EASTSUFFOLK COUNCIL

The Lowestoft Tidal Barrier Order

Transport and Works Act 1992

Transport and Works (Applications and Objections Procedure) (England and Wales) Rules 2006

A17: Environmental Statement

Chapter 10: Biodiversity, Flora and Fauna

LOWESTOFT FLOOD PROTECTION

October 2023

Contents

10. Biodiversity, Flora and Fauna

10.1 Introduction

10.1.1 This chapter addresses the effects of the Scheme on statutory and non-statutory nature conservation sites and legally protected or otherwise notable flora and fauna. The chapter focusses on the potential for significant effects during both the construction and operational stages of the Scheme and, where necessary, proposes mitigation measures to avoid, reduce or minimise significant effects.

10.1.2 The scope of the assessment has been based on the scoping opinion received from the Secretary of State in 2018 (see Appendix 1A: Scoping Responses). The Scoping Opinion stated that the ES should address the environmental issues identified within the PEIR (CH2M, 2017) which was submitted with the scoping request, and the matters raised by consultees who responded to the scoping consultation (ABP, the Environment Agency, Natural England and the MMO - detailed in Table 10-1).

Table 10-1: Response to Scoping Opinion comments.

Consultee	Comment	Response
ABP	Seals are frequently seen by the Port Staff within the Outer Harbour (and occasionally within the Inner Harbour).	This chapter assesses effects of the Scheme in relation to marine mammals. No significant effects are considered likely subject to implementation of mitigation outlined in Section 10.7.
Environment Agency	Noisy works should be planned to avoid bird nesting season (March-August).	This chapter assesses effects of the Scheme in relation to migratory fish and nesting birds. No significant effects are considered likely.
	Whilst operational the Scheme will present a barrier to fish passage. Based on advice from our fisheries team we are content that this issue be scoped out.	
Natural England	Opportunities for habitat creation/ enhancement should be included within the assessment in line with Ecological Impact Assessment (EcIA) guidelines. The ES should thoroughly assess the potential for the proposal to affect designated sites (list of sites potentially affected was provided – see Appendix 1A for further details), impacts on local wildlife, protected species, habitats and/or species listed as Habitats and Species of Principal Importance within the England Biodiversity List, biosecurity and risks of air pollution. The ES should reflect the principles within the England Biodiversity Strategy.	Proposals for habitat creation are provided in Section 10.9 of this chapter. Effects on the listed receptors have been assessed and no significant effects are considered likely. The ES has considered the principles within the England Biodiversity Strategy, notably Theme 3. Reducing environmental pressures within the planning and development sector through committing to achieving biodiversity net gain.
MMO	The ES must consider the potential disturbance to the harbour porpoise interest feature of the cSAC, disturbance to bird species of red throated diver, common tern and little tern, impacts on designated sites, effects on estuarine/marine and migratory fish (including a number of marine fish	Disturbance to harbour porpoise has been considered in the ES. Disturbance to SPA populations of red throated diver, common tern and little tern are considered in the HRA.

Consultee	Comment	Response
	not mentioned in the PEIR, fish spawning and nursery grounds, impacts relating to noise and vibration, impacts relating to changes in water quality and cumulative effects), Otter surveys are required, and scientific monitoring of fish species should be undertaken pre-construction to provide a baseline for monitoring. Noise and vibration effects on aquatic environment should be scoped into the ES. Noisy work to be carried out to avoid bird nesting season (March – August). Cumulative effects arising from this Scheme, the Lake Lothing Third Crossing and the Lowestoft Eastern Energy Facility projects should be considered. Seabass in Lake Lothing have been placed under special measures since 2015. EIA should consider the impacts in the context of the current measures. Essential that good biosecurity practice is included in the method statements. More information is needed on why effects on non-statutory designations are scoped out.	Cumulative effects on fish, arising from this Scheme and other projects, are considered within Chapter 17: Cumulative Effects. The Preliminary Ecological Appraisal (PEA) survey assessed the potential for otter presence within the study area (see Table 10-8). The requirement for scientific monitoring of fish species was discussed further with the MMO and it was agreed that this requirement could be descoped. Works are anticipated within bird nesting season, however no significant effects are considered likely as a result of noise and vibration, subject to the mitigation outlined in Section 10.7. Effects on aquatic receptors associated with noise and vibration are assessed in this chapter. The Lake Lothing Third Crossing and the Lowestoft Eastern Energy Facility East projects are currently under construction and will be completed in 2023. As such, they are considered as part of the future baseline of the Scheme; the assessment reported in this chapter reflects this scenario. The cumulative effects with other projects (including LEEF West) are set out in Chapter 17. Sea bass have been included in the wider assessment of fisheries reported in this chapter. Biosecurity mitigation has been identified to reduce the risk of spread of Invasive Non-Native Species (INNS). Non-statutory sites have been considered and are discussed in Table 10-2.

10.1.3 Information has been gathered through desk-based assessment, survey and consultation to inform the EcIA (the biodiversity assessment for the EIA) documented in this chapter.

10.1.4 This chapter is therefore supported by technical reports detailing the surveys and assessments completed for the Scheme. These are as follows:

- PEA, provided in Appendix 10A;
- Kittiwake survey reports, provided in Appendix 10B;
- Bat roost assessment report, provided in Appendix 10C;
- HRA, provided in Appendix 10D;
- Japanese seaweed survey report, provided in Appendix 10E; and
- Biodiversity Net Gain Report provided in Appendix 10F.

10.2 Assessment Methodology

10.2.1 This section describes how potential effects upon biodiversity have been assessed using an EcIA.

10.2.2 The assessment has been carried out according to EcIA guidance developed by the Chartered Institute of Ecology and Environmental Management (CIEEM) (CIEEM, 2018) hereafter referred to as the CIEEM Guidelines.

10.2.3 EcIA is the process of identifying, quantifying and evaluating the potential effects of development on relevant habitats, species and ecosystems. These are referred to as "Important Ecological Features" in the CIEEM Guidelines however this assessment uses the term receptors.

10.2.4 The emphasis in an EcIA is to identify 'significant effects' rather than all ecological effects. The CIEEM guidelines define a 'significant effect' as one that:

"either supports or undermines biodiversity conservation objectives for 'important ecological features'…. Or biodiversity in general. Conservation objectives may be specific (e.g. for a designated site) or broad (e.g. national / local conservation policy) or more wide-ranging (enhancement of biodiversity).

A significant effect is an effect that is sufficiently important to require assessment and reporting so that the decision maker is adequately informed of the environmental consequences of permitting a project.

In broad terms, significant effects encompass impacts on structure and function of defined sites, habitats or ecosystems and the conservation status of habitats and species (including extent, abundance and distribution)".

Data Collection

10.2.5 To identify the receptors for detailed assessment, data was gathered through desk study and dedicated surveys as described below.

Desk Study

10.2.6 Statutory sites for European designations and for national level designations within 5km of the Scheme were identified using open-source data as set out in the methodology for the Preliminary Ecological Appraisal (PEA) for the Scheme (CH2M, 2017). Biological records within 5km of the Scheme were obtained from Suffolk Biodiversity Information Service (SBIS) and Multi Agency Geographic Information for the Countryside (MAGIC)[1].

[1] Defra (2017). *MAGIC*. https://magic.defra.gov.uk/MagicMap.aspx Accessed July 2017, November 2022 and February 2023.

10.2.7 Desk study records were updated and received from SBIS in 2022 and 2023 including biological records, statutory and non-statutory designated sites within 5km of the Scheme.

10.2.8 Desk study data relating to marine receptors were gathered from the following additional resources:

- Ecology and Fish Data Explorer (Environment Agency, 2022c);
- Seabed Habitats Map (EMODnet, 2022);
- Explore Marine Plans (Defra and MMO, 2021);
- Lowestoft Third River Crossing – Benthic Survey (APEM, 2018); and
- Spawning and nursery grounds of selected fish species in UK waters (Ellis *et al.*, 2012).

Preliminary Ecological Appraisal

10.2.9 A PEA was undertaken in May 2017 (CH2M, 2017b). This covered the barrier location and linear defences to the north and south of the Scheme. The survey identified and mapped terrestrial habitats within this area using the Phase 1 habitat survey methodology[2]. Additionally, the survey included:

- A search for badger setts and field activity, an assessment of trees and structures for their suitability to support roosting bat species;
- An assessment of surrounding habitat for its ability to support commuting bat species;
- An assessment of habitats for their potential to support breeding birds;
- An assessment of habitats to support hibernating and breeding reptiles and amphibians;
- The watercourse was inspected for riparian mammal activity along the Inner Harbour Entrance Channel edge and within voids under the suspended quays in the Yacht and Trawl basins where accessible, for, in particular, otter (*Lutra lutra*).

10.2.10 The results of these surveys informed the scoping stage, documented within the PIER (Jacobs, 2017) which was submitted with the Applicant's request for a Scoping Opinion. An updated habitat survey was undertaken in August 2021 to update habitat mapping around the works area from Phase 1 habitat mapping to UK Habitat Classification mapping to be in line with current guidance. The outcome of the survey is presented in Figure 10-1: *Nesting Kittiwake surveys*.

10.2.11 Due to the presence of the Harbour Kittiwake Colony County Wildlife Site (CWS) (see Section 10.5 and Figure 10-2c) in close proximity to the Scheme, nesting Kittiwake surveys were undertaken in June 2017 and updated in May 2020. The surveys involved recording nest locations and potential nest locations within the harbour area and surrounding areas within Lowestoft to provide an estimate of the local kittiwake population. The results are presented in Appendix 10B.

Bat Risk Assessment Survey

10.2.12 The preliminary ecological appraisal identified the need for a detailed bat risk assessment survey which was subsequently undertaken in August 2017. During this survey, structures adjacent to the Scheme were assessed for their suitability to support bat roosts. This included buildings along Hamilton Road, Battery Green Road, Waveney Road, and the southern side of the harbour. The survey also included an assessment of the likelihood of bats using the surrounding landscape based on the presence and quality of commuting and foraging habitat. The results of the bat risk assessment survey are presented in Appendix 10C.

Wakame Japanese seaweed (Undaria pinnatifida) Survey

10.2.13 A Japanese seaweed survey was undertaken in May 2018. *Undaria pinnatifida*, an invasive species listed under the Wildlife and Countryside Act 1981. The survey covered the extent of Lowestoft Harbour and included categorisation of macroalgae communities within Lowestoft Harbour and a record of the presence of Japanese seaweed in Lowestoft Harbour. The results of the Japanese seaweed survey are presented in Appendix 10E and indicate the presence of this species in both the Outer Harbour and Lake Lothing, exclusively attached to floating pontoons or boat hulls.

Study Area

10.2.14 For this assessment, the study area includes all ecological features that occur within the Zone of Influence (ZoI) of the Scheme as per the Chartered Institute of Ecology and Environmental Management (CIEEM) Guidelines. The ZoI is the area(s) over which ecological features may be affected by the biophysical changes caused by the Scheme and associated activities.

[2] JNCC (Joint Nature Conservation Committee). (2010). Handbook for Phase 1 habitat survey: A technique for environmental audit. JNCC, Peterborough.

10.2.15 The ZoI varies according to the ecological receptor, the sensitivity of each receptor and based on the zone of possible impacts, as per the CIEEM Guidelines. The ZoI has been defined as follows:

- The ZoI for statutory designated sites of international importance was considered to be 5km from the Order Limits of the Scheme;
- The ZoI for statutory designated sites of national importance and non-statutory designated sites was considered to be 2km from the Order Limits of the Scheme;
- For nesting kittiwake, roosting bats, peregrine falcon and black redstart, the ZoI is the Scheme Order Limits. Consideration has been given to their presence in suitable areas within Lowestoft and the desk study records of these species have been considered up to 2km from the Scheme;
- For otter, the ZoI includes the Scheme Order Limits and Lake Lothing. Desk study records for this species have been considered up to 2km from the Scheme;
- For benthic habitats and communities, the ZoI encompasses the Lowestoft Harbour, Lake Lothing and up to 2km seaward of the Scheme;
- For estuarine and marine fish species, the ZoI encompasses Lowestoft Harbour, Lake Lothing and up to 2km seaward of the Scheme. Due to the limited data available, the study area includes the International Council for the Exploration of the Sea (ICES) rectangles adjacent to the Scheme as defined in Ellis *et al.*, 2012;
- For diadromous fish species, the ZoI encompasses the Lowestoft Harbour, Lake Lothing and the river catchment upstream of the proposed working areas that have hydrological links to Lake Lothing and allow free passage (i.e. where barriers to fish movement are not present); and
- For marine mammals, the ZoI can be extensive in open water and the study area encompasses the survey blocks adjacent to the Scheme as defined in Hammond *et al.* (2017) and Carter *et al.* (2020).

Scoping Assessment

10.2.16 The scoping assessment was documented in the PEIR (Jacobs, 2017) and was informed by data collection undertaken in 2017. In light of scheme changes since the EIA scoping stage and the Scoping Opinions received from the Secretary of State, the MMO and the responses from consultees contained in Annex A to that Scoping Opinion (see Table 10-1), the scope of the assessment undertaken in the ES was reviewed. Table 10-2 summarises the receptors and the potential impacts that are assessed in this chapter. The impacts that have been scoped out are not assessed further.

Table 10-2: Summary of biodiversity impacts scoping.

Receptor	Scoped in or scoped out	Justification
Statutory designated sites of international importance: Flamborough and Filey Coast SPA kittiwake compensation sites; The Southern North Sea SAC ; Outer Thames Estuary SPA; The Broads SAC; Broadland SPA; Broadland Ramsar; and Benacre to Easton Bavents SPA.	In	The Scoping Opinion identified the requirement for a screening assessment, to inform a Habitats Regulations Assessment of the effects of the Scheme on internationally designated sites. The aforementioned sites were screened into the assessment given that impact pathways have been identified that could affect at least one of their features. It should be noted that Flamborough and Filey Coast SPA kittiwake compensation sites have been scoped into the assessment since the Scoping Opinion given that they have only recently been secured.
Other Statutory designated sites of international importance: Ald-Ore Estuary SPA.	In	Ald-Ore Estuary SPA is approximately 36km south of the Order Limits and is designated for supporting breeding populations of little tern (*Sternula albifrons)*, sandwich tern (*Sterna sandvicensis),* lesser black-backed gull (*Larus fuscus),* pied avocet *(Recurvirostra avosetta)* and marsh harrier (*Circus aeruginosus),* as well as non-breeding populations of pied avocet, ruff (*Philomachus pugnax)* and common redshank *(Tringa tetanus*). While the tern species and lesser black-backed gull from the SPA may forage along the coastline around Lowestoft, the waters around the harbour are unlikely to form core foraging habitat given the distance and busy nature of the environment as well as the turbidity of the water. Similarly, the ZoI of the Scheme is not considered to include any functional habitat for any of the remaining breeding and non-breeding species. Consequently, there are not considered to be any potential pathways to effects to this site and therefore no likely significant effects can be reasonably concluded.
Statutory designated sites of national importance (Sprat's Water and Marshes Carlton Colville SSSI)	In	Sprat's Water and Marshes Carlton Colville SSSI is located 2km west of the Scheme and falls within the study area. All other statutory designated sites of national importance are located outside of the study area.
Other statutory designated sites of national importance (Barnby Broad and Marshes SSSI)	In	Given the distance (5km) and limited hydrological connectivity between the Scheme and the SSSI, there are not considered to be any potential pathways to effects to this site. The Order Limits also do not fall within the Impact Risk Zone (IRZ) for this SSSI. Consequently, no likely significant effects can be reasonably concluded.
Statutory (and non-statutory) designated sites of county importance (Leathes Ham	Out	The closest statutory designated site of county importance is Leathes Ham LNR/CWS which is approximately 600m northwest of the compound area. There are no likely

Receptor	Scoped in or scoped out	Justification
Local Nature Reserve (LNR)/CWS)		pathways to effects from the works to this site or other statutory designated sites of county importance.
Non-statutory designated sites of county importance (Harbour Kittiwake Colony CWS and Brooke Yachts and Jeld Wen Mosaic CWS)	In	The scoping assessment did not scope these receptors in however it is now deemed necessary, as the Harbour Kittiwake Colony CWS is partially within the Scheme Order Limits. Construction traffic will go through the CWS and therefore nesting kittiwake nests within the CWS may be disturbed. Brooke Yachts and Jeld Wen Mosaic CWS is also situated on the southern bank of Lake Lothing approximately 200m west of the main site compound quayside area where the transfer of materials to vessels will take place.
Other non-statutory designated sites of county importance	Out	There are not considered to be any impacts on any other non-statutory designated sites of county importance due to the distance and/or nature of the Scheme. Whilst the closest other CWS, Kirkley Ham, is situated approximately 125m from the Order Limits, no direct or indirect impact pathways are anticipated and as such, a negligible risk is inferred for this site, as well as any wider non-statutory designated sites of county importance.
Terrestrial Habitats of Principal Importance (HPI)	Out	No terrestrial HPIs are present within the footprint of the Scheme, are anticipated to be lost or indirectly affected during construction and operation. Terrestrial habitat largely includes urban developed sealed surfaces.
Nesting Kittiwake (*Rissa tridactyla*)	In	There is potential for nesting Kittiwake to be present during construction and nests to be lost or disturbed as a result of demolition of parts of the North and Inner South Piers.
Roosting bats	In	Works affecting the Bascule Bridge control building have the potential to cause direct impact and indirect disturbance to roosting bats.
Commuting and foraging bats	Out	Foraging and commuting habitat for bat species is very limited within the Scheme Order Limits and overall habitat suitability for bat species is very poor within the study area.
Hunting Otter	In	Hunting otter may occasionally come into Lowestoft Harbour.
Peregrine Falcon (*Falco peregrinus*)	In	This receptor was not identified during the scoping assessment, but desk study records suggest the species nests within the study area. As the site is urban in nature, there is some suitability for nesting for this species within the study area.
Black redstart (*Phoenicurus ochruros*)	In	This receptor was not identified during the scoping assessment, but desk study records suggest the species nests within the study area. As the site is urban in nature there is

Receptor	Scoped in or scoped out	Justification
		some suitability for nesting for this species within the study area.
Other breeding birds	In	The site is urban in nature and has very limited opportunities for non-urban birds. Species including red-throated diver (*Gavia stellata*), common tern (*Sterna hirundo*) and little tern (*Sternula albifrons*) are considered in the HRA in relation to the Outer Thames Estuary SPA and Benacre to Easton Bavents SPA (see Appendix 10D, Section 4.6). No likely significant effects are concluded.
Amphibians and reptiles	Out	There is no suitable habitat for amphibians and reptiles within the Scheme Order Limits.
Badger	Out	There is no suitable habitat for badger within the Scheme Order Limits.
Wakame Japanese seaweed (*Undaria pinnatifida*)	In	There is a risk of spreading this invasive species if it is present at the North and Inner South Piers demolition or areas involved in the barrier construction.
Intertidal and subtidal habitat and associated aquatic invertebrate communities	In	Intertidal and sub-tidal habitats may be indirectly affected by the construction and operation of the Scheme.
Fish (freshwater migratory, estuarine resident and marine species)	In	There is potential for marine and estuarine fish to be disturbed during construction of the Scheme. Construction and operation of the barrier may affect passage of migratory fish.
Marine mammals (including harbour porpoise and seal species)	In	Marine mammals have the potential to be affected by noise and vibration generated during construction.

Assessment of Impacts

10.2.17 The assessment considers the likely significant effects of the Scheme on ecological features in Table 10-2 (above). Potential impacts have been identified with reference to the design and construction methods outlined in Chapter 6: Proposed Scheme.

10.2.18 The mitigation hierarchy[3] from the CIEEM guidelines has been applied and opportunities to avoid or reduce significant effects taken where possible.

10.2.19 Following the assessment, appropriate mitigation has been identified where adverse effects are unavoidable.

[3] A sequential process to avoid, mitigate and compensate negative ecological impacts and effects.

Defining Sensitivity of the Receptor

10.2.20 The sensitivity of the receptor is determined by:

- The biodiversity importance of the receiving habitat, for example in terms of its relative extent, fragility (including its ability to recover) and rarity; and
- The nature and significance of any nature conservation designations that apply to the receiving site / habitat.

10.2.21 The CIEEM guidelines recommend that the importance of an ecological receptor is considered within a defined geographical context. The definitions for this geographical frame of reference are presented in Table 10-3.

Table 10-3: Criteria for levels of geographical context of importance.

Geographic context of importance	Criteria
International	National site network, including SPAs, SACs, candidate SACs and Sites of Community Importance (SCI). Potential SPAs (pSPA), possible SACs (pSACs), Ramsar sites (designated under international convention) and proposed Ramsar sites, which should also be considered in the same manner in accordance with national planning policy. Areas of habitat or populations of species which meet the published selection criteria for national site network designation or Ramsar site, but which are not themselves currently designated at this level. Resident or regularly occurring populations of species where impacts would occur at an international scale where: a) the loss of these populations would adversely affect the conservation status or distribution of the species at an international scale; or b) the population forms a critical part of a wider population at this scale; or c) the species is at a critical phase of its life cycle at an international scale.
National	A nationally designated site including SSSIs and National Nature Reserves (NNRs). Areas (and the populations of species which inhabit them) which meet the criteria within the guidelines for selection of biological SSSIs[4] but which are not themselves designated. HPI and Species of Principal Importance (SPI), Red listed and legally protected species that are not addressed directly in Part 2 of the "Guidelines for Selection of Biological SSSIs" but can be determined to be of national importance using the principles described in Part 1 of the guidance. Resident, or regularly occurring, populations of species where: a) the loss of these populations would adversely affect the

[4] https://jncc.gov.uk/our-work/guidelines-for-selection-of-sssis/#part-1-rationale-operational-approach-and-criteria-for-site-selection

Geographic context of importance	Criteria
	conservation status or distribution of the species at a UK or national scale; or b) the population forms a critical part of a wider population at this scale; or c) the species is at a critical phase of its life cycle at a UK or national scale.
County	LNR and Non-Statutory Designated sites designated in the county context. Areas which, based on field data collected to inform the EcIA, meet the published selection criteria for those sites designated in the county context (for habitats or species, including those listed in relevant Local Biodiversity Action Plans) but which are not themselves designated. HPI and SPI, Red listed and legally protected species that based on their distribution, population size, quality etc. are determined to be at a lesser level of importance than the geographic contexts above (loss of these populations would adversely affect the conservation status or distribution of the species at a county scale only) e.g. isolated and/or degraded small areas of HPI.
Local	HPI and SPI, Red listed and legally protected species that based on their distribution, population size, quality etc. are determined to be at a lesser level of importance than the geographic contexts above (loss of these populations would adversely affect the conservation status or distribution of the species at a local scale only). Common and widespread habitats occurring within the study area in proportions greater than may be expected in the local context.

10.2.22 The sensitivity of receptors does not necessarily equate directly to its geographical context. For example, an ecological receptor of high conservation importance may comprise a robust ecosystem which is resilient to effects caused by external factors and is therefore not highly sensitive. Conversely, an ecological receptor may be vulnerable to change but widespread or abundant at the geographic scale considered and therefore the population within the study area may not be important at that scale. The sensitivity of each of the ecological receptors assessed within the detailed assessment has been defined by professional judgement. The sensitivity of the receptors is determined as either High, Moderate or Low.

Defining Magnitude of Change

10.2.23 The magnitude of change considers factors such as the extent and integrity of the affected area, and the duration of potentially damaging impacts. Example criteria, based on CIEEM guidelines, for assessing the magnitude of potential impacts are provided in Table 10-4 whose appropriateness for use has been considered on an individual species/habitat basis.

Table 10-4: Example criteria for assessing the magnitude of change.

Magnitude	Criteria
High	More than 50% of a site, area or population affected. Effect on site integrity, in terms of coherence of

Magnitude	Criteria
	ecological structure or function. Impact on population status.
Moderate	Between 20-50% of a site, area or population affected. May result in an effect on a site's ecological objectives but does not result in major effects to the function of the habitat. Effect causes a substantial change in abundance of a species but does not result in effects on population status.
Low	Between 5 – 20% of a site, area or population affected. Neither integrity nor ecological objectives of the site or population status compromised, negligible negative effects. Effect causes a change to small, localised section of habitat which is outside the range of natural variation but resulting in no change to the function of the habitat. Effect causes a change to a small group of localised individuals of a population, outside the range of natural variation, but does not affect the viability of the population.
Very low	Less than 5% of a site, area or population affected. No observable change. Effects on the habitat/population are undetectable or within the range of natural variation.
No Change	No change.

Positive or Negative Definitions

10.2.24 Impacts (and, where relevant, resultant effects) can be positive or negative. For this Biodiversity chapter, these are defined as per the CIEEM guidelines:

- Positive – a change that improves the quality of the environment, or halts or slows an existing decline in quality, e.g. increasing the extent of a habitat of conservation value; and
- Negative – a change that reduces the quality of the environment, e.g. destruction of habitat or increased noise disturbance.

Duration

10.2.25 The likely duration of impacts has been described as either short-term, medium-term, long-term or permanent, to be consistent with other topics in this ES (see Chapter 7: Environmental Assessment Methodology). However, in this assessment the duration has been quantified using the ecological receptor characteristics. These are determined using professional judgement instead of linking the duration to construction and operational timescales. For example, in Chapter 7, a short-term impact is described as being during construction (one to four years) and up to one year following construction but for an invertebrate, these short-term impacts could span up to four generations and lead to permanent population changes and therefore would be assessed as permanent.

Identification of Irreversible Impacts

10.2.26 The reversibility of impacts has been considered based on the definitions within the CIEEM Guidelines:

- An irreversible impact is one which, if an impact was removed, recovery is not possible within a reasonable timescale or for which there is no reasonable chance of action being taken to reverse it. An example of an irreversible impact is where the loss of even a small number of individuals causes a

population to go into a long-term decline from which it is not capable of recovering or the loss of a habitat which has taken decades to establish such as ancient woodland; and

- A reversible impact is one which, if an impact was removed, spontaneous recovery is possible, or the effect may be counteracted by mitigation.

Defining Significance of Effects

10.2.27 The significance of each effect has been defined based on the sensitivity of the receptor and magnitude of the impact, using the matrix set out in Chapter 7: Environmental Assessment Methodology, which for ease of reading is replicated in this chapter in Table 10-5.

10.2.28 The description of significance used in this chapter has been defined so as to maintain consistency with other topics in this ES. For the purposes of this EcIA, significant effects are classified as those identified as 'Moderate' or 'Major', using the matrix provided in Table 10-5.

10.2.29 All identified effects have been described by defining the magnitude of change, the sensitivity of the receptor, the route through which the impact occurs (i.e. direct, indirect) and whether it is reversible.

10.2.30 The CIEEM Guidelines note that "significant effects should be qualified with reference to a geographical scale". Significant effects, and the geographical scale to which they are experienced, is provided for each receptor in Section 10.7. The geographical scale of an identified effect is not always the same as the geographical importance of the receptor. For example, an effect on a species which is on the national (NERC) list of species of principal importance may not have a significant effect on its national population, and therefore the effect may be considered of borough or local scale.

10.2.31 The predicted effects were initially assessed without the implementation of any mitigation. Mitigation measures were then proposed to address any significant negative effects identified. The measures listed are consistent to the geographical scale of the impact as per the CIEEM Guidelines. The effects of the Scheme, incorporating the proposed mitigation measures, were then assessed to provide the significance of any residual effects.

Table 10-5: Assessment of environmental effects and residual effects.

		Sensitivity of receptor		
		High	Moderate	Low
Magnitude of impact	High	Major (significant)	Major (significant)	Moderate (significant)
	Moderate	Major (significant)	Moderate (significant)	Minor
	Low	Moderate (significant)	Minor	Negligible
	Very low	Minor	Negligible	Negligible
	No Change	None	None	None

10.2.32 Mitigation for non-significant effects is provided in Table 10-9 to ensure legal compliance with regards to protected species and habitat legislation and minimise negative effects on biodiversity. See Section 10.4 for the relevant legislation.

Assumptions and Limitations

10.2.33 A desk study was undertaken, the purpose of which was to provide contextual information on the baseline conditions of the Scheme. Information obtained is dependent upon people and organisations having made and submitted records for the area of interest. As such, a lack of records for a particular habitat or species does not necessarily mean that the habitat or species does not occur in the study area. Likewise, the presence of historical records for a particular habitat or species does not mean that it necessarily still occurs within the study area. The desk study is therefore primarily used to provide contextual information on the potential distribution of habitats and species within the study area and to guide the scope of further survey, where considered to be appropriate. The desk study was updated in 2023 which did not present any species or populations with high conservation value.

10.2.34 The PEA and bat risk assessment surveys were undertaken in 2017. The terrestrial habitat data is still considered valid to inform the assessment, as the terrestrial habitats recorded in the PEA were largely developed sealed surfaces and habitats of negligible ecological value which are highly unlikely to change in the intervening time. The bat risk assessment is still considered to provide sufficient context on which to inform the impact assessment given that it is reasonable to assume that species or populations with high conservation status are highly unlikely to be present within the study area based on the urban nature of the habitats and lack of connectivity which has not changed since the time of the initial survey.

10.2.35 The PEA and bat risk assessment survey undertaken in 2017 did not cover the compound area, Belvedere Road Carpark and Royal Green (yacht club storage area). At the time of assessment, the compound area was being utilised by the Third Crossing Project for construction and therefore the Third Crossing PEA (WSP, 2017) was examined alongside aerial imagery to determine its ecological value. The remaining areas were examined using aerial imagery (Google, 2023). These areas were dominated by hardstanding; there was a small area of roadside neutral grassland adjacent to the compound and very clearly a small area of modified grassland at Royal Green. It is considered that these areas are of negligible ecological value and are highly unlikely to support protected species. Therefore, additional survey was not considered necessary.

10.2.36 Japanese seaweed was recorded present in a survey undertaken in 2018. Further survey work is therefore not considered necessary as it has been identified as present and would therefore not change the outcome of the assessment (e.g. mitigation or residual effect).

10.2.37 Where any gaps in ecological survey data were identified, a precautionary approach has been taken with respect to the potential importance of ecological receptors.

10.2.38 Natural England were consulted in April 2023 regarding the approach to surveys and use of additional data sources and confirmed that they were content that the surveys and additional data sources discussed above were appropriate to inform the EIA.

10.2.39 Where the timing of construction activity is a factor in the consideration of impacts on receptors (ie. where the environmental effects are affected by the seasonality), a worst-case scenario is assumed. This is due to uncertainty regarding what time of year certain construction activities and their related impacts will occur.

10.3 Policy and Legislation

10.3.1 In developing the Scheme design, the following legislation and policy has been considered.

Legislation

10.3.2 The legislation protecting species and habitats relevant to the Scheme includes:

- Environment Act 2021;
- Conservation of Habitats and Species Regulations 2017 (as amended);
- Ramsar Convention on Wetlands of International Importance 1971;

- Water Framework Directive 2000;
- The Marine Strategy Regulations 2010;

- Conservation of Offshore Marine Habitats and Species Regulations 2017;
  - Marine and Coastal Access Act 2009;
  - Wildlife and Countryside Act 1981 (as amended);
  - Section 41 of the Natural Environment and Rural Communities (NERC) Act 2006;
  - Salmon and Freshwater Fisheries Act 1975;
  - The Eels (England and Wales) Regulations 2009; and
  - The Conservation of Seals Act 1970.

International and National Legislation and Policy

10.3.3 SPAs, European Marine Sites and SACs, are of International importance. They have been designated and protected under the European Commission (EC) Birds Directive (Council Directive 2009/147/EC on the conservation of wild birds) and Habitats Directive (Council Directive 92/43/EEC, Council Directive 92/43/EEC on the Conservation of natural habitats and of wild fauna and flora). The NPPF (Ministry of Housing, Communities and Local Government (2021)) also specifies that Ramsar sites, classified under the Convention of Wetlands of International Importance, also receive the same level of protection as SPAs and SACs. Refer to the HRA (Appendix 10D) for further details.

10.3.4 The NPPF sets out the national planning policies for the country and provides the framework for local policy. Within the NPPF is a policy for conserving and enhancing the natural environment which states that, "planning policies and decisions should contribute to and enhance the natural and local environment". This should be done through measures such as protecting and enhancing valued sites; recognising the intrinsic character and beauty of the countryside, and its natural capital and ecosystem services; minimising impacts and providing net gains for biodiversity, including establishment of resilient ecological networks; and preventing new and existing development from contributing to pollution or land instability. This chapter provides an assessment of the likely environmental impacts from the Scheme on the topic of biodiversity. The Scheme will achieve net gains for biodiversity.

10.3.5 The UK Government has set out the following policies within the 25 Year Environment Plan (HM Government, 2018) which are relevant to the Scheme and the topic of biodiversity:

- Embedding an 'environmental net gain' principle for development, including housing and infrastructure; and
- Protection and recovering nature.

10.3.6 Targets have also been set by the UK Government for the goals within the 25 Year Environmental Plan. The following are of relevance to the Scheme and the topic of biodiversity:

- Restoring 75% of terrestrial and freshwater protected sites to favourable condition, securing their wildlife value for the long term;
- Creating or restoring 500,000 hectares of wildlife-rich habitat outside the protected site network, focussing on priority habitats as part of a wide set of land management changes providing extensive benefits;
- Taking action to recover threatened, iconic or economically important species of animals, plants and fungi, and where possible to prevent human induced extinction or loss of known threatened species in England;
- Increasing woodland in England in line with aspirations of 12% cover by 2060: this would involve planting 180,000 hectares by the end of 2042; and

- Managing and reducing the impact of existing plant and animal diseases; lowering the risk of new ones and tackling invasive non-native species.

Local Policy

10.3.7 The East Suffolk Council Waveney Local Plan (March 2019) Policy WLP8.34 provides relevant policy information in context of the Scheme as summarised below:

- Development will be supported where it can be demonstrated that it maintains, restores, or enhances the existing green infrastructure network and positively contributes towards biodiversity through the creation of new green infrastructure and improvement to linkages between habitats;
- Proposals that will have a direct or indirect adverse impact on locally recognised sites of biodiversity or geodiversity importance, including County Wildlife Sites, Biodiversity Action Plan (BAP) habitats and species, will not be supported unless it can be demonstrated that new opportunities to enhance the green infrastructure network will be provided as part of the development that will mitigate or compensate for this loss. Where compensatory habitat is created, it should be of equal or greater size than the area lost as a result of the development, be well located to positively contribute towards the green infrastructure network and biodiversity and be supported with a management plan;
- Where there is reason to suspect the presence of protected species or habitat, applications should be supported by an ecological survey undertaken by a suitably qualified person. If present the proposal must be sensitive to, and make provision for their needs. Any development with the potential to impact on a Special Protection Area or Special Area for Conservation within or outside of the District will need to be supported by information to inform a Habitat Regulations Assessment; and
- A Supplementary Planning Document will be prepared to implement a Recreational Avoidance and Mitigation Strategy in order to mitigate any impacts on Special Protection Areas and Special Areas for Conservation. The Council will work with neighbouring authorities and Natural England to develop this strategy. The strategy will include a requirement for developers to make financial contributions towards the provision of strategic mitigation within defined zones.

10.4 Consultation

Natural England, the Environment Agency, East Suffolk Council and the Lowestoft Kittiwake Partnership were consulted for their views on the key findings of this Ecological Impact Assessment in February, March and July 2023, with their feedback incorporated into this document. A summary is provided in Table 10-6, will further details included in Chapter 5: Consultation.

Table 10-6: Environmental stakeholder consultation in relation to the biodiversity chapter – February, March and July 2023.

Consultee	Comment(s)	Response
Environment Agency	▪ Concern regarding mitigation for impacts on roosting availability for gulls; ▪ Need for consideration of practicality of implementing soft start piling protocols. Use of mammal observers important; and ▪ Query regarding potential for impacts on migratory fish during operation when the tidal gates close.	▪ There are limited opportunities to mitigate for the loss of roosting habitat, however the scheme will only affect a limited area, relative to the areas in the vicinity used by roosting gulls; ▪ The use of both soft start piling and mammal observers are included as mitigation for potential effects on marine mammals during construction (see Section 10.7); and ▪ No impacts on migratory fish are considered likely due to the short duration of closures anticipated during

Consultee	Comment(s)	Response
		operation of the Scheme, and therefore migratory fish are scoped out of assessment (see Section 10.6).
Natural England	▪ Natural England has previously made comments on other projects in the vicinity; these comments should be considered as the EIA is updated; and ▪ Comments provided on Kittiwake mitigation and a recommendation to consult with the Kittiwake Partnership.	▪ Comments made on other schemes locally (eg Gullwing Bridge, LEEF) have been considered in this assessment; and ▪ The comments made on the Kittiwake mitigation have been considered and updates made, as required. The Kittiwake Partnership has been consulted (see below).
East Suffolk Council – Ecology	▪ Recommend consideration of kittiwake mitigation advice provided to LEEF project and also of artificial nesting structure for kittiwake provided on outer harbour. Bird spikes to be used as deterrent as last resort only; ▪ Query regarding potential for disturbance to foraging red throated diver from shipping traffic associated with Scheme; and ▪ Referred to a number of artificial kittiwake nesting structures created as mitigation for impacts on the Southern North Sea SAC / Outer Thames Estuary SPA. Recommend inclusion in the Scheme's HRA.	▪ Kittiwake mitigation has been reconsidered and alternative options will be adopted (reconsidered within this assessment); ▪ Red throated diver considered in the HRA. Any increase in shipping traffic as a direct result of the Scheme will not be significant in the context of existing levels; and ▪ Consideration given to the artificial nesting structures in the HRA.
The Lowestoft Kittiwake Partnership	▪ Highlighted that kittiwake have been recorded nesting in the Inner South Pier as well as the Inner North Pier in the Outer Harbour; ▪ Recommendations on the design of kittiwake mitigation were provided. Artificial nesting structures should aim to provide highest breeding productivity feasible. Bird spikes to be used as deterrent as last resort only; and ▪ Recommended monitoring measures and contacts provided to facilitate monitoring of kittiwakes.	▪ Kittiwake mitigation will be extended to cover the Inner South Pier as well as the Inner North Pier; ▪ Recommendations on kittiwake mitigation design will be considered for the final design; and ▪ Consideration given to monitoring requirements.

10.5 Baseline

10.5.1 Baseline appendices have been prepared to support this section of the EcIA; these are provided in Appendix 10A, 10B, 10C, 10D, 10E and 10F.

Designated Sites

Statutory designated sites of international importance

10.5.2 There are no internationally important sites located entirely or partially within the Order Limits of the Scheme. A total of five internationally important sites though are present within the study area as summarised in Table 10-7 below. The locations of the sites are presented in Figure 10-2. These sites have also been subject to a HRA comprising Stage 1 Screening of Likely Significant Effects and Stage 2 Appropriate Assessment, which forms Appendix 10D.

Table 10-7: Statutory designated sites of international importance within the HRA.

Name	Designation	Qualifying Features	Distance and orientation to the Scheme
Southern North Sea	SAC	Harbour porpoise (*Phocoena phocoena*)	9m east
Outer Thames Estuary	SPA	Red-throated diver (*Gavia stellata*) – Non-breeding	9m east
		Common tern (*Sterna hirundo*) - Breeding	
		Little tern (*Sternula albifrons*) - Breeding	
The Broads	SAC	Hard oligo-mesotrophic waters with benthic veg of *Chara spp.*	2km west
		Natural eutrophic lakes with Magnopotamion or Hydrocharition	
		Molinia meadows on calcareous, peat or clay-silt soil	
		Transition mires and quaking bogs	
		Calcareous fens with *C. mariscus* and species of *C. davallianae*	
		Alkaline fens	
		Alluvial woods with *A. glutinosa*, *F. excelsior*	
		Desmoulin's whorl snail (*Vertigo moulinsiana*)	
		Otter (*Lutra lutra*)	
		Fen orchid (*Liparis loeselii*)	
		Little ram's-horn whirlpool snail (*Anisus vorticulus*)	
Broadland	SPA	Bewick's swan (*Cygnus columbianus bewickii*) – Non-breeding	2km west
		Bittern (*Botaurus stellaris*) - Breeding	
		Gadwall (*Anas strepera*) – Non-breeding	
		Hen harrier (*Circus cyaneus*) – Non-breeding	

Name	Designation	Qualifying Features	Distance and orientation to the Scheme
		Marsh Harrier (*Circus aeruginosus*) - Breeding	
		Ruff (*Philomachus pugnax*) – Non-breeding	
		Shoveler (*Anas clypeata*) – Non-breeding	
		Whooper swan (*Cygnus cygnus*) – Non-breeding	
		Wigeon (*Anas penelope*) – Non-breeding	
Broadland	Ramsar	Calcareous fens with *C. mariscus* and species of *C. davallianae*	2km west
		Alkaline fens	
		Alluvial woods with *A. glutinosa, F. excelsior*	
		Desmoulin's whorl snail, *Vertigo moulinsiana*	
		Fen orchid (*Liparis loeselii*)	
		Otter (*Lutra lutra*)	
		Wetland invertebrate assemblage	
		Wetland plant assemblage	
		Bewick's swan (*Cygnus columbianus bewickii*) – Wintering	
		Wigeon (*Mareca penelope*) - Wintering	
		Gadwall (*Anas strepera*) - Wintering	
		Shoveler (*Anas clypeata*) - Wintering	
Benacre to Easton Bavents	SPA	Little tern (*Sternula albifrons*) - Breeding	7km south
		Bittern (*Botaurus stellaris*) - Breeding	
		Marsh Harrier (*Circus aeruginosus*) - Breeding	

Statutory designated sites of national importance

10.5.3 There is one nationally designated site within 2km of the Scheme. This is Sprat's Water and Marshes – Carlton Colville SSSI, a component of the Broads SAC, Broadland SPA and Ramsar site, located 1.5km west of the Scheme from the compound location. The location of this site is presented in Figure 10-2.

10.5.4 The site comprises areas of spring-fed mixed fen, open water, alder carr and wet grazing marsh on deep peat. The fen community is of a type that is typical of Broadland but which is rarely found elsewhere in Suffolk. Maintenance of high summer water levels together with seasonal grazing and reed cutting have led to the development of a very rich flora which includes several uncommon species. The site is also important for breeding birds.

Statutory designated sites of county importance

10.5.5 There is one statutory designated site of county importance within 2km of the Scheme. This is Leathes Ham LNR which is located approximated 600m north west of the main site compound. The location of this site is presented in Figure 10-2. The site comprises a large area of open water with some marginal reedbeds, surrounded by wet woodland with scrub and rough grassland. The site provides opportunities for breeding waterfowl. The site also supports terrestrial and aquatic invertebrates including Norfolk Hawker dragonfly which is listed as Endangered and is fully protected under Schedule 5 of the Wildlife & Countryside Act 1981 (as amended).

Non-statutory designated sites of county importance

10.5.6 One non-statutory designated site is located within the Scheme Order Limits, Harbour Kittiwake Colony CWS. This site is located within the quayside area in the Outer Harbour which falls partly within the Order Limits. The site comprises a Kittiwake nesting colony. The present nucleus of the colony is a constructed artificial cliff on the north pier extension.

10.5.7 Brooke Yachts and Jeld Wen Mosaic CWS is situated approximately 200m west of the Order Limits on the southern bank of Lake Lothing. This semi-natural site has an open mosaic of habitats on previously developed land and a small area of intertidal mudflat (priority habitats). It provides food, shelter and nesting sites for a wide range of wildlife including reptiles, small mammals and birds and is of high wildlife value, particularly in an urban setting. The majority of the shoreline is natural, although eroding and the connectivity with the wetland corridor of Lake Lothing is excellent. The structural diversity is also very good with a wide range of habitats from short to rank grassland, thick scrub (which includes dense area of gorse) and woodland. On parts of the site, industrial debris is covered by scrub.

10.5.8 Leathes Ham LNR (discussed above) is also designated as a CWS.

Habitat Records

10.5.9 A study of Lake Lothing (APEM, 2018) found that the habitat consisted of silty sediments with high turbidity water. Particle size analysis (PSA) data of grab samples showed the sediment is comprised of predominantly mud, with a small amount of sand. No gravel sized particles (>2.0mm) were recorded. The benthic biota was significantly impoverished, as expected in a regularly dredged environment, with two of 15 samples containing no recordable biota and five samples containing only non-countable biota (i.e. algae, bryozoans, etc). Two biotopes were assigned to the habitat in Lake Lothing: *Aphelochaeta marioni* and Tubificoides spp. in variable salinity infralittoral mud (SS.SMu.SMuVS.AphTubi) and Infralittoral fluid mobile mud (SS.SMu.SMuVS.MoMu).

10.5.10 The benthic habitats adjacent to the Outer Harbour entrance have been reported as circalittoral sand, infralittoral sand and circalittoral coarse sediment (EMODnet, 2022) and intertidal habitats appear to be predominantly sandy beach, with no additional intertidal habitats evident from aerial imagery. *Sabellaria spinulosa* on stable circalittoral mixed sediment (SS.SBR.PoR.SspiMx) habitat was recorded close to shore, approximately 200m south of the Outer Harbour in 2016 (Natural England, 2018).

Species Records

10.5.11 The desk study returned records of protected species within 2km of the Scheme which included otter (*Lutra lutra*), water vole (*Arvicola amphibius*), grass snake (*Natrix helvetica*), common lizard (*Zootoca vivipara*), great crested newt (*Triturus cristatus*), Common pipistrelle (*Pippistrellus pipistrellus*), soprano pipistrelle (*Pipistrellus pygmeaus*), noctule bat (*Nyctalus noctule*), Badger (*Meles meles*) and harbour porpoise (*Phocoena phocoena*).

10.5.12 There were 219 records of bird species including notable species such as kittiwake (*Rissa tridactyla*), peregrine falcon (*Falco peregrinus*), black redstart (*Phoenicurus ochruros*), red-throated diver (*Gavia stellata*), common tern (*Sterna hirundo*), little tern (*Sternula albifrons*), kingfisher (*Alcedo atthis*) and barn owl (*Tyto alba*).

10.5.13 In addition, there were records of priority species including common toad (*Bufo bufo*), smooth newt (*Lissotriton vulgaris*), common frog (*Rana temporaria*) and hedgehog (*Erinaceus europaeus*).

10.5.14 Local biological records within 2km of the Scheme are presented on Figure 10-3.

10.5.15 During the desk study, a peregrine falcon survey report and black redstart survey report detailed within an EcIA associated with a nearby Scheme, Lake Lothing Third Crossing Order (Suffolk County Council, 2018) were reviewed. The surveys were undertaken in 2017 and covered part of the study area and did not record any nesting peregrine falcon or breeding black redstart.

10.5.16 A variety of marine and estuarine fish have been recorded in the vicinity of the Scheme. Ellis *et al*. (2012) reported the coastal area around Lowestoft as spawning grounds for Atlantic herring (*Clupea harengus*), sandeels (*Ammodytidae*) and sole (*Solea solea*). The same report identified the area as nursery grounds for multiple marine fish species including those listed above in addition to Atlantic cod (*Gadus morhua*), whiting (*Merlangius merlangus*), mackerel (*Scomber scombrus*) and plaice (*Pleuronectes platessa*). Other species such as European seabass (*Dicentrarchus labrax*), grey mullet (*Mugil cephalus*) and flounder (*Platichthys flesus*) are also known to associate with the transitional waters in the vicinity of the Scheme (MMO Consultation, August 2021). Trawls of the Inner Harbour and Lake Lothing (APEM, 2018) recorded Lozano's goby (*Pomatoschistus lozanoi*), sand gobies (*Pomatoschistus minutus*), transparent gobies (*Aphia minuta*) and common gobies (*Pomatoschistus microps*) in reasonable numbers. Single individuals of each European eel (*Anguilla Anguilla*), European sprat (*Sprattus sprattus*), European seabass and eelpout (*Zoarces viviparus*) were recorded.

10.5.17 The closest freshwater fish monitoring site to the Scheme recorded on the Environment Agency Ecology & Fish Data Explorer (Environment Agency, 2022c) is at Beccles Boat Yards, approximately 19km upstream on the River Waveney. The presence of migratory species (European eel) indicate a pathway for species that will move between coastal waters at Lowestoft and the freshwater River Waveney. A variety of freshwater fish species were recorded, typical of a freshwater lowland river system. Smelt (*Osmerus eperlanus*) are known to utilise the River Waveney as far upstream as Beccles (Moore, *et al*., 2016), and may enter the Waveney system via Lowestoft harbour.

10.5.18 Hammond *et al*. (2017) reported that the area of the North Sea around Lowestoft is estimated to support densities of 0.607 harbour porpoise/km^2, one of the highest densities in the European Atlantic waters survey area, with the coastal areas being more important in the winter months and porpoise moving into open sea during the summer (JNCC, 2019b). No other cetacean species were reported from this area.

10.5.19 Grey seal *Halichoerus grypus* and harbour (common) seal (*Phoca vitulina*) densities are low in the vicinity of the Scheme (Carter *et al*., 2020) with the closest known seal colony on Scroby Sands, approximately 15km north of the Scheme. Seals are known to regularly venture into ports and harbours, especially in the wake of fishing vessels, however, these areas do not provide important core habitat for these species.

10.5.20 The benthic invertebrate community within Lake Lothing is impoverished (APEM, 2018). The infaunal invertebrate community was dominated by annelid worms. While the beam trawls recorded a dominance of brown shrimp (*Crangon crangon*) and mysid shrimp species (*Schistomysis kervillei*, *Schistomysis spiritus*, *Neomysis integer* and *Siriella armata*).

10.5.21 Several non-native species have been recorded in Lake Lothing (APEM, 2018) namely the Darwins barnacle (*Austrominius modestus*), which is common and widespread throughout the UK (Avant, 2007); the Asian Semele (*Theora lubrica*), a small bivalve reported from only a few locations in the UK (National Museum Wales, 2021); the small tube-building polychaete (*Hydroides ezoensis*) previously recorded associated with artificial ports and harbours in the Southampton and Portsmouth area (Environment Agency, 2022e); and *Bugula neritina*, an invasive bryozoan recorded at various locations around the UK coast, associated with ports and harbours (Bilewitch, 2009).

Field Surveys

Habitats

10.5.22 The type and extent of habitats present during the PEA are described in the PEA report (Appendix 10A) which has been used to establish the baseline. No natural or semi-natural habitats were recorded within the main construction working area or access from the public highway to the main site area. Habitats here comprised hard standing / developed land sealed surface, buildings and open water. The UK Habitat classification walkover confirmed the compound area was dominated by hard standing / developed land sealed surface. The compound area also included pockets of other neutral grassland, suburban / mosaic of developed / natural surface and mixed scrub which were very limited in extent and of negligible ecological value.

Species

A summary of species surveys is presented in Table 10-8.

Table 10-8: Species surveys summary.

Species	Description
Badger	The PEA identified no suitable habitat for badger within the study area.
Bats	A total of ten structures which fall within and adjacent to the main construction site area were assessed for their suitability to support bat roosts during the bat roost assessment survey. Ten buildings were assessed: the ABP building was assessed as having moderate suitability; three buildings were assessed as having limited suitability; one building was assessed as having very limited suitability; and five buildings as have negligible/no suitability. No evidence of roosting bats was recorded during the survey. The locations of the buildings are presented in Figure 10-4. The survey reported that foraging and commuting habitat for bat species is very limited and overall habitat suitability for bat species is very poor within the study area. There is likely to be high levels of background disturbance from noise and vibration from the harbour and from street lighting. The survey concluded that habitat suitability is very poor for bat species; no further assessment of foraging and commuting bats is required. Detailed findings from the bat risk assessment survey are presented in Appendix 10C.

Species	Description
Breeding birds	The PEA concluded there is limited opportunities for nesting passerine bird species within the main construction working area. There is potential nesting bird habitat along Hamilton Road in the form of shrubs and bushes.
Otter and water vole	The PEA concluded there was no suitable habitat for water voles within the Order Limits. During the survey no field signs in relation to otters in the form of spraints or footprints were recorded and there were no features suitable for otter holts within the works area.
Reptiles and amphibians	The PEA concluded there is no suitable habitat for reptiles and amphibians within the Order Limits.
Kittiwake	During the 2017 kittiwake survey 300 active nests were observed, of which 25 were within the Outer Harbour area. A further 94 nests were believed to be on Waveney Dock but were not observed during the survey. This gives an estimated total of 390 nests of which 117 (30%) were within the Outer Harbour area. Of these, 11 nests were on the eastern end of the Inner North Pier of the Trawl Basin. During the 2020 kittiwake survey, 27 nests were recorded within the harbour, which represents 10% of the total counted during the 2017 survey, though the actual proportion of the Lowestoft population as a whole, will be much lower given that only selected locations were visited during the survey and that over 400 nests have been recorded in Lowestoft in recent years. Of the nests recorded within the harbour, a total of 21 nests were recorded on the Inner North Pier of the Trawl Basin. The locations of the nest sites are presented in Figure 10-4. Detailed findings of the kittiwake surveys are presented in Appendix 10B. During consultation with the Kittiwake Partnership, it was noted that nesting kittiwake had also been recorded in the Inner South Pier (see Table 10-6).
Japanese seaweed	The Japanese seaweed survey recorded Japanese seaweed in the Outer Harbour (Hamilton Dock, Waveney Dock, Trawl Basin and Yacht Basin) and Lake Lothing. No Japanese seaweed was recorded within the Inner Harbour that separates the two areas. The locations of Japanese seaweed recorded during the survey are presented in Figure 10-4. Detailed findings of the Japanese seaweed survey are presented in Appendix 10E.

10.6 Impact Assessment

Air Quality

10.6.1 Chapter 16: Air Quality and Climate includes an assessment of the effects of dust emissions upon ecologically designated sites during construction. This assessment considered ecologically designated sites up to 50m from the Scheme Order Limits, up to 50m from the edge of the local construction routes and up to 500m from the construction site exit(s). No ecologically designated sites fell within this area and impacts due to construction phase dust emissions on ecologically designated sites have been scoped out.

Construction Impacts

10.6.2 The assessment of significant effects on receptors that have been scoped into this assessment are presented in Table 10-9 below and described in line with the assessment methodology. The impacts considered include:

- Direct or in-direct impacts to features of designated sites;
- Killing and injury of protected species;
- Permanent or temporary severance of commuting, foraging, migration routes / habitat of a protected species;
- Disturbance to protected species from light, vibration or noise;
- Spread of INNS;
- Discharge of pollutants into watercourses; and
- Mobilisation of sediments.

Table 10-9: Assessment of significant effects during the construction phase.

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
Statutory designated sites of international importance	A Stage 1 and 2 HRA (Appendix 10D) was undertaken to assess whether the Scheme could give rise to significant effects on the internationally designated sites identified in Table 10-7. The Stage 1 screening exercise concluded that significant effects on the Southern North Sea SAC could not be ruled out as a consequence of disturbance to harbour porpoise through piling operations when considering the project alone. Further detailed assessment at Stage 2 however determined that adverse effects could be ruled out, further to the implementation of mitigation measures presented here. No significant effects on any of the other internationally designated sites were identified either alone or in-combination with other plans and projects and therefore they are not considered further. See also, commentary in Table 10-9 below, regarding potential impacts on Cetaceans (harbour porpoise).	Significant effects of noise and vibration on harbour porpoise the qualifying feature of Southern North Sea SAC will be mitigated by implementing JNCC Guidance (JNCC, 2010a) including: ▪ The presence of an experienced marine mammal observer on site during piling operations through the water column; ▪ A 30-minute pre-piling search within a 500m radius of the impact piling works to detect the presence of marine mammals with works delayed until 30 minutes has elapsed with no sightings within the 500m zone; ▪ Soft start protocols to be agreed with MMO for all impact piling operations through the water column (JNCC, 2010a); and ▪ These mitigation measures will be delivered through the development of a CEMP.	The assessment of effects results in a **negligible adverse effect**.
Statutory designated sites of national importance - Sprat's Water and Marshes – Carlton Colville SSSI	The Scheme will not result in any land take from statutory designated sites of national importance. The closest site, Sprat's Water and Marshes – Carlton Colville SSSI is approximately 2km from the Scheme, however this is from the main site compound, whereas it is located 3.3km west of the construction working area.	Not required.	N/A

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	Although there is hydrological linkage between the North Sea/Lake Lothing and the Broadland river system including adjacent to Sprat's Water and Marshes SSSI, this is only when Mutford Lock opens to boats so connectivity is limited. Connectivity is then limited even further when considering that the SAC and Ramsar habitats are all found within an embanked floodplain, meaning the only time there is connectivity is when there is a major flood event and the banks overtop. In any case, the risk of a pollution incident occurring during construction is considered to be low when taking into account the strict standard best practice pollution prevention and sediment control measures that will be implemented by the contractor (see Chapter 12: Water, Hydromorphology and Ground Conditions). If an incident did occur then it is likely to be very localised with no potential to have significant effects on the qualifying habitats, particularly when considering the limited connectivity between the two hydrological systems, the distance upstream from the site, the dilution capacity of the tidal river and that construction works wouldn't take place in the lead up to or during a flood event. **No change** is anticipated, therefore the assessment of significant effects results in **none** on a receptor of **high** sensitivity**.**		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
Non-statutory designated sites of county importance - Harbour Kittiwake Colony CWS	There will be no land take from Harbour Kittiwake Colony CWS and no direct impact to kittiwake nests within the CWS. Access from the Outer Harbour to the construction working area is located within the boundary of Harbour Kittiwake Colony CWS. The main kittiwake colony site is located within the lower wall, facing outwards on the south-eastern side of the port of Lowestoft behind a 4m high concrete wall. This will be sheltered from piling and other construction activities, as well as construction traffic, which will be accessing the construction working area from the north-west and south-west side of the port, approximately 100m from the CWS. Nesting kittiwake within the CWS will likely be habituated to noise disturbance from existing harbour traffic. Given the location of the main colony site relative to the access for construction traffic and the likely habituation to noise disturbance, it is considered that there will be no indirect effect from noise disturbance to nesting kittiwake within Harbour Kittiwake Colony CWS. **No change** is anticipated, therefore the assessment of significant effects results in **none**.	Not required.	N/A

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
Non-statutory designated sites of county importance - Brooke Yachts and Jeld Wen Mosaic CWS	Brooke Yachts and Jeld Wen Mosaic CWS is situated on the southern bank of Lake Lothing approximately 200m west of the quayside area of the main site compound where the transfer of materials to vessels will take place. Accidental spillage and/or leakage from mobile or stationary plant and vessels could result in the release of oils, fuels or chemicals into the water impacting the intertidal habitats within the CWS. Many mineral oils and other hydrocarbons are toxic, persistent and bio-accumulate in the environment. Additionally, biodegradation of oils in aquatic systems can lead to oxygen depletion. Concrete pours are limited to within cofferdams and therefore do not present a source of pollution. Pollution is assessed as a **direct, negative** and **reversible** impact on a receptor of **low** sensitivity. This results in a **temporary (short-term)**, **very low** magnitude impact with **negligible** effects that are **non-significant** at a **county** scale.	Standard best practice, including the items below are proposed for non-significant effects: ▪ Production of a CEMP; ▪ Production of a pollution prevention plan; and ▪ Compliance with the exchange standards contained in the IMO Ballast Water Management Convention and carry a Ballast Water Management Plan and a Certificate of Compliance.	**Negligible adverse** effects are predicted.

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
Nesting Kittiwake	During the 2017 and 2020 kittiwake surveys, 11 and 21 kittiwake nests were recorded along the northern aspect of the Inner North Pier of the Trawl Basin. The Inner North Pier lies within the construction working area, a 46m section (approximately one third) of which will be demolished to accommodate the barrier. Although no kittiwake were recorded nesting within the Inner South Pier during the surveys, consultation with the Lowestoft Kittiwake Partnership highlighted that there is record of kittiwake nesting in the Inner South Pier in recent years. The works are scheduled to occur between 2025 and 2027 and therefore has the potential to impact nesting kittiwake over three breeding seasons. Demolition of part of the inner piers will result in the permanent loss of nesting habitat. The impact is therefore **long term, direct** and **irreversible.** It is considered however to be a negligible loss of nesting habitat given the abundance of nesting habitat within the harbour area. Kittiwake typically nest between June and August. Demolition of the inner piers is scheduled for between month 5 and month 7 of the construction programme; nests could be present during these demolition works. Indicative noise modelling predicted construction activities during the nesting kittiwake season would exceed baseline noise levels along the Inner North and South Piers. These activities comprised, the	If demolition of the piers coincide with the breeding bird season (March to August include), anti-bird nesting measures will be installed prior to the start of the breeding season along suitable nesting locations on the Inner North Pier and Inner Inner South Pier to discourage kittiwake from nesting within the vicinity of the construction working area. This will include where possible boarding up of ledges to prevent access to nesting locations or increasing the angle and reducing the width of ledges such that birds cannot find purchase to nest. An ECoW will observe any nesting behaviour on temporary site infrastructure and advise on whether additional anti-nesting measures should be deployed, as appropriate. These measures will be delivered through the development of a CEMP. To compensate for the loss of nesting habitat, it is proposed that ledges will be incorporated into the design within the order limits. Pre-construction monitoring will be undertaken to identify individual kittiwake birds present within the works area. This will be undertaken in the nesting season prior to construction. Monitoring will then be undertaken in the first nesting season during construction to understand the extent of displacement of individuals that were present pre-construction. Post construction monitoring will be undertaken in the first nesting season after construction completion to measure the success of compensatory nesting habitat. Monitoring proposals will be issued to the Lowestoft Kittiwake Partnership for consultation.	The assessment of effects results in a **negligible adverse effect**.

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	demolition of the tug arms, construction of the cofferdams, cross-channel piling works and Inner North and South Pier in-situ concrete pouring. According to N Cutts, K Hemingway & J Spencer (2013) these activities would result in high level noise effects on estuarine birds, although kittiwake are likely to be more resilient to noise disturbance than estuarine birds due to habituation of moderate noise levels in the harbour. Vibration levels will be increased along the Inner North and South Piers during these activities and visual disturbance will be increased by the presence of cranes, construction traffic and other plant. Given the predicted increase in noise, vibration and visual disturbance during these construction activities, it is considered kittiwake nests if present within the Inner North and South Piers will be subject to disturbance which has the potential to cause nest abandonment. The peak count of nesting kittiwake recorded in the construction working area was 21, relative to an estimated over 400 nests within the Lowestoft local population; approximately 5% of the local population will therefore be affected. The magnitude of this change is **low**. Nesting kittiwake are of county importance, as they are a UK Red List species which, in Suffolk, only breeds in Lowestoft and at Sizewell. The local population has been present over several decades, likely due in part to the abundance of nesting opportunities within Lowestoft. The local population		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	is therefore likely to be resilient to small temporary or permanent losses of nesting habitat and/or nests (from nest abandonment). The sensitivity of this receptor is therefore **low** and the effect of loss of kittiwake nests is a **negligible adverse effect.** The effect is **non-significant** at a **county scale**.		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
Roosting bats	The ABP control building was assessed as having moderate suitability to support roosting bats. During the construction phase internal modifications are required to the ABP control building. Utilities will be installed through the cavity wall to facilitate the internal modifications. Bats have the potential to be present within the cavity wall and if present, the works may result in killing and injury of bats and/or disturbance as result of noise and vibration. The duration of the works to the ABP control building are temporary and therefore the impacts is **short-term**, **direct** and **reversible**. The desk study returned a very limited number of records of bat species (five) which were comprised of common and widespread species[5]. The ABP building is surrounded by urban habitat within a well-lit location and has a lack of vegetation and other connective habitat for bat species. It is therefore unlikely be used by anything other than common and widespread species in small numbers. Therefore, the impact would result in a **low** magnitude of change on a receptor of **low** sensitivity. The potential effect to roosting bats is a **negligible adverse effect**. The effect is **non-significant** at a **local scale**.	A pre-construction survey will be undertaken on the ABP control building. The survey will confirm the presence or likely absence of roosting bats within the building to determine the most appropriate course of action to ensure legislative compliance. The pre-construction survey will be delivered through the production of a CEMP.	The assessment of effects results in a **negligible adverse effect**.
Otter	The desk study returned records of otter and they are known to infrequently use Lake Lothing for hunting. No opportunities for otter holts or resting places and no evidence of otter were recorded during the PEA. Otters may occasionally move between the	Not required.	N/A

[5] Taken from species factsheets https://www.bats.org.uk/about-bats/what-are-bats/uk-bats

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	Broadland river system and the sea, however, given the abundance of suitable habitat and food source within the river system, it is likely that any dispersal beyond Oulton Broad or Lake Lothing is infrequent, if it occurs at all. Construction of the barrier will therefore not lead to any fragmentation effects. Lake Lothing will be subject to marine construction traffic which could disturb otter if present, however, it is likely that they would be habituated to the existing traffic within the lake. **No change** is anticipated, therefore the assessment of significant effects results in **none**.		
Peregrine falcon	Peregrine falcon is known to nest within Lowestoft. However, there is no record of nesting peregrine falcon within the Scheme Order Limits. The closest record is approximately 350m northeast of the compound area and 600m west of the main works area, which due to its distance is not anticipated to be subject to significant increase in background disturbance, including noise, vibration or visual disturbance. **No change** is anticipated, therefore the assessment of significant effects results in **none.**	Not required.	N/A
Black redstart	Black redstart are known to nest within Lowestoft. However, there is no record of nesting black redstart within the Scheme Order Limits and nesting opportunities are likely very limited.	Not required.	N/A

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	No change is anticipated, therefore the assessment of significant effects results in **none.**		
Benthic habitats and invertebrates	The benthic habitats in the vicinity of the Scheme are of limited ecological value, consisting of fine, fluid sediments with an impoverished invertebrate community within the harbour area and coarse sands and sediments outside the harbour. This is considered to be a receptor of **low** sensitivity. The benthic habitats will be subject to damage/disturbance under the footprint of areas to be dredged, and a degree of sedimentation due to settlement of sediments disturbed during dredging. However, the harbour area is subject to regular dredging and the benthic habitats and communities that will be directly affected have high resilience to mechanical disturbance (De-Bastos and Hiscock, 2016; Tyler-Walters, 2018). These impacts are assessed as being **direct**, **temporary (short-term)**, **negative** and **reversible**, on a receptor of **low** sensitivity. This results in a **very low** magnitude impact with **negligible effects** that are **non-significant** at the **local** scale. Benthic habitats will be lost under the footprint of the barrier abutments. This impact is assessed as being **direct**, **negative** and ir**reversible**, on a receptor of **low** sensitivity. This results in a **temporary (short-**	Standard best practice, including the items below are proposed for non-significant effects: ▪ Production of a CEMP; ▪ Production of a pollution prevention plan; and ▪ Compliance with the Exchange standards contained in the IMO Ballast Water Management Convention and carry a Ballast Water Management Plan and a Certificate of Compliance.	**Negligible adverse** effects are predicted.

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	term), **very low** magnitude impact with **negligible** effects that are **non-significant** at the **local** scale. Benthic habitats will be lost permanently under the footprint of the cill. This impact is assessed as being **direct**, **negative** and **irreversible**, on a receptor of **low** sensitivity. This results in a **permanent**, **very low** magnitude impact with **negligible** effects that are **non-significant** at the **local** scale. Accidental spillage and/or leakage from mobile or stationary plant and vessels could result in the release of oils, fuels or chemicals into the water. Many mineral oils and other hydrocarbons are toxic, persistent and bio-accumulate in the environment. Additionally, biodegradation of oils in aquatic systems can lead to oxygen depletion. Concrete pours are limited to within the cofferdams and therefore do not present a source of pollution. Pollution is assessed as a **direct, negative** and **reversible** impact on a receptor of **low** sensitivity. This results in a **temporary (short-term)**, **very low** magnitude impact with **negligible** effects that are **non-significant** at a **local** scale. The *Sabellaria spinulosa* reef habitat identified outside the harbour is not anticipated to experience any effects as a result of the Scheme. This is due to the reef lying beyond the effect of any changes to water quality (including resuspension of sediments from dredging activities).		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	A number of INNS have been recorded around Lowestoft Harbour, including Japanese seaweed. The records of Japanese seaweed were reported to be associated with floating structures only, and not on the fixed structures, such as harbour walls. Other non-native species have been reported within Lake Lothing and include more sedentary species of barnacle, mussel and bryozoan. The creation of new substrates and artificial surfaces can lead to the colonisation by INNS owing to the absence of competition and predation. The most likely pathway for the introduction of non-native species will be through marine plant transiting to and from the Scheme. Vessel movements have the potential to transfer INNS from other biogeographical locations through fouling on vessel hulls or in ballast water. The introduction of INNS has the potential to alter the structure and function of existing ecological communities. The INNS present in the existing environment are benthic species and have the potential to have a direct effect on the benthic communities within the harbour. Any vessels entering the harbour for construction purposes will have to follow strict best practice guidance on ballast water exchange in order to control the spread of INNS and therefore the introduction of new species or transfer of existing is considered low.		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	The spread or introduction of INNS is assessed as an **indirect, negative** and **reversible** impact on a receptor of **low** sensitivity. This results in a **long-term**, **very low** magnitude impact with **negligible** effects that are **non-significant** at the **county** scale. Dredged material will be disposed of at a licensed offshore site under a Marine Licence. The marine licence will contain a condition requiring a sediment sampling plan to be in place; which will assess the potential for sediment bound contaminants.		
Fish (estuarine/marine)	The fish community of Lake Lothing is reported to be dominated by goby species (APEM, 2018). A variety of marine and estuarine fish species, several of which are on NERC S41 list of species of principal importance, are reported to utilise areas outside Lowestoft Harbour as nursery and spawning grounds. Therefore, the estuarine and marine fish community is determined to be a receptor of moderate sensitivity. Resuspension of sediments during dredging operations has the potential to reduce water quality around the harbour area. However, the extent of dredging is limited in the context of the harbour, which is subject to routine maintenance dredging. The estuary is already a turbid environment and due to the strong tidal currents along the east coast any sediments will quickly disperse. The impact of resuspension of sediment is assessed as being	Standard best practice, including production of a CEMP and pollution prevention plan, are proposed for non-significant effects. Soft-start protocols (to be agreed with MMO) put in place to protect cetaceans will reduce the potential for effects of noise and vibration on fish as set out above in relation to statutory designated sites of international importance.	Resuspension of sediment and noise and vibration are assessed as having **negligible adverse** effects.

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	indirect, negative and **reversible**, on a receptor of **moderate** sensitivity. This results in a **temporary (short-term)**, **very low** magnitude impact with **negligible** effects that are **non-significant** at the **county** scale. Accidental spillage and/or leakage from mobile or stationary plant and vessels could result in the release of oils, fuels or chemicals into the water. Many mineral oils and other hydrocarbons are toxic, persistent and bio-accumulate in the environment. Additionally, biodegradation of oils in aquatic systems can lead to oxygen depletion. Concrete pours are limited to within the cofferdams and therefore do not present a source of pollution. Pollution is assessed as being **direct, negative** and **reversible**, on a receptor of **moderate** sensitivity. This results in a **temporary (short-term)**, **very low** magnitude impact with **negligible** effects that are **non-significant** at the **county** scale. Noise and vibration caused by construction activities have the potential to cause behavioural (avoidance) and physiological (barotrauma - tissue injury due to rapid changes in pressure) effects on fish. However, the effects vary among different species and the following broad categories of sensitivity can be applied (Popper and Hawkins, 2019): ▪ Fish, such as flatfish and gobies, with no swim bladder or other gas chamber are least susceptible as they detect only particle motion;		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	▪ Fish, such as salmonids, smelt and eel, with swim bladders not involved in hearing are more susceptible to barotrauma, but the hearing still only detects particle motion, not sound pressure; and ▪ Fish, such as gadoids and clupeids, which utilise the swim bladder or other gas volume for hearing are most susceptible to barotrauma as they detect particle motion and sound pressure. The effects of underwater noise on fish are also related to a number of factors such as the source of noise and the distance between the source and the receptor. Transmission of sound waves through water varies with water depth and substrate type, and in general shallow estuarine environments, sound is more readily absorbed due to greater interaction with the seabed compared to deeper areas (Mason and Collett, 2011). Sound exposure guidelines for pile driving (Popper *et al.*, 2014) indicate that a temporary threshold shift (TTS) in hearing could occur at cumulative sound exposure levels (SEL) of great than 186dB re 1μPa^{2}s and that recoverable injury could result at >213dB re 1μPa^{2}s for the least sensitive species and >203dB re 1μPa^{2}s for other species. For mortality or mortal injury to occur peak source level would have to reach 207dB re 1μPa^{2}s for the most sensitive species and medium sensitive species and <213dB re 1μPa^{2}s for the least sensitive.		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	Piling for the abutments will be undertaken within cofferdams, which will minimise the transmission of noise and vibration into the water column. In-water piling will be required for installation of the temporary crane platforms (month 2 – month 5), cofferdams for demolition (month 5 – month 7), abutment cofferdams (month 8 – month 14), abutment piling (month 9 – month 14) and cross-channel piles (month 17 – month 18) and is likely to be a combination of vibration and impact piling. Vibration piling will be used preferentially to first refusal, with impact piling being limited to assist the pile in reaching its desired depth. All piling, with the exception of the abutment piling, will be undertaken in the wet. Source levels of impact piling of sheet piles (used for the cofferdam and cross channel piles) is in the region of 220dB re 1μPa^{2}s which is above the level of potential mortality at source. Following a simple transmission loss model (based on modelling undertaken for the Lowestoft Eastern Energy Facility (ABP 2021a), the zone of potential mortal injury would be within 5m of the source, reducing to TTS out to 27m and potential behavioural effects out to a further 50m. The spreading model accounts for a shallow environment but assumes that the sound wave can extend uninhibited. The works are being undertaken within existing harbour walls and the North and Inner South Piers and will result in significant attenuation		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	of noise and vibration within the harbour, therefore it is unlikely that these effect ranges will be experienced in the harbour. In addition, the noise levels are associated with impact piling operations which will be limited to final positioning of piles rather than full operations. Vibro piling typically emits noise at levels between 165 and 185dB re 1µPa^{2}s which falls below levels for mortality and TTS in sensitive fish species; therefore un-attenuated noise would result in behavioural avoidance out to 23m. In addition to the piling operations, the dredge operations will result in noise and vibration. Sound levels from dredge operations are more commonly attributed to the noise of the vessel itself rather than the specific dredge technique being used. The dredge operations are being undertaken in a busy port where existing background noise is high and therefore is unlikely to be discernible. Those species most sensitive to noise and vibration (such as cod, whiting, herring) will primarily use habitat outside of the harbour. Species such as goby, which are more likely to utilise the habitat in close proximity to the Scheme are less sensitive to noise and vibration (Popper *et al.*, 2014). The species present within the harbour will already be habituated to increased noise levels owing to the busy nature of the port and therefore effects from noise and vibration from the Scheme will be lessened.		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	Noise and vibration is assessed as being **direct, negative** and **reversible**, on a receptor of **moderate** sensitivity. This results in a **temporary (short-term)**, **low** magnitude impact with **minor** effects that are **non-significant** at the **county** scale. Dredged material will be disposed of at a licensed offshore site under a Marine Licence. The marine licence will contain a condition requiring a sediment sampling plan to be in place; which will assess the potential for sediment bound contaminants.		
Fish (migratory)	European eel and smelt are known to migrate between the River Waveney and the North Sea through Lowestoft Harbour. Smelt are anadromous, congregating in estuaries during the winter months and migrating into freshwater in spring to spawn in gravels and vegetation near the tidal limit. After hatching, juveniles stay in fresh or brackish water until autumn, when they move out into the marine environment to feed and grow. A study of smelt on the River Waveney (Moore *et al*., 2016) recorded individuals migrating upstream in early March, spending between one and 13 days in freshwater before passing back out into the coastal zone. The study also found that the majority of migration was undertaken at night and in the direction of the prevailing tide, i.e. upstream migration on an incoming tide and downstream movement on an ebbing outgoing tide.	Standard best practice, including production of a CEMP and pollution prevention plan, are proposed for non-significant effects. Measures to mitigate the effects of noise and vibration are: ▪ No overnight piling is scheduled however daytime piling could over run. Avoidance of piling during hours of darkness, as this is when the majority of migratory activity is undertaken; ▪ Selection of piling methods that reduce noise and vibration, for example vibro piling over impact/percussive piling, as far as is practical; and ▪ Soft-start procedures (to be agreed with MMO) for through the water column piling activities, allowing fish to move from the area prior to the onset of potentially injurious levels of noise and vibration.	Resuspension of sediment and noise and vibration are assessed as having **negligible adverse** effects.

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	European eels are catadromous, hatching in the Sargasso Sea and then migrating into estuaries in spring as glass eels, and developing into elvers as they reach freshwater. European eels spend several years in freshwater growing into yellow eels and then silver eels as they migrate back out into the marine environment in late summer and autumn. European eels are listed as critically endangered on the IUCN red list of threatened species and both European eel and smelt are on the NERC list of species of principal importance Migratory fish are considered to be a receptor of high sensitivity. Resuspension of sediments during dredging operations has the potential to reduce water quality around the harbour area. However, the extent of dredging is relatively limited in the context of the harbour, which is subject to maintenance dredging. Dredging in the Inner Harbour Entrance Channel is currently scheduled to install the cross channel pile (month 5) and cill dredge (month 12). A further dredge may be required within Lake Lothing to allow vessel movement up to the Colin Law Way temporary pier. Dredging will be undertaken by long reach excavator and suction dredge and is not anticipated to be continuous over any 24 hour period. The effect of these short duration dredges is predicted to be negligible compared to the annual maintenance dredge within the harbour. Any suspended sediments would be expected to disperse within a tidal cycle.		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	Resuspension of sediments is assessed as being **direct, negative** and **reversible**, on a receptor of **high** sensitivity. The short-term nature of the dredging activities, undertaken against a background of a relatively disturbed estuarine environment undergoing regular maintenance dredges results in a **temporary (short-term)**, **very low** magnitude impact with **minor** effects that are **non-significant** at the **national** scale. Accidental spillage and / or leakage from mobile or stationary plant and vessels could result in the release of oils, fuels or chemicals into the water. Many mineral oils and other hydrocarbons are toxic, persistent and bio-accumulate in the environment. Additionally, biodegradation of oils in aquatic systems can lead to oxygen depletion. Best practice measures are considered to be incorporated within the Scheme, which will reduce the potential for and severity of pollution. Concrete pours are limited to within the cofferdams and therefore do not present a source of pollution. Pollution is assessed as being **direct, negative** and **reversible**, on a receptor of **high** sensitivity. This results in a **temporary (short-term)**, **very low** magnitude impact with **minor** effects that are **non-significant** at the **national** scale. Noise and vibration produced by the works has the potential to result in injury to or disturbance of migratory fish. Both smelt and eel fall within the medium sensitivity species group as defined in		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	Popper *et al.* (2014), suggesting that TTS could occur at 186dB re 1µPa^{2}s SEL, with recoverable injury at >203dB re 1µPa^{2}s and mortality or mortal injury at 210dB re 1µPa^{2}s. A modelling study at Tilbury Docks in the Thames Estuary found that for small diameter piles (610mm) the range of potential TTS or injury was less than 10m from source, however for large piles (3.5m) the mean range at high tide was 832m for TTS and 131m for recoverable injury (Midforth *et al.*, 2017). Guidance suggests that the potential for behavioural changes (disturbance) for the most sensitive species is high in the near field (10s metres), moderate in the intermediate field (100s metres) and low in the far field (1000s metres) (Popper *et al.*, 2014). Piling for the abutments will be undertaken within cofferdams, which will minimise the transmission of noise and vibration into the water column. In-water piling will be required for installation of the temporary crane platforms (month 2 – month 5), cofferdams for demolition (month 5 – month 6), abutment cofferdams (month 6 – month 14), abutment piling (month 9 to month 14) and cross-channel piles (months 17 and 18) and is likely to be a combination of vibration and impact piling. Vibration piling will be used preferentially to first refusal, with impact piling being limited to assist the pile in reaching its desired depth. All piling, with the exception of the abutment piling, will be undertaken in the wet.		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	Source levels of impact piling of sheet piles (used for the cofferdam and cross channel piles) is in the region of 220dB re 1μPa^{2}s which is above the level of potential mortality at source. Following a simple transmission loss model (based on modelling undertaken for the Lowestoft Eastern Energy Facility (ABP 2021a), the zone of potential mortal injury for migratory species would be within 8m of the source, reducing to TTS out to 27m and potential behavioural effects out to a further 50m. The spreading model accounts for a shallow environment but assumes that the sound wave can extend uninhibited. The works are being undertaken within existing harbour walls and the North and Inner South Piers and will result in significant attenuation of noise and vibration within the harbour therefore it is unlikely that these effect ranges will be experienced in the harbour. In addition, the noise levels are associated with impact piling operations which will be limited to final positioning of piles rather than full operations. Vibro piling typically emits noise at levels between 165 and 185dB re 1μPa^{2}s which falls below levels for mortality and TTS in sensitive fish species, therefore un-attenuated noise would result in behavioural avoidance out to 23m. In addition to the piling operations, both the dredge operations and demolition of existing tug arms will result in noise and vibration. Sound levels from dredge operations are more commonly attributed to		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	the noise of the vessel itself rather than the specific dredge technique being used. Demolition noise in the harbour will be screened from the wider marine environment by a cofferdam wall. Both dredge and demolition activities are short duration and being undertaken in a busy port where existing background noise is high and therefore is unlikely to be discernible. Noise and vibration therefore have the potential to result in injury and / or disturbance to migratory fish with habitat fragmentation possible during the upstream migration of species, due to piling adjacent to the Inner Harbour Entrance Channel. Piling operations are occurring throughout the main construction period. However piling will be non-continuous through the construction period, and not being undertaken 24 hours a day. As such there will be significant periods each day (including overnight) for migratory species to pass through the outer harbour to access either Lake Lothing of the coastal environment. Noise and vibration are assessed as being **direct, negative** and **reversible**, on a receptor of **high** sensitivity. This results in a **temporary (short-term)**, **very low** magnitude impact with **minor** effects that are **non-significant** at the **national** scale. The high mobility of migratory species, and preference to utilise near shore coastal waters in the marine environment indicate no potential effect on		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	these species from offshore disposal of dredged material.		
Cetaceans (harbour porpoise)	Harbour porpoise are listed on Annex II of the Habitats Directive requiring designation of protected areas to maintain or restore the species. All cetaceans in UK waters are classed as European Protected Species (EPS) and are given protection under The Conservation of Habitats and Species Regulations 2017 (as amended). Harbour porpoise in the vicinity of the Scheme will form part of the population of the Southern North Sea SAC. Harbour porpoise is considered to be a receptor of high sensitivity. Underwater noise and vibration as a result of construction works, specifically piling, has the potential to cause disturbance and physical injury to cetaceans. Harbour porpoise are considered to be one of the more sensitive marine mammal species, generally with lower noise thresholds than other species. Reviews of the hearing abilities of marine mammals have indicated that exposure to impulsive noise over 202dB re 1µPa (peak) would result in permanent threshold shift (PTS) and noise over 196dB re 1µPa (peak) has the potential to result in TTS (Southall, *et al.*, 2019). A study of the effects of subtidal impact piling on marine mammals in the Moray Firth found that the zone with the potential to	Standard best practice, including production of a CEMP and pollution prevention plan, are proposed for non-significant effects. The significant effects of noise and vibration will be mitigated by implementing JNCC Guidance (JNCC, 2010a) including: ▪ Selection of piling methods that reduce noise and vibration, for example vibro piling over impact/percussive piling, as far as is practical; ▪ The presence of an experienced marine mammal observer on site during piling operations through the water column; ▪ A 30-minute pre-piling search within a 500m radius of the impact piling works to detect the presence of marine mammals with works delayed until 30 minutes has elapsed with no sightings within the 500m zone; and ▪ Soft start protocols (to be agreed with MMO) for all through the water column impact piling operations. These mitigation measures will be secured by the development of a CEMP.	Noise and vibration are assessed as having **negligible adverse** effects. No other effects are predicted.

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	cause auditory damage to cetaceans was up to 100m around the piling activity (1.8m diameter tubular steel piles). A strong behavioural response could potentially be elicited in harbour porpoise up to 20km away and a weaker response up to 70km away (Bailey *et al.*, 2010). A modelling study of piling works at Tilbury Docks indicated that for impact piling of small tubular piles (610mm diameter) and sheet piles temporary hearing effects could occur to harbour porpoise at distances of up to 2.9km, but that vibro piling of sheet piles would fall below the 140dB threshold within 900m of the source (Midforth *et al.*, 2017). Piling for the abutments will be undertaken within cofferdams, which will minimise the transmission of noise and vibration into the water column. In-water piling will be required for installation of the temporary crane platforms (June - September 2025), cofferdams for demolition (September – November 2025), abutment cofferdams (November 2025- June 2026), abutment piling (January – June 2026) and cross-channel piles (September - October 2026) and is likely to be a combination of vibration and impact piling. Vibration piling will be used preferentially to first refusal, with impact piling being limited to assist the pile in reaching its desired depth. All piling, with the exception of the abutment piling, will be undertaken in the wet. Following a simple transmission loss model (based on modelling undertaken for the Lowestoft Eastern		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	Energy Facility (ABP 2021a), the zone of potential PTS for harbour porpoise based on impact piling of sheet piles would be within 14m of the source, reducing to TTS out to 19m, but behavioural effects are likely at greater distances. The spreading model accounts for a shallow environment but assumes that the sound wave can extend uninhibited. The works are being undertaken within existing harbour walls and the North and Inner South Piers and will result in significant attenuation of noise and vibration within the harbour therefore it is unlikely that these effect ranges will be experienced in the harbour. In addition the noise levels are associated with impact piling operations which will be limited to final positioning of piles rather than full operations. Vibro piling typically emits noise at levels between 165 and 185dB re 1µPa which falls below levels for PTS and TTS in harbour porpoise. Demolition noise in the harbour will be screened from the wider marine environment by a cofferdam wall. Both dredge and demolition activities are short duration and being undertaken in a busy port where existing background noise is high and therefore is unlikely to be discernible. The relatively shallow habitat and busy nature of the area around the Scheme make it unlikely that significant numbers of harbour porpoise will be within the zones of PTS and TTS. However, due to the		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	far-reaching potential for behavioural disturbance, and the proximity of the Scheme to a harbour porpoise population of international importance, underwater noise and vibration are assessed as being **direct, negative and reversible**, on a receptor of **high** sensitivity. This results in a **temporary (short-term)**, **moderate** magnitude impact with **major** effects that are **significant** at the **international** scale. Pollution and sedimentation due to construction have the potential to result in mortality of cetaceans or reduced water and habitat quality. Cofferdams are proposed to contain the majority of works and therefore the potential for pollution comes from the plant or vessels used for the works. Accidental spillage and / or leakage from mobile or stationary plant and vessels could result in the release of oils, fuels or chemicals into the water. Dredging will result in resuspension of sediment. However, the estuary is an already turbid environment and effects are unlikely to extend significantly beyond the immediate vicinity of the harbour. As noted above, the area around the works will not constitute core habitat for cetaceans. Pollution and sedimentation are assessed as being **direct, negative and reversible**, on a receptor of **high** sensitivity. This results in a **temporary (short-term)**, **very low** magnitude impact with **minor** effects that are **non-significant** at the **international** scale.		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	A number of vessels (barges, dredgers) will be required during construction. The proportion of these movements will be undertaken during harbour possessions, when other boat traffic will be restricted. The study area is an active harbour and vessels are anticipated to be moored in the harbour during construction, this is assessed as **no change** in impact for cetaceans and therefore **no effects** are predicted. The high mobility of cetaceans indicate no potential effect on these species from offshore disposal of dredged material. The use of licenced sites, increased boat traffic and regular disposal of material at these sites will not result in an adverse effect on cetaceans.		
Seals	Both species of seal are listed on Annex II of the Habitats Directive and are protected from being killed, injured or taken under the Conservation of Seals (England) Order 1999. Significant populations of seals are known from the east coast of England, however the closest known haul-out site to the Scheme is approximately 15km away. Seals are considered to be a receptor of moderate sensitivity. Noise and vibration as a result of construction works, specifically piling, has the potential to cause disturbance and physical injury to seals. Southall *et al*. (2019) report that seals in water are at risk of PTS when exposed to impulsive noise over 218dB re 1µPa (Peak) and TTS at 212dB re 1µPa (Peak).	Standard best practice, including production of a CEMP and pollution prevention plan, are proposed for non-significant effects. Measures put in place to mitigate the effects of noise and vibration for harbour porpoise will also benefit seals as set out above.	Noise and vibration are assessed as having **negligible adverse** effects. No other effects are predicted.

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	Thresholds in air are reported to be slightly lower at 144dB re 1µPa and 138dB re 1µPa. A study of the effects of underwater impact piling on marine mammals in the Moray Firth found that the zone with the potential to cause auditory damage to pinnipeds such as common seal was up to 100m around the piling activity (1.8m diameter tubular steel piles). A strong behavioural response could potentially be elicited up to 215m away and a weaker response up to 14km away (Bailey *et al.*, 2010). The study to inform piling works at Tilbury Docks indicated that temporary auditory damage could occur to pinnipeds within 300m of impact piling (610mm tubular piles), but individuals would have to be within 10m of the works to incur permanent injury (Midforth *et al.*, 2017). Following a simple transmission loss model (based on modelling undertaken for the Lowestoft Eastern Energy Facility (ABP 2021a), the zone of potential PTS for seal based on impact piling of sheet piles would be within 1m of the source, with TTS out to 6m, but behavioural effects are likely at greater distances. The spreading model accounts for a shallow environment but assumes that the sound wave can extend uninhibited. The works are being undertaken within existing harbour walls and the North and Inner South Piers and will result in significant attenuation of noise and vibration within the harbour therefore it		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	is unlikely that these effect ranges will be experienced in the harbour. In addition the noise levels are associated with impact piling operations which will be limited to final positioning of piles rather than full operations. Vibro piling typically emits noise at levels between 165 and 185dB re 1µPa^{2}s which falls below levels for PTS and TTS in seals. Demolition noise in the harbour will be screened from the wider marine environment by a cofferdam wall. Both dredge and demolition activities are short duration and being undertaken in a busy port where existing background noise is high and therefore is unlikely to be discernible. Given the low numbers of seals anticipated to be in the vicinity of the Scheme, and the absence of significant haul out sites nearby, noise and vibration are assessed as being **direct, negative and reversible**, on a receptor of **moderate** sensitivity. This results in a **temporary (short-term), very low** magnitude impact with **negligible** effects that are **non-significant** at the **county** scale. Pollution and sedimentation due to construction have the potential to result in mortality of seals or reduced water and habitat quality. Cofferdams are proposed to contain the majority of works and therefore the potential for pollution comes from the plant or vessels used for the works. Accidental spillage and/or leakage from mobile or stationary		

Receptor	Assessment of significant effects	Mitigation measures	Assessment of effects with mitigation
	plant and vessels could result in the release of oils, fuels or chemicals into the water. Best practice measures are considered to be incorporated within the Scheme, which will reduce the potential for and severity of pollution. Dredging will result in resuspension of sediment. However, the estuary is an already turbid environment and effects are unlikely to extend significantly beyond the immediate vicinity of the harbour. As noted above, the area around the works will not constitute core habitat for seals. Pollution and sedimentation are assessed as being **direct, negative and reversible**, on a receptor of **moderate** sensitivity. This results in a **temporary (short-term)**, **very low** magnitude impact with **negligible** effects that are **non-significant** at the **county** scale. A number of vessels (barges, dredgers) will be required during construction. However, as the area is an active harbour and vessels are anticipated to be moored in the harbour during construction, this is assessed as **no change** in impact for seals and therefore **no effects** are predicted. Assessments of the potential effects on seals from marine disposal will be undertaken when a disposal site has been confirmed.		

Operational Impacts

10.6.3 Operation will include silt agitation, routine operational checks of the barrier and the tidal flood defence operation. These actions are based within the barrier and its marine setting; no effects are anticipated to terrestrial receptors, including terrestrial protected species and habitats.

10.6.4 No operational impacts are anticipated for any designated sites. Sprat's Water and Marshes – Carlton Colville SSSI has limited hydrological connectivity to the barrier location. However, the principal control of water levels and hydrological functioning upstream in the Broads where Sprat's Water and Marshes – Carlton Colville SSSI is through the tidal regime along the River Waveney and Oulton Dyke which is influenced by the connection through Breydon Water. Therefore, the operation of the barrier will have negligible influence on the existing hydrological regime.

10.6.5 Flood risk modelling (of both the walls and barrier) however showed that there will be a slight (unquantified) reduction in flooding in the Oulton Broad area when the barrier is closed to protect against a tidal surge, assumed to be due to lower water levels in Lake Lothing and increased gravity discharge through Mutford Lock (Jacobs, 2019). This slight decrease in flooding in the Oulton Broad area during tidal surges could potentially be considered to have an incidental beneficial effect on habitats present in Sprat's Water and Marshes – Carlton Colville SSSI by preventing raised salinity levels during tidal inundations, which is an increasing threat to Broadland habitats as sea levels rise.

10.6.6 Otters may occasionally move between the Broadland river system and the sea, however, given the abundance of suitable habitat and food source within the river system it is likely that any dispersal beyond Oulton Broad or Lake Lothing is infrequent, if it occurs at all. Operation of the barrier will therefore not lead to any fragmentation effects on otter.

10.6.7 Operation of the Scheme has the potential to affect the passage of migratory fish. During normal conditions, the barrier will be held in the open position with the gates set into the side recesses in the abutment structure. Operation of the barrier for tidal flood risk management purposes will be triggered at the onset of a forecasted surge tide, with a predetermined tidal height. The barrier will be closed several hours ahead of a forecast surge to allow for a fail-safe operation and will remain closed during the flood event. The barrier will be reopened once the tide level downstream and the fluvial water level upstream reach equilibrium. During barrier closures spanning consecutive high tides, the barrier will re-open on each ebb cycle to release the build-up of water on the fluvial side.

10.6.8 There will be an additional number of barrier closures for operational and maintenance checks, typically between one to four closures per month over the lifetime of the barrier. These operations will only be required during months when the barrier is not operated for flood risk management purposes. Such closures are likely to be brief in duration (typically less than one hour) and would be coordinated to minimise any impact on navigation.

10.6.9 Overall, the closures will be intermittent and short in duration, during which time migratory fish species are expected to temporarily hold in adjacent coastal waters or utilise alternative egress points into the catchment (for example the attractant flow from the Yare). The sensitivity of this receptor is **high** however the impact of barrier closure and habitat fragmentation during barrier closure is **direct**, **reversible**, **infrequent** and **temporary (short-term)**, resulting in a **very low** magnitude, **adverse** effect which is **minor**. The effect is **non-significant** at the **national** scale.

10.6.10 There would also be an on-going maintenance requirement to regularly dredge the area in the vicinity of the barrier. Maintenance dredging to maintain the barrier function is expected to be highly localised and be undertaken within the annual ABP cutter suction and plough maintenance dredge of the wider harbour. Around the barrier water injection dredging may be required. Maintenance activities will be completed under licence from the MMO, subject to this being granted. As such **no effects** are considered significant from operational maintenance on marine receptors.

10.6.11 No operational effects are predicted on other marine receptors.

10.7 Mitigation

10.7.1 Mitigation measures with respect to each scoped in receptor are presented in Table 10-9. These comprise:

- The presence of an experienced marine mammal observer on site during piling operations through the water column;
- A 30-minute pre-piling search within a 500m radius of the impact piling works to detect the presence of marine mammals with works delayed until 30 minutes has elapsed with no sightings within the 500m zone;
- Soft start protocols for all impact piling operations through the water column (JNCC, 2010a);
- Avoidance of piling during hours of darkness, as this is when the majority of migratory activity is undertaken;
- Selection of piling methods that reduce noise and vibration, for example vibro piling over impact/percussive piling, as far as is practical;
- Production of a pollution prevention plan;
- Compliance with the exchange standards contained in the IMO Ballast Water Management Convention and carry a Ballast Water Management Plan and a Certificate of Compliance;
- Installation of anti-bird nesting measures within the Inner North Pier and Inner South Pier prior to construction;
- Creation of kittiwake nesting ledges within the order limits;
- Pre-construction bat survey of the ABP building; and
- Production of a CEMP to capture mitigation measures.

10.8 Residual Effects

10.8.1 Residual effects of each impact on scoped in receptors are presented in Table 10-9. All residual effects are of negligible **adverse** significance.

10.9 Opportunities

10.9.1 Biodiversity net gain will be incorporated into the detailed design for the Scheme and will be secured through inclusion of a commitment to 10% net gain in the MAP (Appendix 18A). This will result in a 10% increase in biodiversity units against the baseline habitats present within the Scheme Order Limits. The biodiversity net gain report is presented in Appendix 10F which provides an overview of the biodiversity losses and gains.

10.10 Summary

10.10.1 The effects of the Scheme on ecological resources have been informed by desk study and field surveys undertaken in connection with the Scheme. The assessment of effects is presented in Table 10-9. No significant effects on biodiversity receptors are anticipated as a result of the Scheme, following the implementation of mitigation.

10.10.2 With respect to the consideration of sites of international ecological importance, a HRA has been undertaken (see Appendix 10D) which concluded that no significant effects on any Internationally Designated sites would occur as a result of the Scheme, subject to the implementation of mitigation measures with respect to harbour porpoise.

10.10.3 No significant effects are anticipated on any other statutory or non-statutory designated sites.

10.10.4 Nesting kittiwake are present within the harbour and within the construction working area in the Trawl Basin, along the Inner North and South Piers. Nests present here are at risk at being lost during demolition of part of the Inner North Piers. These works will result in the loss of suitable nesting features and will have the potential to cause direct loss/disturbance of kittiwake nests given that they may coincide with the kittiwake breeding season. Measures will therefore be implemented including the installation of anti-nesting measures to discourage birds from nesting in the construction working area, prior to the works, as well as the provision of compensatory nest features within the design.

10.10.5 Surveys confirmed the ABP control building has moderate suitability to support roosting bats. Given the building location and surrounding habitat the building is considered to be able to support low numbers of common and widespread bat species only. Works to the building including the installation of utilities through the cavity wall have the potential to result in killing and injury or disturbance of common and widespread bat species if present. In order to adhere to legislation and avoid potential impacts to bat species, a pre-construction bat survey of the ABP control building is required.

10.10.6 The benthic habitats and species in the vicinity of the Scheme are of low ecological value and are resilient to disturbance, therefore no significant effects are predicted on these features despite the direct impact of dredging and small-scale habitat loss.

10.10.7 Estuarine and marine fish species are present in Lowestoft Harbour and beyond. Negligible effects are predicted as a result of resuspension of sediments and noise and vibration. These effects are predicted to be temporary and restricted to the immediate harbour area, therefore not affecting a significant proportion of the populations of these species.

10.10.8 Migratory fish, namely European eel and smelt are at greater risk of being affected by the Scheme due to the potential for habitat fragmentation. To avoid this during construction, piling during construction will not be undertaken continuously, which will allow a disturbance-free period in each 24 hour cycle. Operation of the tidal barrier will directly block the migratory route of species through Lowestoft Harbour. However, the operation of the barrier will be intermittent and short in duration, during which time migratory fish are expected to hold in adjacent waters or make use of alternative routes into the River Yare. Effects of the Scheme are assessed as being negligible on these species.

10.10.9 Marine mammal densities in the vicinity of the Scheme are low, however, due to the sensitivity of these receptors to underwater noise, there is potential for effects as a result of piling activity. To mitigate for this, the contractor will be required to follow statutory guidance on minimising the risk of injury to marine mammals during piling (JNCC, 2010a), including the presence of a marine mammal observer, use of soft-start protocols and preferential use of vibro piling as far as practical. With these measures in place, negligible negative effects are predicted.

EASTSUFFOLK COUNCIL

To find out more about the Lowestoft Tidal Barrier, email or visit our website.

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To view the Lowestoft Tidal Barrier TWAO Application Documents visit:

https://www.eastsuffolk.gov.uk/lowestoft-tidal-barrier-TWAO-application

Lowestoft Tidal Barrier Order

October 2023