of frequency and the spatial extent of effects. The winter marine construction restriction from 1 October to 31 March will minimise disturbance during the colder winter months when waterbirds are considered vulnerable to the effects of disturbance. This proposed mitigation restricts all construction activity including marine piling within a 200m zone of exposed foreshore. The noise suppression system will be used for piling undertaken outside of the 200m restriction zone. The noise

[26] This species is typically recorded on the foreshore. Very low numbers (consisting of a few individuals) are also occasionally recorded floating on the water near the foreshore (< 50 m). These birds are loafing rather than feeding. This species is rarely recorded further offshore in this area.

Site	Features	Potential AEOI	Justification
			suppression system is predicted to reduce noise levels to <70 dB LAmax at distances greater than approximately 200m from the marine piling which will be in the range of existing background noise levels of operational port activities. These mitigation measures are considered effective at preventing ~~waterbirds utilising mudflat habitat~~the very low numbers of Shelduck likely to be present in this area from being exposed to close range visual stimuli and loud noise above typical port background levels (which are the types of stimuli which evidence suggests are most likely to cause regular, repeated disturbance and larger responses such as dispersive flights out of the local area). Instead, birds would be expected to be able to continue to feed on mudflat in the footprint of the Project during the winter months with only very limited responses anticipated (involving infrequent and mild responses i.e. at worst, very localised flight responses with birds resuming feeding quickly in local area). On this basis, any changes to the distribution of ~~birds~~the very low numbers of Shelduck likely to be present in this area on the foreshore is expected to be negligible and temporary with the proposed mitigation and the 'distribution of the qualifying features within the site' conservation objective is not considered to be compromised. The predicted disturbance responses are not expected to cause any changes to 'the population of each of the qualifying features' conservation objective. This is because any disturbance or displacement during construction, with the proposed mitigation, is expected to be limited (with ~~waterbirds~~the very low numbers of Shelduck likely to be present able to continue feed in the same areas during winter as observed prior to construction). Therefore, the predicted residual effects with the proposed mitigation in place are considered inconsequential with respect to impacts to individual energy budgets (i.e. increased energetic costs through disturbance and changes to available feeding resources or prey intake will all be negligible). On this basis, population level consequences (at both a local and fly way level) in terms of mortality or changes in breeding success will not occur.

Site	Features	Potential AEOI	Justification
	A149: Dunlin *Calidris alpina alpina* (Non-breeding)	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	Low numbers in the context of estuary wide populations (i.e. < 100 individuals, representing < 1% of the estuary wide numbers as described in ~~Table 2~~**Table 2**) have been recorded on the foreshore in the vicinity of the Project (i.e. within 400-500m). This is below the 1 % threshold used by Natural England to determine potentially significant numbers. Given the very low numbers of this species present feeding and roosting during the winter and outside the wintering period, potential effects on this species even without the proposed mitigation are considered to be limited in the context of local population numbers. This species is also known to be relatively tolerant to anthropogenic disturbance. Evidence suggests this species has been observed in relatively close proximity to potential disturbance stimuli before responses are recorded (often within 50-100m or less of a disturbance sources). Nevertheless, any birds present could be susceptible to potential distance and displacement at these distances without mitigation. However, with the application of the proposed mitigation measures, disturbance responses in the low numbers of Dunlin likely to be present in this area are expected to be very limited, both in terms of frequency and the spatial extent of effects. The winter marine construction restriction from 1 October to 31 March will minimise disturbance during the colder winter months when waterbirds are considered vulnerable to the effects of disturbance. This proposed mitigation restricts all construction activity including marine piling within a 200m zone of exposed foreshore. The noise suppression system will be used for piling undertaken outside of the 200 m restriction zone. The noise suppression system is predicted to reduce noise levels to <70 dB LAmax at distances greater than approximately 200 m from the marine piling which will be in the range of existing background noise levels of operational port activities. These mitigation measures are considered effective at preventing ~~waterbirds utilising mudflat habitat~~the low numbers of Dunlin likely to be present in this area ~~from~~ being exposed to close range visual stimuli and loud noise above typical port background levels (which are the types of stimuli which evidence suggests are most likely to cause regular, repeated

Site	Features	Potential AEOI	Justification
			disturbance and larger responses area). Instead, birds would be exp mudflat in the footprint of the Proje limited responses anticipated (invo at worst, very localised flight respo in local area). On this basis, any c numbers of Dunlin likely to be pres expected to be negligible and temp the '*distribution of the qualifying fe* objective is not considered to be c The predicted disturbance respons changes to '*the population of each* objective. This is because any dist construction, with the proposed mi ~~waterbirds~~the low numbers of Dun feed in the same areas during win Therefore, the predicted residual e place are considered inconsequen energy budgets (i.e. increased ene changes to available feeding resou On this basis, population level con level) in terms of mortality or chang
	A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding)	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	Relatively low numbers in the cont individuals, representing up to 2% described in ~~Table 2~~**Table 2**) have vicinity of the Project (i.e. within 40 However, Natural England advised estuary-wide WeBS five year mea This species has the potential to b Without mitigation, evidence sugg avoidance responses (i.e., tempor approximately 200m around const

Site	Features	Potential AEOI	Justification
			for the relatively low wintering num present in this area. Any response to only occur infrequently. Howeve mitigation measures, disturbance r limited, both in terms of frequency winter marine construction restricti minimise disturbance during the co considered vulnerable to the effect mitigation restricts all construction 200m zone of exposed foreshore. used for piling undertaken outside suppression system is predicted to distances greater than approximat be in the range of existing backgro activities. These mitigation measures are co ~~waterbirds utilising mudflat habitat~~ Black-tailed Godwit likely to be pre close range visual stimuli and loud levels (which are the types of stimu likely to cause regular, repeated di dispersive flights out of the local ar be able to continue to feed on mud the winter months with only very lin infrequent and mild responses i.e. with birds resuming feeding quickly changes to the distribution of ~~birds~~ Godwit likely to be present on the f negligible and temporary with the p *of the qualifying features within the* considered to be compromised. The predicted disturbance respons

Site	Features	Potential AEOI	Justification
			changes to '*the population of each* objective. This is because any dist construction, with the proposed mi ~~waterbirds~~the relatively low numbe to be present able to continue feed observed prior to construction). Th with the proposed mitigation in pla respect to impacts to individual ene costs through disturbance and cha prey intake will all be negligible). C consequences (at both a local and changes in breeding success will n
	A162: Common Redshank *Tringa totanus* (Non-breeding)	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	~~Low~~Very low numbers in the conte 10-20 individuals, representing < 1 described in ~~**Table 2**~~**Table 2**) have vicinity of the Project (i.e. within 40 used by Natural England to determ the very low numbers of this speci the winter and outside the winterin even without the proposed mitigati context of local population number This species has the potential to b Without mitigation, evidence sugge avoidance responses (i.e., tempora approximately 200m around constr for the very low numbers of Redsh responses at greater distances wo infrequently. However, with the app measures, disturbance responses terms of frequency and the spatial construction restriction from 1 Octo disturbance during the colder winte

Site	Features	Potential AEOI	Justification
			considered vulnerable to the effect mitigation restricts all construction 200m zone of exposed foreshore. used for piling undertaken outside suppression system is predicted to distances greater than approximat be in the range of existing backgro activities. These mitigation measures are co ~~waterbirds utilising mudflat habitat~~ to be present in this area from bein and loud noise above typical port b stimuli which evidence suggests a disturbance and larger responses area). Instead, birds would be exp mudflat in the footprint of the Proje limited responses anticipated (invo at worst, very localised flight respo in local area). On this basis, any ch low numbers of Redshank likely to is expected to be negligible and te the 'distribution of the qualifying fe objective is not considered to be c The predicted disturbance respons changes to 'the population of each objective. This is because any dist construction, with the proposed mi ~~waterbirds~~the very low numbers of area able to continue feed in the sa prior to construction). Therefore, th proposed mitigation in place are co impacts to individual energy budge

Site	Features	Potential AEOI	Justification
			disturbance and changes to availa all be negligible). On this basis, po local and fly way level) in terms of will not occur.
	Waterbird assemblage	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	As well as the qualifying species a vicinity of the Project also supports ~~with the following bird~~. The rationa ~~regularly recorded As summarised~~ **Appendix B**. On this basis, Turns were the assemblage species scre have been recorded in the followin vicinity of the Project (i.e. within 40 of **Appendix A** of this HRA): • Turnstone: <20-30 birds (r wide WeBS five year mea • Teal: <20-30 birds (repres five year mean peak); • Curlew: <10-20 birds (repr five year mean peak); and • Oystercatcher: <10-20 bir WeBS five year mean pea In summary, Teal, Oystercatcher a the foreshore[27] in low numbers in (and below the 1 % threshold used potentially significant numbers) bu basis that they regularly occur in th

27 Very low numbers of Teal (<20-30 birds (representing <1% of the estuary wide WeBS five year mean peak)) are also o near the foreshore (< 50 m). These birds are loafing rather than feeding. This species is rarely recorded further offshor

Site	Features	Potential AEOI	Justification
			However, given the very low numbers of these species present feeding and roosting during the winter (and outside the wintering period), potential effects even without the proposed mitigation are considered to be limited in the context of local population numbers. With specific respect to Turnstone, this species has been recorded in relatively large numbers (as a proportion of SPA numbers) foraging on and near the seawall in the vicinity of the Project. However, this species is considered particularly tolerant to disturbance with evidence suggesting this species has been observed in very close proximity to potential disturbance stimuli before responses are recorded (often within 30-100m or less of a disturbance sources). However, with the application of the proposed mitigation measures, disturbance responses are expected to be very limited, both in terms of frequency and the spatial extent of effects for all assemblage species. The winter marine construction restriction from 1 October to 31 March will minimise disturbance during the colder winter months when waterbirds are considered vulnerable to the effects of disturbance. This proposed mitigation restricts all construction activity including marine piling within a 200m zone of exposed foreshore. The noise suppression system will be used for piling undertaken outside of the 200m restriction zone. The noise suppression system is predicted to reduce noise levels to <70 dB LAmax at distances greater than approximately 200m from the marine piling which will be in the range of existing background noise levels of operational port activities. These mitigation measures are considered effective at preventing waterbirds utilising mudflat habitat in this area from being exposed to close range visual stimuli and loud noise above typical port background levels (which are the types of stimuli which evidence suggests are most likely to cause regular, repeated disturbance and larger responses such as dispersive flights out of the local area). Instead, birds would be expected to be able to continue to feed on mudflat in the footprint of the Project during the winter months with only very limited responses anticipated (involving infrequent and mild responses i.e. at worst, very localised flight responses

Site	Features	Potential AEOI	Justification
			with birds resuming feeding quickly in local area). On this basis, any changes to the distribution of birds on the foreshore is expected to be negligible and temporary with the proposed mitigation and the 'distribution of the qualifying features within the site' conservation objective is not considered to be compromised. The predicted disturbance responses are not expected to cause any changes to 'the population of each of the qualifying features' conservation objective. This is because any disturbance or displacement during construction, with the proposed mitigation, is expected to be limited (with waterbirds able to continue feed in the same areas during winter as observed prior to construction). Therefore, the predicted residual effects with the proposed mitigation in place are considered inconsequential with respect to impacts to individual energy budgets (i.e. increased energetic costs through disturbance and changes to available feeding resources or prey intake will all be negligible). On this basis, population level consequences (at both a local and fly way level) in terms of mortality or changes in breeding success will not occur.
Humber Estuary Ramsar site	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3)	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	Summary information with respect to assemblage and individual qualifying species has been provided above in the table.
	Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed		

Site	Features	Potential AEOI	Justification
	Godwit (overwintering)		

The potential effects of airborne noise and visual disturbance during operation on qualifying species of coastal waterbird within the SPA/Ramsar boundary

General scientific context

4.10.32. Operational ports, wherever located, inevitably present as a potential source of disturbance in the coastal environment. Waterbird monitoring work in the vicinity of port locations (such as the Port of Southampton, Port of Mostyn and Port of Immingham) has generally recorded limited evidence of birds on nearby intertidal habitat being disturbed through regular land side port operations with birds often becoming habituated (such as the movement of vehicles, cranes and cargo containers) (~~Ref 1-144; Ref 1-173~~Ref 1-150; Ref 1-181). For example, Cutts (~~Ref 1-61~~Ref 1-65) reported that most species of waterbird assemblages utilising estuarine habitats adjacent to major infrastructure (such as power stations, jetties, bridges, port facilities etc) appear to be tolerant and will both roost and forage within less than 50 m of the working infrastructure. Waterbirds have also been recorded regularly feeding under large industrial jetties as well as roosting on jetties and harbour walls.

4.10.33. Disturbance events have also been recorded as part of the ongoing IOH monitoring in the Port of Immingham area since winter 2005/06[~~19~~28]. This includes any potential disturbance due to operational activities on various jetties (such as the Immingham Oil Terminal (which includes vehicle activity), Western Jetty, Eastern Jetty and Immingham Bulk Terminal). During the surveys the vast majority of the disturbance observed was caused due to either raptors (such as peregrine and sparrowhawk), recreational activities (angling or dog walking) or maintenance work on the seawall. Disturbance was also recorded on several occasions as a result of construction or maintenance work on several of the jetties. No disturbance, however, was recorded as a result of vessel movements or operational activity at or near the berths or jetties.

4.10.34. In general, human presence on the foreshore (e.g., walking) is considered to cause greater disturbance than vehicles (~~Ref 1-168; Ref 1-169; Ref 1-148~~Ref 1-174; Ref 1-175; Ref 1-154). With specific respect to activity associated with commercial operations and works, observations from monitoring and other cause variation in waterbird response. Literature suggests that large commercial vessels consistently using defined routes (such as ferries or cargo ships) elicit less of a disturbance response than recreational craft which are more unpredictable in terms of speed and course and thus their disturbance potential for birds may be enhanced (~~Ref 1-174; Ref 1-175~~Ref 1-182; Ref 1-183; Ref 1-184; Ref 1-176~~; Ref 1-170~~). Monitoring of potential disturbance due to the movements of vessels berthing at pontoons associated with offshore windfarm Operation and Maintenance ("O&M") facilities in several port locations near to mudflats used by waterbirds recorded evidence of some mild and localised disturbance and avoidance although events were generally infrequent with larger disturbance events (causing bird to fly out of the area) only occurring more rarely. Consistent evidence of changes (reductions) in waterbird abundance in the local area which could be linked to the operational activities was not recorded (~~Ref 1-173; Ref 1-177~~Ref 1-181; Ref 1-185).

Summary of effects

4.10.36. Operational disturbance stimuli could occur as a result of vessel movements associated with the Project. However, the nearest berth during spring tide periods will be located approximately 1km from intertidal mudflat used by coastal waterbirds. All SPA features screened into the Shadow HRA (**Table 2**) are shorebirds that occur on or very near intertidal habitats (and also associated functionally linked land) and are therefore considered to be out of the zone of influence of potential disturbance effects associated with berth vessel movements. Diving birds utilising water column habitats could be potentially exposed to disturbance associated with berth vessel movements. However, no SPA assemblage species of diving bird (such as diving ducks) were screened into the Shadow HRA (**Table 2**) on the basis that they are considered to be absent/only occur very rarely the vicinity of the jetty. On this basis, disturbance responses are considered highly unlikely due to vessel movements and berthing operations.

4.10.37. Disturbance could potentially occur as a result of vehicles on the approach jetty near the intertidal. The movement of vehicles will typically be restricted to periods when a vessel is berthed (i.e. 1-2 hours before vessel arrival to 1-2 hours after vessel departure) with typically up to ten return trips per day anticipated. A maximum of approximately 292 vessel callings per annum is expected to occur during operation. The majority of vehicle movements will be utility vehicles involved in transferring operations personnel, mooring line crew and vessel crew.

4.10.38. Vehicle movement will be undertaken at slow speeds (typically <12 miles per hour) and also in a predictable and consistent manner (i.e. producing the same type of visual/noise stimuli each time). Based on the evidence reviewed above, these are all attributes which support habituation and therefore are likely to limit disturbance responses. It should also be noted that many of the existing approach jetties in the Port of Immingham have some vehicular access. The IOT approach jetty in particular has regular vehicle movements with no disturbance associated with this activity recorded during the IOH bird surveys. Furthermore, pipe racks on one side of the approach jetty (which are approximately 3m in height) will likely obscure the visibility that birds on the foreshore have to moving vehicles on the approach jetty and act as screens to some extent.

4.10.39. Regarding engineering and maintenance works in Work No. 1, this activity is expected to be limited and only required occasionally.

4.10.40. The level of response that waterbirds will have to the new berth when operational will be dependent to some extent on the sensitivity they have to anthropogenic disturbance stimuli. For example, species such as Turnstone and Dunlin are typically more tolerant than Shelduck or Curlew as summarised in ~~Table 26~~Table 26. The evidence presented above, however, suggests that birds are typically less affected by defined regular movements of people or vehicles near the shoreline (as occurs in port environments) than by random movements of people on the foreshore. Birds are regularly recorded feeding nearby or below port structures such as jetties or pontoons and appear to be relatively tolerant to normal day-to-day port operational activities.

4.10.41. It is acknowledged, however, that disturbance can occur as result of any human activity irrespective of habituation, if the activity occurs in sufficiently close proximity to a species so as to trigger a responsive reaction. Given that vessel movements will be occurring close to the foreshore on the approach jetty, intermittent disturbance responses are, therefore, still possible. This may particularly be the case at first when birds are likely to be less habituated to the new activity or as a response to a more infrequent sporadic type of activity on a structure with which birds are less familiar (such as maintenance works which are likely to be highly infrequent). Responses for most species are expected typically to involve infrequent, mild behavioural responses in a localised area in the vicinity of the approach jetty. The responses observed in birds are likely to range from increased vigilance to short flights with birds rapidly resettling and resuming feeding near their original location.

4.10.42. Based on the above, the probability of some mild and infrequent disturbance occurring is considered possible which could cause some limited (localised and temporary) displacement of coastal waterbirds around berthing infrastructure. It is expected, however, that birds will become habituated relatively quickly which will limit any longer-term disturbance responses.

Mitigation

4.10.43. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.10.44. The potential disturbance effects on qualifying species of coastal waterbird during operation is expected to be limited (see above and ~~Table 28~~Table 29). On the basis of this evidence the predicted effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table 28: The Potential for an AEOI on qualifying species due to potential airborne noise and visual disturbance during operation

Site	Features	Potential AEOI	Justification
Humber Estuary SPA	A048; Common Shelduck *Tadorna tadorna* (Non-breeding)	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	*Roosting birds on the intertidal* As stated in paragraphs 1.4.28, Figure A7 and Table A.8 of Appendix A of the Shadow HRA, the section of Sector C foreshore between the IOT Jetty and the mudflat fronting North Beck drain (within approximately 400-500 m of the Project) is only known to typically support very low numbers of SPA species roosting. The only species known to roost in this area present in numbers above the 1% threshold (which is used by NE to determine significant numbers and as an indicator of potential for adverse effects on bird species on the Humber Estuary) is Turnstone as summarised in **Table 2.** The main roosting locations for Turnstone are the upper shore boulders and sea defences in Sector C which are regularly used through the tide by individuals or small flocks of Turnstone with flocks recorded in the vicinity of the project (typically < 20 to 30 birds feeding and roosting year-round). Turnstone are considered to be very tolerant to potential disturbance (**Table 26**) and would be expected to continue using these roosting areas during operation. All other SPA wader and wildfowl species including Black-tailed Godwit are only recorded roosting in very low abundances in this area (<10 birds of each species representing <1 % of estuary-wide populations, as shown in Table A.8). These species occasionally roost on upper shore habitat and sea defences. On this basis, no established roosts which are considered important even on a local scale will be impacted as a result of potential disturbance during operation.

Site	Features	Potential AEOI	Justification
			Loafing birds near the intertidal Very low numbers of Teal and Shelduck are occasionally recorded floating on the water near the foreshore (< 50 m) in the vicinity of the project (consisting of a few individual Shelduck and <20-30 birds (representing <1% of the estuary wide WeBS five year mean peak)). These birds are loafing rather than feeding. These species are rarely recorded further offshore in this area. Potential operational effects on the very low numbers present would be anticipated to be negligible. *Feeding birds on the intertidal* The bird data suggests that the foreshore fronting the Project (i.e. the section of Sector C between the IOT Jetty and the mudflat fronting North Beck drain within approximately 400-500m of the Project) is regularly used by a variety of feeding waterbirds. In an estuary wide context, numbers of most SPA qualifying and assemblage species recorded in this area were generally only recorded in low numbers feeding in the intertidal during winter passage and summer periods (i.e. <10-20 birds representing <1 of the estuary-wide WeBS five year mean peak). Only feeding Black-tailed Godwit during the winter and Turnstone (in winter, passage and summer periods) were present in numbers above the 1% threshold which is used by NE to determine significant numbers as an indicator of potential for adverse effects on bird species on the Humber Estuary as summarized in **Table 2.** Turnstone are considered to be particularly tolerant to potential disturbance with evidence also suggesting that Black-tailed Godwit are relatively habituated to existing port related activity and expected to show limited disturbance responses to operational movements along the jetty. ~~Disturbance~~In summary, disturbance responses during

Site	Features	Potential AEOI	Justification
	A149: Dunlin *Calidris alpina alpina* (Non-breeding)		operation are generally expected to be localised given the tolerance that coastal waterbirds typically show to existing port operations and the expected habituation to disturbance stimuli resulting directly from the Project. As a consequence, any change to '*the distribution of the qualifying features within the site*' conservation objective is expected to be negligible. The predicted disturbance responses of waterbirds are considered unlikely to cause any changes to '*the population of each of the qualifying features*' conservation objective. This is because any responses are considered to be relatively limited and will not cause birds to disperse out of the Humber Estuary to another region. Furthermore, based on the magnitude of disturbance effects, population level consequences (at both a local and fly way level) in terms of mortality or changes in breeding success is considered highly unlikely.
	A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding)		
	A162: Common Redshank *Tringa totanus* (Non-breeding)		
	Waterbird assemblage		
Humber Estuary Ramsar site	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3)		
	Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		

The potential effects of airborne noise and visual disturbance during decommissioning on qualifying species of coastal waterbird within the SPA/Ramsar boundary

General scientific context

4.10.45. Decommissioning effects are considered to be similar to those associated with construction with scientific evidence on this impact pathway is provided in Paragraphs 4.10.1 to 4.10.15.

Summary of effects (without mitigation)

4.10.46. No provision has been made for the decommissioning of the jetty, jetty head, jetty access ramps and the jetty access road. This is because these elements would, once constructed, become part of the fabric of the Immingham port estate and would, in simple terms, continue to be maintained so that they can be used for port-related activities to meet a long-term need. On this basis decommissioning of these elements is not considered within the Shadow HRA as no pathways exist that would cause potential effects on features of the Humber Estuary European Marine Site.

4.10.47. When appropriate, the infrastructure associated with the hydrogen production facility may be decommissioned. The majority of the proposed landside decommissioning works are well in excess of 200 m from the foreshore (located within Work Area 5). Similarly, there are no areas of terrestrial habitat within or adjacent to the Project boundary that are considered functionally linked land (and as such do not provide important habitat for SPA species). On this basis, marine ornithology receptors (i.e. coastal waterbirds) are considered to be out of the zone of potential effects associated with most decommissioning elements. The exception to this will be the removal of pipe racks within Work Area 2 (the jetty access road) and plant and equipment on the approach jetty topside associated with hydrogen production (within Work Area 1) which have been considered in the Shadow HRA (i.e. screened in at Stage 1 in Section 3).

Waterbirds present in the area will be habituated to anthropogenic activities associated with the Project such as vehicle movements, port related noise and human activity. Nevertheless, avoidance responses or dispersive disturbance

a. Winter marine decommissioning restriction from 1 October to 31 March for Work Area 2 (the jetty access road) and the approach jetty topside (within Work Area 1) where the works are located within 200 m of exposed intertidal foreshore.

Assessment of the potential for an AEOI

4.10.49. The potential disturbance effects on qualifying species of coastal waterbird during decommissioning and the effectiveness of the proposed mitigation measures is outlined above and in **Table 29**. On the basis of this evidence the predicted residual effects are not considered to compromise any of the conservation objectives, and as a consequence, this pathway will not result in an AEOI on the qualifying interest features as the mitigation will minimise exposure to potential disturbance during the overwintering period.

Table 29: The Potential for an AEOI on qualifying species due to potential airborne noise and v decommissioning

Site	Features	Potential AEOI	Justification
Humber Estuary SPA	A048; Common Shelduck *Tadorna tadorna* (Non-breeding)	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	The decommissioning will minimise disturba waterbirds are consid disturbance and wher occur in the area. Thi decommissioning acti road) and approach je the works are within a foreshore. With the application o disturbance response terms of frequency ar species. On this basis, any cha foreshore is expected proposed mitigation a features within the sit considered to be com With the proposed mi *each of the qualifying* occur.
	A149: Dunlin *Calidris alpina alpina* (Non-breeding)		
	A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding)		
	A162: Common Redshank *Tringa totanus* (Non-breeding)		
	Waterbird assemblage		
Humber Estuary Ramsar site	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3)		
	Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		

4.11. Disturbance through Underwater Noise and Vibration

The potential effects of underwater noise and vibration during marine piling on qualifying species of fish and marine mammals

General scientific context

Underwater noise and vibration: implications for fish

4.11.1. Elevated underwater noise and vibration levels during construction activities can potentially disturb fish by causing physiological damage and/or inducing adverse behavioural reactions. A detailed underwater noise assessment has been undertaken for the Project **(Appendix 9.B [TR030008/APP/6.4])** and is briefly summarised in this section.

4.11.2. For most marine piling activities, the main source of noise and vibration relates to where piles are hammered or vibrated into the ground. Percussive marine piling involves hammering the pile into the seabed resulting in an impact blow and high levels of noise. Vibro marine piling produces lower levels of noise as piles are vibrated into the seabed.

4.11.3. There is a wide diversity in hearing structures in fish which leads to different auditory capabilities across species (~~Ref 1-178~~Ref 1-186). All fish can sense the particle motion[~~20~~29] component of an acoustic field via the inner ear as a result of whole-body accelerations (~~Ref 1-179~~Ref 1-187), and noise detection ('hearing') becomes more specialised with the addition of further hearing structures. Particle motion is especially important for locating sound sources through directional hearing (~~Ref 1-180; Ref 1-181; Ref 1-182~~Ref 1-188; Ref 1-189; Ref 1-190). Although many fish are also likely to detect sound pressure[~~21~~30], particle motion is considered equally or potentially more important (~~Ref 1-183~~Ref 1-191).

4.11.4. From the few studies of hearing capabilities in fish that have been conducted, it is evident that there are potentially substantial differences in auditory capabilities from one fish species to another (~~Ref 1-183~~Ref 1-191). Popper *et al.* (~~Ref 1-180~~Ref 1-188) proposed the following three categories of fish which are described below:

a. Fish with a swim bladder or air cavities that aid hearing.

b. Fish with a swim bladder that does not aid hearing.

c. Fish with no swim bladder.

4.11.5. Sea lamprey *Petromyzon marinus* and River lamprey *Lampetra fluviatilis* lack swim bladders, are sensitive only to sound particle motion and show sensitivity to only a narrow band of frequencies.

[~~20~~29] Particle motion is a back and forth motion of the medium in a particular direction; it is a vector quantity that can only be fully described by specifying both the magnitude and direction of the motion, as well as its magnitude, temporal, and frequency characteristics.

[~~21~~30] Pressure fluctuations in the medium above and below the local hydrostatic pressure; it acts in all directions and is a scalar quantity that can be described in terms of its magnitude and its temporal and frequency characteristics.

Underwater noise and vibration: implications for grey seal and common seal

4.11.6. Marine mammals are particularly sensitive to underwater noise at higher frequencies and generally have a wider range of hearing than other marine fauna, (i.e., their hearing ability spans a larger range of frequencies). The hearing sensitivity and frequency range of marine mammals varies between different species and is dependent on their physiology.

4.11.7. The National Oceanic and Atmospheric Administration (“NOAA”) (~~Ref 1-184~~Ref 1-192) provides technical guidance for assessing the effects of underwater anthropogenic (human-made) sound on the hearing of marine mammal species. Specifically, the received levels, or acoustic thresholds, at which individual marine mammals are predicted to experience changes in their hearing sensitivity (either temporary or permanent) for acute, incidental exposure to impulsive and non-impulsive underwater anthropogenic sound sources are provided. These thresholds update and replace the previously proposed criteria in Southall *et al.* (~~Ref 1-185~~Ref 1-193) for preventing auditory/physiological injuries in marine mammals. Further recommendations have recently been published regarding marine mammal noise exposure by Southall *et al.* (~~Ref 1-186~~Ref 1-194) which complement the NOAA (~~Ref 1-184~~Ref 1-192) thresholds and also look at a wider range of marine mammal species.

4.11.8. The NOAA (~~Ref 1-184~~Ref 1-192) and Southall *et al.* (~~Ref 1-186~~Ref 1-194) thresholds are categorised according to marine mammal hearing groups. According to NOAA (~~Ref 1-184~~Ref 1-192) grey seals and common seals are categorised as phocid pinniped (PW) (earless seals or “true seals”).

4.11.9. There are no equivalent Sound Pressure Level (“SPL”) behavioural response criteria that would represent the sources of underwater noise associated with the Project. Behavioural reactions to acoustic exposure are less predictable and difficult to quantify than effects of noise exposure on hearing or physiology as reactions are highly variable and context specific (~~Ref 1-185~~Ref 1-193).

4.11.10. Few studies have documented responses of seals to underwater noise in the field (~~Ref 1-187~~Ref 1-195). Tracking studies found reactions of the grey seals to pile driving during the construction of windfarms were diverse (~~Ref 1-188~~Ref 1-196). These included altered surfacing or diving behaviour, and changes in swim direction including swimming away from the source, heading into shore or travelling perpendicular to the incoming sound, or coming to a halt. Also, in some cases no apparent changes in their diving behaviour or movement were observed. Of the different behavioural changes observed a decline in descent speed occurred most frequently, which suggests a transition from foraging (diving to the bottom), to more horizontal movement. These changes in behaviour were on average larger, and occurred more frequently, at smaller distances from the pile driving events, and such changes were statistically significantly different at least up to 36km from the marine piling. In addition to changes in dive behaviour, also changes in movement were recorded. There was evidence that on average grey seals within 33km were more likely to swim away from the pile driving. In some cases, seals exposed to pile-driving at close range, returned to the same area on subsequent trips. This suggests that some seals had an incentive to go to these areas, which was stronger than the deterring effect of the pile-driving.

4.11.11. A telemetry study found no overall significant displacement of common seal during construction of a wind farm in The Wash, south-east England (~~Ref 1-189~~Ref 1-197). However, during marine piling, seal usage (abundance) was significantly reduced up to 25km from the marine piling activity; within 25km of the centre of the wind farm, there was a 19 to 83% (95% confidence intervals) decrease in usage compared to during breaks in marine piling, equating to a mean estimated displacement of 440 individuals. This amounts to significant displacement starting from predicted received levels of between 166 and 178 dB re 1 µPa (peak-peak). Displacement was limited to marine piling activity; within two hours of cessation of pile driving, seals were distributed as per the non-marine piling scenario.

4.11.12. Koschinski *et al.* (~~Ref 1-190~~Ref 1-198) conducted a playback experiment on harbour seals in which the recorded sound of an operational wind turbine was projected via a loudspeaker, resulting in modest displacement of seals from the source (median distance was 284 vs 239 m during control trials). Two further studies of ringed seals (*Phoca hispida*), which are closely related to both harbour and grey seals, have observed behaviour in response to anthropogenic noise: Harris *et al*., (~~Ref 1-191~~Ref 1-199) reported animals swimming away and avoidance within ~150m of a seismic survey, while Moulton *et al*., (~~Ref 1-192~~Ref 1-200) found no discernible difference in seal densities in response to construction and drilling for an oil pipeline.

4.11.13. Another way to evaluate the responses of marine mammals and the likelihood of behavioural responses is by comparing the received sound level against species specific hearing threshold levels. Further information on the dB_{ht} metric and its limitations is provided in **Appendix 9.B [TR030008/APP/6.4].**

Summary of effects

Effects on fish

4.11.14. The distances at which mortality and potential mortal injury, recoverable injury, Temporary Threshold Shift ("TTS") and behavioural effects in fish are predicted to occur as a result of the percussive marine piling and vibro marine piling associated with the development are included in in **Appendix 9.B [TR030008/APP/6.4].**

4.11.15. The Project will involve the installation of piles of varying sizes. The highest peak noise levels are generally associated with larger-sized piles given the larger surface area of the pile in contact with the water and the larger hammer energy and/or pile driving time involved in driving them. On this project, the largest piles are up to 2.3m in diameter. However, given that only a total of two of these piles will be driven for the Project, they only represent a very small proportion of all the piles (< 1%). In addition to modelling the propagation of noise associated with these larger 2.3m diameter piles as a worst case, therefore, the propagation of noise associated with the second largest of up to 1.5m diameter piles, which comprise a more significant proportion of all the piles (45%), has also been modelled. Total number of piles will be subject to final design of the jetty which will fall within parameters set out in OCEMP and subject to a condition on the DML.

4.11.16. The predicted range (R) at which the Popper *et al.* (~~Ref 1-180~~Ref 1-188) quantitative instantaneous peak SPL thresholds for pile driving are reached indicates that for 2.3m diameter piles, there is a risk of mortality, potential mortal injury or recoverable injury within 40 m in fish with no swim bladder (lamprey). For 1.5m diameter piles, there is a risk of mortality, potential mortal injury or recoverable injury within 10 m from the source of impact marine piling in fish with no swim bladder.

4.11.17. The calculator developed by the United States National Marine Fisheries Service ("NMFS") (~~Ref 1-193~~Ref 1-201) as a tool for assessing the potential effects to fish exposed to elevated levels of underwater sound produced during pile driving was used to calculate the range at which the cumulative Sound Exposure Level ("SEL") thresholds for pile driving (~~Ref 1-180~~Ref 1-188) are reached. Based on the assumptions highlighted in **Appendix 9.B [TR030008/APP/6.4]**, for the 2.3m diameter piles, there is predicted to be a risk of mortality and potential mortal injury within 40m in fish with no swim bladder and for 1.5m diameter piles, there is predicted to be a risk within 10m. The distance at which the received level of noise is within the limits of the recoverable injury threshold in fish without a swim bladder is within 60m for the 2.3m diameter piles and within 20m for the 1.5m diameter piles.

4.11.18. For vibro marine piling of either 2.3m or 1.5m diameter piles, there is predicted to be a risk of mortality, potential mortal injury or recoverable injury within 10m in fish with no swim bladder.

4.11.19. Given the mobility of fish, any individuals that might be present within the localised areas associated with potential mortality/injury during pile driving activities would be expected to easily move away and avoid harm. Furthermore, the area local to the Project is not considered a key foraging, spawning or nursery habitat for sea lamprey or river lamprey and, therefore, this localised zone of injury is unlikely to result in effects.

4.11.20. The range at which the Popper *et al*. TTS (~~Ref 1-86~~Ref 1-92) and Hawkins *et al*. (~~Ref 1-194~~Ref 1-202) quantitative instantaneous peak SPL behaviour thresholds for percussive pile driving are reached indicates that there is a risk of a behavioural response in fish within around 2-3km from the source of impact marine piling for 2.3m diameter piles and 1-2km from the source of impact marine piling 1.5 m diameter piles. For the 2.3m diameter piles, TTS and behavioural reactions during impact marine piling are, therefore, anticipated to occur across 87% to 100% width of the Humber Estuary at low water and 59% to 88% of the width of the estuary at high water. For the 1.5m diameter piles, TTS and behavioural reactions are anticipated to occur across 43% to 87% width of the Humber Estuary at low water and 29% to 59% of the estuary width at high water. Impact marine piling, therefore, has the potential to create a partial to full temporary barrier to fish movements. For vibro marine piling, there is a risk of TTS and behavioural response in fish within around 1km from the source which equates to 43% of the width of the Humber Estuary at low water respectively and 29% of the estuary width at high water.

4.11.21. However, the scale of the behavioural response is partly dependent on the hearing sensitivity of the species. Fish without a swim bladder (e.g., river lamprey) are likely to show only very subtle changes in behaviour in this zone.

4.11.22. The scale of the behavioural effect is also dependent on the size of fish (which affects maximum swimming speed). Smaller fish, juveniles and fish larvae swim at slower speeds and are likely to move passively with the prevailing current. Larger fish are more likely to actively swim and, therefore, may be able to move out of the behavioural effects zone in less time, although it is recognised that the movement of fish is very complex and not possible to define with a high degree of certainty.

4.11.23. The effects of marine piling noise on fish also need to be considered in terms of the duration of exposure. Marine piling noise will take place over a period of approximately 343 days. However, marine piling will not take place continuously as there will be substantial periods of downtime, pile positioning and set up.

4.11.24. The piling works will be undertaken seven days per week. Intended working hours will be from 07:00 to 19:00 in certain winter months (March, September and October) and sunrise to sunset in certain summer months (June and August) which will be secured by a condition on the deemed marine licence. The maximum impact marine piling scenario is for three tubular piles to be installed each day using up to two marine piling rigs driving piles at any one time, involving approximately 270 minutes of impact marine piling per day and 60 minutes of vibro marine piling per day in a 12-hour shift. There will, therefore, be significant periods over a 24-hour period when fish will not be disturbed by any marine piling noise. The actual proportion of marine piling is estimated to be at worst around 23% over a 24 hour period (based on 270 minutes of impact marine piling and 60 minutes of vibro marine piling each working day) over any given construction week. In other words, any fish that remain within the predicted behavioural effects zone at the time of marine piling will not be exposed up to 77% of the time over the period of a day.

4.11.25. The marine piling will occur between 07:00 to 19:00 in certain winter months (March, September and October) and sunrise to sunset in certain summer months (June and August) (approximately 38% of impact marine piling and 8% of vibro marine piling over a 12-hour shift), which has the potential to disproportionately affect fish that migrate during daylight hours, whilst reducing the potential exposure of fish that predominantly migrate during night time hours (e.g., river lamprey).

4.11.26. It is also important to consider the noise from marine piling against existing background or ambient noise conditions. The levels of underwater noise generated by impact marine piling are predicted to reach existing background levels previously measured in the Humber Estuary within around 2 to 3km from the source. The levels of underwater noise generated by vibro marine piling are predicted to reach background levels within around 1km from the source. Furthermore, the wider local area in which the construction will take place already experiences regular vessel operations and ongoing maintenance dredging, and, therefore, fish are likely to be habituated to a certain level of anthropogenic background noise.

4.11.27. Given the uncertainty regarding the actual timing and programme for the marine piling, this assessment has been undertaken on the basis that the works could take place at any time of year as a worst case. There is the potential for marine piling to occur during the sensitive migratory periods of lamprey in the Humber Estuary. Both river and sea lamprey moving between the Humber Estuary and the sea could potentially pass near to the proposed marine works (with a risk of injury potentially occurring in very close proximity to the marine piling activity). In addition, a TTS/behavioural response (e.g., displacement) or acoustic barrier could occur over all or the majority of the width of the Humber Estuary at low water and a slightly smaller proportion of the estuary width at high water.

4.11.28. Although the effect of underwater noise and vibration from marine piling works is temporary and of short duration, there is uncertainty with respect to the timing of the works which could in the worst case scenario coincide with the migration periods of river and sea lamprey. The potential for an AEOI cannot, therefore, be ruled out and on this basis mitigation has been proposed which will be secured by a condition on the deemed marine licence.

Effects on grey seal and common seal

4.11.29. The distances at which permanent threshold shifts (“PTS”), TTS and behavioural effects in grey seals and common seals are predicted to occur during impact marine piling and vibro marine piling for the Project are included in **Appendix 9.B [TR030008/APP/6.4]**.

4.11.30. As discussed above for fish, the Project will involve the installation of piles of varying sizes. The largest piles that will be driven for the Project comprise two 2.3m diameter piles, which represent a very small proportion of all the piles (< 1%). In addition to modelling the propagation of noise associated with these larger 2.3m diameter piles as a worst case, therefore, the propagation of noise associated with the second largest 1.5 m diameter piles, which comprise a more significant proportion of all the piles (45%), has also been modelled.

4.11.31. There is predicted to be a risk of instantaneous PTS and TTS in seals within approximately 10 and 30m respectively from the source of the percussive (impact) marine piling of the 2.3m diameter piles and within approximately 5m and 10m respectively marine piling of the 1.5m diameter piles.

4.11.32. If the propagation of underwater noise from impact marine piling were unconstrained by any boundaries, the maximum theoretical distance at which the predicted cumulative SEL weighted levels of underwater noise during impact marine piling is within the limits of PTS and TTS in seals is approximately 2km and 10km respectively for 2.3m diameter piles, and 800m and 5km respectively for 1.5m diameter piles. The maximum theoretical distance at which the predicted cumulative SEL weighted levels of underwater noise during vibro marine piling is within the limits of PTS and TTS in seals of 80m and 1km respectively.

4.11.33. Assuming a worst case of a lower swimming speed of 1.5 m/s for all marine mammal species (including both adults and juveniles), the maximum time that would take a grey seal or common seal to leave the centre of the cumulative SEL weighted PTS and TTS injury zones during impact marine piling is estimated to be 20 minutes and two hours respectively for 2.3m diameter piles and around nine minutes and one hour respectively from 1.5m diameter piles. This is less than 9% of the time that would be required for an injury to occur and, therefore, assuming seals avoid the injury effects zone, they are not considered to be at risk of any permanent or temporary injury during impact marine piling.

4.11.34. Assuming a worst case of a lower swimming speed of 1.5 m/s for all marine mammal species (including both adults and juveniles), the maximum time that would take a grey seal or common seal to leave the centre of the cumulative SEL weighted PTS and TTS injury zones during vibro marine piling is estimated to be one minute and ten minutes respectively. This is less than 1% of the time that would be required for an injury to occur and, therefore, assuming seals evade the injury effects zone, they are not considered to be at risk of any permanent or temporary injury during vibro marine piling.

4.11.35. Impact marine piling is predicted to have the potential to cause instantaneous injury effects within close proximity to the activity and strong behavioural responses over a wider area although this will be constrained to within the outer section of the Humber Estuary between Hull and Cleethorpes.

4.11.36. The results indicate that if grey or common seals present in the Humber Estuary were to remain stationary within the cumulative SEL distances from the source of marine piling over a 24 hour period, it could result in temporary and/or permanent hearing injury. However, it is considered highly unlikely that any individual seal will in fact stay within this “injury zone” during the marine piling operations.

4.11.37. Any grey or common seal present are likely to avoid the area. Behavioural responses could include movement away from a sound source, aggressive behaviour related to noise exposure (e.g., flipper slapping, abrupt directed movement), visible startle response and brief cessation of reproductive behaviour (~~Ref 1-185~~Ref 1-193). Mild to moderate behavioural responses of any individuals within these zones could include movement away from a sound source and/or visible startle response (~~Ref 1-185~~Ref 1-193).

4.11.38. Any evasive response could also lead to the potential temporary avoidance of the outer section of the Humber Estuary between Hull and Cleethorpes. There is therefore potential for the restriction of the movements of grey and common seal upstream and downstream (i.e., a barrier to movements). The Humber Estuary upstream of the Project is not known to be used as a breeding site for seals (with the nearest known grey seal breeding colony located over 25km away at Donna Nook at the mouth of the estuary). However, as noted in the baseline (**Section 1.3 of Appendix A**), seals are regularly recorded foraging in the Humber Estuary and have been observed within several kilometres of the Project. While numbers at any given time in the Immingham area will only represent a small proportion of regional populations[~~22~~31], foraging individuals in this area are nevertheless

[~~22~~31] The Humber Estuary/Lincolnshire coast region supports supports thousands of grey seals with counts over 4,000-6,000 seals recorded hauling out and over 2,000 pups born in recent years at Donna Nook. In expected to occur relatively frequently. Any barrier to movements caused by the noise during marine piling, however, would be temporary with significant periods during a 24-hour period when no marine piling will be undertaken (see below). This of itself will allow the unconstrained movements of seals through the Humber Estuary. Furthermore, as summarised in **Section 1.3 of Appendix A**, grey seals can undertake wide ranging seasonal movements over several thousand kilometres (~~Ref 1-195~~Ref 1-203; Ref 1-19; ~~Ref 1-189~~Ref 1-197). Seals tagged at Donna Nook were recorded undertaking wide ranging movements in the outer Humber Estuary and approaches as well as more widely in the North Sea (~~Ref 1-189~~Ref 1-197). Therefore, seals are likely to be able to exploit a much wider area for foraging during any marine piling activity.

4.11.39. The effects of marine piling noise on marine mammals also need to be considered in terms of the duration of exposure. Marine piling noise will take place over a period of approximately 343 days. Marine piling will not take place continuously as there will be periods of downtime, pile positioning and set.

4.11.40. The marine piling works will be undertaken 07:00 to 19:00 (Monday to Sunday). At present, the maximum impact marine piling scenario is for 3 tubular piles to be installed each day using up to two marine piling rigs pile driving at any one time), involving approximately 270 minutes of impact marine piling per day and 60 minutes of vibro marine piling per day in a 12 hour shift. There will, therefore, be significant periods over a 24-hour period when marine mammals will not be disturbed by any marine piling noise. The actual proportion of impact marine piling is estimated to be at worst around 23% over a 24 hour period (based on 270 minutes of impact marine piling and 60 minutes of vibro marine piling each working day) over any given construction week. In other words, any marine mammals that remain within the predicted behavioural effects zone at the time of percussive marine piling will not be exposed up to 77% of the time over the period of a day.

4.11.41. It is also important to consider the noise from marine piling against existing background or ambient noise conditions. The levels of underwater noise generated by impact marine piling are predicted to reach existing background levels previously measured in the Humber Estuary within around 2 to 3km from the source. The levels of underwater noise generated by vibro marine piling are predicted to reach background levels within around 1km from the source. Furthermore, the area in which the construction will take place already experiences constant vessel operations and ongoing maintenance dredging, and, therefore, marine mammals are likely to be habituated to a certain level of anthropogenic background noise.

4.11.42. Although the effect of underwater noise and vibration from marine piling works is temporary and of short duration, there is uncertainty with respect to the timing of the works which could in the worst case scenario result in a restriction of the movements of grey seal upstream and downstream (i.e., a barrier to

over 4,000-6,000 seals recorded hauling out and over 2,000 pups born in recent years at Donna Nook. In addition, counts of approximately 100-150 common seals have also been recorded at Donna Nook in recent years (**Section 1.3 of Appendix A**).

movements). Whilst this effect would be temporary and short in duration, the potential for an AEOI cannot therefore be ruled out and on this basis mitigation has been proposed.

Mitigation

4.11.43. In order to reduce the level of impact associated with underwater noise and vibration on fish and marine mammals during construction (which is assessed as minor to moderate adverse), the following mitigation measures will be implemented during marine piling:

a. **Soft start:** The gradual increase of marine piling power, incrementally, until full operational power is achieved will be used as part of the marine piling methodology. This will give fish and marine mammals the opportunity to move away from the area before the onset of full impact strikes. The duration of the soft start is proposed to be 20 minutes in line with the JNCC marine piling protocol [~~23~~32].

b. **Vibro marine piling**: Vibro marine piling is proposed to be used where possible (which produces lower peak source noise levels than percussive marine piling) although it is recognised that impact marine piling is anticipated to always be required to reach the design depths. For the purposes of this assessment, the maximum pile driving scenario is assumed as a worst case to involve approximately 60 minutes of vibro -marine piling followed by 270 minutes of impact marine piling per day in a 12 hour shift.

c. **Seasonal marine piling restrictions**: During percussive marine piling the following further restrictions are proposed:

   i. No percussive marine piling is to take place within the waterbody between 1 April and 31 May inclusive in any calendar year. This will minimise the potential impact on the greatest number of different migratory fish in the Humber Estuary, including sea lamprey, in accordance with the periods identified in **Section 1.3 of Appendix A**, and also the more vulnerable earlier life stages of a number of migratory fish species[~~24~~33]. This restriction does not apply to percussive marine piling that can be undertaken outside the waterbody at periods of low water[~~25~~34].

[~~23~~32] JNCC (~~Ref 1-212~~Ref 1-204). Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals from piling noise.

[~~24~~33] Spring is the peak period when Atlantic salmon and sea trout smolts migrate downstream to the sea and it is also the peak migration period for European eel elvers moving into the estuary. In addition, it is the period when allis shad move into estuaries and when sea lamprey and twaite shad gather in estuaries and move up to spawn. It is also the period when the highest densities of smelt are present in the Humber Estuary.

[~~25~~34] The force generated by piling outside the waterbody will be exerted on the ground at that location. The sound waves can travel outwards through the seabed or be reflected from deeper sediments. As these waves propagate, sound will also "leak" upwards contributing to the airborne sound wave. The

ii. The duration of percussive marine piling is to be ~~restricted~~actively managed within the waterbody from 1 June to 30 June and 1 August to 31 October inclusive in any year to minimise the impacts on fish migrating through Humber Estuary during this period such as silver eels, river lamprey and returning adult Atlantic salmon. ~~The maximum amount of percussive marine piling permitted within any four week period must not exceed 140 hours where a single marine piling rig is in operation or a total of 196 hours where two or more rigs are in operation (it is assumed that up to two marine piling rigs will pile driving at any one time). The measurement of time during each work-block described above must begin at the start of each timeframe, roll throughout it, then cease at the end, where measurement will begin again at the start of the next timeframe, such process to be repeated until the end of marine piling works. This restriction~~Over these periods, reports detailing the total duration of piling each day are to be submitted to the MMO on a weekly basis and the Applicant will hold fortnightly meetings with the MMO (unless otherwise agreed with the MMO). A 60-minute contingency period is allowed as well as the 270 minutes per day maximum percussive pile driving scenario – this reflects 20 minutes of additional soft start procedures required for up to three piles and rigs. In the event of an abnormal situation arising which triggers the contingency period, an environmental representative for the works will be notified who will agree a plan with the contractor to limit the duration of percussive piling to 330 minutes for that day, as well as measures to prevent a future recurrence. Circumstances that trigger the contingency period will be recorded and explained in the weekly reporting to the MMO. The Applicant proposes to use the fortnightly meeting to discuss and agree further corrective action with the MMO should it be required. This piling reporting protocol does not apply to percussive marine piling that can be undertaken outside the waterbody at periods of low water. This approach has been developed in consultation with the MMO and Cefas.

d. **Night time marine piling restriction:** The upstream migration of river lamprey takes place almost exclusively at night (~~Ref 1-196~~Ref 1-205). During the periods 1 March to 31 March, 1 June to 30 June and 1 August to 31 October inclusive, piling will be restricted at night. Specifically, no percussive or vibro piling will be undertaken from 19:00 to 07:00 in March, September and October and between sunset and sunrise in June and August. With respect to river lamprey, the restriction covering the period 1 August to 31 October will specifically benefit the nocturnal migratory periods of this species. This is based on the information provided by the Environment Agency (2013) (~~Ref 1-196~~Ref 1-205) which states that 'in the Humber basin, river lamprey mainly enter the rivers from the estuary in autumn and then spawn in April'. The Environment Agency (~~Ref 1-196~~Ref 1-205) report also

underwater noise from piling outside the waterbody will, therefore, be considerably reduced (and negligible in scale) as a result of absorption of the sound by the ground and air, the interaction with the ground surface (reflection and scattering), and the interaction with and transmission through the ground.

stated that during Humber Estuary fish surveys, most river lamprey were caught in summer and autumn. ~~Percussive marine~~Marine piling operations that have already been initiated will, however, be completed where an immediate cessation of the activity would form an unsafe working practice. This restriction does not apply to ~~percussive~~ marine piling that can be undertaken outside the waterbody at periods of low water;

e. **Marine Mammal Observer**: In addition, in order to further reduce the significance of the impact to marine mammals the JNCC "Statutory nature conservation agency protocol for minimising the risk of injury to marine mammals during marine piling" (~~Ref 1-212~~Ref 1-204) will be followed during percussive marine piling. The key procedures highlighted in this document include the following:

   i. Establishment of a 'mitigation zone' of 500m from the marine piling locations, prior to any percussive marine piling. Within this mitigation zone, observations of marine mammals will be undertaken by a trained member of the construction team using marine mammal identification resources.

   ii. 30 minutes prior to the commencement of percussive marine piling, a search will be undertaken by the Marine Mammal Observer to determine that no marine mammals are within the mitigation zone. Percussive marine piling activity will not be commenced if marine mammals are detected within the mitigation zone or until 20 minutes after the last visual detection.

   iii. During percussive marine piling, the Marine Mammal Observer will observe the mitigation zone to determine that no marine mammals are within this area. Construction workers will be alerted if marine mammals are identified, and marine piling will cease whilst any marine mammals are within the mitigation zone. Marine piling can recommence when the marine mammal exits the mitigation zone and there is no further detection after 20 minutes.

   iv. If there is a pause in percussive marine piling operations for any reason over an agreed period of time, then another search (and soft-start procedures for marine piling) will be repeated before activity recommences. If, however, the mitigation zone has been observed while marine piling has ceased and no marine mammals have entered the zone, marine piling activity can recommence immediately.

Assessment of the potential for an AEOI

4.11.44. Based on outputs of the underwater noise assessment (as summarised above and in **~~Table 29~~Table 30),** including the consideration of the effectiveness of the proposed mitigation measures, the predicted residual effects are not considered to compromise any of the conservation objectives. It is therefore concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway as the mitigation will minimise exposure to potential underwater effects during sensitive migratory periods for lamprey. The mitigation will be secured through a condition on the deemed marine licence. The potential effects of underwater noise and vibration during marine piling on qualifying species of fish and marine mammals.

Table ~~29~~30: The Potential for an AEOI on qualifying species due to potential underwater noise piling

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	S1095: Sea lamprey *Petromyzon marinus*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	Based on the information highligh during marine piling have the pot in lamprey species within a relativ piling activity and behavioural rea marine piling in the most sensitiv avoided as a result of the propos the potential for injury effects on limited. On this basis, underwate marine piling is considered unlike *of qualifying species'* conservatio With the proposed mitigation me '*distribution of qualifying species* also considered unlikely as sea la migrate through the estuary.
	S1099: River lamprey *Lampetra fluviatilis*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	Based on the information highligh during marine piling have the pot in lamprey species within a relativ piling activity and behavioural rea seasonal restriction on marine pi potential for injury effects to river On this basis, underwater noise e piling is considered unlikely to ca *qualifying species'* conservation o With the proposed mitigation me '*distribution of qualifying species* also considered unlikely as river

Site	Features	Potential AEOI	Justification
			migrate through the estuary.
	S1364: Grey seal *Halichoerus grypus*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	Based on the information highligl cause some temporary changes grey seals with marine piling cau intermittent barrier effects during short term changes in the local d no permanent changes in the ove region will occur. On this basis, tl *the site'* conservation objective w Potential injury or lethal effects tc to a very localised area in the dire However, with the proposed mitig effects on seals is considered to noise effects on grey seals during causes changes to '*The populatic* objective.
Humber Estuary Ramsar site	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	Summary information with respe provided above in the table.
	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying	Summary information with respe above in the table.

Site	Features	Potential AEOI	Justification
	Petromyzon marinus between coastal waters and their spawning areas.	interest feature.	
The Wash and North Norfolk Coast	1365: Harbour seal *Phoca vitulina*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	It is acknowledged that there cou Wash and North Norfolk Coast S to common seal movements. Co over 200km from haul out sites o 1-15; Ref 1-16; Ref 1-17). The W located over 75km from the Proje harbour seals typically forage wit 1-18) which is reflected high pred in the Wash and along the North much lower predicted densities in Point (Ref 1-19). On this basis, th be key foraging habitat for comm Coast SAC population although i individuals from this population c Based on the information highligh zone of influence associated with considered part of the core range North Norfolk Coast SAC popula *species within the site'* conservat compromised. Potential injury or to be restricted to a very localised operations. However, with the pro for injury effects on seals is cons underwater noise effects on grey unlikely to causes changes to *'Th* conservation objective.

The potential effects of underwater noise and vibration during capital dredge and dredge disposal on qualifying species of fish and marine mammals

General scientific context

4.11.45. Elevated underwater noise and vibration levels during construction activities can potentially disturb fish and marine mammals by causing physiological damage and/or inducing adverse behavioural reactions. A detailed underwater noise assessment has been undertaken for the Project (**Appendix 9.B ([TR030008/APP/6.4])** and is briefly summarised in this section.

4.11.46. Scientific evidence on this impact pathway is provided in Paragraphs 4.11.3 to 4.11.5 in relation to lamprey and in Paragraphs 4.11.6 to 4.11.13 in relation to marine mammals (grey seal).

4.11.47. The dredging process involves a variety of sound generating activities which can be broadly divided into sediment excavation, transport and placement of the dredged material at the disposal site (~~Ref 1-197; Ref 1-198; Ref 1-199~~Ref 1-206; Ref 1-207; Ref 1-208). For most dredging activities, the main source of sound relates to the vessel engine noise.

Summary of effects

Effects on fish

4.11.48. The relative distances at which mortality and potential mortal injury, recoverable injury, TTS and behavioural effects in fish are predicted to occur as a result of the dredging and vessel movements associated with the development are included in in **Appendix 9.B [TR030008/APP/6.4].**

4.11.49. The qualitative guidelines for continuous noise sources (~~Ref 1-180~~Ref 1-188) consider that the risk of mortality and potential mortal injury in all fish is low in the near, intermediate and far-field. Applying the cumulative SEL thresholds for marine piling (~~Ref 1-180~~Ref 1-188) on a precautionary basis, indicate that there is a risk of mortality/ potential mortal injury within 10 m in fish with no swim bladder (i.e. lampreys).

4.11.50. According to Popper *et al.* (~~Ref 1-180~~Ref 1-188), the risk of recoverable injury is considered lower for fish with no swim bladder (lamprey) compared to fish where the swim bladder is involved in hearing (e.g., herring). For the latter group whereby a cumulative noise exposure threshold is recommended (170 dB rms for 48 h), the distance at which recoverable injury is predicted as a result of the dredging and vessel movements is 10 m, and therefore the distance to recoverable injury in lamprey is assumed to be less than 10 m. Applying the cumulative SEL thresholds for marine piling (~~Ref 1-180~~Ref 1-188) on a precautionary basis, indicate that there is a risk of recoverable injury within 20 m for fish with no swim bladder.

4.11.51. Popper *et al*. (~~Ref 1-180~~Ref 1-188) advise that there is a moderate risk of a TTS occurring in the nearfield (i.e., tens of metres from the source) in fish with no swim bladder (lamprey) and a low risk in the intermediate and far-field. There is a greater risk of TTS in fish where the swim bladder is involved in hearing (e.g., herring) when a guideline quantitative threshold is recommended (158 dB rms for 12 h). The distance at which TTS is predicted in these fish as a result of the dredging and vessel movements is 50m, and therefore the distance to TTS in lamprey is assumed to be less than 50m. Applying the cumulative SEL thresholds for marine piling on a precautionary basis, indicate that there is a risk of TTS occurring within 700m in all fish.

4.11.52. Popper *et al.* (~~Ref 1-180~~Ref 1-188) guidelines suggest that there is considered to be a moderate risk of potential behavioural responses occurring in the nearfield (i.e., tens of metres from the source) for fish species with no swim bladder (lamprey). At intermediate distances (i.e., hundreds of metres from the source), there is considered to be a moderate risk of potential behavioural responses in all fish and in the farfield (i.e., thousands of metres from the source) there is considered to be a low risk of a response in all fish.

4.11.53. Overall, there is generally considered to be a low risk of any injury in lamprey as a result of the underwater noise generated by dredging and vessel movements although mortality/potential mortal injury or recoverable injury could potentially occur in very close proximity to the dredger. The level of exposure will depend on the position of the fish with respect to the source, the propagation conditions, and the individual's behaviour over time. However, it is unlikely that a fish would remain in the vicinity of a dredger for extended periods within the distances at which mortality/potential mortal injury or recoverable injury are predicted in lamprey as a result of the dredging and vessel movements, as explained in **Paragraph 4.11.51**. TTS and behavioural responses are anticipated to be relatively localised in scale, in the context of the estuary width and the unconstrained nature of the location, and lamprey will be able to move away and avoid the source of the noise as required. Furthermore, the period of capital dredging during construction will be very short term and temporary, lasting a period of approximately 12 days in total. Based on the above considerations, the effect of underwater noise on river and sea lamprey due to dredging and disposal activities is considered to be relatively minor.

Effects on grey seal and common seal

4.11.54. The distances at which PTS and TTS and behavioural effects in marine mammals that occur in the study area are predicted to occur as a result of the dredging and vessel movements to and from the disposal sites associated with the Project are included in **Appendix 9.B [TR030008/APP/6.4]**.

4.11.55. NOAA's user spreadsheet tool (~~Ref 1-200~~Ref 1-209) has been used to predict the range at which the weighted cumulative SEL acoustic thresholds (~~Ref 1-184~~Ref 1-192) for PTS and TTS are reached during the proposed dredging and disposal activity based on the assumptions highlighted in in **Appendix 9.B [TR030008/APP/6.4]**.

4.11.56. There is predicted to be no risk of PTS in seals and the risk of TTS is limited to within 10 m from the dredging or vessel activity.

4.11.57. Overall, there is not considered to be any risk of injury or significant disturbance to grey seal or common seal from the dredging and vessel activities that are proposed at the Port of Immingham even if the dredging and vessel movements were to take place continuously 24/7. Furthermore, the period of capital dredging during construction will be very short term and temporary, lasting a period of around 12 days in total.

4.11.58. Hearing damage is unlikely to occur and the main effect that could be expected in the vicinity of the dredge vessels would be short-term mild behavioural avoidance. Based on these factors, the effect of underwater noise on grey seal or common seal due to dredging and disposal activities is considered to be negligible.

Mitigation

4.11.59. Mitigation is not required for this impact pathway.

Assessment of the potential for an AEOI

4.11.60. Based on outputs of the underwater noise assessment (as summarised above and in ~~Table 30~~**Table 31**), the predicted effects from this pathway are not considered to compromise any of the conservation objectives. It is therefore concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table ~~30~~31: The potential for an AEOI on qualifying species due to potential underwater noise a

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	S1095: Sea lamprey *Petromyzon marinus*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	The risk of injury to fish as result of dre Behavioural responses are only predic dredging vessel with lamprey able to e noise. The capital dredging noise will t movements of lamprey or causes char *species'* or the '*distribution of qualifying* objectives.
	S1099: River lamprey *Lampetra fluviatilis*		
	S1364: Grey seal *Halichoerus grypus*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	The risk of injury to grey seal as a resu low. Behavioural responses are only pr the dredging vessel with grey seals abl source of noise. The capital dredging r to 'The populations of qualifying specie within the site' conservation objectives
The Wash and North Norfolk Coast	S1365 Harbour seal *Phoca vitulina*	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest feature.	The risk of injury to common seal as a very low. Behavioural responses are o near to the dredging vessel with grey s the source of noise. The capital dredgi changes to 'The populations of qualifyi qualifying species within the site' conse
Humber Estuary Ramsar site	Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Summary information with respect to tl above in the table.

Sit e	Features	Potential AEOI	Justification
	second largest grey seal colony in England and the furthest south regular breeding site on the east coast.		
	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	Summary information with respect to la above in the table.

4.12. Biological Disturbance due to Potential Introduction and Spread of Non-native Species

The potential effects of the introduction and spread of non-native species during construction on qualifying habitats

General scientific context

4.12.1. Non-native, or invasive, species are described as 'organisms introduced into places outside of their natural range of distribution, where they become established and disperse, generating a negative impact on the local ecosystem and species' (International Union for Conservation of Nature (~~Ref 1-201~~Ref 1-210). The ecological impacts of such 'biological invasions' are considered to be the second largest threat to biodiversity worldwide, after habitat loss and destruction. In the last few decades marine and freshwater systems have been impacted by invasive species, largely as a result of increased global shipping (~~Ref 1-202~~Ref 1-211).

4.12.2. The introduction and spread of non-native species can occur either accidentally or by intentional movement of species as a consequence of human activity (~~Ref 1-203~~Ref 1-212 cited in ~~Ref 1-204~~Ref 1-213). The main pathway for the potential introduction of non-native species is via fouling of vessels' hulls, transport of species in ballast or bilge water and the accidental imports from materials brought into the system during development activities. Pathways involving vessel movements (fouling of hulls and ballast water) have been identified as the highest potential risk routes for the introduction of non-native species (~~Ref 1-205; Ref 1-204~~Ref 1-214; Ref 1-213), particularly from different biogeographical regions, which agrees with the fact that areas with a high volume of shipping traffic are hotspots for non-native species in British waters (~~Ref 1-204~~Ref 1-213).

4.12.3. The fouling of a vessel hull and other below-water surfaces can be reduced through the use of protective coatings. These coatings usually contain a toxic chemical (such as copper) or an irritant (such as pepper) that discourages organisms from attaching. Other coatings, such as those that are silicone-based, provide a surface that is more difficult to adhere to firmly, making cleaning of the hull less laborious. The type and concentration of coatings that can be applied to a boat hull is regulated and can vary between countries. Maintenance of hulls through regular cleaning will minimise the number of fouling organisms present. Hull cleaning can take place on land or in-water. In both cases, care needs to be taken to prevent the organisms and coating particles from being released into the water. By following best management practices, the impact of the cleaning procedure on the environment can be minimised.

4.12.4. Non-native invasive species also have the potential to be transported via ship ballast water. Seawater may be drawn into tanks when the ship is not carrying cargo, for stability, and expelled when it is no longer required. This provides a vector whereby organisms may be transported long distances. In 2004, the International Maritime Organisation ("IMO") adopted the 'International Convention for the Control and Management of Ships' Ballast Water and Sediments', which introduced two performance standards seeking to limit the risk of non-native invasive species being imported (including distances for ballast water exchange and standards for ballast water treatment). The Convention came into force internationally in September 2017.

4.12.5. The UK is bound by international agreements such as the Convention on the Conservation of Migratory Species of Wild Animals (Bonn Convention 1979), the Convention on the Conservation of European Wildlife and Natural Habitat (Berne Convention, 1979) and the Habitats and Birds Directives. All of these include provisions requiring measures to prevent the introduction of, or control of, non-native species, especially those that threaten native or protected species (~~Ref 1-206~~Ref 1-215). Additionally, Section 14(1) of the Wildlife and Countryside Act ("WCA") (~~Ref 1-207~~Ref 1-216) makes it illegal to release, or allow to escape into the wild, any animal which is not ordinarily resident in Great Britain and is not a regular visitor to Great Britain in a wild state or is listed in Schedule 9 to the WCA.

Summary of effects

4.12.6. As discussed above, non-native species have the potential to be transported into the study area on ships' hulls during capital dredging and construction activity (such as crane barges used in marine piling). Non-native invasive species also have the potential to be transported via ship ballast water. Seawater may be drawn into the dredger tanks or hopper when the ship is not carrying cargo, for stability, and expelled when it is no longer required. This provides a vector whereby organisms may be transported long distances.

4.12.7. Within England and Wales, best practice guidance has been developed on how to manage marine biosecurity risks at sites and when undertaking activities through the preparation and implementation of biosecurity plans (~~Ref 1-208~~Ref 1-217). This guidance will be followed when developing biosecurity control measures to minimise the risk of the introduction and spread of non-native species during construction of the scheme. These measures will be included within the **Construction Environmental Management Plan ("CEMP") [TR030008/APP/6.4]**. On this basis, the probability of the introduction and spread of non-native species from the construction phase is considered to be low.

Mitigation

4.12.8. No additional mitigation has been identified in relation to this pathway, however the assessment is based on the application of standard best practice measures in the form of robust biosecurity management procedures.

4.12.9. Biosecurity control measures during construction will be included within the **CEMP [TR030008/APP/6.4].**

Assessment of the potential for an AEOI

4.12.10. Based on the proposed biosecurity measures, the probability of the introduction and spread of non-native species from the construction phase is considered to be low (see above and ~~**Table 31**~~**Table 32**). The predicted effects are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table ~~31~~32: The potential for an AEOI on qualifying habitats due to the potential introduction and spread of non-native species during construction

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1110: Sandbanks which are slightly covered by sea water all the time	In the context of the site's conservation objectives, there is no potential AEOI on qualifying interest features.	Taking into account the considerations highlighted above and the proposed biosecurity measures, the probability of the introduction and spread of non-native species from the construction phase is considered to be low. On this basis, this pathway is not expected to cause a change to the '*the extent and distribution of qualifying natural habitats and habitats of the qualifying species*' conservation objective. This pathway will also not cause any changes to the '*the structure and function of qualifying natural habitats*' or cause modifications to '*the supporting processes on which qualifying natural habitats rely*' conservation objectives.
	H1130: Estuaries		
	H1140: Mudflats and sandflats not covered by seawater at low tide		
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.		

The potential effects of the introduction and spread of non-native species during operation on qualifying habitats

General scientific context

4.12.11. Scientific evidence on this impact pathway is provided in Paragraphs 4.12.1 to 4.12.5.

Summary of effects

4.12.12. Non-native species have the potential to be transported into the study area on ships' hulls during maintenance dredging and through operational vessels. Non-native invasive species also have the potential to be transported via ship ballast water. Seawater may be drawn into tanks when the ship is not carrying cargo, for stability, and expelled when it is no longer required. This provides a vector whereby organisms may be transported long distances. Non-native species may negatively affect native species and alter habitats due to direct interactions like predation and competition as well as spreading disease to and between native species.

4.12.13. Piles and other artificial structures can provide suitable habitats for non-indigenous marine species and function as corridors for the expansion of these species in terms of range and distribution. However, artificial structures are widespread in the Immingham area with a wide variety of jetty structures, sea walls and sea defences available for species to colonise. On this basis, the presence of new infrastructure as a result of the Project is considered unlikely to significantly increase the rate of spread of non-native species in the area.

4.12.14. In view of current legislation (described in **Paragraph 4.12.5**) and the fact that potential biosecurity risks are managed through ABP's existing biosecurity management procedures, the probability of the introduction and spread of non-native species from operational phase is considered to be low.

Mitigation

4.12.15. No additional mitigation has been identified in relation to this pathway, however there is a requirement to ensure the application of standard best practice measures in the form of robust biosecurity management procedures.

4.12.16. ABP’s existing biosecurity management procedures will be followed during operation.

Assessment of the potential for an AEOI

4.12.17. Based on the proposed biosecurity measures, the probability of the introduction and spread of non-native species from the operational phase is considered to be low (see above and ~~**Table 32**~~**Table 33**). The predicted effects are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features as a result of this pathway.

Table ~~32~~33: The potential for an AEOI on qualifying habitats due to the potential introduction a during operation

Site	Features	Potential AEOI	Justification
Humber Estuary SAC	H1110: Sandbanks which are slightly covered by sea water all the time	In the context of the site's conservation objectives, there is no potential AEOI on qualifying interest features.	Taking into account the considera biosecurity measures, the probabi non-native species from the opera this basis, this pathway is not expe *and distribution of qualifying natur species'* conservation objective. T changes to the '*the structure and* cause modifications to '*the suppo natural habitats rely*' conservation
	H1130: Estuaries		
	H1140: Mudflats and sandflats not covered by seawater at low tide		
Humber Estuary Ramsar site	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	In the context of the site's conservation objectives, there is considered to be no potential AEOI on the qualifying interest features.	

4.13. Consideration of Combined Effects

4.13.1. The potential impact pathways have also been considered collectively. The assessment of intra-project effects involves the consideration of where two or more different types of effect arising from the Project could interact or combine to influence the same qualifying interest feature and whether this combined effect could potentially undermine the conservation objectives of the European Site.

4.13.2. Potential intra-project effects were identified for the features of the Humber Estuary SAC, SPA and Ramsar considering all impact pathways screened into the assessment (see **Section 4.2**). The following potential effects which could interact or combine were identified:

a. During construction there are potential combined effects on Humber Estuary SAC habitats (sandbanks which are slightly covered by sea water all the time; estuaries; and mudflats and sandflats not covered by seawater at low tide) from habitat loss, damage, contamination and biological disturbance.

b. During operation there are potential combined effects on Humber Estuary SAC habitats from habitat loss/damage and biological disturbance.

c. During construction there are potential combined effects on Humber Estuary SAC species sea lamprey and river lamprey from contamination and disturbance through underwater noise and vibration.

d. During construction there are potential combined effects on features of the Humber Estuary SPA (Common Shelduck, Dunlin, Black-tailed Godwit, Common Redshank and the waterbird assemblage) from habitat loss/damage and airborne noise and visual disturbance.

4.13.3. Multiple impact pathways were similarly identified for the Humber Estuary Ramsar with potential effects relating to the following:

a. Criterion 1: Habitat loss/damage, contamination and disturbance during construction and habitat loss/damage and disturbance during operation.

b. Criterion 5 and Criterion 6: Habitat loss/damage and disturbance in both construction and operation.

c. Criterion 8: Contamination and disturbance during construction[~~26~~35].

4.13.4. The combined intra-project effects of all impact pathways have been considered in relation to each feature and in the context of the sites' conservation objectives. The majority of effects are small scale and are assessed as negligible/*de minimis* magnitude and it is concluded that there are no intra-project effects that would result in an AEOI of the Humber SAC, SPA or Ramsar.

4.13.5. It is noted that for two instances there is a reliance on mitigation measures to enable a conclusion of no AEOI to be reached. This relates to mitigation measures that are required during construction to minimise the effects due to

[~~26~~35] JNCC (~~Ref 1-213~~Ref 1-218). Information Sheet on Ramsar Wetlands - Humber Estuary. Available at: https://jncc.gov.uk/jncc-assets/RIS/UK11031.pdf (accessed 2 January 2023).

airborne noise and visual disturbance and from underwater noise and vibration which are discussed in more detail below.

4.13.6. During construction, coastal waterbirds which are features of the Humber Estuary SPA (Common Shelduck, Dunlin, Black-tailed Godwit, Common Redshank and the waterbird assemblage) will be subject to effects from airborne noise and visual disturbance as well as loss of intertidal mudflat which is a feeding resource. In theory these effects could combine to result in a synergistic effect if birds which are displaced as a result of noise are also limited by the availability of food resource. However, in reality the direct loss of a very small area of lower shore intertidal mudflat (>0.002 ha) and the indirect loss from alterations to physical processes (0.03 ha) are within the scale of natural variability and is expected to be immeasurable in real terms when taking account of the variation in water levels, wave climate and accuracy of the modelled bathymetry. The combined loss of intertidal mudflat is considered inconsequential to these mobile coastal waterbird species even at a local scale (see **Section 4.3**). Based on the evidence provided in **Section 4.10** in relation to airborne noise and visual disturbance during construction and with reference to the mitigation measures, the predicted combined effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features of the Humber Estuary SPA.

4.13.7. There is also the potential for combined effects of marine and landside piling to cause potential noise disturbance to coastal waterbirds. However, terrestrial noise modelling has predicted that the nearest landside piling to the foreshore (within Work Area No. 5. associated with piling of the foundations of the ammonia storage tanks) is predicted to cause noise levels <55 dB $L_{Aeq,1hr}$ and <65 dB L_{Amax} on the foreshore. This is lower than the 70 dB criteria applied in the assessment and also in the range of background noise in the local Port of Immingham area. The terrestrial piling is also more than 300 m from the foreshore (which is greater than the 200 m disturbance buffer applied in the assessment). On this basis, SPA waterbird features on the foreshore are predicted to be out of the zone of potential disturbance effects arising from terrestrial piling noise during construction. Correspondingly, combined effects resulting from terrestrial and marine piling will be negligible and not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features of the Humber Estuary SPA.

4.13.8. ~~4.13.7.~~ During construction there are potential combined effects on Humber Estuary SAC species sea lamprey and river lamprey from contamination and disturbance through underwater noise and vibration. There are no anticipated effects on fish from toxic and non-toxic contamination pathways. Based on modelling the sediment plumes resulting from dredging will be localised and will dissipate relatively rapidly and be immeasurable against background levels within a short duration of time (less than a single tidal cycle. There are generally low levels of contamination in the sediment contamination samples and elevations in the concentrations of contaminants within the water column are not anticipated. Based on the evidence provided in **Section 4.11** in relation to disturbance from underwater noise and vibration during construction and with reference to the mitigation measures, the predicted combined effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features of the Humber Estuary SAC.

4.14. In-combination Assessment

4.14.1. The Habitats Regulations require an assessment of the potential in-combination effects of the proposed works on European/Ramsar sites with other plans and projects. These refer to effects, which may or may not interact with each other, but which could affect the same interest feature.

4.14.2. Potential in-combination effects on interest features of European/Ramsar sites that have been screened into the AA (see **Section 3**) have been considered in this section.

4.14.3. Proposed plans or projects in the Humber Estuary which have the potential to cause potential cumulative/in-combination effects with marine ecology and ornithology features are discussed in more detail in the cumulative and in-combination effects assessment (**Chapter 25: Cumulative and In-Combination Effects [TR030008/APP/6.2].** Those plans or projects which overlap with the zone of influence of potential effects on marine ecology receptors as a result of the Project and are assessed in **Chapter 25: Cumulative and In-Combination Effects** have been taken forward for this Shadow HRA in-combination assessment. The details of each short-listed application including a description of the project, the application and approval status and project timescales are provided in **Table 25.5** in **Chapter 25: Cumulative and In-Combination Effects[TR030008/APP/6.2]**. The projects and pathways screened into the in-combination assessment (i.e. have the potential for LSE) are detailed in ~~**Table 33**~~**Table 34**.

4.14.4. Potential in-combination effects are then considered in detail in ~~**Table 34** (Humber Estuary SAC),~~ **Table 35**(Humber Estuary ~~SPA) and~~SAC and the Wash and North Norfolk Coast SAC), **Table 36** (Humber Estuary SPA) and **Table 37** (Humber Estuary Ramsar) in the context of the sites' conservation objectives. This includes consideration of all projects combined.

4.14.5. In summary, none of the ongoing activities, plans and projects are anticipated to result in in-combination effects of a scale that would change the existing condition status of the interest features recognised within the European/Ramsar sites screened into the AA. On this basis, the Project is considered to result in no potential for an AEOI on any interest features of European/Ramsar sites in-combination with other plans, projects and activities.

Table ~~33~~34: Identification of projects and impact pathways screened into the in-combination as

	Project	Distance From IGET Project	Impact Pathways In-combinatio
9	DM/0865/19/FUL Erection of 20MW gas fuelled embedded energy generation compound – Site 4	Approx. 0.5km south	**Habitat loss/damage** • Physical change to hal airborne pollutants
10	DM/0864/19/FUL Erection of 20MW gas fuelled embedded energy generation compound - Site 3	Approx. 0.5km south	**Habitat loss/damage** • Physical change to hal airborne pollutants
13	DM/0628/18/FUL (includes variation of conditions DM/0274/20/FUL) Partially demolish existing building and erect 20MWE waste to energy power generation facility, 65m stack and associated plant, machinery	Approx. 0.5km south	**Habitat loss/damage** • Physical change to hal airborne pollutants
16	DM/0862/19/FUL Erection of 20MW gas fuelled embedded energy generation compound - Site 1	Approx. 0.4km south	**Habitat loss/damage** • Physical change to hal airborne pollutants
17	DM/0863/19/FUL Erection of 20MW gas fuelled embedded energy generation compound - Site 2	Approx. 0.4km south	**Habitat loss/damage** • Physical change to hal airborne pollutants

	Project	Distance From IGET Project	Impact Pathways Relevant to the Shadow HRA In-combination Assessment
18	DM/0026/18/FUL Erect an Energy Recovery Facility with an electricity export capacity of up to 49.5MW and associated infrastructure including a stack to 90m high	Approx. 0.1km south	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants
21	EN010107 South Humber Bank Energy Centre	Approx. 2.1km south	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants
35	DM/0329/18/FUL Erection of industrial building and adjoined two storey office/control room to create power plant (18MW Energy From Waste)	Approx. 5km south	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants
37	DM/1070/18/FUL Construction of an energy from waste facility of up to 49.9MWe gross capacity including emissions stack(s) and associated infrastructure	Approx. 3km south	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants
95	PA/2018/918 Planning permission to construct a new gas-fired power station with a gross electrical output of up to 49.9 megawatts. A further non-material amendment application has been made (PA/2021/1039)	Approximately 3.7km	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants

	Project	Distance From IGET Project	Impact Pathways Relevant to the Shadow HRA In-combination Assessment
116	DM/0664/19/FUL Velocys Waste to Fuel Plant, off Moody Lane - Development of a sustainable transport fuels facility, including various stacks up to 80m high, creation of new accesses, installation of pipelines, rail link, associated infrastructure and ancillary works	Approx. 2km	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants
117	PA/SCO/2022/7 Station Road South Killingholme, works on land to the east of Rosper Road, Killingholme	Approx 4.5km	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants
115.	MLA/2014/00431/4 Maintenance dredge disposal at Grimsby, Immingham and Sunk Dredged Channel	Approx. 0.1km	**Habitat loss/damage** • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species • Physical loss or damage of habitat through alterations in physical processes • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases

	Project	Distance From IGET Project	Impact Pathways Relevant to the Shadow HRA In-combination Assessment
			Disturbance • Disturbance through underwater noise and vibration • Airborne noise and visual disturbance
94.	MLA/2020/00520 Humber International Terminal (HIT) berth 2: adaptation for car carriers	Approx. 2.6km	**Habitat loss/damage** • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species • Physical loss or damage of habitat through alterations in physical processes • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases **Disturbance** • Disturbance through underwater noise and vibration • Airborne noise and visual disturbance

	Project	Distance From IGET Project	Impact Pathways Relevant to the Shadow HRA In-combination Assessment
25.	TR030001, TR030005 and TR030006 Able Marine Energy Park including Material Changes 1 and 2	4.10km north of the Site	**Habitat loss/damage** • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species • Physical loss or damage of habitat through alterations in physical processes • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases **Disturbance** • Disturbance through underwater noise and vibration • Airborne noise and visual disturbance
28.	EN070006 Humber Low Carbon Pipelines	6.41km north West of the Site	**Habitat loss/damage** • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species • Physical loss or damage of habitat through alterations in physical processes • Physical change to habitats resulting from the deposition of airborne pollutants

	Project	Distance From IGET Project	Impact Pathways Relevant to the Shadow HRA In-combination Assessment
			Contamination • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases **Disturbance** • Disturbance through underwater noise and vibration • Airborne noise and visual disturbance
29.	EN070008 Viking CCS Pipeline	2km south of the Site	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases **Disturbance** • Disturbance through underwater noise and vibration • Airborne noise and visual disturbance
22.	Immingham Eastern Ro-Ro Terminal (IERRT)	Approx. 0.1km	**Habitat loss/damage** • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species

	Project	Distance From IGET Project	Impact Pathways In-combinatio
			• Physical loss or damag physical processes • Physical change to hal airborne pollutants **Contamination** • Non-toxic contaminatio • Toxic contamination th bound in sediments, a releases **Disturbance** • Disturbance through u • Airborne noise and vis
27.	North Killingholme Power Project	6.38km north West of the Site	**Habitat loss/damage** • Physical damage throu habitat • Physical loss of (or cha • Physical loss or damag physical processes • Physical change to hal airborne pollutants **Contamination** • Non-toxic contaminatio • Toxic contamination th bound in sediments, a

	Project	Distance From IGET Project	Impact Pathways In-combinatio
			releases **Disturbance** • Disturbance through u • Airborne noise and vis
102.	DM/1071/22/FUL Rock revetment repair and reinforcement along a 4.5km section of the Humber Estuary, works to repair, reinstate and enable access to the gravity outfalls at Middle Drain, Oldfleet Drain and Mawmbridge Drain, associated landscape improvements, installation of temporary construction compounds and associated infrastructure	1.6km from the Site	**Habitat loss/damage** • Physical damage throu habitat • Physical loss of (or cha • Physical loss or damag physical processes • Physical change to hal airborne pollutants **Contamination** • Non-toxic contaminatio • Toxic contamination th bound in sediments, a releases **Disturbance** • Disturbance through u • Airborne noise and vis
	Immingham Onshore Wind	Approx. 2 km	Disturbance (including colli • Airborne noise and vis • Collision risk

Table ~~34~~35: The potential for an AEOI on qualifying habitats and species of the Humber Estuary SAC and the Wash and North in-combination effects.

ID	Plan/Project	Features *	Summary of potential effects	Potential for AE
9	DM/0865/19/FUL Erection of 20MW gas fuelled embedded energy generation compound – Site 4	H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	**Construction:** The air quality assessme Consultants ("AQC"), 20 isolation, and the impact in-combination. The asse bulk of the impact from t there is no relevant air q rounded to 1% or less of Road and receptors on t It is noted that the air qu the four generator site e sensitivity. A second air quality asse site in 2020 (Air Pollution generation sites at sever of which were mudflat ha impacts in the Project ES impact (or Process Cont threshold for nitrogen de reported. Construction p this same location. **Operation**: The second air quality as current lower Critical Loa Project and IERRT emis 0.4% of the same lower emission standards and deposition is below the 1 therefore no potential for of nitrogen deposition. It is concluded that in-co not result in an AEOI

ID	Plan/Project	Features *	Summary of potential effects	Potential for AE
				cumulative development the impact (or process c threshold. Construction p have a negligible impact **Operation:** The saltmarsh habitat th assessment (the North K process contribution) tha same location, the opera (assuming all vessels vis Again, the cumulative de report impacts at the nat Project, the annual mean reasoned estimate. The conservation impact in th annual mean NO_2 impac deposition impact of arou cumulative impact of this It is concluded that in-co not result in an AEOI.
16	DM/0862/19/FUL Erection of 20MW gas fuelled embedded energy generation compound - Site 1	H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	**Construction**: As per assessment repo **Operation**: As per assessment repo It is concluded that in-co not result in an AEOI.
17	DM/0863/19/FUL Erection of 20MW gas fuelled embedded energy generation compound - Site 2	H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	**Construction**: As per assessment repo **Operation**: As per assessment repo It is concluded that in-co not result in an AEOI.

ID	Plan/Project	Features *	Summary of potential effects	Potential for A
				Threshold (1% of the up (receptors O_E1 and O_ compliant, the Project ar 1% of the lower Critical L Load threshold). Thus, th impacts is minimal. It is concluded that in-co not result in an AEOI.
21	EN010107 South Humber Bank Energy Centre	H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	**Construction**: At the shared nature con development impact to a and the nitrogen deposit However, the impact of t considered to be negligi impacted saltmarsh habi **Operation**: The cumulative develop Level and the nitrogen d same location as the IGE account for 1% of the Cr deposition, assuming IG standards, and 0.5% of t nitrogen deposition, whe the cumulative impact of It is concluded that in-co not result in an AEOI.
35	DM/0329/18/FUL Erection of industrial building and adjoined two storey office/control room to create power plant (18MW Energy From Waste)	H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	**Construction** At the saltmarsh habitat development impacts ac Critical Load threshold fo Given the distance betw IGET project constructio IGET Project's key recep the risk of cumulative im

ID	Plan/Project	Features *	Summary of potential effects	Potential for AEOI
37	DM/1070/18/FUL Construction of an energy from waste facility of up to 49.9MWe gross capacity including emissions stack(s) and associated infrastructure	H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	**Construction**: Impacts associated with the cumulative development relate to those from its energy centre plant stack emissions. At the saltmarsh habitat to the north of the cumulative development site, cumulative development impacts account for 2.5% of the Critical Level for NO_X and 4% of the lower Critical Load threshold for nitrogen deposition (2% of the upper Critical Load threshold). Given the distance between the larger cumulative development impacts and the IGET Project, the fact that IGET project construction emissions will impact close to source and the fact that the IGET Project's key receptors are not located downwind of the cumulative development, the risk of cumulative impacts with this project being anything more than negligible are considered low. **Operation**: Impacts associated with the cumulative development relate to those from its energy centre plant stack emissions. At the saltmarsh habitat to the north of the cumulative development site, cumulative development impacts account for 2.5% of the Critical Level for NO_X and 4% of the lower Critical Load threshold for nitrogen deposition (2% of the upper Critical Load threshold). IGET Project and IERRT impacts at the same location account for 1.1% of the Critical Level for NO_X and 0.4% of the lower Critical Load threshold for nitrogen deposition (0.2% of the upper Critical Load threshold), assuming IGET vessels all comply with Tier II emission standards. Based on IGET vessels complying with Tier III standards, IGET Project and IERRT impacts at the same location account for 0.5% of the Critical Level for NO_X and 0.3% of the lower Critical Load threshold for nitrogen deposition (0.15% of the upper Critical Load threshold). Thus, the cumulative impact of this cumulative development to Project impacts is minimal. It is concluded that in-combination changes in air quality arising from the two projects will not result in an AEOI.
95	PA/2018/918 Planning permission to construct a new gas-fired power station with a gross electrical output of up to 49.9 megawatts. A further non-material amendment application has been made (PA/2021/1039)	H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	**Construction**: Impacts from the cumulative development are set out in the air quality assessment that supported its ES (VPI Immingham B Ltd, 2019), and concern emissions from the operation of an OCGT plant. During the cumulative development's construction phase, it has impacts on annual mean NO_X of less than 0.1% of the Critical Level at an area that represents the nearest and worst-affected section of saltmarsh habitat (represented in the IGET air quality assessment as receptor O_E6). During the cumulative development's operation, the same saltmarsh habitat experiences an impact of 0.5% of the Critical Level for NO_X and <0.1% of the Critical Load for nitrogen deposition. **Operation**: During the cumulative development's operation, the same saltmarsh habitat experiences an impact of 0.5% of the Critical Level for NO_X and <0.1% of the Critical Load for nitrogen deposition. At this location, operational IGET Project and IERRT emissions have an impact that is 1% of the Critical Level for NO_X and 0.4% of the Critical Load for nitrogen deposition (assuming IGET vessels are MARPOL Regulation 13 Tier II compliant). Assuming vessels are Tier III compliant, IGET Project and IERRT have emissions have an impact that is 0.5% of the Critical Level and 0.3% of the Critical Load. Given the distance between the saltmarsh habitat most affected by the cumulative development impacts and the IGET Project, the limited impact of the cumulative development and the fact that IGET project construction emissions will impact close to source, the risk of cumulative impacts with this project being anything more than

ID	Plan/Project	Features *	Summary of potential effects	Potential for AE
				negligible are considered It is concluded that in-co not result in an AEOI.
116	DM/0664/19/FUL Velocys Waste to Fuel Plant, off Moody Lane - Development of a sustainable transport fuels facility, including various stacks up to 80m high, creation of new accesses, installation of pipelines, rail link, associated infrastructure and ancillary works	H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	**Construction** The construction of the c emissions that could cor Project's construction, du the nearest air quality se The cumulative developr maximum impact within habitat. It reports an ann deposition rate that is 0.5 type (or 0.28% of the up shared saltmarsh habitat Project, cumulative effec **Operation** The construction of the c emissions that could cor Project's operation, due the nearest air quality se The cumulative developr maximum impact within habitat. It reports an ann deposition rate that is 0.0 type (or 0.3% of the uppe cumulative development O_E5, where impacts ac 0.4% of the lower Critica Critical Load threshold), Tier III emission limits, IG the Critical Level and Lo Critical Load threshold). Project impacts is minim It is concluded that in-co not result in an AEOI.

ID	Plan/Project	Features *	Summary of potential effects	Potential
		H1130: Estuaries H1140: Mudflats and sandflats not covered by seawater at low tide	• Physical loss of (or change to) habitat and associated species **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	only a very small increas Immingham area and dis **Contamination** The physical processes future maintenance dred adjacent berths at IOT, t keep the bed generally s predicted underneath the into the berth pocket, so is, however, this is likely small volume of material completeness, the follow with respect to increased and disposal of material Immingham, and Sunk D The assessment of the p Project indicates a neglig effects from dredge or di period of time (a matter o next peak tide (ebb or flo increased SSC values a concentrations. It is also the ports and approache will mean the potential fo same time is limited. In relation to the release sediment samples to be minimises the potential f concerned with the dispo comprise a source of his cumulative effect. Considering all pathways volume) for any mainten in-combination effects ar objectives, and it is conc features.
		H1330: Atlantic salt meadows	Habitat loss/damage	The cumulative develop

ID	Plan/Project	Features *	Summary of potential effects	Potential for Al
		S1099: River lamprey *Lampetra fluviatilis* S1364: Grey seal *Halichoerus grypus* S1365: Harbour seal *Phoca vitulina*		Grimsby) will mean the p at the same time is limite Further, dredging for bot most) in a relatively loca proposed mitigation mea in-combination effects ar objectives, and it is conc features.
94.	MLA/2020/00520 Humber International Terminal (HIT) berth 2: adaptation for car carriers	H1110: Sandbanks which are slightly covered by sea water all the time H1130: Estuaries H1140: Mudflats and sandflats not covered by seawater at low tide H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical loss or damage of habitat through alterations in physical processes • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	**Habitat loss/damage** The piles required for the habitat. In addition, sedi result of seabed disturba sedimentary processes c directly around piles effe Furthermore, the benthic localised physical disturb considered fast growing physical loss of habitat a **Contamination** In relation to water and s respect to increased SSC as a result of seabed dis localised and temporary sediment bound contam negligible on features fo **Air Quality** The construction and op the Project will likely cau which is represented in t Project and IERRT emis and 0.4% of the lower C Critical Load threshold), standards. Based on IGI IERRT impacts at the sa 0.3% of the lower Critica Critical Load threshold).

ID	Plan/Project	Features *	Summary of potential effects	Potential for AE
		S1099: River lamprey *Lampetra fluviatilis* S1364: Grey seal *Halichoerus grypus* ~~H1130: Estuaries~~S1365: Harbour seal *Phoca vitulina* ~~H1140: Mudflats and sandflats not covered by seawater at low tide~~	noise and vibration	and North Norfolk Coast effects in fish and marine and strong behavioural r projects. Both projects w effects (such as soft star migratory fish and the us Therefore, assuming the implemented, the predic compromise any of the c no potential for AEOI on
25.	TR030001, TR030005 and TR030006 Able Marine Energy Park including Material Changes 1 and 2	H1110: Sandbanks which are slightly covered by sea water all the time	**Habitat loss/damage** • Physical loss or damage of habitat through alterations in physical processes • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	**Habitat loss/damage** B to marine habitats as a r sediment removal, sedin hydrodynamic and sedin resulting in an AEOI for I Immingham are typically high levels of physical di sediment transport. Dep predicted to be localised pockets with species occ deposition. The cumulati highly localised and sma processes are considere The AMEP project will re as a result of the reclam will be provided at the C a result of the Project wi an AEOI. Therefore, with there is no cumulative ef the conservation objectiv qualifying interest feature **Contamination** In relation to water and s respect to increased SS as a result of seabed dis

ID	Plan/Project	Features *	Summary of potential effects	Potential for AE
		H1130: Estuaries H1140: Mudflats and sandflats not covered by seawater at low tide H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand		and nitrogen deposition Load threshold for saltm construction phase emis distance between the de *Operation* At the worst-impacted na development emissions, and nitrogen deposition Load threshold for saltm SAC. If it is assumed tha cumulative development predicted to experience annual mean NO_X and 0 (assuming IGET vessels with the cumulative deve cumulative development Estuary. This activity is a emissions accounted for assessment for the Proje quality sensitive receptor period in which emission unlikely. It is concluded that in-co result in no AEOI.
		H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*)	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	The traffic data used to i cumulative with regards in-combination effects ar interest features.
		S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis* S1364: Grey seal *Halichoerus grypus*	**Disturbance** • Disturbance through underwater noise and vibration	Underwater noise genera with the AMEP works ha grey seal features of the and North Norfolk Coast behavioural reactions in fish and marine mamma fish and marine mamma

ID	Plan/Project	Features *	Summary of potential effects	Potential for AE
		H1130: Estuaries	• Physical loss of (or change to) habitat and associated species	for the Humber Low Car is not considered possib subject to controls by sta SAC features. Therefore the Project, the predicted compromise any of the c reached.
		H1140: Mudflats and sandflats not covered by seawater at low tide	**Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	
		S1095: Sea lamprey *Petromyzon marinus*	**Disturbance** • Disturbance through underwater noise and vibration	
		S1099: River lamprey *Lampetra fluviatilis*		
		S1364: Grey seal *Halichoerus grypus*		
		S1365: Harbour seal *Phoca vitulina*		
29.	EN070008 Viking CCS Pipeline	S1099: River lamprey *Lampetra fluviatilis*	**Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases **Disturbance**	Only the onshore transpo Pipeline DCO application development. In addition construction vehicles ass site and there are no ope potential for effects on ri qualifying feature of the Watercourses which will potential to support river techniques. There is a lo result of open-cut crossi impacts on lamprey from migration periods. There constructions areas (i.e.

ID	Plan/Project	Features *	Summary of potential effects	Potential for AE
	Immingham Eastern Ro-Ro Terminal	covered by sea water all the time	• Physical loss or damage of habitat through alterations in physical processes • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	~~4.14.6.~~ *Intertidal habita* ~~It is anticipated that the I~~ ~~habitat due to the followi~~ ~~• Direct loss of 0.01~~ ~~which will becon~~ ~~• Capital dredging a~~ direct loss of 0.0 ~~intertidal (up to 0~~ the presence of The ~~Project~~IERRT proje Examining Authority on 6 ha (due to ~~the~~ marine pil ~~0.03~~0.02 ha (due to pote ~~changes in currents~~of th intertidal as a result of ~~b~~ ~~0.054 ha.~~0.044 ha (base together to calculate pot habitat loss represents a and approximately ~~0.000~~ seawater at low tide' fea intertidal losses for both consist of very narrow st losses are considered to background changes in r in accretion and erosion ~~marine piling for both pro~~ mudflat extent are of a m of the nearby mudflats w Estuary. *Subtidal habitat loss* Marine piling will result in seabed habitat for the Pr habitat loss of 0.083 ha r Estuary SAC.

ID	Plan/Project	Features *	Summary of potential effects	Potential for AEoI
		H1130: Estuaries		~~(with the capital dredge for the Project removing 4,000 m³ of material over a maximum area of approximately 10,000m²~~). For both projects following dredging, it is considered

ID	Plan/Project	Features *	Summary of potential effects	Potential for AEoI
		H1140: Mudflats and sandflats not covered by seawater at low tide		

ID	Plan/Project	Features *	Summary of potential effects	Potential for AEOI
		H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	MARPOL Tier III Emissions Standard Vessels Scenario In-combination exceedances of the 1% screening threshold (i.e. where predicted emissions >1% of the relevant critical levels/ loads) for MARPOL Tier III vessels were identified for the Project operating alongside the IERRT project at the following Humber Estuary SAC receptors: • NOx >1% of the critical Level at receptors O_E1 and OE_2, and around 1% of the critical level at receptor O_E3. However, these impacts occur at locations where total NOx concentration with the Project and IERRT project in operation account for no more than 53% of the critical level (i.e. the critical level would not be exceeded). • Nitrogen deposition – around 1% of the Critical Load at receptors O_E1 and OE_2. However, the Critical Load for nitrogen deposition is already exceeded by the background contribution alone and the in-combination contribution accounts for just 0.9% of the total nitrogen deposition predicted at these locations. • SO_2 – critical levels not exceeded at any location. • NH_3 – critical levels are not exceeded at any location. Since the '1% of the critical load' threshold will not be exceeded, it can be concluded that under a MARPOL Tier III scenario the 'in combination' effect for all pollutants would be imperceptible and no adverse effect on integrity would arise MARPOL Tier II Emissions Standard Vessels Scenario In-combination exceedances of the 1% screening threshold (i.e. where predicted emissions >1% of the relevant critical levels/ loads) for MARPOL Tier II vessels were identified for the Project operating alongside the IERRT project at the following Humber Estuary SAC receptors: • NOx >1% of the critical level at receptors O_E1, OE_2, OE_3 and OE_4 and around 1% of the critical level at receptors O_E5, OE_6 and OE_7. However, impacts of more than 1% occur at locations where total NOx concentration with the Project and IERRT project in operation account for no more than 57% of the critical level (i.e. the critical level would not be exceeded). • Nitrogen deposition – around 1% of the critical load at receptors O_E1 and OE_2, and less than 1% of the critical load at all other receptors. However, the critical load for nitrogen deposition is already exceeded by the background contribution alone and the in-combination contribution accounts for just 1.4% of the total nitrogen deposition predicted at these locations. • SO2 – critical levels not exceeded at any location • NH3 – critical levels are not exceeded at any location Therefore, the impact of the Project 'in combination' with the IERRT project, on nitrogen deposition under a MARPOL Tier II emissions scenario is greater than 1% of the critical load (being approximately 2% of the critical load) at two receptor locations, and therefore needs further consideration. For saltmarsh, the APIS provides a Critical Load range of 10 - 20 kg/ha/yr and nitrogen inputs have been experimentally demonstrated to have an effect on overall species composition of saltmarsh. However, the Critical Loads on APIS are generic for each habitat type and cover a wide range of deposition rates. They do not (and are not intended to) take other influences (to which the habitat on a given site may be exposed) into consideration. Moreover, it is important to note from APIS that the experimental studies which underlie

ID	Plan/Project	Features *	Summary of potential effects	Potential for AEoI
				conclusions regarding the sensitivity of saltmarsh have '… *neither used very realistic N doses nor input methods i.e. they have relied on a single large application more representative of agricultural discharge*', which is far in excess of anything that would be deposited from atmosphere. Expert judgement is therefore required in order to determine which part of the critical load range to use for saltmarsh habitat. Generally, nitrogen inputs from the air are not as important to plants as nitrogen from other sources. Effects of nitrogen deposition from atmosphere are likely to be dominated by much greater impacts from marine or agricultural sources. This is reflected on APIS itself, which states regarding saltmarsh that 'Overall, N deposition [from atmosphere] is likely to be of low importance for these systems as the inputs are probably significantly below the large nutrient loadings from river and tidal inputs'. Another mitigating factor is that the nature of intertidal saltmarsh in the Humber estuary means that there is daily flushing from tidal incursion. This is likely to further reduce the role of nitrogen from atmosphere in controlling botanical composition. The change in threshold values for critical loads in APIS has been informed by recent studies in Ireland and the Netherlands, and a collaboration under the Working Group on Effects ("WGE") of the UNECE Convention on Long-Range Transboundary Air Pollution reported by the German Environment Agency (Ref 1)-. That research has shown that position of the saltmarsh in the tidal profile is relevant to which part of the critical load range is more appropriate. This is because the less the frequency or duration of inundation by seawater, the more important atmosphere becomes as a source of nitrogen. The APIS Site Relevant Critical Load app for the Humber Estuary SAC states that the lowest part of the new critical load range for upper saltmarsh (10 kg N/ha/yr) is most appropriate to the '*more densely vegetated upper marsh (e.g. EUNIS class MA223, MA224)*' with the highest part of the range being more appropriate for more frequently inundated marsh. Classes MA223 and MA224 are '*regularly but not daily flooded by seawater*' with a figure cited of 100-200 days/year. The evidence therefore leads to the conclusions that the upper part (20 kgN/ha/yr) of the critical load range is appropriate for the affected areas of saltmarsh. It follows that the additional predicted contribution from nitrogen emissions from the Project does not result in any exceedance of the Critical Load range for saltmarsh, as the modelled annual mean deposition rate at receptor O_E12 will be 16.0 kg N/ha/yr, which is well below the 20 kg N/ha/yr upper critical load. Moreover, guidance within the Highways Agency's Design Manual for Roads and Bridges ("DMRB") in respect of Air Quality (Ref 1-238), identifies a threshold of 0.4 kg N/ ha/ yr as resulting in 'no significant effect' on all habitats based on Natural England Research Report NECR 210 (Ref 1-239), which collated dose response research and found that the lowest additional nitrogen deposition to reduce species richness in any habitat by one species was 0.4 kg/ N/ ha/ yr. The modelled cumulative Process Contribution from the Project under the worst-case MARPOL Tier II Emissions Standards scenario is 0.2 kg/ N/ ha/ yr and therefore is well under this threshold for effecting a measurable change in vegetated habitat species diversity. Although the emissions to air arising from the Project are mainly from marine vessels, as the pollutants are the same as those assessed for road vehicle engine emissions in the DMRB, it is considered appropriate to apply this threshold in the assessment for the Project. In addition, Natural England's Supplementary Advice on Conservation Objectives for the Humber Estuary SAC states that the conservation objective for the '*Atlantic salt meadows Glauco-Puccinellietalia maritimae*' and '*Salicornia and other annuals colonising mud and sand*' habitat features relevant to the assessment of air quality effects is to "*Maintain concentrations and deposition of air pollutants to below the site-relevant Critical Load or Level values given for this feature on the Air Pollution Information System*" (Ref 1-240). As set out above, the Process Contribution from the Project, which results in a mean deposition rate of 16 kg N/ ha/ yr on the nearest saltmarsh habitat does, not result

ID	Plan/Project	Features *	Summary of potential effects	Potential for AEoI
				in any exceedances of the Critical Load published on the APIS. Indeed, air quality modelling for this Project forecasts a slight improvement in nitrogen deposition between the base year and 2036 even when allowing for the Project and the IERRT. Therefore, the Project will not compromise the air quality 'maintain' target for the Humber Estuary SAC. It is therefore concluded that operational emissions from marine vessels and landside plant in combination with emissions from IERRT scheme will not adversely affect the integrity of designated habitats or undermine the conservation objectives within the Humber Estuary SAC.
		S1095: Sea lamprey *Petromyzon marinus*	**Disturbance** • Disturbance through underwater noise and vibration	Underwater noise generated during marine piling required as part of the IERRT project along with the Project have the potential to result in cumulative effects on ~~fish (including diadromous migratory species) and marine mammal receptors in~~lamprey and grey seal features of the Humber Estuary~~. Marine piling noise has the potential to cause injury effects in~~ SAC and the harbour seal feature of the Wash and North Norfolk Coast SAC. Dredging for both projects is only expected to cause behavioural reactions in a relatively localised area in the vicinity of the dredger for both fish and marine mammals~~ within close proximity to the marine piling activity and behavioural responses over a wider area of the Humber Estuary for both projects. ~~. Piling noise has the potential to cause injury effects in fish and marine mammals within close proximity to the piling activity and strong behavioural responses over a wider area of the Humber estuary for both projects. Lamprey form part of the least sensitive noise hearing fish group according to the Popper *et al.* (2014) guidelines and the predicted zone of behavioural effects are based on the sound levels to which schools of sprat, which are in the highest sensitive noise hearing fish group, responded on 50% of observations (Hawkins *et al.*, 2014). The predicted behavioural zone is therefore considered overly precautionary and conservative and is likely to be a more localised area for lamprey. Instantaneous peak Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) effects in grey seal are predicted to occur within close proximity to the impact piling activity and cumulative SEL PTS and TTS effects are predicted over a wider area. Assuming seals evade the injury effects zone, they are not considered to be at risk of any instantaneous or cumulative injury effects during impact piling. Strong behavioural responses may occur over a wider area although the existing constraints of the estuary are such that elevated underwater noise levels generated during piling for the Project and IERRT are physically constrained to within the outer section of the Humber Estuary and are unable to directly reach the grey seal breeding site at Donna Nook. The Spurn on the Outer Humber Estuary and promontory of Grimsby Docks means that much of the underwater noise will be limited by these hard constraints and will not propagate to the outer part of the estuary and beyond. In addition, the upstream bend in the estuary at Salt End will mean that elevated underwater noise levels will not be able to propagate beyond this point. In other words, potential behavioural responses and/or displacement effects are primarily limited to the section of the estuary between around Salt End (upstream) and Grimsby to Spurn Bight (downstream). The maximum impact piling scenario for both projects assuming the construction works overlap is for up to 7 tubular piles to be installed each day (4 piles for IERRT and 3 piles for the Project) using up to 6 piling rigs driving at any one time (4 piling rigs for IERRT and 2 piling rigs for the Project). If none of the pile driving activity for both projects were to occur at the exact same time and temporally overlap over a 24-hour period, the maximum impact pile driving scenario would involve approximately 80 minutes of vibro piling per day (20 minutes for IERRT and 60 minutes for the Project) and 450 minutes of impact piling per day (180 minutes for IERRT and 270 minutes for the Project).

ID	Plan/Project	Features *	Summary of potential effects	Potential for AEOI
		S1099: River lamprey *Lampetra fluviatilis* S1364: Grey seal *Halichoerus grypus* S1365: Harbour seal *Phoca vitulina*		Any disturbance and barrier to lamprey and grey seal movements caused by the noise during piling for IERRT and the Project would be temporary with periods during a 24-hour period when no piling will be undertaken. The proportion of impact piling is estimated to be at worst around 31 % over a 24-hour period (based on 450 minutes of impact piling per day). In other words, any lamprey and grey seals that remain within the predicted behavioural effects zone at the time of impact piling will be exposed a maximum of up to 31 % over the period of a day. The proportion of vibro piling is estimated to be at worst around 6 % over a 24- hour period (based on 80 minutes of vibro piling per day). In other words, any lamprey and grey seals that remain within the predicted behavioural effects zone at the time of piling will be exposed a total maximum of up to 37 % over the period of a day. In reality, less than 7 piles are likely to be driven per day and also there is likely to be some temporal overlap in the pile driving activity, therefore, the assumptions on maximum pile driving periods and daily exposures are considered to represent a worst case. Piling will also not take place continuously as there will be periods of downtime, pile positioning and set up. The same mitigation measures are proposed for both ~~projects~~the Project and IERRT to help minimise potential adverse effects (i.e., soft start procedures, timing restrictions to avoid sensitive periods for migratory fish and the use of marine mammal observers). In order to take account of any potential in-combination effects should the piling programmes for both projects overlap, it is proposed that the maximum duration of percussive piling permitted within any 4-week period must not exceed a total of 196 hours where any percussive pile drivers for either one or both projects are in operation. Where percussive piling is occurring simultaneously across the two projects these respective time periods will not be double counted as the temporal exposure to this effect is not increased. This restriction applies from 1 June to 30 June and 1 August to 31 October inclusive in any year to minimise the impacts on fish (including lamprey) migrating through Humber Estuary during this period. The measurement of time during each 196-hour work-block must begin at the start of each timeframe, roll throughout it, then cease at the end, where measurement will begin again at the start of the next timeframe, such process to be repeated until the end of piling works. This restriction does not apply to percussive piling that can be undertaken outside the waterbody at periods of low water. This joint restriction will be secured in the outline Construction Environmental Management Plan. Therefore, assuming the proposed mitigation measures for both projects are implemented, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
27.	North Killingholme Power Project	H1110: Sandbanks which are slightly covered by sea water all the time H1130: Estuaries H1140: Mudflats and sandflats not covered by seawater at low tide	**Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	**Contamination** Given the extent of seabed disturbance from the North Killingholme Power Project which involves construction of an intake and marine piling any changes would cause highly localised and temporary changes in suspended sediment levels (and related changes in sediment bound contaminants and dissolved oxygen). There are no anticipated cumulative effects. Considering all pathways, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	**Construction** At the worst-impacted saltmarsh habitat site within the SAC, from the worst-case cumulative development emissions, annual mean NO_X impacts account for 4% of the Critical Level and nitrogen deposition rates account for 1.8% of the current lower Critical Load threshold for saltmarsh habitat and 0.9% of the upper threshold. At the saltmarsh habitat within the North Killingholme Haven Pits SSSI, the worst-case cumulative development impacts account for 1.8% of the Critical Level for NO_X and 0.2% of the lower Critical Load threshold for nitrogen deposition. It is considered that the impact of IGET construction phase emissions at these same locations is likely to be negligible,

ID	Plan/Project	Features *	Summary of potential effects	Potential for AEOI
				given the distance between the development work areas. **Operation** The worst-case cumulative development emissions have annual mean NO_X impacts of around 4% of the Critical Level and nitrogen deposition rates of around 1.8% of the current lower Critical Load threshold for saltmarsh habitat (0.9% of the upper threshold). At the saltmarsh habitat within the North Killingholme Haven Pits SSSI, the worst-case cumulative development impacts account for 1.8% of the Critical Level for NO_X and 0.2% of the lower Critical Load threshold for nitrogen deposition (0.1% of the upper threshold). Emissions predicted closest to the cumulative development's worst-case impacts are represented by receptor O_E12, where impacts assuming all IGET vessels are MARPOL Regulation 13 Tier II compliant account for 0.4% of the Critical Level for NO_X and 0.2% of the lower Critical Load range for nitrogen deposition. At the SSSI, cumulative impacts account for 0.3% of the Critical Level for NO_X and 0.1% of the lower Critical Load threshold for nitrogen deposition, assuming Tier II emission standards. Thus, the cumulative impact of this cumulative development to Project impacts is minimal. It is concluded that in-combination changes in air quality arising from the two projects will not result in an AEOI.
		S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis* S1364: Grey seal *Halichoerus grypus* S1365: Harbour seal *Phoca vitulina*	**Disturbance** • Disturbance through underwater noise and vibration	Underwater noise generated during marine piling required as part of the Project along with construction of the intake and marine piling for the North Killingholme Power Project have the potential to result in cumulative effects on sea and river lamprey and grey seal features in the Humber Estuary. Marine piling noise has the potential to cause injury if these features are within close proximity to the marine piling activity and strong behavioural responses over a wider area of the Humber Estuary for both projects. Both projects will require similar mitigation to help minimise potential adverse effects (such as soft start procedures, timing restrictions to avoid sensitive periods for migratory fish and the use of marine mammal observers). With these mitigation measures, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
102.	DM/1071/22/FUL Rock revetment repair and reinforcement along a 4.5km section of the Humber Estuary, works to repair, reinstate and enable access to the gravity outfalls at Middle Drain, Oldfleet Drain and Mawmbridge Drain, associated landscape improvements, installation of temporary construction compounds and associated	H1110: Sandbanks which are slightly covered by sea water all the time	**Habitat loss/damage** • Physical loss or damage of habitat through alterations in physical processes • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species **Contamination** • Non-toxic contamination through elevated SSC Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	**Habitat loss/damage** The coastal defence project will result in a permanent loss of 0.25 ha of intertidal habitat in 11 discrete narrow strips averaging 227 m^2, of which the largest is no more than 10m wide and 30m long. These discrete areas of mudflat loss along the revetment are distanced roughly 100m apart. The HRA undertaken for the Project concluded that *'within the Pyewipe area, there is approximately 300 ha of this Annex 1 habitat, being over 700 m at its widest extent to the south. Therefore, the loss of 0.25 ha equates to a loss of 0.08% of the total mudflats within Pyewipe. The loss of these small and discrete parcels of mudflat along the base of the existing revetment is not considered to adversely affect the function of the mudflats as a self-sustaining habitat within the Pyewipe area. This impact is considered to be ecologically inconsequential to the Humber Estuary SAC and so not adversely affecting the integrity of the site. As the impact is considered to be ecologically inconsequential, it is not considered to frustrate the conservation objective of restore the total extent. No adverse effect on the site integrity of the Humber Estuary SAC is anticipated as a result of loss of habitat constituting the qualifying feature of mudflats and sandflats not covered by seawater at high tide associated with construction of rock armour revetment*'. Losses of intertidal as a result of the Project will be *de minimis* in extent (up to 0.0316 ha) and were assessed as not resulting in an AEOI. **Contamination** In relation to water and sediment quality, the potential impacts resulting from the flood defence works (such as increased suspended sediment levels) will be highly localised, temporary and effects on features are considered negligible.

ID	Plan/Project	Features *	Summary of potential effects	Potential for AEOI
				In relation to the release of sediment -bound contaminants, prior to excavation of the toe of the revetment sediment samples will be tested in line with OSPAR requirements to minimise the potential for mobilisation of contaminants. In addition, excavation is restricted to within a few metres of the revetment and therefore this is unlikely to result in a cumulative effect. Considering all pathways, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		H1130: Estuaries		
		H1140: Mudflats and sandflats not covered by seawater at low tide		
		H1330. Atlantic salt meadows *(Glauco-Puccinellietalia maritimae)* H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** Physical change to habitats resulting from the deposition of airborne pollutants	**Air Quality** At the nature conservation sensitive saltmarsh habitat potentially impact on by cumulative development and the cumulative development will have some impact from site plant emissions, although such emissions will only be present for a limited period. Operational cumulative impacts at this location (receptor O_E5) account for 1.1% of the annual mean Critical Load for NO_X and 0.4% of the lower Critical Load threshold of nitrogen deposition (0.2% of the upper Critical Load threshold), assuming MARPOL Regulation 13 Tier II emission limits. With Tier III emission limits, impacts account for 0.5% and 0.3% of the Critical Level and Lower Critical Load threshold respectively (0.15% of the upper Critical Load threshold). Thus, the cumulative impact of this cumulative development to Project impacts is minimal. It is concluded that in-combination changes in air quality arising from the two projects will not result in an AEOI.
		S1095: Sea lamprey *Petromyzon marinus*	**Disturbance** Disturbance through underwater noise and vibration	Potential underwater noise effects on marine ecology receptors (invertebrates, fish and marine mammals) are expected to be negligible as a result of the revetment project. This is because revetment construction is typically undertaken when the revetment footprint is not inundated with sea water (i.e., remains in the air) which limits underwater noise propagation. Even assuming some noise propagation, the low noise levels associated with this type of coastal defence activity will at worst produce underwater noise levels that will be barely discernible above background conditions and unlikely to cause any behavioural reactions in marine species (even in very close proximity). Underwater noise effects on features as a result of the Project were assessed as not resulting in an AEOI with the proposed mitigation measures in place. The predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		S1099: River lamprey *Lampetra fluviatilis*		
		S1364: Grey seal *Halichoerus grypus*		
		S1365: Harbour seal *Phoca vitulina*		
All projects		H1110: Sandbanks which are slightly covered by sea water all the time	**Habitat loss/damage** • Physical loss or damage of	**Habitat loss/damage** With respect to intertidal habitat loss, noting that compensatory habitat will be provided

ID	Plan/Project	Features *	Summary of potential effects	Potential for AEOI
		H1130: Estuaries H1140: Mudflats and sandflats not covered by seawater at low tide	habitat through alterations in physical processes • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	for the Able Marine Energy Park ("AMEP") project and also for indirect losses associated with the Stallingborough Phase 3 Flood Alleviation Scheme (DM/1071/22/FUL), all other projects have intertidal habitats losses that are considered de minimis in extent and ecologically inconsequential. Subtidal losses are also considered de minimis in extent and ecologically inconsequential for all projects. Potential changes to marine habitats during construction or operation as a result of seabed disturbance (such as due to dredging or marine piling) are considered to be localised, temporary and low magnitude for the Project and all other projects with direct no spatial overlap of dredge or construction footprints occurring. Considering all pathways, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features. **Contamination** Water quality effects are anticipated to be localised and temporary for all projects with effects on marine habitats or species considered negligible even when considered cumulatively. Considering all pathways, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		H1330. Atlantic salt meadows (*Glauco-Puccinellietalia maritimae*) H1310. *Salicornia* and other annuals colonising mud and sand; Glasswort and other annuals colonising mud and sand	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants	A number of projects have been scoped into the in-combination effects assessment for air quality impacts and the assessment has concluded that none will result in AEOI. The detailed AQ modelling undertaken for the Project included specific cumulative effect modelling of the marine vessel and road vehicle emissions for the adjacent IERRT project given the proximity of the two projects, and the potential for cumulative effects to occur in the same part of the Estuary and hence affect the same sensitive receptors.
		S1095: Sea lamprey *Petromyzon marinus* S1099: River lamprey *Lampetra fluviatilis* S1364: Grey seal *Halichoerus grypus* S1365: Harbour seal Phoca vitulina	**Disturbance** • Disturbance through underwater noise and vibration	Underwater noise impacts (on lamprey species and grey seal) as a result of the Project along with several other projects have the potential to result in adverse significant effects in migratory fish and marine mammals species. However, there is considered to be no potential for AEOI on qualifying interest features as a result of the Project with the proposed mitigation measures in place. All projects will be subject to similar mitigation measures to avoid the potential for any adverse cumulative underwater noise effects on these features. It is therefore considered a reasonable and robust conclusion that the predicted residual in-combination effects will not compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
* All features in the table relate to the Humber Estuary SAC with the exception of S1365: Harbour seal *Phoca vitulina* which is a feature of the and the Wash and North Norfolk Coast SAC.				

Table ~~35~~36: The potential for an AEOI on qualifying species of the Humber Estuary SPA due to in-combination effects.

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
115.	MLA/2014/00431/4 Maintenance dredge disposal at Grimsby, Immingham and Sunk Dredged Channel	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A149: Dunlin *Calidris alpina alpina* (Non-breeding) A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage	**Disturbance** • Airborne noise and visual disturbance	There is the potential for cumulative effects on birds features if the dredging activities associated with MLA/2014/00431 occur at the same time as construction and maintenance dredging as part of the Project. The noise and visual stimuli associated with MLA/2014/00431 is likely to be similar to the dredging operations for the Project and will be limited due the periodic frequency over the course of a year. Any disturbance responses would be expected to be infrequent, short duration and localised. It is also considered likely that the availability of dredging plant (servicing the ports and approaches across the wider Humber, including Goole, Hull and Grimsby) will mean the potential for dredging to be taking place at adjacent locations and at the same time is limited. Assuming the proposed mitigation measures for the Project are implemented, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
94.	MLA/2020/00520 Humber International Terminal (HIT) berth 2: adaptation for car carriers	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A149: Dunlin *Calidris alpina alpina* (Non-breeding) A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage	**Disturbance** • Airborne noise and visual disturbance	There is the potential for the Project along with HIT berth 2 works to cause cumulative effects in term of visual and noise disturbance to coastal waterbirds along the foreshore during construction. Data presented as part of the marine licence application for the HIT berth 2 works suggest that waterbirds such as Shelduck, Dunlin, Curlew, Redshank and Black-tailed Godwit are only recorded in very low numbers (typically <10-20 individuals) representing <1% of estuary-wide numbers. Marine piling for the HIT berth 2 works will be short term (two weeks) with only intermittent marine piling activity undertaken each day (several hours per day) during this period. Mild disturbance responses and short-term and localised displacement of the very low numbers of these species present in the vicinity of the HIT project during the works is possible. However, rather than being displaced from the local area completely, birds would be expected to redistribute to nearby foreshore in the Immingham area and continue to feed and roost in these alternative locations following dispersal. Following completion of the construction phase, birds would be expected to return to use the same areas as used prior to construction with any effects considered temporary. In order to reduce potential waterbird disturbance effects associated with the Project a range of mitigation measures are proposed. Assuming the proposed mitigation measures for the Project are implemented, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
25.	TR030001, TR030005 and TR030006 Able Marine Energy Park including Material Changes 1 and 2	A048; Common Shelduck (Non-breeding) *Tadorna tadorna*	**Habitat loss/damage** • Physical loss of (or change to) habitat and associated species **Disturbance** • Airborne noise and visual disturbance	**Habitat loss/damage** The AMEP project will result in a direct loss of intertidal habitat (mudflat and saltmarsh) as a result of the reclamation of the proposed quay (33 ha). Compensation for this loss will be provided at the Cherry Cobb Sands compensation site. Losses of intertidal as a result of the Project will be de minimis in extent (up to 0.0316 ha) and effects negligible given that the spatial extent of these losses represents a barely measurable and inconsequential reduction in available habitat for waterbird species even at a local scale along the eastern frontage of the port. Therefore, with the provision of the compensatory habitat required for AMEP project, there is no cumulative effect with the Project that could compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features. **Disturbance**

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		A149: Dunlin *Calidris alpina alpina* (Non-breeding) A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage		There is the potential for the AMEP project along with the Project to cause cumulative effects in term of visual and noise disturbance to coastal waterbirds along the foreshore during construction and operation. Mitigation measures for AMEP include a cold weather construction restriction. In addition, compensation for indirect loss of functional intertidal habitat (mudflat and saltmarsh) through disturbance will also be provided at the Cherry Cobb Sands site. Assuming the proposed mitigation measures for the Project are implemented, the predicted residual in-combination effects relating to disturbance are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
28.	EN070006 Humber Low Carbon Pipelines	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A149: Dunlin *Calidris alpina alpina* (Non-breeding) A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage	**Disturbance** • Airborne noise and visual disturbance	Both projects have the potential to cause potential disturbance to waterbirds. Coastal waterbirds using functionally linked land within the footprint of the pipeline corridor could be potentially impacted due to disturbance during construction which could lead to cumulative effects with the Project. Given the current uncertainties with respect to the construction methods and programme for the Humber Low Carbon Pipeline, a detailed assessment of effects on birds which are features of the SPA is not considered possible. However, it is assumed that if required this project will be subject to controls by statutory bodies to avoid the potential for any adverse effects on marine habitats and species such as seasonal restrictions on construction activity. Therefore, assuming the proposed mitigation measures for the Project are implemented, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
29.	EN070008 Viking CCS Pipeline	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A149: Dunlin *Calidris alpina alpina* (Non-breeding) A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage	**Disturbance** • Airborne noise and visual disturbance	Only the onshore transportation system is being considered as part of the Viking CCS Pipeline DCO application. No marine works are proposed as part of the terrestrial development. ~~Both projects have the potential to cause potential disturbance to waterbirds.~~ Coastal waterbirds using functionally linked land within the footprint of the pipeline corridor could be potentially impacted due to disturbance during construction which could lead to ~~cumulative effects~~in-combination with the Project. ~~Given the current uncertainties with respect to the construction methods and programme for the V Net Zero Pipeline, a detailed assessment of effects on birds which are features of the SPA is not considered possible. However, it is assumed that if required this project will be subject to controls by statutory bodies to avoid the potential for any adverse effects on marine habitats and species~~However, with the application of noise fencing for works in proximity to functionally linked land for non-breeding waterbird species, residual effects on these features are not considered to result in an AEOI (Ref 1-220).Therefore, assuming the proposed mitigation measures for the Project are implemented, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
22.	Immingham Eastern Ro-Ro Terminal (IERRT)	A048; Common Shelduck (Non-breeding) *Tadorna tadorna*	**Habitat loss/damage** • Physical loss of (or change to) habitat and associated species **Disturbance**	**Habitat loss/damage** ~~It is anticipated that the IERRT project will result in the loss of 0.022 ha of intertidal habitat due to the following direct and indirect effects:~~ • ~~Direct loss of 0.012 ha of intertidal habitat (0.006 ha due to marine piling and 0.006 which will become subtidal habitat as a result of the deepening).~~ • ~~Capital dredging and marine infrastructure will cause~~The Project will result in the direct loss of 0.00158 ha (due to the marine piling) and a potential indirect loss of ~~intertidal (up to 0.01 ha)~~ 0.03 ha (due to potential erosion ~~caused by~~as a result of the presence of the jetty causing changes in currents).

	Plan/Project	Features	Summary of potential effects	Potential for AEoI
			• Airborne noise and visual disturbance	The ~~Project~~IERRT project, including changes made to application (accepted by the Examining Authority on 6 December 2023) will result in direct loss of ~~up to 0.00158~~0.012 ha (due to ~~the~~ marine piling and capital dredging) and ~~a~~ potential indirect loss of ~~up to 0.03~~0.02 ha (due to potential erosion ~~as a result of the presence of the jetty causing changes in currents~~of the foreshore). The ~~On this basis, the~~ anticipated total loss of intertidal as a result of ~~both projects~~the Project and IERRT is anticipated to be ~~up to 0.054 ha.~~0.044 ha (based on combined direct losses and modelling both schemes together to calculate potential for indirect intertidal losses). The combined loss of habitat ~~also~~ represents approximately ~~0.000144~~0.000117 % of the Humber Estuary SPA~~/Ramsar~~. When considering this ~~in~~is the context of intertidal, the area of loss represents approximately ~~0.000608~~0.000495 % of intertidal foreshore habitats and approximately ~~0.000847~~0.000690 % of mudflat within the SPA~~/Ramsar.~~. The predicted potential indirect intertidal losses for both projects (and direct loss due to capital dredging for IERRT), consist of very narrow strips on the lower shore around the sublittoral fringe. These losses are considered to be of a similar scale to that which can occur due to natural background changes in mudflat extent in the local region (e.g.~~,~~ due to seasonal patterns in accretion and erosion or following storm events). ~~While waterbird~~ Waterbird species could potentially be feeding in the predicted areas of habitat loss (albeit minimal habitat loss as explained above) during low water periods, however, these very small areas remain largely inundated with water and are only uncovered for a very short duration. The direct losses of habitat due to marine piling for both projects will also be highly localised. The spatial extent of these losses represents a barely measurable and inconsequential reduction in available habitat for these mobile species even at a local scale along the eastern frontage of the port. On this basis, any change to prey resources for birds feeding in the local area will be negligible. Individual survival rates or local population levels (either directly through mortality or due to birds dispersing to new feeding areas in other areas of the Humber Estuary) will not be affected. These *de minimis* changes in mudflat extent are of a magnitude that will not change the overall structure or functioning of the nearby mudflats within the Port of Immingham area or more widely in the Humber Estuary. ***The potential effects due to changes to waterbird foraging and roosting habitat as a result of the presence of marine infrastructure*** The approach jetties for both projects will be an open piled structure with large gaps between each of the piles and between the jetty deck and the foreshore seabed (i.e. the mudflat surface). This will minimise the enclosed feel and allow birds feeding near the structure to maintain sightlines. It should be noted that observations from the ornithology surveys in the area suggest that birds regularly feed in very close proximity to both the Eastern Jetty (approximately 1km from the Project) and the Immingham Oil Terminal approach jetty (approximately 500m from the Project) – which are both similar open piled structures - with species such as Redshank, Dunlin, Turnstone regularly recorded underneath jetties and Curlew, Shelduck and Black-tailed Godwit approaching them closely (<10-20m). On this basis, birds would be expected to show similar highly localised responses to structures associated with both projects with responses ranging from no avoidance for some species to potentially some local avoidance (i.e. directly underneath or in close proximity) for other species. As a consequence, any avoidance of marine infrastructure is expected to be limited (and highly localised) and is unlikely to change the overall distribution of waterbird assemblages more widely on the foreshore in the local area. ***Disturbance*** There is the potential for the IEERT project along with the Project to cause cumulative effects in term of visual and noise disturbance to coastal waterbirds along the foreshore if disturbing activities associated with each of the construction programmes are being undertaken concurrently. This could reduce the amount of foreshore available with limited disturbance stimuli in the local area. It should be noted that in-combination effects are

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		A149: Dunlin *Calidris alpina alpina* (Non-breeding) A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding)		considered to be limited outside of the winter months due to the very low numbers of SPA qualifying and assemblage species occurring in proximity to the IGET Project during passage and summer months. Broadly similar mitigation measures are proposed for both projects in order to minimise potential disturbance. This includes a winter marine construction restriction from 1 October to 31 March (for works within 200m of exposed mudflat) which will limit potential disturbance over the colder winter months when birds are considered particularly vulnerable to the effects of disturbance. This measure along with the use of acoustic barriers/screens (predicted to reduce noise levels to <70 dB Lmax at distances greater than approximately

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		Waterbird assemblage		
27.	North Killingholme Power Project	A048; Common Shelduck (Non-breeding) *Tadorna tadorna*	**Disturbance** • Airborne noise and visual disturbance	There is the potential for the Project along with North Killingholme Power Project to cause cumulative effects in term of visual and noise disturbance to coastal waterbirds. However, given the mitigation proposed for both projects which includes soft start procedures and timing restrictions to avoid sensitive periods, it is considered that the impacts are likely to result in mild and localised disturbance responses.. Therefore, assuming the proposed

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		A149: Dunlin *Calidris alpina alpina* (Non-breeding)		mitigation measures are followed during construction of both projects, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding)		
		A162: Common Redshank *Tringa totanus* (Non-breeding)		
		Waterbird assemblage		
102.	DM/1071/22/FUL Rock revetment repair and reinforcement along a 4.5km section of the Humber Estuary, works to repair, reinstate and enable access to the gravity outfalls at Middle Drain, Oldfleet Drain and Mawmbridge Drain, associated landscape improvements, installation of temporary construction compounds and associated infrastructure	A048; Common Shelduck (Non-breeding) *Tadorna tadorna*	**Habitat loss/damage** • Physical loss of (or change to) habitat and associated species **Disturbance** • Airborne noise and visual disturbance	**Habitat loss/damage** The coastal defence project will result in a permanent loss of 0.25 ha of intertidal habitat in 11 discrete narrow strips averaging 227 m^2, of which the largest is no more than 10m wide and 30m long. These discrete areas of mudflat loss along the revetment are distanced roughly 100m apart. The Shadow HRA undertaken for the project concluded that '*within the Pyewipe area, there is approximately 300 ha of this Annex 1 habitat, being over 700 m at its widest extent to the south. Therefore, the loss of 0.25 ha equates to a loss of 0.08% of the total mudflats within Pyewipe. The loss of these small and discrete parcels of mudflat along the base of the existing revetment is not considered to adversely affect the function of the mudflats as a self-sustaining habitat within the Pyewipe area. This impact is considered to be ecologically inconsequential to the Humber Estuary SAC and so not adversely affecting the integrity of the site. As the impact is considered to be ecologically inconsequential, it is not considered to frustrate the conservation objective of restore the total extent. No adverse effect on the site integrity of the Humber Estuary SAC is anticipated as a result of loss of habitat constituting the qualifying feature of mudflats and sandflats not covered by seawater at high tide associated with construction of rock armour revetment*'. It should also be noted that indirect loss could also occur with respect to coastal squeeze effects with habitat loss compensated at Skeffling managed realignment site as part of the wider Humber Flood Risk Management Strategy ("HFRMS") with no additional adverse effects from this project (beyond what has already been assessed as part of the HFRMS). Losses of intertidal as a result of the Project will be de minimis in extent (up to 0.0316 ha) and effects considered negligible given the spatial extent of these losses represents a barely measurable and inconsequential reduction in available habitat for waterbird species even at a local scale along the eastern frontage of the port. **Disturbance** There is the potential for the Project along with the flood defence works to cause cumulative effects in term of visual and noise disturbance to coastal waterbirds along the foreshore if disturbing activities associated with each of the construction programmes are being undertaken concurrently. This could reduce the amount of foreshore available with limited disturbance stimuli in the local area. ~~However~~It should be noted that in-combination effects are considered to be limited outside of the winter months due to the very low numbers of SPA qualifying and assemblage species occurring in proximity to the IGET Project during passage and summer months. Furthermore, the flood defence works will not be undertaken during the winter period (between October and March) which will help minimise potential disturbance effects associated with this project. In order to reduce potential waterbird disturbance effects associated with the Project a range of mitigation measures are proposed. With the proposed mitigation in place for the Project, Black-tailed Godwit and other birds would be expected to be able to continue to feed on mudflat in the footprint of the Project during the winter months with only very limited responses anticipated (involving infrequent and mild responses i.e. at worst, very localised flight responses with birds resuming feeding quickly in local area). If any of these infrequent local flights do occur there is still considered extensive areas of

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		A149: Dunlin *Calidris alpina alpina* (Non-breeding) A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage		mudflat available in the local area. As the Environment Agency Stallingborough 3 flood risk management scheme will not be undertaken during the winter period (between October and March), any locally dispersed birds will have extensive areas of mudflat east of the Project towards the Pyewipe Mudflat available during the key wintering period. Furthermore, ringing data suggests that the local wintering population of Black-tailed Godwits are known to have a relatively wide-ranging movements, with flocks frequently moving between alternative feeding sites in the Immingham/Grimsby area. This species is therefore considered to have some plasticity in terms of switching between different sites for feeding compared to some other wader species known to be more site faithful and which utilise smaller wintering ranges. On this basis, potential effects on alternative feeding sites are predicted to be limited. Furthermore, it is anticipated that majority of the Environment Agency Stallingborough 3 flood risk management will be completed by October 2024 and therefore limited temporal overlap between both of the works will occur. With the proposed mitigation, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
	Immingham Onshore Wind	A048; Common Shelduck (Non-breeding) *Tadorna tadorna* A143: Red Knot (Non-breeding) *Calidris canutus* A149: Dunlin *Calidris alpina alpina* (Non-breeding) A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) A157: Bar-tailed Godwit (Non-breeding) *Limosa lapponica* A162: Common Redshank *Tringa totanus* (Non-breeding) Waterbird assemblage	**Disturbance** • Airborne noise and visual disturbance **Collision Risk**	There is the potential for the onshore turbine project to cause displacement effects to SPA coastal waterbird features as well as a collision risk. However, based on the latest scheme design, the turbine locations are too distant from the foreshore and from any associated functionally linked land to cause displacement effects in waterbird species (based on a detailed review of the zone of influence of potential turbine displacement effects). In addition, collision risk modelling based on established methods and industry guidance predicts potential collision rates will be very low for all SPA waterbird species and will not cause population level effects. Therefore, assuming the proposed mitigation measures for the Project are implemented, the residual predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
	All projects	A048; Common Shelduck (Non-breeding) *Tadorna tadorna*	**Habitat loss/damage** • Physical loss of (or change to) habitat and associated species. Physical change to habitats resulting from the deposition of airborne pollutants **Disturbance** • Airborne noise and visual disturbance	**Habitat loss/damage** With respect to intertidal habitat loss for coastal waterbirds, on the basis that compensatory habitat will be provided for the Able Marine Energy Park (AMEP project) and also for indirect losses associated with the Stallingborough Phase 3 Flood Alleviation Scheme (DM/1071/22/FUL), all other projects have intertidal habitats losses that are considered de minimis in extent and ecologically inconsequential. On this basis, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features. A number of projects have been scoped into the in-combination effects assessment for air quality impacts due to the potential for changes in air quality a to occur in the same part of the Estuary and hence affect the same sensitive receptors. The assessment has concluded that none will result in AEOI either alone or in-combination with any other plans or projects. **Disturbance** Potential noise and visual disturbance impacts during construction as a result of the Project along with several other projects have the potential to result in potential disturbance to

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		A149: Dunlin *Calidris alpina alpina* (Non-breeding)		coastal waterbirds. ~~However,~~ It should be noted that in-combination effects are considered to be limited outside of the winter months due to the very low numbers of SPA qualifying and assemblage species occurring in proximity to the IGET Project during passage and summer months. With the proposed mitigation in place for the Project, wintering Black-tailed Godwit and other birds would be expected to be able to continue to feed on mudflat in the footprint of the Project during the winter months with only very limited responses anticipated (involving infrequent and mild responses i.e. at worst, very localised flight responses with birds resuming feeding quickly in local area). If any of these infrequent local flights do occur there is still considered extensive areas of mudflat available in the local area available even if both the nearby Environment Agency Stallingborough 3 flood risk management scheme and IERRT project may be taking place at the same time as the Project. With respect to the Environment Agency Stallingborough 3 flood risk management scheme, the flood defence works will not be undertaken during the winter period (between October and March). On this basis, any locally dispersed birds will have extensive areas of mudflat east of the Project towards the Pyewipe Mudflat available during the key wintering period. With respect to IERRT, with the proposed winter restriction on construction in place (from 1 October to 31 March on activity including piling within 200 m of exposed foreshore), extensive mudflat is also available for feeding west of the IOT jetty for any locally dispersed birds due to the Project. With this measure, birds would be anticipated to have alternative feeding opportunities along the foreshore fronting the Port of Immingham. It should also be noted that approximately 90 and 70 % respectively of the foreshore at low water between the Inner Dock entrance and the IOT (i.e the mudflat habitat fronting the Port of Immingham) will be at distances of more than 200 m and 300 m respectively from the construction zone. Furthermore, ringing data suggests that the local wintering population of Black-tailed Godwits are known to have a relatively wide-ranging movements, with flocks frequently moving between alternative feeding sites in the Immingham/Grimsby area. This species is therefore considered to have some plasticity in terms of switching between different sites for feeding compared to some other wader species known to be more site faithful and which utilise smaller wintering ranges. On this basis, potential effects on alternative feeding sites are predicted to be limited. Therefore, with the proposed mitigation required for each project there is considered to be no potential for AEOI on qualifying interest features. Furthermore, it is anticipated that majority of the Environment Agency Stallingborough 3 flood risk management will be completed by October 2024 and therefore limited temporal overlap between both of the works will occur. It is therefore considered a reasonable and robust conclusion that the predicted residual in-combination effects will not compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding)		
		A162: Common Redshank *Tringa totanus* (Non-breeding)		
		Waterbird assemblage		

Table ~~36~~37: The potential for an AEOI on qualifying habitats and species of the Humber Ramsar due to in-combination effects.

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
115.	MLA/2014/00431/4 Maintenance dredge disposal at Grimsby, Immingham and Sunk Dredged Channel	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	**Habitat loss/damage** • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species • Physical loss or damage of habitat through alterations in physical processes • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	**Habitat loss/damage** The habitats in the area are already subject to considerable seabed disturbance as a result of the existing maintenance dredging regime. The variations proposed to this existing maintenance dredge licence will not change the volumes of material to be dredged from the Port of Immingham area. The marine habitats and species occurring in the area are also considered to be commonly occurring and of low conservation value. Changes during dredging as a result of the Project are considered to be localised and of low magnitude and in-combination with this maintenance dredging project will result in only a very small increase in the potential maintenance dredge commitment for the Immingham area and disposal site. There is the potential for cumulative effects on local air quality. Activities associated with MLA/2014/00431 may have emissions to air that could coincide with proposed IGET emissions and effect shared receptors. Due to the location of MLA/2014/00431 emission sources, shared receptors are limited to air quality sensitive habitats within the Humber Estuary Ramsar, namely the closet areas of saltmarsh. The proposed Project does not impact on the nearest saltmarsh habitats to the extent that the effect is significant. Any emissions associated with MLA/2014/00431 will be limited due to the number of emission sources and intermittent operation of those sources over the course of a year. **Contamination** The physical processes assessment of the Project indicates a negligible future maintenance dredge requirement for the IGET berths. Similarly to the existing adjacent berths at IOT, the flow regime within the berth pocket is considered sufficient to keep the bed generally swept clear of deposited material. Some limited accretion is predicted underneath the IGET jetty head and, should this accrete sufficiently to spill over into the berth pocket, some very limited future maintenance dredge may be required. If it is, however, this is likely to be very infrequent (years between campaigns) and for a very small volume of material (considerably lower than the initial capital dredge). For completeness, the following assessment considers the potential for cumulative effects with respect to increased SSC as a result of the possible limited maintenance dredging and disposal of material from IGET alongside the existing disposals from Grimsby, Immingham, and Sunk Dredged Channel. The assessment of the potential future maintenance dredging requirements for the Project indicates a negligible future maintenance dredge requirement. In-combination effects from dredge or disposal plumes from adjacent sites will only exist for a short period of time (a matter of hours) when activities are taking place concurrently. Once the next peak tide (ebb or flood) has dispersed the plume across the wider study area, the increased SSC values are unlikely to be distinguishable from the existing background concentrations. It is also considered likely that the availability of dredging plant (servicing the ports and approaches across the wider Humber, including Goole, Hull and Grimsby) will mean the potential for dredging to be taking place at adjacent locations and at the same time is limited. In relation to the release of sediment -bound contaminants, the Marine Licence requires sediment samples to be tested in line with OSPAR requirements prior to disposal which minimises the potential for mobilisation of contaminants. In addition, the Project is concerned with the disposal of recently accreted sediment which is less likely to comprise a source of historic contamination and therefore this is unlikely to result in a cumulative effect. Considering all pathways, and the very limited potential (in terms of frequency and volume) for any maintenance dredge requirement for the Project, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 5 – Bird Assemblages of International Importance:	**Disturbance** • Airborne noise and visual disturbance	There is the potential for cumulative effects on birds features if the dredging activities associated with MLA/2014/00431 occur at the same time as construction and maintenance dredging as part of the Project. The noise and visual stimuli associated with MLA/2014/00431 is likely to be similar to the dredging operations

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		for IGET and will be limited due the periodic frequency over the course of a year. Any disturbance responses would be expected to be infrequent, short duration and localised. It is also considered likely that the availability of dredging plant (servicing the ports and approaches across the wider Humber, including Goole, Hull and Grimsby) will mean the potential for dredging to be taking place at adjacent locations and at the same time is limited. Assuming the proposed mitigation measures for the Project are implemented, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast. Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	**Disturbance** • Disturbance through underwater noise and vibration	There is the potential for cumulative effects on lamprey and grey seal features if the dredging activities associated with MLA/2014/00431 occur at the same time as construction and maintenance dredging as part of the Project. The noise associated with MLA/2014/00431 is likely to be similar to the dredging operations for the Project and will be limited due the intermittent operation over the course of a year. It is also considered likely that the availability of dredging plant (servicing the ports and approaches across the wider Humber, including Goole, Hull and Grimsby) will mean the potential for dredging to be taking place at adjacent locations and at the same time is limited. However, dredging for both projects is only expected to cause behavioural reactions (at most) in a relatively localised area in the vicinity of the dredger. Therefore, assuming the proposed mitigation measures for the Project are implemented, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
94.	MLA/2020/00520 Humber International Terminal (HIT) berth 2: adaptation for car carriers	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	**Habitat loss/damage** • Physical loss or damage of habitat through alterations in physical processes • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	**Habitat loss/damage** The piles required for the HIT berth 2 works will result in a *de minimis* loss of subtidal habitat. In addition, sedimentation due to the localised resuspension of sediment as a result of seabed disturbance during marine piling and changes to hydrodynamic and sedimentary processes due to the presence of the piles including potential scouring directly around piles effects are anticipated to be negligible and highly localised. Furthermore, the benthic community is expected to recover relatively rapidly from any localised physical disturbance with subtidal species known to occur in the area typically considered fast growing and/or have rapid reproductive rates. The cumulative effects of physical loss of habitat are considered negligible. **Contamination** In relation to water and sediment quality, there is the potential for cumulative effects with respect to increased SSC and changes to dissolved oxygen and chemical water quality as a result of seabed disturbance during marine piling. Any changes would cause highly localised and temporary changes in suspended sediment levels (and related changes in sediment bound contaminants and dissolved oxygen) and the effects are considered negligible on features for both projects. Considering all pathways, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 5 – Bird Assemblages of International Importance:	**Disturbance** • Airborne noise and visual disturbance	There is the potential for the Project along with HIT berth 2 works to cause cumulative effects in term of visual and noise disturbance to coastal waterbirds along the foreshore during construction. Data presented as part of the marine licence application for the HIT berth 2 works suggest that waterbirds such as Shelduck,

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3)		Dunlin, Curlew, Redshank and Black-tailed Godwit are only recorded in very low numbers (typically <10-20 individuals) representing <1% of estuary-wide numbers. Marine piling for the HIT berth 2 works will be short term (two weeks) with only intermittent marine piling activity undertaken each day (several hours per day) during this period. Mild disturbance responses and short-term and localised displacement of the very low numbers of these species present in the vicinity of the HIT project during the works is possible. However, rather than being displaced from the local area completely, birds would be expected to redistribute to nearby foreshore in the Immingham area and continue to feed and roost in these alternative locations following dispersal. Following completion of the construction phase, birds would be expected to return to use the same areas as used prior to construction with any effects considered temporary. In order to reduce potential waterbird disturbance effects associated with the Project a range of mitigation measures are proposed. Assuming the proposed mitigation measures for the Project are implemented, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		
		Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.	**Disturbance** • Disturbance through underwater noise and vibration	Underwater noise generated during marine piling required as part of the Project along with HIT berth 2 works have the potential to result in cumulative effects on lamprey and grey seal features of the Humber Estuary Ramsar. Marine piling noise has the potential to cause injury effects in fish and marine mammals within close proximity to the marine piling activity and strong behavioural responses over a wider area of the Humber Estuary for both projects. Both projects will require similar mitigation to help minimise potential adverse effects (such as soft start procedures, timing restrictions to avoid sensitive periods for migratory fish and the use of marine mammal observers). Therefore, assuming the proposed mitigation measures for both projects are implemented, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.		
25.	Able Marine Energy Park (AMEP) DCO as consented and Material Change 1 and 2	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	**Habitat loss/damage** • Physical loss or damage of habitat through alterations in physical processes • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	**Habitat loss/damage** Both the AMEP and the Project have the potential to result in changes to marine habitats as a result of capital dredging due to physical disturbance during sediment removal, sediment deposition and indirectly as a result of changes to hydrodynamic and sedimentary processes. These potential effects were assessed as not resulting in an AEOI for both projects. The subtidal habitats around the Port of Immingham are typically impoverished and of low ecological value reflecting the existing high levels of physical disturbance in the area due to strong near bed tidal currents and sediment transport. Deposition of sediment as a result of dredging for both projects was predicted to be localised and similar to background variability away from the dredge pockets with species occurring in the local area considered tolerant to some sediment deposition. The cumulative effects of change on marine habitats and species from the highly localised and small scale predicted effects due to hydrodynamic and sedimentary processes are considered negligible. The AMEP project will result in a direct loss of intertidal habitat (mudflat and saltmarsh) as a result of the reclamation of the proposed quay (33 ha). Compensation for this loss will be provided at the Cherry Cobb Sands compensation site. Direct loss of intertidal as a result of the Project will be de minimis (up to 0.0316 ha) and not considered to result in an AEOI. Therefore, with the provision of the compensatory habitat required for AMEP, there is no cumulative effect taking account of the Project that could compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features. With respect to airborne pollutants, the traffic data used to inform the air quality assessment for the proposed

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
				IGET project is inherently cumulative with regards to the Consent Order for the AMEP. There are no predicted in-combination effects and it is concluded that there is no potential for AEOI on qualifying interest features. **Contamination** In relation to water and sediment quality, there is the potential for cumulative effects with respect to increased SSC and changes to dissolved oxygen and chemical water quality as a result of seabed disturbance. Any changes would cause localised and temporary changes in suspended sediment levels (and related changes in sediment bound contaminants and dissolved oxygen) and the effects are considered negligible on features. In relation to the release of sediment -bound contaminants, the level of contamination in the proposed dredge areas for both projects was considered to be low with material expected be rapidly dispersed by strong tidal currents in the area. Considering all pathways, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)	**Habitat loss/damage** • Physical loss of (or change to) habitat and associated species **Disturbance** • Airborne noise and visual disturbance	**Habitat loss/damage** The AMEP project will result in a direct loss of intertidal habitat (mudflat and saltmarsh) as a result of the reclamation of the proposed quay (33 ha). Compensation for this loss will be provided at the Cherry Cobb Sands compensation site. Losses of intertidal as a result of the proposed Project will be de minimis in extent (up to 0.0316 ha) and effects negligible given that the spatial extent of these losses represents a barely measurable and inconsequential reduction in available habitat for waterbird species even at a local scale along the eastern frontage of the port. Therefore, with the provision of the compensatory habitat required for AMEP project, there is no additional cumulative effect from the Project that could compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features. **Disturbance** There is the potential for the AMEP project along with the Project to cause cumulative effects in term of visual and noise disturbance to coastal waterbirds along the foreshore during construction and operation. Mitigation measures for AMEP include a cold weather construction restriction. In addition, compensation for indirect loss of functional intertidal habitat (mudflat and saltmarsh) through disturbance will also be provided at the Cherry Cobb Sands site. Assuming the proposed mitigation measures for the Project are implemented, the predicted residual in-combination effects relating to disturbance are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast. Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal	**Disturbance** • Disturbance through underwater noise and vibration	Underwater noise generated during marine piling required as part of the Project along with the AMEP works have the potential to result in cumulative effects on lamprey and grey seal features of the Humber Estuary Ramsar. Dredging for both projects is only expected to cause behavioural reactions in a relatively localised area in the vicinity of the dredger for both fish and marine mammals. Marine piling noise has the potential to cause injury effects in fish and marine mammals within close proximity to the marine piling activity and strong behavioural responses over a wider area of the Humber Estuary for both projects. Both projects will require similar mitigation to help minimise potential adverse effects (such as soft start procedures, timing restrictions to avoid sensitive periods for migratory fish and the use of marine mammal observers). Therefore, assuming the proposed mitigation measures for both projects are implemented, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		waters and their spawning areas.		
28.	EN070006 Humber Low Carbon Pipelines	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	**Habitat loss/damage** • Physical loss or damage of habitat through alterations in physical processes • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	Based on information provided in the EIA scoping report for the Humber Low Carbon Project, trenchless methods (e.g., bored tunnel) could be used to minimise potential effects on SAC habitats where the pipelines cross the Humber Estuary. However, construction method has not been confirmed at the landfall (trenchless, e.g., HDD, or via cofferdam) and, therefore, features of the SAC could not be scoped out. Given the current uncertainties with respect to the construction methods and programme for the Humber Low Carbon Pipeline, a detailed assessment of effects on SAC features is not considered possible. However, it is assumed that if required this project will be subject to controls by statutory bodies to avoid the potential for any adverse effects on Ramsar features. Therefore, assuming the proposed mitigation measures are followed for the Project, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and a conclusion of no AEOI can be reached, subject to further information becoming available.
		Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)	**Disturbance** • Airborne noise and visual disturbance	Both projects have the potential to cause potential disturbance to waterbirds. Coastal waterbirds using functionally linked land within the footprint of the pipeline corridor could be potentially impacted due to disturbance during construction which could lead to cumulative effects with the Project. Given the current uncertainties with respect to the construction methods and programme for the Humber Low Carbon Pipeline, a detailed assessment of effects on birds which are features of the Ramsar is not considered possible. However, it is assumed that if required this project will be subject to controls by statutory bodies to avoid the potential for any adverse effects on marine habitats and species. Therefore, assuming the proposed mitigation measures for the Project are implemented, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast. Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal	**Disturbance** • Disturbance through underwater noise and vibration	Given the current uncertainties with respect to the construction methods and programme for the Humber Low Carbon Pipeline, a detailed assessment of underwater noise and vibration effects on Ramsar features is not considered possible. However, it is assumed that if required this project will be subject to controls by statutory bodies to avoid the potential for any adverse cumulative effects on Ramsar features. Therefore, assuming the proposed mitigation measures are followed for the Project, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and a conclusion of no AEOI can be reached, subject to further information becoming available.

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		waters and their spawning areas.		
29.	EN070008 Viking CCS Pipeline	Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	**Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases • **Disturbance** • Disturbance through underwater noise and vibration	Only the onshore transportation system is being considered as part of the Viking CCS Pipeline DCO application. No marine works are proposed as part of the terrestrial development. In addition, in-combination air quality effects are anticipated since no construction vehicles associated with that project will travel within 200m of any European site and there are no operational emissions. However, there is considered the potential for effects on river lamprey (which migrate through the estuary and are a qualifying feature of the Humber Estuary SAC/Ramsar). Watercourses which will be crossed by the proposed Viking CCS Pipeline have the potential to support river lamprey. Smaller watercourses will be crossed using open cut techniques. There is a low risk of direct mortality and / or injury to river lamprey as a result of open-cut crossing methodologies. There is also a risk of noise and vibration impacts on lamprey from drilling techniques particularly if carried out during spawning or migration periods. There is potential risk of indirect impacts from surface runoff from constructions areas (i.e., fine sediments) and impacts on water quality from potential pollution incidents (i.e. chemical spills) thereby having potential effects on aquatic species where there are requirements for works taking place above or in proximity to aquatic habitats. However, a wide range of mitigation measures outlined in the CEMP are proposed (Ref 1-219; Ref 1-220). On this basis, with the application of the mitigation proposed for the Viking CCS Pipeline and the mitigation measures proposed for the Project for lamprey species (to minimise underwater noise effects during piling such as soft starts and seasonal restrictions), predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on the river lamprey feature.
~~29.~~	~~EN070008~~ ~~Viking CCS Pipeline~~	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3)	**Disturbance** • Airborne noise and visual disturbance	The onshore transportation system only is being considered as part of the Viking CCS Pipeline DCO application. No marine works are proposed as part of the terrestrial development. ~~Both projects have the potential to cause potential disturbance to waterbirds.~~ Coastal waterbirds using functionally linked land within the footprint of the pipeline corridor could be potentially impacted due to disturbance during construction which could lead to ~~cumulative effects~~in-combination with the Project. ~~Given the current uncertainties with respect to the construction methods and programme for the V Net Zero Pipeline, a detailed assessment of effects on birds which are features of the Ramsar is not considered possible. However, it is assumed that if required this project will be subject to controls by statutory bodies to avoid the potential for any adverse e effects on marine habitats and species~~However, with the application of noise fencing for works in proximity to functionally linked land for non-breeding waterbird species, residual effects on these features are not considered to result in an AEOI (Ref 1-220).Therefore, assuming the proposed mitigation measures for the Project are implemented, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		
22.	Immingham Eastern Ro-Ro Terminal (IERRT)	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	**Habitat loss/damage** • Physical loss or damage of habitat through alterations in physical processes • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated	**Habitat loss/damage** *Intertidal habitat loss* ~~It is anticipated that the IERRT project will result in the loss of 0.022 ha of intertidal habitat due to the following direct and indirect effects:~~ ~~• Direct loss of 0.012 ha of intertidal habitat (0.006 ha due to marine piling and 0.006 which will become subtidal habitat as a result of the deepening).~~ ~~• Capital dredging and marine infrastructure will cause~~The Project will result in the direct loss of 0.00158 ha (due to the marine piling) and a potential indirect loss of ~~intertidal (up to 0.01 ha)~~ 0.03 ha (due to potential erosion ~~caused by~~as a result of the presence of the jetty causing changes in currents). The ~~Project~~IERRT project, including changes made to application (accepted by the ExA on 6 December 2023) will result in direct loss of ~~up to 0.00158~~0.012 ha (due to ~~the~~ marine piling and capital dredging) and ~~a~~ potential indirect loss of ~~up to 0.03~~0.02 ha (due to potential erosion ~~as a result of the presence of the jetty~~

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
			SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	~~causing changes in currents~~of the foreshore). The ~~On this basis, the~~ anticipated total loss of intertidal as a result of ~~both projects~~the Project and IERRT is anticipated to be ~~up to 0.054~~0.044 ha~~.~~ (based on~~The combined intertidal habitat~~ combined direct losses and modelling both schemes together to calculate potential for indirect intertidal losses). The combined loss of habitat represents approximately 0.000117 % of the Humber Estuary SPA/Ramsar. When considering this is the context of intertidal, the area of loss represents approximately ~~0.000147% the Humber Estuary SAC~~0.000495 % of intertidal foreshore habitats and approximately ~~0.000575% of the 'mudflats and sandflats not covered by seawater at low tide' feature of the Humber Estuary SAC.~~0.000690 % of mudflat within the SPA. The predicted potential indirect intertidal losses for both projects (and direct loss due to capital dredging for IERRT), consist of very narrow strips on the lower shore around the sublittoral fringe. These losses are considered to be of a similar scale to that which can occur due to natural background changes in mudflat extent in the local region (e.g.~~,~~ due to seasonal patterns in accretion and erosion or following storm events). ~~The direct losses of habitat due to marine piling for both projects will also be highly localised.~~ These de minimis changes in mudflat extent are of a magnitude that will not change the overall structure or functioning of the nearby mudflats within the Port of Immingham area or more widely in the Humber Estuary. *Subtidal habitat loss* Marine piling will result in a direct loss of ~~0.027 ha and~~ 0.051 ha and l ha of seabed habitat for the Project and IERRT ~~and the Project~~ respectively. This combined habitat loss of 0.083 ha represents approximately ~~0.000213~~0.000218 % of the Humber Estuary ~~SAC.~~ Ramsar. The combined loss in subtidal habitat as a result of the piles is considered negligible in the context of the extent of the overall amount of similar marine habitats found locally in the Humber Estuary. All the species recorded were considered commonly occurring and not protected. Furthermore, faunal assemblage recorded during project specific benthic surveys for both projects are also considered characteristic of subtidal habitats found more widely in this section of the Humber Estuary. Localised losses of this magnitude are also not considered to adversely affect the overall functioning of subtidal habitats within this section of the Humber Estuary. **Physical damage through disturbance and/or smothering of habitat** Capital dredging for the ~~IERRT project~~Project will remove ~~approximately 190,000 m³ of material over a maximum area of approximately 70,000m² (with the capital dredge for IGET removing~~ 4,000m³ of material over a maximum area of approximately 10,000m² (with the capital dredge for IERRT removing approximately 190,000m³ of material over a maximum area of approximately 70,000m²). For both projects following dredging, it is considered likely that the dredge pocket would provide similar ~~substate~~substrate for infaunal colonisation to that under pre-dredge conditions which would then be expected to be recolonised by a similar assemblage to baseline conditions. In addition, sedimentation as a result of capital dredging for both projects is predicted to be highly localised and similar to background variability. Species recorded in both dredge footprint areas are considered tolerant to the predicted millimetric changes in deposition and therefore smothering effects as considered unlikely. In addition, the species recorded in the benthic invertebrate surveys are fast growing and/or have rapid reproductive rates which allow populations to fully re-establish in typically less than ~~1~~one to ~~2~~two years and for some species within a few months. For the Project, maintenance dredging is expected to be very limited (if required at all). As a result, any dredging that is required will only be undertaken very periodically (frequency will be dictated by operational requirements but is anticipated there could be several years or more between maintenance dredge campaigns). For the IERRT project, regular maintenance dredging (i.e. occurring every 3-4 months) is anticipated to be restricted to a relatively small proportion of the total maintenance dredge area (i.e. focused around the finger pier piles and adjacent areas of the berth pockets and pontoons). The remainder of the area will only be required to be dredged much more periodically (frequency in these areas will be dictated by operational requirements but is anticipated to be approximately every 1-2 years or more). ~~For the Project, maintenance dredging is expected to be to be very limited (if required at all). As a result, any dredging that is required will only be undertaken very periodically (frequency will be dictated by operational requirements but~~

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
				~~is anticipated there could be several years or more between maintenance dredge campaigns).~~ In both areas, a generally impoverished benthic community was recorded in the dredge footprint which is likely to reflect the existing high levels of physical disturbance in the area due to strong near bed tidal currents and sediment transport with infaunal populations anticipated to fully re-establish in between several months and 1-2 years. On this basis, given the expected frequency of dredging, a comparable macrofaunal community to pre dredge conditions would be expected to occur over much of both the maintenance dredging footprints. **Contamination** The resuspension of sediment as a result of seabed disturbance during marine piling and capital dredging for both projects will cause highly localised and temporary changes in suspended sediment levels (and related changes in sediment bound contaminants and dissolved oxygen) with potential effects on features considered to be negligible. Considering all pathways, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl – 153,934 waterfowl (five year peak mean 1998/99-2002/3)	**Habitat loss/damage** • Physical loss of (or change to) habitat and associated species **Disturbance** • Airborne noise and visual disturbance	**Habitat loss/damage** ~~It is anticipated that the IERRT project will result in the loss of 0.022 ha of intertidal habitat due to the following direct and indirect effects:~~ *Intertidal habitat loss* ~~• Direct loss of 0.012 ha of intertidal habitat (0.006 ha due to marine piling and 0.006 which will become subtidal habitat as a result of the deepening).~~ ~~• Capital dredging and marine infrastructure will cause~~The Project will result in the direct loss of 0.00158 ha (due to the marine piling) and a potential indirect loss of ~~intertidal (up to 0.01 ha)~~ 0.03 ha (due to potential erosion ~~caused by~~as a result of the presence of the jetty causing changes in currents). The ~~Project~~IERRT project, including changes made to application (accepted by the ExA on 6 December 2023) will result in direct loss of ~~up to 0.00158~~0.012 ha (due to ~~the~~ marine piling and capital dredging) and ~~a~~ potential indirect loss of ~~up to 0.03~~0.02 ha (due to potential erosion ~~as a result of the presence of the jetty causing changes in currents~~of the foreshore). The ~~On this basis, the~~ anticipated total loss of intertidal as a result of ~~both projects~~the Project and IERRT is anticipated to be ~~up to 0.054 ha.~~0.044 ha (based on combined direct losses and modelling both schemes together to calculate potential for indirect intertidal losses). The combined loss of habitat ~~also~~ represents approximately ~~0.000144~~0.000117 % of the Humber Estuary ~~SPA/~~Ramsar. When considering this is the context of intertidal, the area of loss represents approximately ~~0.000608~~0.000495 % of intertidal foreshore habitats and approximately ~~0.000847~~0.000690 % of mudflat within the ~~SPA/~~Ramsar. The predicted potential indirect intertidal losses for both projects (and direct loss due to capital dredging for IERRT), consist of very narrow strips on the lower shore around the sublittoral fringe. These losses are considered to be of a similar scale to that which can occur due to natural background changes in mudflat extent in the local region (e.g.~~,~~ due to seasonal patterns in accretion and erosion or following storm events). ~~While waterbird~~Waterbird species could potentially be feeding in the predicted areas of habitat loss (albeit minimal habitat loss as explained above) during low water periods, these very small areas remain largely inundated with water and are only uncovered for a very short duration. The direct losses of habitat due to marine piling for both projects will also be highly localised. The spatial extent of these losses represents a barely measurable and inconsequential reduction in available habitat for these mobile species even at a local scale along the eastern frontage of the port. On this basis, any change to prey resources for birds feeding in the local area will be negligible. Individual survival rates or local population levels (either directly through mortality or due to birds dispersing to new feeding areas in other areas of the Humber Estuary) will not be affected. These *de minimis* changes in mudflat extent are of a magnitude that will not change the overall structure or functioning of the nearby mudflats within the Port of Immingham area or more widely in the Humber Estuary. ***The potential effects due to changes to waterbird foraging and roosting habitat as a result of the presence of marine infrastructure*** The approach jetties for both projects will be an open piled structure with large gaps between each of the

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
				piles and between the jetty deck and the foreshore seabed (i.e. the mudflat surface). This will minimise the enclosed feel and allow birds feeding near the structure to maintain sightlines. It should be noted that observations from the ornithology surveys in the area suggest that birds regularly feed in very close proximity to both the Eastern Jetty (approximately 1km from the Project) and the Immingham Oil Terminal approach jetty (approximately 500m from the Project) – which are both similar open piled structures - with species such as Redshank, Dunlin, Turnstone regularly recorded underneath jetties and Curlew, Shelduck and Black-tailed Godwit approaching them closely (<10-20m). On this basis, birds would be expected to show similar highly localised responses to structures associated with both projects with responses ranging from no avoidance for some species to potentially some local avoidance (i.e. directly underneath or in close proximity) for other species. As a consequence, any avoidance of marine infrastructure is expected to be limited (and highly localised) and is unlikely to change the overall distribution of waterbird assemblages more widely on the foreshore in the local area. ***Disturbance*** There is the potential for the IEERT project along with the Project to cause cumulative effects in term of visual and noise disturbance to coastal waterbirds along the foreshore if disturbing activities associated with each of the construction programmes are being undertaken concurrently. This could reduce the amount of foreshore available with limited disturbance stimuli in the local area. It should be noted that in-combination effects are considered to be limited outside of the winter months due to the very low numbers of SPA qualifying and assemblage species occurring in proximity to the IGET Project during passage and summer months. Broadly similar mitigation measures are proposed for both projects in order to minimise potential disturbance. This includes a winter marine construction restriction from 1 October to 31 March (for works within 200m of exposed mudflat) which will limit potential disturbance over the colder winter months when birds are considered particularly vulnerable to the effects of disturbance. This measure along with the use of acoustic barriers/screens (predicted to reduce noise levels to <70 dB Lmax at distances greater than approximately 200m from the marine piling) and soft start procedures will also help minimise the potential spatial extent of disturbance. Therefore, with the application of the proposed mitigation measures, disturbance responses are expected to be limited, both in terms of frequency and the spatial extent of effects with alternative locations in the Immingham area are available to birds to feed and roost ~~which~~. These areas will ~~not~~ be ~~in~~outside of the zone of influence of potential disturbance~~. Furthermore,~~ including extensive mudflat east of the Project towards the Pyewipe. With the proposed winter restriction on construction in place for IERRT, extensive mudflat is also available for feeding west of the IOT jetty for any locally dispersed birds due to the Project. With this measure, birds would be anticipated to have alternative feeding opportunities along the foreshore fronting the Port of Immingham. It should also be noted that approximately 90 and 70 % respectively of the foreshore at low water between the Inner Dock entrance and the IOT (i.e the mudflat habitat fronting the Port of Immingham) will be at distances of more than 200 m and 300 m respectively from the construction zone. Furthermore, ringing data suggests that the local wintering population of Black-tailed Godwits are known to have a relatively wide-ranging movements, with flocks frequently moving between alternative feeding sites in the Immingham/Grimsby area. This species is therefore considered to have some plasticity in terms of switching between different sites for feeding compared to some other wader species known to be more site faithful and which utilise smaller wintering ranges. On this basis, potential effects on alternative feeding sites are predicted to be limited.. Furthermore, following completion of the construction phase, birds would be expected to return to broadly use the same areas as used prior to construction with any effects considered temporary. With the proposed mitigation measures, the residual predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features. There is also the potential for cumulative effects during operation with respect to potential disturbance to waterbirds. Coastal waterbirds are regularly recorded feeding nearby or below port structures such as jetties or pontoons and appear to be relatively tolerant to normal day-to-day port operational activities on existing

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		jetties. Therefore, while there is the potential for some mild and infrequent disturbance occurring near to the approach jetties for both projects, it is expected that birds will become habituated relatively quickly which will limit any longer-term disturbance responses. Given the low anticipated magnitude of potential effects and given the screening is also proposed for the IERRT project on a precautionary basis, potential cumulative effects are not considered to result in an AEOI.
		Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.	**Disturbance** • Disturbance through underwater noise and vibration	Underwater noise generated during marine piling required as part of the ~~IERRT project~~Project along with the ~~Project~~IERRT project have the potential to result in cumulative effects on ~~fish (including diadromous migratory species) and marine mammal receptors in~~lamprey and grey seal features of the Humber Estuary~~.~~ ~~Marine piling noise has the potential to cause injury effects in~~ Ramsar. Dredging for both projects is only expected to cause behavioural reactions in a relatively localised area in the vicinity of the dredger for both fish and marine mammals~~within close proximity to the marine piling activity and behavioural responses over a wider area of the Humber Estuary for both projects.~~ . Piling noise has the potential to cause injury effects in fish and marine mammals within close proximity to the piling activity and strong behavioural responses over a wider area of the Humber estuary for both projects. Lamprey form part of the least sensitive noise hearing fish group according to the Popper *et al.* (2014) guidelines and the predicted zone of behavioural effects are based on the sound levels to which schools of sprat, which are in the highest sensitive noise hearing fish group, responded on 50% of observations (Hawkins *et al.*, 2014). The predicted behavioural zone is therefore considered overly precautionary and conservative and is likely to be a more localised area for lamprey. Instantaneous peak Permanent Threshold Shift (PTS) and Temporary Threshold Shift (TTS) effects in grey seal are predicted to occur within close proximity to the impact piling activity and cumulative SEL PTS and TTS effects are predicted over a wider area. Assuming seals evade the injury effects zone, they are not considered to be at risk of any instantaneous or cumulative injury effects during impact piling. Strong behavioural responses may occur over a wider area although the existing constraints of the estuary are such that elevated underwater noise levels generated during piling for the Project and IERRT are physically constrained to within the outer section of the Humber Estuary and are unable to directly reach the grey seal breeding site at Donna Nook. The Spurn on the Outer Humber Estuary and promontory of Grimsby Docks means that much of the underwater noise will be limited by these hard constraints and will not propagate to the outer part of the estuary and beyond. In addition, the upstream bend in the estuary at Salt End will mean that elevated underwater noise levels will not be able to propagate beyond this point. In other words, potential behavioural responses and/or displacement effects are primarily limited to the section of the estuary between around Salt End (upstream) and Grimsby to Spurn Bight (downstream). The maximum impact piling scenario for both projects should the marine piling works overlap is for up to 7 tubular piles to be installed each day (4 piles for IERRT and 3 piles for the Project) using up to 6 piling rigs driving at any one time (4 piling rigs for IERRT and 2 piling rigs for the Project). If none of the pile driving activity for both projects were to occur at the exact same time and temporally overlap over a 24-hour period, the maximum impact pile driving scenario would involve approximately 80 minutes of vibro piling per day (20 minutes for IERRT and 60 minutes for the Project) and 450 minutes of impact piling per day (180 minutes for IERRT and 270 minutes for the Project). Any disturbance and barrier to lamprey and grey seal movements caused by the noise during piling for the Project and IERRT would be temporary with periods during a 24-hour period when no piling will be undertaken. The proportion of impact piling is estimated to be at worst around 31 % over a 24-hour period (based on 450 minutes of impact piling per day). In other words, any lamprey and grey seals that remain within the predicted behavioural effects zone at the time of impact piling will be exposed a maximum of up to 31 % over the period of a day. The proportion of vibro piling is estimated to be at worst around 6 % over a

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.		24- hour period (based on 80 minutes of vibro piling per day). In other words, any lamprey and grey seals that remain within the predicted behavioural effects zone at the time of piling will be exposed a total maximum of up to 37 % over the period of a day. In reality, less than 7 piles are likely to be driven per day and also there is likely to be some temporal overlap in the pile driving activity, therefore, the assumptions on maximum pile driving periods and daily exposures are considered to represent a worst case. Piling will also not take place continuously as there will be periods of downtime, pile positioning and set up. The same mitigation measures are proposed for both ~~projects~~the Project and IERRT to help minimise potential adverse effects (i.e., soft start procedures, timing restrictions to avoid sensitive periods for migratory fish and the use of marine mammal observers). In order to take account of any potential in-combination effects should the piling programmes for both projects overlap, it is proposed that the maximum duration of percussive piling permitted within any 4-week period must not exceed a total of 196 hours where any percussive pile drivers for either one or both projects are in operation. Where percussive piling is occurring simultaneously across the two projects these respective time periods will not be double counted as the temporal exposure to this effect is not increased. This restriction applies from 1 June to 30 June and 1 August to 31 October inclusive in any year to minimise the impacts on fish (including lamprey) migrating through Humber Estuary during this period. The measurement of time during each 196-hour work-block must begin at the start of each timeframe, roll throughout it, then cease at the end, where measurement will begin again at the start of the next timeframe, such process to be repeated until the end of piling works. This restriction does not apply to percussive piling that can be undertaken outside the waterbody at periods of low water. Therefore, assuming the proposed mitigation measures for both projects are implemented, the predicted ~~residual~~ in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
27.	North Killingholme Power Project	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	**Habitat loss/damage** • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	**Contamination** Given the extent of seabed disturbance which involves construction of an intake and marine piling any changes would cause highly localised and temporary changes in suspended sediment levels (and related changes in sediment bound contaminants and dissolved oxygen). There are no anticipated cumulative effects. Considering all pathways, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features. **Changes in marine habitats (air quality)** The assessment for the North Killingholme Power Project found no risk of exceedances for the majority of pollutants but considered the potential for an increase in nitrogen deposition which show a maximum impact around 1km north-east of the stack. The model showed maximum impacts on NOx are >1% of the critical level in all scenarios, and the total concentration exceeds critical level, however project-specific monitoring has shown that the Defra and APIS datasets overestimated NOx in the vicinity of the facility and that total concentrations are therefore likely to be below the critical level. The proposed North Killingholme Power Project will operate in accordance with BAT and will be regulated by the Environment Agency which will include measures to minimise the impacts of emissions. It is reasonable to assume that the planning application process has identified a proportionate level of mitigation to do likewise for North Killingholme Power Project. The predicted in-combination effects are therefore not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3) Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance:	**Disturbance** • Airborne noise and visual disturbance	There is the potential for the Project along with North Killingholme Power project to cause cumulative effects in term of visual and noise disturbance to coastal waterbirds. However, given the mitigation proposed for both projects which includes soft start procedures and timing restrictions to avoid sensitive periods, it is considered that the impacts are likely to result in mild disturbance responses. Therefore, assuming the proposed mitigation measures are followed during construction, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		
		Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.	**Disturbance** • Disturbance through underwater noise and vibration	Underwater noise generated during marine piling required as part of the Project along with construction of the intake and marine piling for the North Killingholme Power project have the potential to result in cumulative effects sea and river lamprey and grey seal features in the Humber Estuary. Marine piling noise has the potential to cause injury if these features are within close proximity to the marine piling activity and strong behavioural responses over a wider area of the Humber Estuary for both projects. Both projects will require similar mitigation to help minimise potential adverse effects (such as soft start procedures, timing restrictions to avoid sensitive periods for migratory fish and the use of marine mammal observers). With these mitigation measures, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.		
102.	DM/1071/22/FUL Stallingborough Phase 3 Flood Alleviation Scheme-Rock revetment repair and reinforcement along a 4.5km section of the Humber Estuary, works to repair, reinstate and enable access to the gravity outfalls at Middle Drain, Oldfleet Drain and Mawmbridge Drain, associated landscape improvements, installation of temporary construction compounds and associated infrastructure	Criterion 1 – natural wetland habitats that are of international importance: The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	**Habitat loss/damage** • Physical loss or damage of habitat through alterations in physical processes • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated SSC Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	**Habitat loss/damage** The coastal defence project will result in a permanent loss of 0.25 ha of intertidal habitat in 11 discrete narrow strips averaging 227 m^2, of which the largest is no more than 10m wide and 30m long. These discrete areas of mudflat loss along the revetment are distanced roughly 100m apart. The Shadow HRA undertaken for the project concluded that '*within the Pyewipe area, there is approximately 300 ha of this Annex 1 habitat, being over 700 m at its widest extent to the south. Therefore, the loss of 0.25 ha equates to a loss of 0.08% of the total mudflats within Pyewipe. The loss of these small and discrete parcels of mudflat along the base of the existing revetment is not considered to adversely affect the function of the mudflats as a self-sustaining habitat within the Pyewipe area. This impact is considered to be ecologically inconsequential to the Humber Estuary SAC and so not adversely affecting the integrity of the site. As the impact is considered to be ecologically inconsequential, it is not considered to frustrate the conservation objective of restore the total extent. No adverse effect on the site integrity of the Humber Estuary SAC is anticipated as a result of loss of habitat constituting the qualifying feature of mudflats and sandflats not covered by seawater at high tide associated with construction of rock armour revetment*'. It should also be noted that indirect loss could also occur with respect to coastal squeeze effects with habitat loss compensated at Skeffling managed realignment site as part of the wider HFRMS with no additional adverse effects from this project (beyond what has already been assessed as part of the HFRMS). Losses of intertidal as a result of the proposed Project will be de minimis in extent (up to 0.0316 ha) and were assessed as not resulting in an AEOI. There are potential for cumulative effects on local air quality, due to the proximity of the Humber Stallingborough Phase 3 Project from the proposed Project, shared receptors and pollutants. There is no AEOI of the proposed IGET project alone, and whilst the effects of the Humber Stallingborough Phase 3 Project cannot be confirmed until further information on that application is published, given the scale of the works it is very unlikely that any in-combination effects will be generated. **Contamination** In relation to water and sediment quality, the potential impacts resulting from the Humber Stallingborough Phase 3 Project (such as increased suspended sediment levels) will be highly localised, temporary and

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
				effects on features are considered negligible. In relation to the release of sediment -bound contaminants, prior to excavation of the toe of the revetment sediment samples will be tested in line with OSPAR requirements to minimise the potential for mobilisation of contaminants. In addition, excavation is restricted to within a few metres of the revetment and therefore this is unlikely to result in a cumulative effect. Considering all pathways, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3)	**Habitat loss/damage** • Physical loss of (or change to) habitat and associated species **Disturbance** • Airborne noise and visual disturbance	**Habitat loss/damage** The coastal defence project will result in a permanent loss of 0.25 ha of intertidal habitat in 11 discrete narrow strips averaging 227 m^2, of which the largest is no more than 10m wide and 30m long. These discrete areas of mudflat loss along the revetment are distanced roughly 100m apart. The Shadow HRA undertaken for the project concluded that '*within the Pyewipe area, there is approximately 300 ha of this Annex 1 habitat, being over 700 m at its widest extent to the south. Therefore, the loss of 0.25 ha equates to a loss of 0.08% of the total mudflats within Pyewipe. The loss of these small and discrete parcels of mudflat along the base of the existing revetment is not considered to adversely affect the function of the mudflats as a self-sustaining habitat within the Pyewipe area. This impact is considered to be ecologically inconsequential to the Humber Estuary SAC and so not adversely affecting the integrity of the site. As the impact is considered to be ecologically inconsequential, it is not considered to frustrate the conservation objective of restore the total extent. No adverse effect on the site integrity of the Humber Estuary SAC is anticipated as a result of loss of habitat constituting the qualifying feature of mudflats and sandflats not covered by seawater at high tide associated with construction of rock armour revetment*'. It should also be noted that indirect loss could also occur with respect to coastal squeeze effects with habitat loss compensated at Skeffling managed realignment site as part of the wider Humber Flood Risk Management Strategy (HFRMS) with no additional adverse effects from this project (beyond what has already been assessed as part of the HFRMS). Losses of intertidal as a result of the proposed Project will be de minimis in extent (up to 0.0316 ha) and effects considered negligible given the spatial extent of these losses represents a barely measurable and inconsequential reduction in available habitat for waterbird species even at a local scale along the eastern frontage of the port. **Disturbance** There is the potential for the Project along with the with the flood defence works to cause cumulative effects in term of visual and noise disturbance to coastal waterbirds along the foreshore if disturbing activities associated with each of the construction programmes are being undertaken concurrently. This could reduce the amount of foreshore available with limited disturbance stimuli in the local area. ~~However~~It should be noted that in-combination effects are considered to be limited outside of the winter months due to the very low numbers of SPA qualifying and assemblage species occurring in proximity to the IGET Project during passage and summer months. Furthermore, the flood defence works will not be undertaken during the winter period (between October and March) which will help minimise potential disturbance effects associated with this project. In order to reduce potential waterbird disturbance effects associated with the Project a range of mitigation measures are proposed. With the proposed mitigation in place for the Project, Black-tailed Godwit and other birds would be expected to be able to continue to feed on mudflat in the footprint of the Project during the winter months with only very limited responses anticipated (involving infrequent and mild responses i.e. at worst, very localised flight responses with birds resuming feeding quickly in local area). If any of these infrequent local flights do occur there is still considered extensive areas of mudflat available in the local area. As the Environment Agency Stallingborough 3 flood risk management scheme will not be undertaken during the winter period (between October and March), any locally dispersed birds will have extensive areas of mudflat east of the Project towards the Pyewipe Mudflat available during the key wintering period. Furthermore, ringing data suggests that the local wintering population of Black-tailed Godwits are known to have a relatively wide-ranging movements, with flocks frequently moving between alternative feeding sites in the Immingham/Grimsby area. This species is therefore considered to have some plasticity in terms of

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		switching between different sites for feeding compared to some other waders species known to be more site faithful and which utilise smaller wintering ranges. On this basis, potential effects on alternative feeding sites are predicted to be limited. Furthermore, it is anticipated that majority of the Environment Agency Stallingborough 3 flood risk management will be completed by October 2024 and therefore limited temporal overlap between both of the works will occur. With the proposed mitigation measures, the predicted residual in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.	**Disturbance** • Disturbance through underwater noise and vibration	The works for the flood defence works will be carried out from land and in the dry as far as possible. Sources of underwater noise and vibration would be limited to excavation at the toe of the revetment. Given the extent and nature of the impacts there are no predicted cumulative effects and it is concluded that there is no potential for AEOI on qualifying interest features, subject to further information becoming available.
		Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.		
	Immingham Onshore Wind	Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (5-year peak mean 1998/99-2002/3)	**Disturbance** • Airborne noise and visual disturbance **Collision Risk**	There is the potential for the onshore turbine project to cause displacement effects to Ramsar coastal waterbird features as well as a collision risk. However, based on the latest scheme design, the turbine locations are too distant from the foreshore and from any associated functionally linked land to cause displacement effects in waterbird species (based on a detailed review of the zone of influence of potential turbine displacement effects). In addition, collision risk modelling based on established methods and industry guidance predicts potential collision rates will be very low for all Ramsar waterbird species and will not cause population level effects. Therefore, assuming the proposed mitigation measures for the Project are implemented, the residual predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		
	All projects	Criterion 1 – natural wetland habitats that are of international importance:	**Habitat loss/damage** • Physical loss or damage of habitat	**Habitat loss/damage** With respect to intertidal habitat loss, on the basis that compensatory habitat will be provided for the Able

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		The site is a representative example of a near-natural estuary with the following component habitats: dune systems and humid dune slacks, estuarine waters, intertidal mud and sand flats, saltmarshes, and coastal brackish/saline lagoons.	through alterations in physical processes • Physical damage through disturbance and/or smothering of habitat • Physical loss of (or change to) habitat and associated species • Physical change to habitats resulting from the deposition of airborne pollutants **Contamination** • Non-toxic contamination through elevated SSC • Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases	Marine Energy Park (AMEP) project and also for indirect losses associated with the Stallingborough Phase 3 Flood Alleviation Scheme (DM/1071/22/FUL), all other projects have intertidal habitats losses that are considered de minimis in extent and ecologically inconsequential. Subtidal losses are also considered de minimis in extent and ecologically inconsequential for all projects. Potential changes to marine habitats during construction or operation as a result of seabed disturbance (such as due to dredging or marine piling) are considered to be relatively localised, temporary and low magnitude for the Project and all other projects with no direct spatial overlap of dredge or construction footprints occurring. Air quality Considering all pathways, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features. **Contamination** Water quality effects are anticipated to be localised and temporary for all projects with effects on marine habitats or species considered negligible even when considered cumulatively. Considering all pathways, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (five year peak mean 1998/99-2002/3)	**Habitat loss/damage** • Physical loss of (or change to) habitat and associated species **Disturbance** • Airborne noise and visual disturbance	**Habitat loss/damage** With respect to intertidal habitat loss for coastal waterbirds, on the basis that compensatory habitat will be provided for the AMEP project and also for indirect losses associated with the Stallingborough Phase 3 Flood Alleviation Scheme (DM/1071/22/FUL), all other projects have intertidal habitats losses that are considered de minimis in extent and ecologically inconsequential. On this basis, the predicted in-combination effects are not considered to compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features. **Disturbance** Potential noise and visual disturbance during construction as a result of the Project along with several other projects have the potential to result in potential disturbance to coastal waterbirds. ~~However,~~ It should be noted that in-combination effects are considered to be limited outside of the winter months due to the very low numbers of SPA qualifying and assemblage species occurring in proximity to the IGET Project during passage and summer months. With the proposed mitigation in place for the Project, wintering Black-tailed Godwit and other birds would be expected to be able to continue to feed on mudflat in the footprint of the Project during the winter months with only very limited responses anticipated (involving infrequent and mild responses i.e. at worst, very localised flight responses with birds resuming feeding quickly in local area). If any of these infrequent local flights do occur there is still considered extensive areas of mudflat available in the local area available even if both the nearby Environment Agency Stallingborough 3 flood risk management scheme and IERRT project may be taking place at the same time as the Project. With respect to the Environment Agency Stallingborough 3 flood risk management scheme, the flood defence works will not be undertaken during the winter period (between October and March). On this basis, any locally dispersed birds will have extensive areas of mudflat east of the Project towards the Pyewipe Mudflat available during the key wintering period. With respect to IERRT, with the proposed winter restriction on construction in place (from 1 October to 31 March on activity including piling within 200 m of exposed foreshore), extensive mudflat is also available for feeding west of the IOT jetty for any locally dispersed birds due to IGET. With this measure, birds would be anticipated to have alternative feeding opportunities along the foreshore fronting the Port of Immingham. It should also be noted that approximately 90 and 70 % respectively of the foreshore at low water between the Inner Dock entrance and the IOT (i.e the mudflat habitat fronting the Port of Immingham) will be at distances of more than 200 m and 300 m respectively from the construction zone.

	Plan/Project	Features	Summary of potential effects	Potential for AEOI
		Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)		Furthermore, ringing data suggests that the local wintering population of Black-tailed Godwits are known to have a relatively wide-ranging movements, with flocks frequently moving between alternative feeding sites in the Immingham/Grimsby area. This species is therefore considered to have some plasticity in terms of switching between different sites for feeding compared to some other waders species known to be more site faithful and which utilise smaller wintering ranges. On this basis, potential effects on alternative feeding sites are predicted to be limited. Therefore, with the proposed mitigation required for each project there is considered to be no potential for AEOI on qualifying interest features. Furthermore, it is anticipated that majority of the Environment Agency Stallingborough 3 flood risk management will be completed by October 2024 and therefore limited temporal overlap between both of the works will occur. It is therefore considered a reasonable and robust conclusion that the predicted residual in-combination effects will not compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast.	**Disturbance** • Disturbance through underwater noise and vibration	Underwater noise (on lamprey species and grey seal) as a result of the Project along with several other projects have the potential to result in adverse significant effects in migratory fish and marine mammals species. However, there is considered to be no potential for AEOI on qualifying interest features as a result of the Project with the proposed mitigation measures. All projects will be subject to similar mitigation measures to avoid the potential for adverse underwater noise effects on these features. It is therefore considered a reasonable and robust conclusion that predicted residual in-combination effects will not compromise any of the conservation objectives, and it is concluded that there is no potential for AEOI on qualifying interest features.
		Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path: The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.		

5. Conclusions

5.1.1. This report provides information for the Secretary of State, as the relevant Competent Authority for the DCO application, to undertake the first two stages of a Habitats Regulations Assessment as required under Regulation 63 of the Conservation of Habitats and Species Regulations 2017 (as amended) (Ref 1-4).

5.1.2. The Stage one (Screening) assessment has considered how the Project might affect five European sites in the vicinity of the Project. This screening stage concluded that Likely Significant Effects could not be discounted with respect to four European sites, all with coincident boundaries:

a. Humber Estuary SAC.

b. Humber Estuary SPA.

c. Humber Estuary Ramsar site.

d. The Wash and North Norfolk Coast SAC.

5.1.3. The impact pathways screened into stage 2 (AA) covered the following pathways:

a. Physical loss of habitat and associated species.

b. Physical damage through disturbance and/or smothering of habitat.

c. Physical loss or damage of habitat through alterations in physical processes.

d. Direct changes to qualifying habitats beneath marine infrastructure due to shading.

e. Physical change to habitats resulting from the deposition of airborne pollutants.

f. Non-toxic contamination through elevated SSC.

g. Toxic contamination through release of toxic contaminants bound in sediments, and accidental oil, fuel or chemical releases.

h. Airborne noise and visual disturbance.

i. Disturbance through underwater noise and vibration.

j. Biological disturbance due to potential introduction and spread of non-native species.

5.1.4. At Stage two AA, further information has been collated to examine the potential for changes in the baseline conditions as a result of the Project with reference to the conservation objectives for each site. Where relevant, mitigation measures have been proposed to reduce the potential for adverse effects.

5.1.5. The assessment has concluded that for the majority of pathways there is no potential for an adverse effect on site integrity or any potential for the predicted effects to compromise any of the conservation objectives. However, for two pathways there was uncertainty in this conclusion either due to uncertainties in timing of construction (e.g., in relation to sensitive migration periods). This was relevant to the following pathways:

a. The potential effects of airborne noise and visual disturbance during construction and ~~operation~~decommissioning on qualifying species of coastal waterbird.

b. The potential effects of underwater noise and vibration during marine piling on qualifying species of fish and marine mammals.

5.1.6. Mitigation has been identified in relation to the effects of airborne noise and visual disturbance during construction which includes restrictions on working over winter in certain locations, acoustic barriers and visual screens, soft-start marine piling and cold weather restrictions. In addition, due to the uncertainty associated with the techniques to undertake the removal of pipe racks within Work Area 2 (the jetty access road) and plant and equipment on the approach jetty topside associated with hydrogen production (within Work Area 1), a commitment has been made to undertake these works outside of the overwintering period.

5.1.7. Based on the distribution of birds, the likely level of disturbance and the Applicant's commitment to mitigation, it is considered that there will be no adverse effects on the integrity of either the Humber Estuary SPA or Ramsar from the effects of airborne noise and visual disturbance.

5.1.8. Mitigation has been identified in relation to the effects of underwater noise and vibration during marine piling which includes soft-start marine piling, vibro marine piling where possible, seasonal marine piling restrictions, night-time marine piling restrictions and use of Marine Mammal Observers.

5.1.9. Based on the assessment of effects on qualifying species (river and sea lamprey and grey seal), the likely level of disturbance and the Applicant's commitment to mitigation, it is considered that there will be no adverse effects on the integrity of the Humber Estuary SAC or Ramsar from the effects of underwater noise and vibration during marine piling. There is also considered to be no adverse effects on the integrity of The Wash and North Norfolk Coast SAC (as a result of underwater noise and vibration during marine piling on the common seal qualifying feature), based on the Applicant's commitment to mitigation.

5.1.10. A summary of the mitigation measures that the Applicant has committed to is provided in **Table 38**. Further detail is provided in Section 4 of this report.

5.1.11. ~~5.1.10.~~ A review of other plans and projects that could contribute to effects has established that no significant adverse in-combination effects on site integrity with other plans and projects will occur.

5.1.12. ~~5.1.11.~~ In conclusion, based on best available scientific information and professional judgement, it is considered that the construction and consequent operation of the Project (alone or in combination with other plans or projects) will not have an adverse effect on the integrity of any European designated sites in view of that sites conservation objectives.

Table 38: Summary of proposed mitigation measures

Impact pathway	Proposed mitigation	Mitigation effectiveness	Target feature	Confidence in mitigation effectiveness
Airborne noise and visual disturbance during construction	Winter marine construction restriction from 1 October to 31 March within 200 m of exposed mudflat (until acoustic barrier/visual screen on approach jetty from 1 October to 31 March) for activity associated with the approach jetty within 200 m of exposed mudflat. Further details on this mitigation measure are provided in paragraph 4.10.30. This will be secured through a condition of the deemed marine licence.	The measure is considered effective at minimising disturbance and when applied as part of the overall construction disturbance mitigation package is considered effective at reducing disturbance to a level which will not cause an AEOI. The effectiveness of this measure is described in more detail in Appendix E and specifically with respect to minimising the potential for AEOI on qualifying features in **Table 27**.	Humber Estuary SPA: • A048; Common Shelduck (Non-breeding) *Tadorna tadorna* • A149: Dunlin *Calidris alpina alpina* (Non-breeding) • A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) • A162: Common Redshank *Tringa* • Waterbird assemblage Humber Estuary Ramsar site: • Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (5-year peak mean 1998/99-2002/3) • Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage) Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)	High: Spatial and temporal effectiveness of the restriction is well understood based on existing evidence.
	Noise suppression system during all percussive piling activities for the approach jetty. Further details on this mitigation measure are provided in	The measure is considered effective at helping to reduce potential noise related disturbance associated with piling and when applied as part	Humber Estuary SPA: • A048; Common Shelduck (Non-breeding) *Tadorna tadorna* • A149: Dunlin *Calidris alpina alpina*	High: The effectiveness of the measure is based on applying well established noise criteria and detailed

	paragraph 4.10.30. This will be secured through a condition of the deemed marine licence.	of the overall construction disturbance mitigation package is considered effective at minimising disturbance to a level which will not cause an AEOI. The effectiveness of this measure is described in more detail in Appendix E and specifically with respect to minimising the potential for AEOI on qualifying features in **Table 27**.	(Non-breeding) • A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) • A162: Common Redshank *Tringa* • Waterbird assemblage Humber Estuary Ramsar site: • Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (5-year peak mean 1998/99-2002/3) • Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage)Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)	airborne noise modelling.
	Apply soft start procedures during all percussive piling. Further details on this mitigation measure are provided in paragraph 4.10.30. This will be secured through a condition of the deemed marine licence.	The measure is considered effective at helping to reduce potential noise related disturbance associated with piling and when applied as part of the overall construction disturbance mitigation package is considered effective at minimising disturbance to a level which will not cause an AEOI. The effectiveness of this measure is described in more detail in Appendix E and specifically with respect to	Humber Estuary SPA: • A048; Common Shelduck (Non-breeding) *Tadorna tadorna* • A149: Dunlin *Calidris alpina alpina* (Non-breeding) • A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) • A162: Common Redshank *Tringa* • Waterbird assemblage Humber Estuary Ramsar site:	Medium: The measure is considered likely to be effective based on existing information.

		minimising the potential for AEOI on qualifying features in **Table 27**.	• Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (5-year peak mean 1998/99-2002/3) • Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage)Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)	
	Cold weather construction restriction implemented following seven consecutive days of freezing (zero or sub-zero temperature) weather conditions. Further details on this mitigation measure are provided in paragraph 4.10.30. This will be secured through a condition of the deemed marine licence.	This measure will ensure that no foreshore or marine construction activity is undertaken during freezing periods when waterbirds are considered particularly vulnerable to disturbance with potential disturbance effects completely avoided during the restriction. When applied as part of the overall construction disturbance mitigation package, this measure is considered effective at minimising disturbance to a level which will not cause an AEOI.	Humber Estuary SPA: • A048; Common Shelduck (Non-breeding) *Tadorna tadorna* • A149: Dunlin *Calidris alpina alpina* (Non-breeding) • A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) • A162: Common Redshank *Tringa* • Waterbird assemblage Humber Estuary Ramsar site: • Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (5-year peak mean 1998/99-2002/3) • Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank	High: Effectiveness is well understood based on existing evidence.

			(passage)Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)	
Airborne noise and visual disturbance during decommissioning	Winter restriction from 1 October to 31 March for decommissioning work associated with the removal of pipe racks within Work Area 2 (the jetty access road) and plant and equipment on the approach jetty topside associated with hydrogen production (within Work Area 1) where the works are located within 200 m of exposed mudflat.	This measure will ensure that wintering coastal waterbirds on the foreshore are not exposed to potentially disturbing activity associated with the removal of pipe racks within Work Area 2 (the jetty access road). This measure is considered effective at minimising disturbance to a level which will not cause an AEOI.	Humber Estuary SPA: • A048; Common Shelduck (Non-breeding) *Tadorna tadorna* • A149: Dunlin *Calidris alpina alpina* (Non-breeding) • A156: Black-tailed Godwit *Limosa limosa islandica* (Non-breeding) • A162: Common Redshank *Tringa* • Waterbird assemblage Humber Estuary Ramsar site: • Criterion 5 – Bird Assemblages of International Importance: Wintering waterfowl - 153,934 waterfowl (5-year peak mean 1998/99-2002/3) • Criterion 6 – Bird Species/Populations Occurring at Levels of International Importance: Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Redshank (passage)Shelduck, Golden Plover, Red Knot, Dunlin, Black-tailed Godwit, Bar-tailed Godwit (overwintering)	
Underwater noise and vibration during piling on qualifying species	Apply soft start procedures during percussive piling based on JNCC piling protocol. Further details on this mitigation measure are provided in	The measure will help reduce potential underwater effects to lamprey and seals and marine mammals through providing an opportunity to move away from the area before the onset of full impact strikes as described in	Humber Estuary SAC: • S1099: River lamprey *Lampetra fluviatilis* • S1095: Sea lamprey *Petromyzon marinus*	Medium to high: Effectiveness is generally well understood based on existing evidence.

	paragraph 4.11.43. This will be secured through a condition of the deemed marine licence.	paragraph 4.11.43. When applied as part of the overall construction disturbance mitigation package this measure is considered effective at minimising disturbance to a level which will not cause an AEOI.	• S1364: Grey seal *Halichoerus grypus* Humber Estuary Ramsar site: • Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path:The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas. • Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast. The Wash and North Norfolk Coast SAC: • 1365: Harbour seal *Phoca vitulina*	
	Use vibro piling where possible. Further details on this mitigation measure are provided in paragraph 4.11.43. This is secured in condition 15 (5) of Part 2 of the Deemed	The measure will help cause less potential displacement and a reduced acoustic barrier compared to percussive piling as described in paragraph 4.11.43. When applied as part of the overall construction disturbance mitigation package this measure is considered	Humber Estuary SAC: • S1099: River lamprey *Lampetra fluviatilis* • S1095: Sea lamprey *Petromyzon marinus* • S1364: Grey seal *Halichoerus grypus*	Medium to high: Effectiveness is generally well understood based on existing evidence.

	Marine Licence (DML) at Schedule 3 of the draft DCO.	effective at minimising disturbance to a level which will not cause an AEOI.	Humber Estuary Ramsar site: • Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path:The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas. • Criterion 3 – supports populations of plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast. The Wash and North Norfolk Coast SAC: • 1365: Harbour seal *Phoca vitulina*	
	Seasonal percussive piling including no percussive piling is to take place within the waterbody between 1 April and 31 May and restrictions on the duration of percussive piling within the waterbody from 1 June to 30 June and 1 August to 31 October. Further details on this mitigation measure are	The seasonal restriction will help limit potential disturbance effects to sea lamprey during sensitive migratory periods as described in paragraph 4.11.43. When applied as part of the overall construction disturbance mitigation package this measure is considered effective at minimising disturbance to a level which will not cause an	Humber Estuary SAC • S1095: Sea lamprey *Petromyzon marinus* Humber Estuary Ramsar site: • Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path:The Humber Estuary acts as an	Medium to high: The effectiveness of the measure is based on an understanding of sensitive periods for lamprey species and the approach taken for other consented developments on the Humber Estuary.

	provided in paragraph 4.10.43. This will be secured through a condition of the deemed marine licence.	AEOI.	important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	
	Night-time piling restriction within the waterbody between 1 March to 31 March, 1 June to 30 June and 1 August to 31 October inclusive, piling will be restricted at night. Specifically, no percussive piling will be undertaken from 19:00 to 07:00 in March, September and October and between sunset and sunrise in June and August. Further details on this mitigation measure are provided in paragraph 4.11.43. This will be secured through a condition of the deemed marine licence.	The restriction will help limit potential disturbance effects to river lamprey during sensitive migratory periods as described in paragraph 4.11.43. When applied as part of the overall construction disturbance mitigation package this measure is considered effective at minimising disturbance to a level which will not cause an AEOI.	Humber Estuary SAC: • S1099: River lamprey *Lampetra fluviatilis* Humber Estuary Ramsar site: • Criterion 8 – Internationally important source of food for fishes, spawning grounds, nursery and/or migration path:The Humber Estuary acts as an important migration route for both river lamprey *Lampetra fluviatilis* and sea lamprey *Petromyzon marinus* between coastal waters and their spawning areas.	High: The effectiveness of the measure is based on an understanding of sensitive periods for lamprey.
	Marine Mammal Observer will follow JNCC protocol to minimise the risk of injury to marine mammals during percussive piling. Further details on this mitigation measure are provided in	Following JNCC measures will help limit potential injury effects to seals as described in paragraph 4.11.43. When applied as part of the overall construction disturbance mitigation package this	Humber Estuary SAC: • S1364: Grey seal *Halichoerus grypus* Humber Estuary Ramsar site: • Criterion 3 – supports populations of	High: The mitigation is based on well established protocols which are widely applied to both inshore and offshore developments involving piling.

	paragraph 4.11.43. This will be secured through a condition of the deemed marine licence.	measure is considered effective at minimising disturbance to a level which will not cause an AEOI.	plants and/or animal species of international importance: The Humber Estuary Ramsar site supports a breeding colony of grey seals *Halichoerus grypus* at Donna Nook. It is the second largest grey seal colony in England and the furthest south regular breeding site on the east coast. The Wash and North Norfolk Coast SAC: • 1365: Harbour seal *Phoca vitulina*	

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7. Abbreviations/Acronyms

AA	Appropriate Assessment
ABB	ABB Power Generation Ltd
ABP	Associated British Ports
AEOI	Adverse Effect On Integrity
AMEP	Able Marine Energy Park
APIS	Air Pollution Information System
AQ	Air Quality
AQC	Air Quality Consultants
BAT	Best Available Techniques
BTO	British Trust for Ornithology
CCS	Carbon Capture and Storage
CEDA	Centre for Environmental Data Analysis
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CEMP	Construction Environmental Management Plan
CHEEM	Cutts & Hemingway Estuarine Ecology and Management
CoCP	Code of Construction Practice
COVID	Coronavirus
CREAM	Calculator for Road Emissions of Ammonia
cSAC	Candidate Special Areas of Conservation
CSIP	Cetacean Strandings Investigation Programme
dB	Decibel
dBA	A-weighted decibel
DCO	Development Consent Order

Defra	Department for Environment, Food and Rural Affairs
DML	Deemed Marine Licence
DMRB	Design Manual for Roads and Bridges
DNA	Deoxyribonucleic Acid
EC	European Commission
EEA	European Economic Area
EEC	European Economic Community
EIA	Environmental Impact Assessment
EMP	Environmental Management Plan
EMS	European Marine Site
EPUK	Environmental Protection UK
ERM	ERM Group
ES	Environmental Statement
EU	European Union
EUNIS	European Nature Information System
FID	Flight Initiation Distance
GPS	Global Positioning System
HDD	Horizontal Directional Drilling
HEEs	High Energy Events
HFRMS	Humber Flood Risk Management Strategy
HGVs	Heavy Goods Vehicle
HIT	Humber International Terminal
HM	Her Majesty’s (His Majesty’s)
HRA	Habitats Regulations Assessment
IAQM	Institute of Air Quality Management
ID	Identity

IECS	Institute of Estuarine & Coastal Studies
IERRT	Immingham Eastern Ro-Ro Terminal
IGET	Immingham Eastern Roll-on Roll-off Terminal
IMO	International Maritime Organisation
IOH	Immingham Outer Harbour
IOT	Immingham Oil Terminal
IROPI	Imperative Reasons of Overriding Public Interest
IUCN	International Union for Conservation of Nature
JNCC	In-combination Climate Change Impacts
LAeq	Equivalent Continuous Sound Pressure Level,
LAmax F	Maximum 'A'-weighted Sound Pressure Level (Fast Time Weighed)
Lmax.	Maximum 'A'-weighted Sound Pressure Level
LSE	Likely Significant Effect
MAGIC	Multi-Agency Geographic Information for the Countryside
MarESA	Marine Evidence based Sensitivity Assessment
MarLIN	Marine Life Information Network
MARPOL	The International Convention for the Prevention of Pollution from Ships
MCAA	Marine and Coastal Access Act
MHWS	Mean High Water Springs
MLWN	Mean Low Water Neaps
MLWS	Mean Low Water Springs
MMO	Marine Management Organisation
MP	Mean Peak
MPA	Marine Protected Area
MPS	Marine Policy Statement
MS	Marine Straggler species

MW	Megawatt
NBN	National Biodiversity Network
NE	Natural England
NECR	Natural England Research Report
NGR	National Grid Reference
NIFPP	Nseleni Independent Floating Power Plant
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPFF	National Planning Policy Framework
NSIP	Nationally Significant Infrastructure Projects
O&M	Operation and Maintenance
OCEMP	Outline Construction Environmental Management Plan
OCGT	Open Cycle Gas Turbine
OSPAR	Convention for the Protection of the Marine Environment of the North-East Atlantic
OtSMRS	Outstrays to Skeffling Managed Realignment Scheme
PAH	Polycyclic Aromatic Hydrocarbons
PCBs	Polychlorinated Biphenyl
PEI	Preliminary Environmental Information
PEIR	Preliminary Environmental Information Report
PIANC	The World Association for Waterborne Transport Infrastructure
PINS	Planning Inspectorate
pSAC	Possible Special Area of Conservation
pSPA	Potential Special Protection Areas
PTS	Permanent Threshold Shifts
PW	Phocid Pinniped

Ramsar	Wetlands of international importance, designated under The Convention on Wetlands (Ramsar, Iran, 1971)
REC	Regional Environmental Characterisation
Ro-Ro	Roll On-Roll Off
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SCI	Site of Community Importance
SCOS	Special Committee on Seals
SEL	Sound Exposure Levels
SL	Source Level
SPA	Special Protection Area
SPL	Sound Pressure Levels
SSC	Suspended Sediment Concentrations
SSSI	Site of Special Scientific Interest
TBT	Tributyltin
TSHD	Trailer Suction Hopper Dredger
TTS	Temporary Threshold Shift
UK	United Kingdom
UNECE	United Nations Economic Commission for Europe
UNESCO	United Nations Educational, Scientific and Cultural Organization
WCA	Wildlife and Countryside Act
WeBS	Wetland Bird Survey
WGE	Working Group on Effects
WODA	World Organization of Dredging Associations
ZoI	Zone of Influence

Cardinal points/directions are used unless otherwise stated.

SI units are used unless otherwise stated.

Appendix A: Baseline to ~~inform~~Inform the Shadow HRA

Appendix B: SPA Assemblage Species Screening Rationale

Appendix ~~B~~C: European/Ramsar Designated Sites Citations

Appendix ~~C~~D: Summary Table of Sites, Features and Effects

Appendix E: Mitigation Effectiveness Document

Back Cover

Summary report: **Litera Compare for Word 11.5.0.74 Document comparison done on 13/03/2024 17:27:58**	
Style name: Default Style	
Intelligent Table Comparison: Active	
Original filename: IGET HRA v01_14Sep23.docx	
Modified filename: TR030008_7.6_Habitats_Regulations_Assessment_v2.0_Clean.docx	
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Add	1616
~~Delete~~	1169
~~Move From~~	0
Move To	0
Table Insert	30
~~Table Delete~~	1
Table moves to	0
~~Table moves from~~	0
Embedded Graphics (Visio, ChemDraw, Images etc.)	5
Embedded Excel	0
Format changes	0
Total Changes:	2821