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## 10. MARINE ECOLOGY

### 10.1 Introduction

10.1.1 This chapter identifies the potential marine ecological impacts that are to be considered as part of the Environmental Impact Assessment (EIA) of the Silvertown Tunnel Scheme. As explained in Chapter 5 of this Preliminary Environmental Information Report (PEIR), at the time that a request was made to the Planning Inspectorate (PINS) for an EIA Scoping Opinion in accordance with Regulation 8(3) of the Regulations, no marine impacts were envisaged as no works were proposed to be undertaken within the marine environment. However, the Scheme now includes a possible temporary jetty to facilitate the movement of construction materials, therefore impacts on the marine environment are now being considered. This chapter sets out a review of the existing baseline understanding of the marine environment and potential impacts on it, and identifies the scope of further work required to assess these impacts.

10.1.2 The elements of the Scheme that could impact on the marine environment include recommissioning of the existing NABSA (Not Afloat but Safely Aground) berth facility at the Thames Wharf, or the construction, operation, and decommissioning of a new temporary jetty within the River Thames, along with an associated dredge and the disposal of the dredge arisings. The methods for disposal of dredge arisings will be determined as part of a Detailed Site Waste Management Plan (SWMP) a Preliminary SWMP is included in the suite of documents available as part of the s.42, s.47 and s.48 consultation, however options would not include disposal at sea.

10.1.3 The marine related works are temporary and as such impacts during the operation phase of the Scheme are not considered further in this chapter.

10.1.4 The marine ecology receptors that have been included within this chapter include:

- Nature Conservation Protected Areas and Species;
- Marine ecology - benthic habitat and species (including invasive non-native species);
- Fish and shellfish; and
- Marine mammals.

## **10.2 Regulatory and policy framework**

- 10.2.1 This impact assessment has been undertaken in accordance with current international and national legislation, and national, regional and local plans and policies relating to nature conservation in the context of the Scheme. A summary of the relevant legislation and policies and the requirements of these policies has been provided in Table 10-1 below. The final Scheme design and the overarching mitigation strategy will be designed to ensure compliance with all relevant policy and legislation.

**Table 10-1 Policy and Legislation**

Policy/Legislation	Summary of Requirements	Scheme Response
National policy statement for national networks (NN NPS)	<p>NN NPS aims to reduce overall biodiversity loss, support healthy well-functioning ecosystems and establish coherent ecological networks.</p> <p>It states that EIA applications should show how the project has taken advantage of opportunities to conserve and enhance biodiversity interests.</p>	<p>Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>
National Planning Policy Framework	<p>The National Planning Policy Framework sets out the Government’s planning policies for England and how these are expected to be applied. The framework acts as guidance for local planning authorities and decision-takers, both in drawing up plans and making decisions about planning applications. The framework incorporates policies relating to biodiversity and coastal change.</p>	<p>The potential for the presence of protected habitats and species has been reviewed as part of the baseline description. Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>
National Planning Practice Guidance (NPPG)	<p>NPPG provides that the planning system should contribute to and enhance the natural and local environment, minimise pollution and other adverse effects on the local and natural environment and minimise impacts on biodiversity.</p>	<p>Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>
The Convention on the Conservation of European Wildlife and Natural Habitats 1979 (the Bern Convention)	<p>The principal aims of the Bern Convention are the conservation and protection of the wild plant and animal species (and the natural habitats thereof) listed in Appendices I and II of the Convention. It also seeks to increase co-operation between governments and to regulate</p>	<p>The potential for the presence of protected habitats and species has been reviewed as part of the baseline description. Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	<p>the exploitation of the species listed in Appendix III, which includes migratory fish species, cetaceans and grey seal.</p> <p>The Bern Convention was implemented in Europe via two directives: Council Directive 79/409/EEC on the Conservation of Wild Birds (the EC Birds Directive) in 1979 and Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the EC Habitats Directive) in 1992. The Convention is implemented in UK law by the Wildlife and Countryside Act (1981 and as amended).</p>	
<p>The Convention on Biological Diversity 1992 (Biodiversity Convention or CBD)</p>	<p>The CBD was the first treaty to provide a legal framework for biodiversity conservation. It focuses on the conservation of all species and ecosystems and, therefore, provides protection to all biodiversity. The Convention requires that national strategies, plans or programmes are developed for the conservation and sustainable use of biodiversity.</p> <p>In the UK, the CBD is implemented via the Post-2010 Biodiversity Framework, which in 2012 replaced the UK Biodiversity Action Plan.</p>	<p>Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>
<p>The Convention on the Conservation of European Wildlife and</p>	<p>The Convention aims to conserve migratory species and their habitats by providing strict protection for endangered migratory species that are listed in Appendix I of the</p>	<p>The potential for the Scheme to adversely affect migratory species has been evaluated as part of the impact assessment. Mitigation measures will be</p>

Policy/Legislation	Summary of Requirements	Scheme Response
<p>Natural Habitats 1979 (the Bern Convention)</p>	<p>Convention. It involves multilateral agreements for conserving and managing those migratory species that would benefit from international co-operation (listed in Appendix II of the Convention) and the undertaking of co-operative research.</p> <p>Within the UK, protection of Appendix I species is carried out through the Wildlife &amp; Countryside Act (1981 as amended). The Countryside and Rights of Way Act 2000 (CRoW) was also enacted in England and Wales to offer further support by increasing penalties and enforcement powers. It also strengthened the protection of sites from damage caused by third parties.</p>	<p>implemented to ensure no adverse effects on marine ecological features.</p>
<p>The Convention for the Protection of the Marine Environment of the North-East Atlantic 1992 (the OSPAR Convention)</p>	<p>The OSPAR Convention provides a comprehensive approach to addressing sources of maritime pollution and other matters affecting the marine environment. Annex V of the Convention provides a framework for governments to develop their own conservation measures. Article 2 requires parties to ‘take necessary measures to protect and conserve the ecosystems and the biological diversity of the maritime area, and to restore, where practicable, marine areas which have already been adversely affected’.</p>	<p>The potential for the presence of protected habitats and species has been reviewed as part of the baseline description. Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	<p>The Convention includes the establishment of a list of threatened and/or declining species and habitats. This list provides an overview of the biodiversity in need of protection in the north-east Atlantic and is being used by the OSPAR Commission to guide the setting of priorities for further work on the OSPAR Convention and protection of marine biodiversity OSPAR Convention protected habitats and species.</p> <p>The most recent OSPAR List of Threatened and/or Declining Species and Habitats lists inter alia native oyster, allis shad, European eel, cod, sea lamprey, thornback ray, Atlantic salmon and harbour porpoise as being under threat and/or in decline in Region II (the Greater North Sea, which includes the English Channel).</p>	
<p>The Convention on Wetlands of International Importance Especially as Waterfowl Habitat 1971 (the Ramsar Convention or Wetlands Convention)</p>	<p>The Ramsar Convention is an intergovernmental treaty that embodies the commitments of its member countries to maintain the ecological character of their wetlands of international importance and to plan for the 'wise use', or sustainable use, of all of the wetlands in their territories. Ramsar sites are wetlands of international importance designated under the Ramsar Convention.</p>	<p>The closest Ramsar site that supports marine features (the Thames Estuary and Marshes Ramsar site) is located approximately 30km from proposed order limits and as such is considered to fall outside of the assessment study area.</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	<p>Policy statements relating to the status of Ramsar sites have been issued by Government, to extend their level of protection to that of sites designated as part of the EU Natura 2000 network under the EC Birds and Habitats Directives.</p>	
<p>EC Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (92/43/EEC) (EC Habitats Directive)</p>	<p>The Habitats Directive was adopted in 1992 and is the means by which the EU meets its obligations under the Bern Convention. The Directive promotes the maintenance of biodiversity by requiring Member States to maintain or restore natural habitats and wild species that are listed on the Directive’s annexes. Economic, social and cultural requirements must be considered, alongside regional and local characteristics.</p> <p>To maintain or restore habitats listed in Annex I and species listed in Annex II of the Directive to ‘Favourable Conservation Status’, a network of Special Areas of Conservation (SACs) have been created. Annex II species include Atlantic salmon, harbour porpoise and grey and common seals.</p> <p>Annex IV of the Habitats Directive lists European Protected Species which are species of plants and animals (other than birds) protected by law throughout the European Union. All</p>	<p>The closest SAC that supports marine features (Essex Estuaries SAC) is located over 50km from proposed order limits and as such is considered to fall outside of the assessment study area.</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	<p>species of cetacean are listed in Annex IV of the Habitats Directive.</p> <p>In England, the Directive is implemented under the Conservation (Natural Habitats, &amp;c.) Regulations 1994 (as amended), which apply to land and territorial waters to the 12 nautical mile (nm) limit. The amendments are consolidated by the Conservation of Habitats and Species Regulations 2010 out to 12nm from the coast and by the Offshore Marine Conservation (Natural Habitats &amp;c.) Regulations 2007 (as amended) between 12nm from the coast and 200nm or the limit of the UK Continental Designated Area.</p>	
<p>EC Directive on the Conservation of Wild Birds (2009/147/EC) (EC Birds Directive)</p>	<p>The Birds Directive was adopted by the Members States in 1979 as a response to increasing concern about the declines in Europe's wild bird populations resulting from pollution and loss of habitats as well as unsustainable use. It was also in recognition that wild birds, many of which are migratory, are a shared heritage of the Member States and that their effective conservation required international co-operation.</p> <p>The directive recognises that habitat loss and degradation are the most serious threats to the conservation of wild birds. It therefore places great emphasis on the protection of</p>	<p>The closest SPA that supports marine features (the Thames Estuary and Marshes SPA) is located approximately 30km from proposed order limits and as such is considered to fall outside of the assessment study area.</p>



Policy/Legislation	Summary of Requirements	Scheme Response
	<p>habitats for endangered as well as migratory species (listed in Annex I), especially through the establishment of a coherent network of Special Protection Areas (SPAs) comprising all the most suitable territories for these species. Since 1994 all SPAs form an integral part of the NATURA 2000 ecological network.</p> <p>In England the provisions of the Birds Directive are implemented through the Wildlife &amp; Countryside Act 1981 (as amended), the Conservation of Habitats and Species Regulations 2010 and the Offshore Marine Conservation Regulations 2007.</p>	
<p>The Water Framework Directive (2000/60EC)</p>	<p>The Water Framework Directive (WFD) establishes a framework for the management and protection of Europe's water resources. It is implemented in England and Wales through the Water Environment (Water Framework Directive) (England and Wales) Regulations 2003 (the Water Framework Regulations). The aim of the WFD is to achieve 'good ecological and good chemical status' in all inland and coastal waters by 2015 unless alternative objectives are set or there are grounds for derogation. Ecological status is an expression of the quality of the structure and functioning of surface water ecosystems as indicated by the condition of a number of 'quality elements'. These include hydro-</p>	<p>A WFD Assessment is being undertaken (see Appendix 10-A). The assessment will identify any requirement for mitigation measures.</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	<p>morphological, chemical and biological indicators (including benthic invertebrates, macroalgae, fish, phytoplankton and angiosperms).</p> <p>The WFD Directive was transposed into UK law via the Water Environment (WFD) (England and Wales) Regulations 2003 SI 3242. The Regulations provide the mechanism to implement river basin districts within England and Wales in accordance with the Water Framework Directive. The proposed development is in the South East River Basin District.</p>	
<p>EU Marine Strategy Framework Directive (2008/56/EC)</p>	<p>The Marine Strategy Framework Directive (MSFD) provides a framework for managing human activities with an ecosystem-based approach to support the sustainable use of marine goods and services. The objective of the MSFD is for EU marine waters to achieve ‘good environmental status’ (GES) by 2020. GES involves protecting the marine environment, preventing its deterioration and restoring it where practical, while using marine resources sustainably. For the UK, the co-ordination of strategies for reaching GES is achieved through the OSPAR Convention.</p> <p>The Directive sets out 11 high-level Descriptors of GES which cover all the key aspects of the marine ecosystem and</p>	<p>The potential for the presence of protected habitats and species has been reviewed as part of the baseline description. Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	<p>all the main human pressures on them, including the consideration of hydrographical conditions. The European Commission has also produced a Decision document (Commission Decision 2010/477/EU) which provides more detailed criteria and indicators of GES which Member States must use when implementing the Directive. The Directive came into force on 15 July 2008, and was transposed into UK law via the Marine Strategy Regulations 2010.</p>	
<p>The Conservation of Habitats and Species Regulations 2010 (Habitats Regulations)</p>	<p>The Conservation of Habitats and Species Regulations 2010 (referred to as the Habitats Regulations) consolidate all the various amendments made to the 1994 Regulations in respect of England and Wales. The Regulations transpose the EC Habitats Directive into national law. The Habitats Regulations provide for the designation of Special Areas of Conservation (SACs). They also require the compilation of a register of European sites in a network called Natura 2000. European sites include SACs and Special Protection Areas (SPAs), the latter of which is classified under the Birds Directive.</p> <p>Natural England has statutory responsibility to advise relevant authorities as to the conservation objectives for European Marine Sites and operations which may cause deterioration or disturbance of natural habitats and species.</p>	<p>The potential for the presence of protected habitats and species has been reviewed as part of the baseline description. Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	<p>This advice is provided under Regulation 35 of the Habitats Regulations. The role of the conservation objectives for a European Marine Site is to define the nature conservation aspirations for the features of interest, thereby representing the aims and requirements of the Habitats and Birds Directives in relation to the site.</p> <p>The Habitats Regulations also protect animal species listed in Schedule 2 from deliberate capture, killing, disturbing or trading, and plant species in Schedule 4 from being picked, collected, cut, uprooted, destroyed or traded without a licence.</p>	
<p>Marine and Coastal Access Act 2009</p>	<p>The Marine and Coastal Access Act 2009 aims to enable better protection of marine ecosystems and prevent a decline in marine biodiversity. The Act sets out provisions for more coherent planning in the marine environment in terms of issuing consents and permits for activities in the marine and coastal environment and sets out how decision makers should take account of the appropriate marine policy documents.</p> <p>The Act also contains provisions to allow for the creation of a new type of Marine Protected Area (MPA), called a Marine Conservation Zone (MCZ). MCZs protect a range of</p>	<p>The overlap of the Scheme with the Thames Estuary rMCZ site has considered in the identification of possible impact pathways. There are no second tranche of MCZs.</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	<p>nationally important marine wildlife, habitats, geology and geomorphology and can be designated anywhere in English inshore and UK offshore waters. Sites are selected to protect not just rare and threatened habitats and/or species, but the full range of marine wildlife. Within the south east region, the development of recommendations for MCZ has been coordinated by the Balanced Seas Regional MCZ Project (Balanced Seas, 2011).</p> <p>The UK Government consulted on the first round of recommended Marine Conservation Zones (rMCZs) in English Inshore and English and Welsh Offshore Waters between 13 December 2012 and 31 March 2013. On 21 November 2013, Defra announced the designation of 27 MCZs around England’s coast, none of which fall within the vicinity of the proposed development. In January 2015, Defra opened the consultation on a second tranche of MCZs with the aim of designating sites in 2016. For the second tranche, 23 sites from the Regional MCZ Project recommendations have been identified as suitable candidates for consideration (proposed MCZ (pMCZs)).</p>	
<p>The Wildlife and Countryside Act 1981 (as amended)</p>	<p>The Wildlife and Countryside Act (WCA) consolidates and amends existing legislation to implement the Bern Convention and the Birds Directive. The act contains four</p>	<p>The potential for the presence of protected habitats and species has been reviewed as part of the baseline description. Mitigation measures will be</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	<p>parts and 17 schedules, covering inter alia: protection of wildlife (birds and some animals and plants); the countryside; national parks; and the designation of protected areas.</p> <p>The WCA 1981 provides for the designation and management of Sites of Special Scientific Interest (SSSI). These sites are designated to safeguard, for present and future generations, the diversity and geographic range of habitats, species, and geological and physiographical features, including the full range of natural and semi-natural ecosystems and of important geological and physiographical phenomena throughout England and Wales. Various species of marine animals are also protected from being killed, injured or disturbed under provisions in Schedule 5 of the WCA 1981.</p> <p>All cetaceans (whales and dolphins) are protected under Schedule 5 of the Wildlife and Countryside Act 1981 (and amendments), under which it is an offence to take, injure or kill these species. Disturbance in their place of rest, shelter or protection is also prohibited.</p>	<p>implemented to ensure no adverse effects on marine ecological features.</p>
<p>Salmon and Freshwater Fisheries Act</p>	<p>The Salmon and Freshwater Fisheries Act 1975 applies to salmon, trout (including sea trout), eel and freshwater fish.</p>	<p>The potential impact pathways by which fish could be affected by the Scheme have been identified.</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	<p>Section 38 concerns the construction on, over or under tidal lands below high-water mark of ordinary spring tides. In this scenario, construction must be undertaken in accordance with plans and regulations approved in writing by the Secretary of State.</p>	<p>Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>
<p>The Eels (England and Wales) Regulations 2009</p>	<p>The Eels Regulations came into force in 2010 and implement Council Regulation (EC) No. 1100/2007 of 18 September 2007, which established measures for the recovery of the stock of European eel. The UK submitted 15 Eel Management Plans for approval by the Commission in December 2008. These plans are set at the River Basin District level, as defined under the Water Framework Directive 2000/60/EC, covering England and Wales, Scotland and Northern Ireland. The proposed development falls into the South East River Basin District.</p>	<p>The potential impact pathways by which fish could be affected by the Scheme have been identified. Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>
<p>Conservation of Seals Act 1970</p>	<p>Pinnipeds (seals) are protected under the Conservation of Seals Act 1970 (taking effect in England, Scotland, Wales). This Act does not prohibit the killing of seals but does regulate the way in which seals can be killed. For example, there is an annual close season for grey seals extending from 1 September to 31 December and an annual close season for common seals extending from 1 June to 31 August. It is a criminal offence to wilfully kill, injure or take a seal during the close season or to attempt to do so. The Act</p>	<p>The potential impact pathways by which marine mammals could be affected by the Scheme have been identified. Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	<p>also gives the Secretary of State the power to make an order prohibiting the killing, injuring or taking of seals in an area where such an order is necessary for the proper conservation of seals.</p>	
<p>UK Marine Policy Statement, 2011</p>	<p>The UK Marine Policy Statement (MPS) is the framework for preparing Marine Plans and taking decisions affecting the marine environment. Adopted by the UK Government, the Scottish Government, the Welsh Government and the Northern Ireland Executive, the MPS is intended to help achieve the shared UK vision for clean, healthy, safe, productive and biologically diverse oceans and seas. The MPS aims to enable an appropriate and consistent approach to marine planning across UK waters, and to ensure the sustainable use of marine resources and strategic management of marine activities from renewable energy to nature conservation, fishing, recreation and tourism. The MPS recognises that the primary environmental considerations of marine dredging and disposal activities include morphological changes, hydrological effects, increase in turbidity and changes to natural sedimentary systems. The proposed development falls within the South East Inshore marine plan area. A marine plan has not yet been produced for this area.</p>	<p>The Scheme is consistent with high level marine objectives.</p>



Policy/Legislation	Summary of Requirements	Scheme Response
<p>UK Biodiversity Action Plan</p>	<p>The UK Biodiversity Action Plan (UK BAP) was published in 1994, and was the UK Government’s response to the Convention on Biological Diversity (CBD), which the UK signed up to in 1992 in Rio de Janeiro. Action plans for the most threatened species and habitats were set out to aid recovery, and national reports, produced every three- to five-years, showed how the UK BAP was contributing to the UK’s progress towards the significant reduction of biodiversity loss called for by the CBD. The UK BAP priority list contains 1150 species and 65 habitats requiring special protection.</p> <p>The ‘UK Post-2010 Biodiversity Framework’, published in July 2012, succeeds the UK BAP, and is the result of a change in strategic thinking following the publication of the CBD’s ‘Strategic Plan for Biodiversity 2011–2020’ and its 20 ‘Aichi Biodiversity Targets’, at Nagoya, Japan in October 2010, and the launch of the new EU Biodiversity Strategy in May 2011. The Framework demonstrates how the work of the UK contributes to achieving the Aichi Biodiversity Targets, and identifies the activities required to complement the country biodiversity strategies in achieving the targets. Many of the tools developed under UK BAP remain of use. The lists of priority species and habitats agreed under UK</p>	<p>The potential for the presence of protected habitats and species has been reviewed as part of the baseline description. Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>

Policy/Legislation	Summary of Requirements	Scheme Response
	BAP still form the basis of much biodiversity work in each of the devolved administrations.	
The Natural Environment and Rural Communities Act (NERC Act) 2006	The NERC Act makes provision about bodies concerned with natural environment and rural communities, and it regulates inter alia nature conservation in the UK, wildlife and SSSIs. The UK BAP list has been used as a reference to draw up the species and habitats of principal importance in England under S41 of the NERC Act 2006 (NERC 2006). The S41 list contains 943 species and 56 habitats of principal importance which occur in England. These are the species and habitats which were identified as requiring action under the UK BAP and which continue to be regarded as conservation priorities under the UK Post-2010 Biodiversity Framework.	The potential for the presence of protected habitats and species has been reviewed as part of the baseline description. Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.
Thames Catchment Abstraction Management Strategy (CAMS)	The Thames catchment abstraction licensing strategy sets out how the Environment Agency will manage water resources in the Thames catchment and how they will manage existing abstraction licences and water availability for further abstraction.	Existing activities on the Thames Estuary have been used to inform the baseline description.
Biodiversity 2020: A strategy for England's Wildlife and Ecosystem Services	The Strategy aims to halt the loss of biodiversity, support healthy ecosystems and establish coherent ecological networks.	Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.

Policy/Legislation	Summary of Requirements	Scheme Response
The London Plan (2011)	Regional planning policy for London is presented in the London Plan: Spatial Development Strategy for Greater London. It contains various policies with regard to nature conservation in London.	Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.
The Mayor's Biodiversity Strategy (2002)	Connecting with London's Nature: The Mayor's Biodiversity Strategy provides a framework for the delivery of biodiversity policies in London.	Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.
London Biodiversity Action Plan	Managed by the London Biodiversity Partnership (2006) the London BAP sets out priority habitats and species for the city (Ref 10-1).	Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.
Newham's Biodiversity Resource: Evidence Base For The Local Development Framework (May 2010)	This is the Biodiversity Action Plan for the London Borough of Newham. The action plan lists a number of habitats (including rivers and wetlands) and species within Newham for which targets have been set to increase their range and distribution.	Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.
Greenwich Biodiversity Action Plan (March 2010)	The Greenwich BAP aims to achieve the targets relevant to the Royal Borough of Greenwich identified in both the UK and London BAP. The action plan lists a number of habitats and species within Greenwich for which targets have been set to increase their range and distribution. Waters' edge, rivers, ponds and wetland are listed as a priority habitat.	Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.
Newham Core Strategy (2013) London Borough	Core policy SC4 on Biodiversity states that: <i>'Biodiversity will be protected and enhanced and development will contribute</i>	Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.

Policy/Legislation	Summary of Requirements	Scheme Response
<p>of Newham Unitary Development Plan (2012)</p> <p>Policy EQ10</p>	<p><i>to a net gain in the quantity and quality of Newham's natural environment by the following measures:</i></p> <ol style="list-style-type: none"> <li><i>1. Expecting that all major developments make a contribution to achieving the targets and actions for biodiversity, as set out in the Newham Biodiversity Action Plan, and in conjunction with provision of green infrastructure;</i></li> <li><i>2. Permitting development only where it can be demonstrated that significant adverse impact on species and habitats is avoided;</i></li> <li><i>3. Sites of Importance for Nature Conservation (SINCs) will be protected, and the designation of new SINCs will be supported. Development should contribute to their qualitative enhancement, including improvements to access'.</i></li> </ol>	
<p>The Royal Greenwich Local Plan</p> <p>Policy OS(g) Green and River Corridors</p>	<p>The Policy states: <i>'The network of main green corridors and the ecological and wildlife value of the Borough's rivers, canals and lakes will be protected and enhanced. Development will not normally be permitted where it would damage the continuity of the wildlife habitat within the corridor.'</i></p>	<p>Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.</p>
<p>London Invasive Species Initiative</p>	<p>The London Invasive Species Initiative objectives follow the principles of prevention, detection/surveillance and control/eradication of invasive species.</p>	<p>A review of the presence of non-native species within the vicinity of the Scheme has been undertaken to inform the baseline description. A risk assessment will be undertaken to identify measures</p>

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Policy/Legislation	Summary of Requirements	Scheme Response
		to minimise the potential for the import of invasive species into the area and minimise the risk of spreading those which are already present.
TE2100 plan	The TE2100 project was established by the Environment Agency in 2002 with the aim of developing a strategic flood risk management plan for London and the Thames Estuary to the end of the century. The TE2100 plan covers the tidal Thames and its floodplain from Teddington in the west to Shoeburyness in the east and is divided into 23 policy units.	Mitigation measures will be implemented to ensure no adverse effects on marine ecological features.

### **10.3 Methodology**

#### **General approach**

- 10.3.1 This preliminary assessment has been (and the final EIA impact assessment will be) completed in accordance with the Chartered Institute of Ecology and Environmental Management's (CIEEM) Guidelines for Ecological Impact Assessment in the UK (Ref 10-2) and Guidance on Impact Assessment in Marine and Coastal Environments (Ref 10-3)). These determine which ecological receptors are significant within a geographical context before the assessment of the impacts of the Scheme on significant receptors is undertaken.
- 10.3.2 As explained previously, the requirement for the marine elements of the Scheme had not been identified at the time of the formal scoping exercise in July 2014. This chapter therefore includes the rationale for the scoping out of a number of potential impact pathways. Section 10.6 of the Chapter contains a summary of the potential impacts, however there is no determination of the 'significance of effects'. This will be undertaken in the final ES when further surveys and hydrodynamic modelling have been completed.
- 10.3.3 This chapter also differs from the other assessment chapters within the PEIR in terms of the definitions that are applicable to each of the project stages. The marine related works are temporary during the construction period and as such impacts during the operation phase of the Scheme are not considered further. The following definitions for construction phase have been assumed:
- Construction: Recommissioning of the NABSA berth facility, and/or construction of the temporary jetty and associated works (including a dredge);
  - Operation of the jetty and/or NABSA berth facility; and
  - Decommissioning of the jetty.
- 10.3.4 The full details of the marine elements of the Scheme are still being developed and assessed. An indication has therefore been provided in this chapter as to the likely scale of the impact along with the details of the additional information that will be used to complete the assessments for the EIA being undertaken as part of the DCO application. The focus of the assessment has been on the new jetty and associated works, as this is

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considered to be a worst case in terms of marine impacts. The NABSA type facility is already present at Thames Wharf in the area and would require minimal works to make it useable.

### **Consultation**

- 10.3.5 The requirement for the marine elements of the Scheme had not been identified at the time of the formal scoping exercise. Consultation with regard to the marine ecology elements of the Scheme have been undertaken with the Marine Management Organisation (MMO), Natural England (NE), Port of London Authority (PLA) and the Environment Agency (EA) on the basis of this PEIR chapter in line with S.42 of the Planning Act 2008 'duty to consult' with prescribed consultees.

### **The study area**

- 10.3.6 The 'main study area' encompasses the full spatial and temporal extent of the likely significant effects that could arise from the Scheme. It is anticipated that the study area will be restricted to the Silvertown and Greenwich Peninsula area. However, the final extent of the study area will be dependent on the results of the physical processes and water quality assessments as well as ongoing consultation.

### **Methodology for establishing baseline conditions**

- 10.3.7 The description of the baseline environment has been established through a desk study. A list of the data sources that have been accessed is provided at the start of the baseline description of each of the individual receptors.
- 10.3.8 A phase 1 intertidal habitat survey will be undertaken in the vicinity of the proposed works. The approach will be based on the standardised Phase 1 mapping methodology detailed in the Marine Monitoring Handbook, procedural guidance No 3-1 (Ref 10-81) and CCW handbook for marine intertidal Phase 1 survey and mapping (Ref 10-82). Invertebrate samples will also be collected from both intertidal and subtidal locations to characterise the benthic assemblage in this area.

### **Forecasting the future baseline ('without scheme' scenario)**

- 10.3.9 The marine works associated with the Scheme are temporary (less than four years) and as such there would not be expected to be any perceptible change in the baseline during this period. No further consideration has therefore been given to the forecasting the future baseline of the marine

ecology receptors. The potential for any changes as a result of the implementation of others plans/ projects will, however, form part of the cumulative assessment.

Defining the importance/sensitivity of resource

10.3.10 The importance of a receptor, as described in Table 10-1 is based on its value and rarity (e.g. to either ecosystem or economy), such as the levels of protection it is afforded.

**Table 10-1 Receptor sensitivity**

<b>Receptor Importance</b>	<b>Definition</b>
<b>High</b>	Receptor internationally designated and/or of international importance. Likely to be rare with minimal potential for substitution or unable to tolerate change. May also be of high or very high socioeconomic importance.
<b>Moderate</b>	Receptor nationally designated and/or of national importance and/or some ability to tolerate change and recover in the medium term. Likely to be relatively rare. May also be of high socioeconomic importance.
<b>Low</b>	Receptor not designated but of local to regional importance and able to tolerate the effect to a large extent, with relatively rapid rate of recovery or not designated/ of local importance but not tolerant to change.
<b>Negligible</b>	Receptor only of local importance with a high tolerance to change.

**Methodology for assessing the significance of environmental effects**

10.3.11 The potential significance of the environmental effects arising from the marine works on marine ecological features has not yet been determined. The relatively recent addition of the marine works (i.e. post the formal scoping exercise) means that it has only been possible to scope the potentially significant impact pathways at this stage. The four main steps that will be used to determine the significance of environmental effects within the Environmental Statement are summarised below.



Step 1

- 10.3.12 This will identify the potential environmental changes resulting from the Scheme and the features of interest receptors (including their respective value) that are likely to be affected (which are together referred to as the impact pathway).

Step 2

- 10.3.13 Understand the nature of the environmental changes in terms of: their exposure characteristics, the natural conditions of the marine ecology system and the sensitivity of the specific receptors (i.e. predict the impact).

Step 3

- 10.3.14 Evaluate the value (sensitivity) and vulnerability of the features as a basis for assessing the nature of the impact and its significance.

- 10.3.15 The value of a feature and the likelihood of it being vulnerable to an impact pathway will be evaluated as a basis for assessing the level of the impact and its significance. The key significance levels for either beneficial or adverse impacts are described as follows:

- Negligible – negligible change not having a discernible effect;
- Minor – effects tending to be discernible but tolerable and unlikely to require mitigation;
- Moderate – Where these changes are adverse they might require mitigation which can include changes to the project design; and
- Major – effects are highest in magnitude and reflect the high vulnerability and importance of the receptor (e.g. to nature conservation). Where these changes are adverse they will require mitigation.

- 10.3.16 Those impacts that are identified as being moderate or above are considered to be significant.

Step 4

- 10.3.17 Manage any effects which are found to be significant and require the implementation of impact reduction/mitigation measures; identify the significance of the residual effect.

- 10.3.18 The final stage will identify any impacts that are found to be of moderate and/or major adverse significance of effect and that could require mitigation measures to reduce residual impacts, as far as possible, to environmentally acceptable levels. Within the assessment procedure, the use of mitigation measures will alter the risk of exposure and hence will require significance to be re-assessed and thus the residual effect identified.

#### **10.4 Description of the baseline conditions**

- 10.4.1 Within the description of the baseline environment a list of available data sources has been presented for each of the marine ecological receptors in turn. This has been followed by a description of each receptor at two spatial scales, firstly as an overview of the Thames Estuary to provide wider context followed by more site specific information.

##### **Nature conservation protected habitats and species**

###### Data sources

- 10.4.2 The locations of environmental designations in the vicinity of the proposed Scheme were mapped using the Natural England GIS Boundary Database. The distance to these sites were calculated in a GIS framework. Where an overlap was identified the respective citations were consulted.

###### General overview

- 10.4.3 The closest internationally designated sites that support marine features (the Thames Estuary and Marshes Special Protection Area (SPA) and Ramsar site) are located approximately 30km from the proposed order limits and as such are considered to fall outside of the assessment study area.
- 10.4.4 The closest nationally designated site that supports marine features (the Inner Thames Marshes Site of Special Scientific Interest (SSSI)) is located approximately 15km from the proposed order limits and as such is considered to fall outside of the assessment study area.
- 10.4.5 The Scheme falls within the boundary of the Thames Estuary recommended Marine Conservation Zone (rMCZ) which stretches from Richmond to the wider mouth at Southend and Grain. Four subtidal and intertidal habitats and three species features are considered for designation in this site. The habitat features are: intertidal mixed

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sediments (note: intertidal mud or saltmarshes are considered to be sufficiently protected by other designations), subtidal coarse sediment, subtidal sand and subtidal mud. The species features proposed are: tentacled lagoon worm (*Alkmaria romijni*), European eel (*Anguilla anguilla*) and smelt (*Osmerus eperlanus*) (Balanced Seas, 2011). This rMCZ has, however, not been included in the second tranche of sites proposed for designation in 2015/16; it is currently on hold as Defra has indicated a need to better understand the implications of designation of the site on potential developments within the estuary. A formal MCZ assessment is consequently not required at this time (Ref 10-4).

- 10.4.6 The UK Biodiversity Action Plan (UK BAP) is the UK Government's response to the Convention on Biological Diversity signed in 1992. It describes the UK's biological resources and commits a detailed plan for the protection of these resources. Several priority habitats and species have been identified as part of the UK BAP at a nation-wide level.
- 10.4.7 UK BAP priority habitats identified within the vicinity of the proposed Scheme include mudflats and coastal saltmarsh. Local Biodiversity Action Plans (LBAPs) aim to conserve biodiversity through local partnerships, taking into account both national and local priorities. The London LBAP identifies the whole of the Tidal Thames as a priority habitat. Similarly the Greenwich and the London Borough of Newham LBAPs include rivers and wetland as a priority habitat.
- 10.4.8 It should be noted that the majority of habitats and species contained within the BAP priority lists are now considered as habitats or species of principal importance for the conservation of biodiversity in England and Wales under the Natural Environment and Rural Communities (NERC) Act 2006.
- 10.4.9 The closest National Nature Reserve (NNR) and Local Nature Reserve (LNR) which support marine features are located over 44km and 10km from the application boundary respectively. These sites are considered to fall outside of the assessment study area that is being applied to this Scheme.
- 10.4.10 Several Sites of Interest for Nature Conservation (SINCs) have been designated throughout London. Those with aquatic elements linked to or part of the Thames Estuary in the vicinity of the Scheme are the East India Dock Basin, Royal Docks and Thames and Tidal Tributaries SINCs.

10.4.11 The East India Dock Basin SINC is located approximately 0.5km from the proposed Scheme boundary; one of the qualifying features being the presence of saltmarsh. The Royal Docks SINC is an open body of water connected to the Thames and is located approximately 0.2km east of the proposed Scheme. The Thames and Tidal Tributaries is the only SINC that directly overlaps with the proposed Scheme. This SINC has been designated due to its importance to a number of features. Habitats that are described as important features of the site include saltmarsh, reedbeds, marsh-sow thistle and wetlands (Ref 10-5). These in turn provide important functions such as nursery habitats for several species of fish. A phase 1 intertidal survey will be undertaken to confirm whether these features are located within the study area.

#### Benthic habitats and species

##### *Data sources*

10.4.12 The benthic ecology of the Thames Estuary has been described based on a number of data sources. These data were used to inform the understanding of the relative importance and functionality of the Thames Estuary. The key data sources reviewed include:

- **Hub for London:** A desk based ecological study characterising the existing environment within the Thames. Produced for Transport for London as a result of investigations into expanding London's hub airport capacity (Ref 10-6);
- **Environmental Baseline for TE2100:** A plan to set out the strategic direction for managing flood risk in the Thames estuary to the end of the century and beyond. Provides information on the current environment and species present within the Thames (Ref 10-7);
- **Greater Thames Coastal Habitat Management Plan (CHaMP) Scoping Document:** The (CHaMP) identifies and sets out plans to protect the important habitats within the Thames (Ref 10-8);
- **Non-Native Species Secretariat (NNS):** The NNS coordinates the approach to invasive non-native species in Great Britain. The organisation provides information in the form of fact sheets on the most common/ most harmful invasive species currently present within the UK;
- **Environment Agency data (2012):** Environment Agency data taken from subtidal and intertidal sites at Woolwich and Greenwich;

- **Crossrail Instone Wharf Intertidal Studies:** An Environmental Statement carried out for the development at Instone Wharf which discusses the benthic habitat and species present at the site (Mott Ref 10-9);
- **Emirates Air Line (EAL):** An Environmental Statement for the cable car development running between the Greenwich Peninsula and the Royal Victoria Dock. A description of the benthic environment and community in the area is provided (Ref 10-10);
- **Enderby Wharf Benthic Biological Resource Assessment:** An Environmental Statement written to support the application of the development of Enderby Wharf. The existing benthic environment in the area is characterised (Ref 10-11); and
- **Gallions Reach, Thames River Crossings Marine Benthic Survey:** A benthic survey to support an Environmental Statement characterising the sub-tidal and intertidal communities of the benthic environment at Gallions Reach.

*Thames estuary overview*

- 10.4.13 The intertidal habitats in the Thames Estuary include areas of saltmarsh, eelgrass beds and shingle. Extensive intertidal sand and mudflats are present, with the mudflats up to 2km wide in places, however as the estuary narrows, mudflat fringes also become narrower. The intertidal flats of the estuary are mostly fine, silty sediment, with a few sandy areas. Salinity is generally considered the most significant factor influencing species distributions in estuaries (Ref 10-12). Changes in the invertebrate composition along the estuary reflect the tolerance that individual species have to variations in salinity (Ref 10-6).
- 10.4.14 The benthic assemblage of the Thames Estuary has been described previously in the Thames Estuary Benthic Programme (TEBP), wind farm environmental statements (Ref 10-13), the Greater Thames CHaMP (Ref 10-8) and Thames Estuary 2100 related studies (Ref 10-7,10-14 and 10-15;) as well as data held by the Port of London Authority.
- 10.4.15 Invertebrate species typically found within the intertidal zone in brackish sections of the Thames Estuary include polychaetes (or bristle worms) (such as *Nereis sp* and *Streblospio shrubsolii*) and tubificid oligochaetes such as *Limnodrilus hoffmeisteri*. Species found within the subtidal zone in brackish sections of the Thames Estuary include the estuarine

amphipod *Gammarus zaddachi*, the oligochaete *Tubifex tubifex* and a non-native mollusc *Potamopyrgus antipodarum*. Freshwater invertebrate species that are tolerant of elevated salinity such as the gastropod *Lymnaea peregra*, leech *Helobdella stagnalis* and midges (*Chironomidae* spp.) are also recorded in the inner estuary.

*Silvertown and Greenwich peninsula area*

- 10.4.16 The marine works are located in the inner estuary. The width of the estuary at this point is approximately 400m with a narrow strip of intertidal mudflat visible at low water. A phase 1 habitat survey will be undertaken in the vicinity of the proposed marine works along with invertebrate sampling in both the intertidal and subtidal sediments. The following description of the local area is therefore based on the best available information at this time.
- 10.4.17 The subtidal community within the immediate vicinity of the proposed Scheme has not been sampled to date, however, several other studies have characterised the subtidal community within this region of the Thames (Ref 10-16; 10-9; 10-17). These are described below in the order of decreasing distance from the proposed Scheme.
- 10.4.18 Subtidal benthic communities at Gallions Reach, downstream of the proposed Scheme, were found to support the nationally rare bryozoan *Victorella* sp. This species is protected under Schedule 5 of the Wildlife and Countryside Act 1981, listed as a priority species in the UK BAP and Species of Principle Importance in the Natural Environment and Rural Communities Act, 2006. Also of note was the presence of the sea mat *Electra crustulenta*, a species only recorded at a few locations around the UK but not listed under any importance categories (Ref 10-18). Chinese mitten crab were also present in the area (Ref 10-17).
- 10.4.19 In 2012 the subtidal community at Woolwich was dominated by the mud shrimp *C. volutator* and the invasive polychaete *Boccardiella ligERICA*. This community differs in species composition relative to earlier years; for example *Limnodrilus* sp, and *P. antipodarum* were common in the area until autumn in 2007 after which they reduced in abundance, resulting in *Marenzelleria viridis*, *C. volutator* and *B. ligERICA* becoming more dominant (Ref 10-16).
- 10.4.20 The subtidal community at Greenwich was sampled between 2005 and 2007. The species composition was broadly similar over the sampled

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- period, with the species present being similar to those found at Woolwich (Ref 10-16).
- 10.4.21 Subtidal surveys at Instone Wharf recorded low species abundance and diversity. The most abundant assemblage was found in the central channel and was dominated by prawns (*Crangon crangon*) and shrimps (*Palaemon spp.*) (Ref 10-7).
- 10.4.22 The benthic habitat at Enderby Wharf, slightly upstream of the proposed Scheme, supports two main sediment types that are broadly similar; gravelly mud and gravelly muddy sand (Ref 10-11). The benthic community found in this area was reported to be widespread and common throughout the Thames. The only species of interest found in the area were *Cochliopidae* Type A, *Cochliopidae* Type B and *Tenellia adspersa* (protected under the Wildlife and Countryside Act (1981) and listed as a UK BAP and UK Red Data Book Species). Areas of high biomass coincided with areas possessing high abundances of *C. volutator* and *A. lacustre* (Ref 10-11). The consistency in the communities found in the subtidal zone in this area of the Thames suggests the presence of a relatively uniform habitat.
- 10.4.23 Intertidal habitats present within the Thames were mapped as part of the TE2100 project (Ref 10-7). This habitat map indicates that the intertidal area within the proposed Scheme boundary is consistent with the Integrated Habitat System code LS41, 'mudflats and sandflats not covered by sea water at low tide'. Reported intertidal data that is available in vicinity of the marine works is described below in the order of decreasing distance from the proposed Scheme.
- 10.4.24 The intertidal habitat on the north bank at Gallions Reach was described as mudflat. The south bank intertidal area comprised a mixture of bricks, boulders, pebbles and a small area of mud. The upper intertidal area comprised fixed boulders and rocks with green algae with underlying substrate consisting of either hard chalk or clay (Ref 10-17).
- 10.4.25 The intertidal community at Woolwich between 2005 and 2006 was heavily dominated by *Limnodrilus sp.*, however, *B. ligerica* was also recorded in high numbers (Ref 10-16).
- 10.4.26 The intertidal area at the entrance to the river Lea is composed of mud inhabited mainly by low densities of oligochaete annelids (Ref 10-9). The largest faunal densities in the intertidal zone were found in the upper shore where rocks and rubble were present. Within this zone the highest

and most diverse species assemblages were associated with water retentive substrates, such as wooden fenders and algae (Ref 10-9).

*Non-native species*

10.4.27 In general non-native species find their way into UK coastal waters by a variety of means however, the most significant mode is via shipping by attachment to hulls or in ballast water, with the latter being identified as one of the four greatest means of transfer (ABPmer, 2013). The high levels of commercial shipping, recreational boating and imports of animals for aquaculture or the seafood trade within the Thames Estuary has resulted in several non-native invasive species becoming established within the estuary. These include the following species that have been identified in the River Thames that could occur in the vicinity of the proposed Scheme (based on their environmental tolerances and a review of site specific data) (Ref 10-19; Ref 10-16):

- **Chinese mitten crab (*Eriocheir sinensis*):** The Chinese mitten crab originates from Asia, but over the past 20 years has become increasingly prevalent in British river systems. British wildlife is affected by the Chinese mitten crab because it is a voracious predator. It also poses a threat to habitats through the burrowing activity of adults, which leads to the erosion of river banks (Ref 10-20)
- **Zebra mussel (*Dreissena polymorpha*):** The Thames Estuary was invaded by the zebra mussel during the early 18th century and they are still commonly found in high abundances (Ref 10-19). The major threat to British wildlife is from their sheer abundance. These high abundances affect other wildlife by using up space for attachment needed by native species, and even colonizing the shells of other species (which affects their ability to feed and burrow. Each female can release up to one million eggs per season, giving a single mussel the ability to establish a whole population (Ref 10-21);
- **Asiatic clam (*Corbicula fluminea*):** This species was first discovered in Western Europe during the 1980's. They are capable of self-fertilisation and release 400 juveniles each per day (Ref 10-22). The Asiatic clam competes with native mussel species for food and space, but is also responsible for altering benthic substrates upon which other species rely. Furthermore, the Asiatic clam has a greater resilience against pollution, increasing its potential to outcompete the more sensitive species found in the UK. They also have foul water intake pipes of power plants and other industrial water systems (Ref 10-23);



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- **Slipper limpet (*Crepidula fornicata*):** Slipper limpet competes for food and space with other filter-feeding species, and has been known to displace mussel beds (Ref 10-24). The modern British population is known to have been introduced to Essex between 1887 and 1890 in association with the oyster, *Crassostrea virginica*, which was imported from North America (Ref 10-25);
  - **Carpet sea squirt (*Didemnum vexillum*):** This invasive sea squirt grows in colonies, often in a carpet-like form on the seabed and other substrates. The sea squirt is able to spread rapidly, and become dominant in new environments, thus excluding other benthic organisms and creating a homogenous habitat (Ref 10-26). Fragments from a colony are able to break off and establish in a new location. The colonies may overgrow fish spawning grounds and hinder the ability of fish to feed on benthic species (Ref 10-27). Commercially, the carpet sea squirt poses a risk to aquaculture, for example through the colonisation of substrates preventing scallop recruitment (Ref 10-28);
  - **Pacific oyster (*Crassostrea gigas*):** The Pacific oyster was first introduced from Portugal into the River Blackwater, Essex, in 1926 as a commercial crop and has since established itself in the wild. Pacific oysters themselves attach to almost any hard surface in sheltered waters. Whilst they usually attach to rocks in their native range, the oysters can also be found in muddy or sandy areas and will also settle on adult specimens of the same or other mollusc species. Impacts on native populations include displacement through competition for food and space; habitat change and hybridization with local oyster species (Ref 10-25);
  - **Polychaete (*B. ligerica*):** This brackish water species tolerant of a wide range of salinities that originates from Europe. Its native range extends between Germany and Portugal where it can be found on a variety of substrate types including soft mud, sand, hard clay, shell debris, wood and fouled ships. No impacts have been reported for this species, but introduced populations can reach high densities in some areas, outcompeting local species and becoming the dominant member of the benthos (Ref 10-30). The Environment Agency benthic sampling in the Thames Estuary (Ref 10-16 ) has recorded this species in close proximity to the proposed Scheme; and
  - **Jenkin's spire shell (*P. antipodarum*):** Originally native to the freshwater streams and lakes of New Zealand this species was first

introduced in the Thames Estuary in 1852 and has since become widespread in freshwater and brackish habitats in the UK. The species may establish very dense populations (several 100,000 snails/m<sup>2</sup>), and can dominate communities. Consequently, it can consume large amounts of primary production, alter ecosystem dynamics, compete with and displace native invertebrates, and negatively influence higher trophic levels (Ref 10-31).

- 10.4.28 Many of these species are widespread throughout the Thames Estuary with records of Chinese mitten crab, Zebra mussel, the polychaete *B. ligerica* and Jenkin's spire shell recorded both upstream and downstream of the proposed Scheme (Ref 10-16; Ref 10-32).

### Fish

#### *Data sources*

- 10.4.29 The fish and shellfish ecology of the Thames Estuary has been described based on a number of data sources. These data were used to inform the understanding of the relative importance and functionality of the Thames Estuary. The key data sources reviewed include:
- FishBase ([www.fishbase.org](http://www.fishbase.org)) (Ref 10-33): An online database containing data on fish ecology, distribution and biological information;
  - Marine Aggregate Regional Environmental Assessment of the Outer Thames Estuary: Summary of the distribution and ecology of fish and shellfish in the southern North Sea and Thames Estuary (Ref 10-34);
  - Spawning and nursery grounds of selected fish species in UK waters: During the late 1990s, a collaborative project between the Centre for Environment, Fisheries and Aquaculture Science (Cefas), the Fisheries Research Service, the UK Offshore Operator's Association (UKOOA), the Scottish Fishermen's Association (SFF) and the National Federation of Fishermen's Organisations (NFFO) produced the Fisheries Sensitivity Maps in British Waters. This report (Ref 10-35) included maps of the main spawning and nursery grounds for 14 commercially important species (cod, haddock, whiting, saithe, Norway pout, blue whiting, mackerel, herring, sprat, sandeels, plaice, lemon sole, sole and Norway lobster). This data has since been updated by Cefas based on more recent survey data and additional analyses to complement the original maps (Ref 10-32);

- Benthic Ecology of the Thames Estuary: Trawl data held by the Port of London Authority (PLA) from between February 2002 and November 2005 from a large number of surveys undertaken in the Thames Estuary (Ref 10-37);
- Kentish Flats Beam, Otter and Bass Trawl Surveys: Trawl surveys undertaken during pre-construction and post-construction of the Kentish Flats offshore wind farm between 2002 and 2007 (Ref 10-34).

10.4.30 Of particular relevance are a number of recent monitoring projects which have been undertaken specifically in the Silvertown and the Greenwich Peninsula area. These data sources include the following:

- Environment Agency Transitional and Coastal Water Bodies (TraC) Fish Monitoring: The results of ongoing annual Water Framework Directive (WFD) fish monitoring at Woolwich and Greenwich using trawls, seine netting and kick sampling techniques. Data for the most recent five years (2011 to 2015) has been analysed (Ref 10-39); and
- Limmo Peninsula Fish Surveys. The fish populations within Limmo Peninsula and Bow Creek region of the River Lea (a tributary to the Thames with its mouth nearby to the proposed Scheme) were sampled on three occasions in 2005 and 2006. The surveys which were undertaken as part of the baseline data for a proposed development used a combination of seine and fyke nets (Crossrail, 2006).

10.4.31 A number of other surveys and scientific studies on fish and shellfish have also been included where appropriate.

*General overview*

10.4.32 The Thames Estuary supports a diverse fish fauna with over 100 fish species having been recorded in the estuary over the past 30 years (Ref 10-40; 10-1). Fish species with known spawning and nursery locations within the Thames Estuary include herring, lemon sole, and Dover sole. Other commercially important fish species which also utilise the Thames Estuary for nursery areas include plaice, sprat and bass. Diadromous fish which migrate through the estuary include the European eel, sea lamprey, river lamprey and the twaite shad. The Thames Estuary is also an important area for many shellfish species, with large beds of common cockle, native oyster and blue mussel being present throughout the outer Estuary (Ref 10-32; 10-34).

10.4.33 The distribution and ecology of demersal fish, pelagic fish, elasmobranchs, diadromous fish and shellfish within the Thames Estuary are each reviewed in more detail below. The review has primarily focused on key species which are of either commercial and/ or conservation importance. Each section initially provides a Thames Estuary wide overview before focusing specifically on the Silvertown and the Greenwich Peninsula study area. The functional guilds for estuarine fish defined by Elliott *et al.*, (2007) (Ref 10-37) have been used in the tables of this review in order to provide a summary on the life history and ecology of each fish species:

- Freshwater stragglers (FS): Freshwater species found in low numbers in estuaries and whose distribution is usually limited to the upper reaches of estuaries with low salinity;
- Marine stragglers (MS): Species that spawn at sea and typically enter estuaries only in low numbers and occur most frequently in the lower reaches. This category contains fish that are generally intolerant of reduced salinity;
- Marine migrant opportunistic species (MMOS): Species that spawn at sea and often enter estuaries in large numbers; particularly as juveniles. Some of these species are highly euryhaline and move throughout the full length of the estuary. Species in this category can use, to varying degrees, near-shore marine waters as an alternative habitat;
- Marine migrant dependent (MMD): Species that spawn at sea but often enter estuaries in large numbers, particularly as juveniles that seek the shelter of estuarine habitats. Some of these species are highly euryhaline and move throughout the full length of the estuary;
- Estuarine residents (ER): Estuarine species capable of completing their entire life cycle within the estuarine environment;
- Anadromous (A): Migrate from the sea into fresh water to breed; and
- Catadromous (C): Migrate from fresh water into the sea to breed.

10.4.34 The smelt and European eel are both proposed features of the Thames Estuary rMCZ. Further consideration of the potential impacts on each of the cited features will be provided in the assessment. In addition, certain fish species are protected under a range of legislation including the EU Habitats Directive, the Wildlife and Countryside Act 1981 (and

amendments) and the Bern Convention, as well as being on OSPAR threatened species list, International Union for Conservation of Nature (IUCN) red list and Biodiversity Action Plan (BAP) priority species/grouped plan list.

10.4.35 A summary of legislation protecting species relevant to the Thames Estuary can be seen in Table 10-2.

**Table 10-2 Summary of UK protection legislation for fish and shellfish species within the Thames Estuary**

Group	Fish Species Category	Species	Conservation Status and Importance
Diadromous fish species	C	European eel <i>Anguilla anguilla</i>	UK BAP, OSPAR listed and on the global red list; Thames Estuary rMCZ feature (High)
	A	Salmon <i>Salmo salar</i>	UK BAP, Appendix III of Bern Convention; Annexes II, V of the EC Habitats Directive, OSPAR. (High)
	A	Sea lamprey <i>Petromyzon marinus</i> and River lamprey <i>Lampetra fluviatilis</i>	Annexes II, V of the EC Habitats Directive, UK BAP, Appendix III of Bern Convention (river lamprey), OSPAR (sea lamprey). (High)
	A	Shads <i>Alosa alosa</i> and <i>A. fallax</i>	UK BAP, Appendix III Bern Convention, Annexes II and V EC Habitats Directive, Wildlife and Countryside Act (High)
	A	Brown/Sea Trout <i>Salmo trutta</i>	UK BAP (Moderate)
Pelagic bony fish species	MMOS	Atlantic herring <i>Clupea harengus</i>	UK BAP (grouped plan); of commercial importance (Moderate)
	MMD	Bass <i>Dicentrarchus labrax</i>	Of commercial importance (Moderate)
	MS	Mackerel <i>Scomber scombrus</i>	UK BAP (grouped plan); of commercial importance (Moderate)
	MMOS	Sprat <i>Sprattus sprattus</i>	Of commercial importance (Low)
	ER and MMD	Smelt <i>Osmerus eperlanus</i>	UK BAP; Thames Estuary rMCZ feature (Moderate)

Group	Fish Species Category	Species	Conservation Status and Importance
Elasmobranchs species	MS	Spotted ray <i>Raja montagui</i>	OSPAR threatened / declining (Moderate)
	MMOS	Thornback skate/ray <i>Raja clavata</i>	OSPAR threatened / declining; of commercial importance (Moderate)
Demersal bony fish species	MMOS	Atlantic cod <i>Gadus morhua</i>	Vulnerable (IUCN red list); OSPAR threatened / declining, UK BAP (grouped); of commercial importance (Moderate)
	MMD	Dover Sole <i>Solea solea</i>	UK BAP (grouped plan); of commercial importance (Moderate)
	MMOS	European Plaice <i>Pleuronectes platessa</i>	UK BAP (grouped plan); of commercial importance (Moderate)
	MMD	Lemon Sole <i>Microstomus kitt</i>	Of commercial importance (Moderate)
	MS	Sandeel <i>Ammodytes</i> species	UK BAP; of commercial importance (Moderate)
	MMOS	Whiting <i>Merlangius merlangus</i>	UK BAP (grouped plan); of commercial importance (Moderate)
	MS	Short-snouted seahorse <i>Hippocampus hippocampus</i> and long-snouted seahorse <i>Hippocampus guttulatus</i>	UK BAP, Wildlife and Countryside Act (Moderate)

Source: (JNCC, 2011 ([Ref 10-42](#))) and (Elliot *et al.*, 2007 (Ref 10-37))

#### Demersal bony fish species

##### *Thames estuary overview*

- 10.4.36 Demersal species are bottom-dwelling or mid-water fish that have a close association with the seabed.
- 10.4.37 The Thames Estuary is considered to be a low intensity nursery ground for several commercially important gadoids including cod and whiting. The Thames Estuary is also a low intensity spawning ground for cod and sandeel (Ref 10-32). Other demersal roundfish species regularly recorded

in the estuary include included gobies, pogge and dragonet (Ref 10-34; 10-34; ERM, 2010, 10-37).

10.4.38 A range of flatfish species are commonly recorded in the Thames Estuary including the commercially important sole. This species has high intensity spawning and nursery grounds in the estuary. The Thames Estuary is also a low intensity nursery ground for plaice. Flounder and dab are also regular recorded (Ref 10-32).

*Silvertown and Greenwich peninsula*

10.4.39 The most abundant demersal roundfish species recorded in Environment Agency TraC fish monitoring data for the period 2011 to 2015 at Woolwich and Greenwich was the sand goby (total of 1097 fish recorded) (Table 10-3). This species is commonly recorded in estuarine waters. Other estuarine fish species which were relatively abundant in the surveys included the sand smelt and common goby. Demersal marine species such as whiting and red gurnard were also recorded in the surveys. These species occur seasonally in the inner Thames Estuary. Of particular interest was the occurrence of a short-snouted seahorse in the Greenwich seine net sampling in 2011 (Ref 10-39).

10.4.40 Flounder and the commercially important Dover sole were the most numerous flatfish species recorded during the surveys. Small numbers of freshwater species tolerant of low salinity conditions such as common bream, zander and roach were also recorded (Ref 10-39).

10.4.41 Fish monitoring at the nearby River Lea in the Limmo Peninsula and Bow Creek area also found the demersal fish assemblage to comprise predominantly brackish species including common goby and flounder (Ref 10-43).

**Table 10-3 The abundance of demersal fish recorded in Environment Agency TraC fish monitoring at Woolwich and Greenwich (2011 to 2015).**

Species	Category	Greenwich Beam Trawl	Greenwich Seine Net	Woolwich Otter Trawl	Total
Three-spined stickleback	ER and FS		6	1	7
Chub	FS		2		2
Common bream	FS	2	134		136
Common goby	ER	2	7	36	45

Species	Category	Greenwich Beam Trawl	Greenwich Seine Net	Woolwich Otter Trawl	Total
Dab	MMOS			1	1
Dace	FS		5		5
Dover sole	MMD	1		923	924
Flounder	MMD	27	78	840	945
Pogge	MMOS			2	2
Painted goby	MMD			9	9
Perch	FS		2	2	4
Pike	FS		1		1
Pouting / Bib	MMOS			3	3
Red mullet	MS			6	6
Roach	FS		3		3
Roach/comm on bream hybrid	FS		1		1
Sand goby	ER	6	2	1089	1097
Sand smelt	ER and MMD		23		23
Short-snouted seahorse	MS		1		1
Tub gurnard	MS			2	2
Whiting	MMOS			42	42
Zander	FS		1		1

Source: Environment Agency, 2015 (Ref 10-39)

Pelagic bony fish (osteichthyes) species

*Thames estuary overview*

10.4.42 Pelagic species are free-swimming fish that inhabit the mid-water column. They tend to have little association with the seabed and as a result are often distributed over widespread and indistinct grounds, often forming large shoals. Pelagic fish, such as clupeids (herring and sprats) and mackerel are important prey resources for seabirds and marine mammals (Ref 10-44).

10.4.43 The Thames Estuary is considered to be a high intensity spawning ground for herring (Ref 10-32). Herring have been found to be most commonly recorded during the spring and summer in the Thames Estuary, with only very small catches inshore in winter (Ref 10-34). The Thames Estuary is also a low intensity nursery ground for mackerel. Other commonly recorded pelagic species in the estuary include sea bass and sprat (Ref 10-34, 10-37; 10-34).



*Silvertown and Greenwich peninsula*

10.4.44 The smelt, which is a commonly occurring midwater species in estuaries, was the most abundant pelagic species recorded in Environment Agency TraC fish monitoring data at Woolwich and Greenwich for the period 2011 to 2015 (Table 10-4). Marine species such as sprat and sea bass, which occur seasonally in the inner River Thames, were also recorded in the surveys. Fish surveys at the nearby River Lea in the Limmo Peninsula and Bow Creek area, also found the pelagic fish assemblage to comprise predominantly of smelt and sea bass (Ref 10-39).

**Table 10-4 The abundance of pelagic fish recorded in Environment Agency TraC fish monitoring at Woolwich and Greenwich (2011 to 2015)**

Species	Category	Greenwich Seine Net	Woolwich Otter Trawl	Total
Herring	MMOS	8	2	10
Sea bass	MMD	76	4	80
Smelt	ER and MMD	14	262	276
Sprat	MMOS	54	40	94

Source: Environment Agency, 2015 (Ref 10-39)

Elasmobranchs

*Thames estuary overview*

10.4.45 Elasmobranchs are fish which possess a cartilaginous skeleton and include sharks and rays. The Thames Estuary is a low intensity spawning ground for Thornback ray with the estuary considered to be of regional importance to the species (ERef 10-32). Studies of ray movements in the Thames Estuary showed that 96% of rays tagged were recaptured there, suggesting that these rays form distinct sub-populations and exhibit small scale movements (Ref 10-34). Other commonly recorded elasmobranchs include the small-spotted catshark and starry smoothhound.

*Silvertown and Greenwich peninsula*

10.4.46 No Elasmobranchs have been recorded in recent fish monitoring data in the area (Ref 10-39; Ref 10-39). This is expected because commonly occurring elasmobranch species in the Thames Estuary such as thornback rays and small-spotted catshark, are unlikely to be able to tolerate the low salinity conditions found in the study area.

Diadromous fish species

*Thames estuary overview*

- 10.4.47 Diadromous fish migrate between salt and freshwater and in the Thames Estuary include river lamprey, sea lamprey, twaite shad, Atlantic salmon, sea trout and European eel.
- 10.4.48 The river lamprey and the sea lamprey are both anadromous species, spawning in freshwater but completing part of their lifecycle in estuaries or at sea (Ref 10-45). The sea lamprey adult growth phase is short and lasts around two years. In this time the species is parasitic, feeding on a variety of marine and anadromous fishes, including shad, herring, salmon, cod, haddock and basking sharks. Unlike sea lamprey, the growth phase of river lamprey is primarily restricted to estuaries. These species have begun to recolonise the catchment areas of the Thames Estuary with sightings increasing in recent years.
- 10.4.49 The twaite shad is an anadromous species which migrates from marine waters into the lower reaches of estuaries between April and June to spawn in freshwater near the tidal limit (Ref 10-46). Occasional seasonal presence is suspected but has yet to be proven for the Thames (Ref 10-1).
- 10.4.50 Atlantic salmon are an anadromous species which migrates to freshwater to spawn, whilst spending most of its life in the marine environment. They spawn in upper reaches of rivers, where they live for one to three years before migrating to sea as smolts. At sea, salmon grow rapidly and after one to three years return to their natal river to spawn. The UK and Irish Atlantic salmon population comprises a significant proportion of the total European stock (Ref 10-47). The species has been reintroduced into the Thames in recent years but the population is only maintained by periodic stocking.
- 10.4.51 European eel is catadromous species which migrates to the marine environment (Sargasso Sea) to spawn. The Thames Estuary is considered to be particularly important for the European eel. In their multi-method sampling surveys for estuaries, the Environment Agency have collected numerous records for the species throughout the Thames Estuary, and the estuary has the second highest density of eels in all surveyed estuaries in the UK (Ref 10-44).

*Silvertown and Greenwich peninsula*

10.4.52 The only migratory species recorded in recorded in Environment Agency TraC fish monitoring data at Woolwich and Greenwich for the period 2011 to 2015 was the European eel (Table 10-5). This species was also the most numerous species recorded in fish monitoring in the nearby River Lea in the Limmo Peninsula and Bow Creek area (Ref 10-39). Other species such as river and sea lamprey will pass through the area on migration.

**Table 10-5 The abundance of migratory fish recorded in Environment Agency TraC fish monitoring at Woolwich and Greenwich (2011 to 2015)**

Species	Category	Greenwich Beam Trawl	Greenwich Kick sample	Greenwich Seine Net	Woolwich Otter Trawl	Total
European eel*	C	2	23	12	4	41
*(including elvers and glass eel development stages)						

Source: Environment Agency, 2015 (Ref 10-39)

Shellfish species

10.4.53 This section focuses on shellfish species (i.e. molluscs or crustaceans) which are consumed by humans. Information on other macrofauna is reviewed within the Benthic Habitat and Species section.

*Thames estuary overview*

10.4.54 The Thames Estuary is an important area for many shellfish species, with large beds of common cockle and native oyster. The most important cockle-harvesting area in the Thames Estuary is the Maplin Sands (off the Essex coast) and surrounding area. Oysters are widely distributed through the outer Thames Estuary with major oyster fishing grounds located at Whitstable (Ref 10-34). The Estuary also provides important habitat for other shellfish species including blue mussel, whelk, pink shrimp and brown shrimp, lobster, and crabs (Ref 10-34; 10-34). Within the Thames Estuary there are currently 12 designated shellfish waters:

- Dengie;
- Upper Roach;

- Roach and Lower Crouch;
- Upper Roach;
- Foulness;
- Outer Thames;
- Southend;
- Sheppey;
- Swalecliffe;
- Margate;
- Swale Central; and
- Swale East.

*Silvertown and Greenwich peninsula*

- 10.4.55 Recent benthic surveys in the vicinity of the Scheme have recorded few shellfish species although low numbers of brown shrimp have been recorded (Ref 10-16; 10-11,; 10-9).

Marine mammals

*Data sources*

- 10.4.56 Numerous sources of information have been reviewed to inform the marine mammal baseline description. These include a number of national and regional studies to provide information on marine mammal distribution and ecology. The data was used to inform the understanding of the relative importance and functionality of the Thames Estuary in the context of the wider southern North Sea and eastern English Channel area. The main data sources include:

- Small Cetacean Abundance in the European Atlantic and North Sea programmes (SCANS and SCANS-II): The surveys undertook widespread ship based and aerial surveys of cetaceans in UK and adjacent waters in the summers of 1994 and 2005 (Ref 10-49). The programme provides detailed wide-scale survey data on cetacean abundance, distribution and density in North West European waters;

- Atlas of Cetacean Distribution in North West European Waters: Comprehensive information on cetacean distribution in North West European waters is presented in Reid *et al.* (2003) (Ref 10-50). This report provides a compilation of cetacean sighting records from a variety of systematic surveys and opportunistic sightings amounting to over 2,500 days of observation carried out since 1973;
- Offshore Energy Strategic Environmental Assessment (SEA): Detailed reviews of marine mammal distribution and ecology in UK waters have been carried out by the Sea Mammal Research Unit (SMRU), University of St. Andrews, as a contribution to the UK Department of Energy and Climate Change (DECC) Offshore Energy Strategic Environmental Assessment (SEA) (Ref 10-44); and
- Special Committee on Seals Annual Report: Information on the status of seals around the UK coast is reported annually by the SMRU-advised Special Committee on Seals (SCOS) (Ref 10-51).

10.4.57 Of particular relevance are a number of recent monitoring and survey projects which have been undertaken specifically in the Thames Estuary area. These data sources include the following:

- Thames Marine Mammal Sightings Survey (2004-2015): Shore based opportunistic sightings of marine mammals in the Thames compiled by the Zoological Society London (ZSL) (Ref 10-52; 10-49);
- Greater Thames Estuary Seal Surveys Report: Aerial transects and boat based surveys undertaken in August and December 2014 to better understand seal populations in the Thames Estuary (Ref 10-50);
- Common Seal Satellite Telemetry Surveys in the Thames Estuary: Satellite tagging surveys undertaken by ZSL and SMRU in January 2012. In total ten seals were tagged from seal colonies near Southgate and Margate Sands Ref 10-55);
- Common Seal Satellite Telemetry Surveys in the Thames Estuary: Satellite tagging surveys undertaken by SMRU in February 2006. Nine common seals were tagged from Margate and Long Sands cSAC (Ref 10-52); and
- Thames Strategic Environmental Assessment (SEA) Area aerial surveys (2002-2006): A series of larger scale aerial surveys were undertaken by Wildfowl and Wetlands Trust to cover the Thames

Strategic Environmental Assessment (SEA) Area, as part of the Round 2 programme, supported and funded by both the Department of Trade and Industry (DTI, now DECC) and the offshore wind farm developers. These surveys were primarily undertaken to survey marine waterbirds although observations of marine mammals were also recorded (Ref 10-34; Ref 10-57).

- 10.4.58 A number of other surveys and scientific studies on marine mammals have also been included where appropriate.

*General overview*

- 10.4.59 The cetacean fauna (whales and dolphins) of the southern North Sea including the Thames Estuary is relatively poor, both in terms of the number of animals and diversity of species (Ref 10-58; 10-50; 10-44). While over ten species of cetaceans have been recorded in the southern North Sea, only harbour porpoise occurs relatively frequently in the Thames Estuary (Ref 10-59; 10-53). The bottlenose dolphin is occasionally observed in the eastern part of the English Channel and very rarely in the Thames Estuary (Ref 10-60;10-52).
- 10.4.60 With regard to pinnipeds (seals), both grey and common seals breed at haul out sites along the Norfolk coast, Kent coast and Thames Estuary and are regularly recorded foraging in the Thames Estuary (Ref 10-51; 10-52).
- 10.4.61 All cetaceans are protected under Schedule 5 of the Wildlife and Countryside Act 1981 (and amendments), under which it is an offence to take, injure or kill these species. Disturbance in their place of rest, shelter or protection is also prohibited. All species of cetacean are also protected under the EU Habitats Directive, in Annex II and IV and the Bern Convention. In addition, harbour porpoise are listed as an OSPAR threatened species and in Appendix II of the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals).
- 10.4.62 Pinnipeds are protected under the Conservation of Seals Act 1970 (England, Scotland, Wales). Grey and common seals are also listed in Annex II of the EU Habitats Directive and protected from disturbance both inside and outside the designated sites. The grey seal is also listed as an Appendix III species under the Bern Convention (1979), which prohibits their deliberate disturbance, capture or killing and the disturbance of their breeding grounds.

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10.4.63 The baseline review has focused on the three most commonly occurring marine mammal species in the Thames Estuary (common seal, grey seal and harbour porpoise). The distribution, abundance and ecology of each of these species are discussed further in the sections below. Each section initially provides a Thames Estuary wide overview before focusing specifically on the Silvertown and the Greenwich Peninsula study area.

Common seal (*Phoca vitulina*)

10.4.64 The common seal (also known as harbour seal) is the smaller of the two native UK seals measuring up to approximately 1.85m in length and typically weighing 80-100kg. Britain is home to approximately 30% of the population of the European sub-species of common seal (having declined from approximately 40% in 2002). Common seals are found in a wide variety of coastal habitats and come ashore in sheltered waters, including on sandbanks, in estuaries and along rocky areas.

10.4.65 Common seals normally feed within 40-50km of their haul-out sites (SCOS, 2015). Scotland holds approximately 79% of the UK common seal population (Ref 10-51). On the east coast of England, their distribution is more restricted with concentrations in the major estuaries of the Thames, The Wash, Firth of Tay and the Moray Firth (Ref 10-51).

*Thames estuary overview*

10.4.66 Aerial and boat based surveys in the outer Thames Estuary were undertaken in August and December 2014 to better understand seal populations in the area (particularly at key haul out sites) (Ref 10-54). In total 489 and 345 harbour seals were counted during the August and December surveys respectively. The main coastal haul out locations included Pegwell Bay, Hamford Water and approaches to the river Crouch (Foulness Sands, Dengie Flats and Buxey Sands).

10.4.67 Satellite tagging of nine common seals in February 2006 by ZSL/SMRU and ten common seals in January 2012 by SMRU from haul out sites in the Thames Estuary showed that common seals travel widely throughout the Thames with high usage recorded. The 2012 tagging survey recorded seals diving up to 85m deep and utilising ranges up to 8,473km<sup>2</sup> for foraging. In general common seals are not believed to travel as far as grey seals, usually staying closer to haul out sites (typically within 40-60km) (Ref 10-51). However, one of the 2006 tagged animals travelled into the English Channel, hauling-out near Saint-Valery-sur-Somme in

France and foraged and hauled out in The Wash, with more than 660km between the southern and northern extent of its movements (Ref 10-56).

- 10.4.68 The Thames Marine Mammal Sightings Survey 2004-2015 has recorded 301 sightings of common seal to date. The sightings ranged from Benfleet and Southend Marshes, Southend-on-Sea and Canvey Island in the outer estuary to the Isle of Dogs, and upstream to Teddington (Ref 10-52; 10-54).

*Silvertown and Greenwich peninsula*

- 10.4.69 The nearest haul out sites to Silvertown and the Greenwich Peninsula area are located approximately 50km away around Gravesend and Canvey. However, common seal are frequently recorded foraging within the Silvertown and Greenwich Peninsula area (Drawing 10-1) (Ref 10-52; 10-53; 10-54).

Grey seal (*Halichoerus grypus*)

- 10.4.70 The grey seal is the larger of the two seal species found in British waters, with males reaching a length of 2.45m and a weight over 300kg (Ref 10-51). Grey seals predominantly inhabit remote islands and coastlines in Wales, breeding on undisturbed beaches of cobble and boulders or within sea-caves along the coast. Pupping time occurs primarily from August through to December with September generally being the busiest month.
- 10.4.71 About 38% of the world's population of grey seal is found in Britain with over 88% of the British grey seals breeding in Scotland (Ref 10-51). During the 2012 breeding season UK grey seal production was estimated at 56,988. To estimate the total grey seal population size in 2013, trajectories from a population dynamics model using the 2012 pup counts and population demographic parameters gave a total UK population of 111,600 (Ref 10-51).

*Thames estuary overview*

- 10.4.72 Aerial and boat based surveys in the outer Thames Estuary in August 2014 recorded a total of 449 grey seals (Ref 10-54). Of these counts over 70% (347 grey seals) were recorded in the Goodwin Sands area which is the main grey seal haul out in the region.
- 10.4.73 A range of studies have shown that grey seals can undertake long distance travel between different haul-out sites but foraging trips are generally much smaller. For example, Thompson *et al.* (1996) found that



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four seals tracked from the Moray Firth moved to haul-out sites 125-365km away, and provided evidence of interchange between the Moray Firth and other grey seal breeding areas in Orkney, the Firth of Forth and the Farne Islands (Ref 10-61). While grey seals may range widely between haul out sites, tracking has also shown that most foraging probably occurs within 100 km of a haul-out site (Ref 10-51).

*Silvertown and Greenwich peninsula*

- 10.4.74 Goodwin Sands, the main grey seal haul out site is located well over 100 km from the Silvertown and Greenwich Peninsula area with the nearest minor colonies (Maplin Sands and West Barrow) located over 60km away. However, sightings data suggests grey seals are regularly recorded foraging in the Silvertown and Greenwich Peninsula area (Drawing 10-1) (Ref 10-52; 10-53; 10-54). Some of these sightings relate to the same individual grey seal which has been regularly observed in the area for over ten years, primarily in the Isle of Dogs docks area (particularly Canary Wharf and Billingsgate fish market, where he is often fed by fisherman).

Harbour porpoise (*Phocoena phocoena*)

- 10.4.75 Harbour porpoise distribution is restricted to temperate and sub-arctic (primarily 5-14°C) seas of the Northern Hemisphere. The harbour porpoise is the most commonly recorded cetacean in UK waters, primarily occurring on the continental shelf (DECC, 2009). In coastal waters, they are often encountered close to islands and headlands with strong tidal currents (Ref 10-62; 10-64; 10-44). The seasonal pattern in the southern North Sea appears to be for an early spring peak in numbers in coastal waters, followed by a northward migration towards more offshore waters. Harbour porpoise forage on a range of species including sandeels and gadoids such as whiting and clupeids (herring and sprats) (Ref 10-63; 10-65; 10-62).

*Thames estuary overview*

- 10.4.76 Harbour porpoise were found to be the most abundant cetacean during the aerial surveys of the outer Thames Estuary and southern North Sea undertaken as part of the offshore energy SEA between 2002 and 2006, with 952 records, representing an estimated 1,121 porpoises. Recordings from the aerial surveys obtained unadjusted densities of porpoises of up to 0.9 animals/km<sup>2</sup> (Ref 10-57).

- 10.4.77 The Thames Marine Mammal Sightings Survey 2004-2015 has recorded 241 sightings of harbour porpoise to date. The sightings ranged from the outer estuary at Benfleet and Southend Marshes, Southend-on-Sea to the Isle of Dogs and upstream to Teddington (Ref 10-52; 10-53).

*Silvertown and Greenwich peninsula*

- 10.4.78 Occasional sightings of harbour porpoise have also been recorded within the Silvertown and Greenwich Peninsula area with the species expected to only occur relatively infrequently (Drawing 10-1) (Ref 10-52; 10-53).

## **10.5 Scheme design and mitigation**

- 10.5.1 The following mitigation measures will be considered as part of the ongoing design process alongside the site specific baseline characterisation data:

- the development of a Construction Environment Management Plan (CEMP), an preliminary Code of Construction Practice (CoCP) is included in Volume 3, Appendix 4-1 of the PEIR;
- the application of established industry guidance and protocols through the construction phase;
- the development of a non-native species risk assessment and management plan;
- the size/ type of piles used for the jetty and the associated piling technique (including the possibility of soft start procedures);
- the dredging method that is deployed;
- review of the site specific data (including the contamination data) to inform the detailed waste disposal strategy;
- the use of long bored techniques for the construction of the tunnel;
- timing of the works in relation to the presence of sensitive marine ecology features; and
- monitoring during the marine works.

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## 10.6 Assessment of impacts

### Nature conservation protected areas and species

10.6.1 The importance of the marine ecology of the River Thames is recognised through a number of biodiversity initiatives. The Scheme falls within the boundary of Thames Estuary rMCZ. However, a formal MCZ assessment is not required as designation of the MCZ is currently on hold (Ref 10-4). However, there is a potential for features that are cited within the rMCZ to be affected by the Scheme. Further consideration of the potential impacts on each of the cited features is incorporated within the respective receptor types below. Accordingly, no impact pathways relating to nature conservation receptors have been assessed in this section.

#### Benthic habitats and species

10.6.2 In the absence of site specific data the value of benthic habitats and species has been described as Moderate whilst scoping potential impact pathways for further consideration within the EIA.

10.6.3 The following pathways have been scoped out of requiring further assessment:

- **Noise disturbance (all phases):** During all phases of the marine works there is the potential for noise disturbance to benthic species. Piling, dredging, vessel movements and the dismantling of the jetty will produce underwater noise above background conditions. Very little is known about the hearing capabilities of invertebrates. Some crustacea are able to detect and use sound in ways that are similar to detection and processing of acoustic stimuli in aquatic and terrestrial vertebrates. However, studies have indicated that crustacean species are able to respond to a wide frequency bandwidth, although their sensitivity to underwater sound and vibration is very much lower than fish (Ref 10-66). It is therefore considered unlikely that noise levels would adversely affect the benthic community found in the vicinity of the Scheme. This pathway has therefore been scoped out of the EIA.
- **Water quality during the decommissioning of the jetty:** There is the potential for impacts on benthic species associated with changes in water quality during the decommissioning works. Decommissioning activities may increase suspended sediment concentrations and release toxic contaminants bound in sediments. This can cause changes in a range of water quality parameters including turbidity and

dissolved oxygen level. However, the steel piles supporting the jetty will be cut at bed level and therefore bed disturbance will be negligible. Accidental spillages will be negligible through following established industry guidance and protocols. This pathway has therefore been scoped out of the EIA.

- **Indirect changes in habitat extent and quality during decommissioning:** The potential impact on benthic habitats and species is associated with the resettlement of suspended sediments during dismantling works. The steel piles supporting the jetty will be cut at bed level and therefore bed disturbance will be negligible. The amount of sediment available for deposition is therefore deemed to be small in the context of the Thames Estuary. This pathway has therefore been scoped out of the EIA.

- 10.6.4 The proposed marine works have the potential to affect benthic ecology receptors during construction, operation and removal of the jetty. The potential impact pathways, associated with each of these project stages based on current Scheme understanding, are discussed and assessed below.

*Construction of the jetty and associated works*

Water quality

- 10.6.5 There is the potential for impacts on benthic habitats and species associated with changes in water quality during the construction works. Construction activities (particularly dredging) may increase suspended sediment concentrations (SSC) and release toxic contaminants bound in sediments. This can cause changes in a range of water quality parameters including turbidity and dissolved oxygen level.
- 10.6.6 The type of dredging equipment will be dependent on the bed material encountered and could involve water injection dredging, grab dredging and trailer suction hopper dredging.
- 10.6.7 Increased SSC has the potential to reduce light penetration through the water column, restricting the light availability for photosynthesis in primary producers such as phytoplankton, periphyton and macrophytes. Such primary producers are important sources of food and oxygen, a reduction in their productivity and growth rates can reduce the diffusion of waste products and water quality (Ref 10-68). High SSC may also increase chemical oxygen demand (COD) and encourage the oxidation of organic

matter by bacteria, depressing dissolved oxygen content (Biological Oxygen Demand or BOD).

- 10.6.8 It is acknowledged that there is the potential for elevated contaminant levels in the sediments in the vicinity of the works as a legacy of the historical industrial use of the area. Resuspension of any contaminants contained within the sediment also has the potential to result in adverse ecological effects. Contamination testing of the sediments that will be dredged/ disturbed through the construction of the jetty will be undertaken prior to the works taking place. This will determine the suitability of the material for dredging and inform the potential significance of this pathway for benthic habitats and species.
- 10.6.9 The potential for accidental spillages will be negligible through following established industry guidance and protocols.
- 10.6.10 The significance of these effects will be considered further as part of the final impact assessment taking into account the Scheme design and the results of the hydrodynamic and water quality assessment.
- 10.6.11 Mitigation measures (including the development of a Code of preliminary CoCP, Appendix 4-1 and CEMP) will be incorporated into the Scheme design as required. Monitoring of water quality during the construction works (particularly the dredging) may be required dependent on the outputs of the site specific data and the ongoing water quality assessments. There may also be restrictions with respect to the method of dredging that is permitted.

Indirect changes in habitat extent and quality

- 10.6.12 A number of the construction related activities (including piling and the associated dredge) will result in increased SSC within the water column. This has the potential to result in localised smothering of benthic habitats and species where the material settles out of suspension back onto the seabed.
- 10.6.13 Benthic invertebrates typically live in the top 100 mm of the seabed and must maintain some connection to the sediment-water interface for ventilation and feeding (Ref 10-67). It is this connection that is disturbed by excessive sediment deposition or 'smothering' of benthic invertebrate fauna within sedimentary seabed habitats. This smothering occurs where individuals are unable to migrate through any deposited sediment and their feeding and respiration apparatus become clogged (Ref 10-69).

10.6.14 Resettlement is dependent on the total amount of suspended sediment and physical parameters such as the hydrodynamic regime and properties of the sediment. In turn, the effect of smothering is dependent on resettlement and the species present within the affected area as certain species may be able to withstand burial to a greater extent than others. The potential significance of this effect will be considered further as part of the final impact assessment taking into account the Scheme design and the results of the hydrodynamic and water quality assessments.

10.6.15 Mitigation measures (including the development of a preliminary CoCP, Appendix 4-1 and CoCP and CEMP) will be incorporated into the Scheme design as required. Monitoring of accretion during the construction works may be required dependent on the outputs of the site specific data and the ongoing water quality assessments. There may also be restrictions with respect to the method of dredging that is permitted.

#### Introduction of non-native invasive species during construction

10.6.16 Vessels involved in the construction of the jetty and associated works have the potential to introduce non-native invasive species into the area. Non-native, or invasive, species are described as 'organisms introduced by man into places outside of their natural range of distribution, where they become established and disperse, generating a negative impact on the local ecosystem and species' (International Union for Conservation of Nature (Ref 10-70)). The ecological impacts of such 'biological invasions' are considered to be the second largest threat to biodiversity worldwide, after habitat loss and destruction. In the last few decades marine and freshwater systems have suffered greatly from invasive species as a result of increased global shipping (Ref 10-71).

10.6.17 The most common means of non-native species is through attachment to hulls or presence in ballast water although other means do exist. Construction vessels undertaking work in the Thames therefore have the potential to unintentionally introduce non-native species into the Thames. Non-native species have the potential to alter interactions with existing intertidal and subtidal communities, compete for space and resources with native species, smother native species, consume native pelagic larvae and ultimately result in the loss of prey and refuge for native species.

10.6.18 A number of invasive non-native species are currently present within the Thames, resulting in a high probability that the benthic habitat within the boundary of the proposed Scheme is already inhabited by some invasive non-native species. However, the introduction of new invasive non-native

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species is still a possibility. A risk assessment will be undertaken for the construction phase associated with the marine works to identify measures to minimise the potential for the import of invasive species into the area and minimise the risk of spreading those which are already present. The potential significance of this pathway will therefore be evaluated further once additional Scheme detail is available.

*Operation of the jetty*

Direct loss and/or damage to benthic habitats and species

- 10.6.19 Direct physical loss and/ or damage to the existing benthic habitat will result from the presence of the temporary jetty and the associated dredge. Loss of existing habitat will be limited to the footprint of the deployed piles and any necessary scour protection, while damage is likely to be caused by maintenance dredging activity and disturbance from jack up barge feet.
- 10.6.20 Both subtidal and intertidal benthic habitats are sensitive to direct physical loss and/or damage where permanent or temporary structures are introduced to the seabed (i.e. within the development 'footprint'). The significance of such losses vary on a site-by-site basis in response to differences in the extent and duration of the losses as well as the relative value of the respective habitats and species.
- 10.6.21 For the purposes of the assessment, it is assumed that approximately 20-32 tubular steel piles approximately 600-700mm in diameter will be put in place to support the temporary jetty, resulting in a maximum direct habitat loss of 12.32m<sup>2</sup>. Any additional scour protection that may be required will increase the amount of habitat lost. The spud feet of the jack up barge will also result in additional habitat damage; however this area is expected to be relatively small. In addition, initial dredging will directly impact on an area of approximately 25,700m<sup>2</sup>.
- 10.6.22 Site specific surveys have yet to be undertaken. However, studies in the surrounding area suggest that the benthic habitat within the vicinity of the proposed Scheme will be characterised by low diversity mud (see Section 10.4). Given the current uncertainty surrounding the species present in the area and the amount of habitat to be lost, a more detailed assessment will be required to inform the potential level of significance of this pathway. If required, the works will be designed to avoid important ecological features where feasible.

Indirect changes in habitat extent and quality

- 10.6.23 There is the potential for indirect impacts to benthic habitats and species arising from changes to hydrodynamic and sedimentary transport regimes. This will be in response to the presence of the jetty structure (including the piles) and the change in bathymetry as a result of the dredge. In addition any maintenance dredging activities and ongoing vessel movements have the potential to increase SSC resulting in the potential for localised smothering.
- 10.6.24 Given the likely scale over which these indirect changes will occur the potential for adverse effects on benthic habitats and species is considered to be relatively limited at this stage. The significance of these effects will, however, be considered further as part of the final impact assessment. This will take into account the site specific benthic survey data (once collected) as well as the Scheme design and the results of the hydrodynamic and water quality assessments.

Water quality

- 10.6.25 There is the potential for elevated contaminant levels in the sediments in the vicinity of the works as a legacy of the historical industrial use of the area. It is currently anticipated that some localised maintenance dredging in the berth pocket may be required. Maintenance dredging and vessel movements may have the potential to adversely affect water quality by increasing SSC and potentially releasing toxic contaminants bound in the sediment into the water column. This can cause changes in a range of water quality parameters including turbidity and dissolved oxygen.
- 10.6.26 The potential for accidental spillages will be negligible through following established industry guidance and protocols.
- 10.6.27 The significance of these effects will be considered further as part of the final impact assessment taking into account the Scheme design and the results of the hydrodynamic and water quality assessment. Mitigation measures (including the development of a preliminary CoCP, Appendix 4-1 and CEMP) will also be incorporated into the Scheme design as required. Monitoring of water quality during the maintenance dredging may be required dependent on the outputs of the site specific data and the ongoing water quality assessments. There may also be restrictions with respect to the method of dredging that is permitted.



Introduction of non-native invasive species during operation of the jetty

10.6.28 Vessels that may be involved in the operational phase (including maintenance dredging vessels) have the potential to introduce non-native species into the area. Non-native species have the potential to alter interactions with existing intertidal and subtidal communities, compete for space and resources with native species, smother native species, consume native pelagic larvae and ultimately result in the loss of prey and refuge for native species.

10.6.29 A number of invasive non-native species are currently present within the Thames Estuary, resulting in a high probability that the benthic habitat within the boundary of the proposed Scheme is already inhabited by some invasive non-native species. However, the introduction of new invasive non-native species is still a possibility. A risk assessment will be undertaken identify measures to minimise the potential for the import of invasive species into the area and minimise the risk of spreading those which are already present. The potential significance of this pathway will therefore be evaluated further once additional Scheme detail is available.

Colonisation of new surfaces by invasive non-native species

10.6.30 The introduction of a new surface in the marine environment as a result of the works has the potential to facilitate the encroachment of invasive non-native species. The Scheme will introduce new surfaces into the marine environment in the form of jetty piles and potentially scour protection.

10.6.31 The surface of the piles and/or scour protection has the potential to provide a fresh surface for invasive non-native species to colonise with limited initial competition from indigenous species. Such spread of non-native species could lead to a reduction in population numbers of native species and biodiversity of the region. Given the presence of several invasive non-native species within the Thames, it is highly likely that these structures will be colonised, at least to some degree, by invasive non-native species.

*Removal of the jetty*

Introduction of non-native invasive species when dismantling the jetty

10.6.32 Vessels involved in the dismantling of the jetty have the potential to introduce non-native invasive species into the area. Non-native species have the potential to alter interactions with existing intertidal and subtidal communities, compete for space and resources with native species,

smother native species, consume native pelagic larvae and ultimately result in the loss of prey and refuge for native species.

- 10.6.33 A number of invasive non-native species are currently present within the Thames Estuary, resulting in a high probability that the benthic habitat within the boundary of the proposed Scheme is already inhabited by some invasive non-native species. However the introduction of new invasive non-native species is still a possibility. A risk assessment will be undertaken identify measures to minimise the potential for the import of invasive species into the area and minimise the risk of spreading those which are already present. The potential significance of this pathway will therefore be evaluated further once additional Scheme detail is available.

#### Fish and shellfish

- 10.6.34 The importance of fish that have been recorded within the Vicinity of the Scheme ranges between species. This receptor has therefore been considered to be of High importance on a precautionary basis whilst scoping potential impact pathways for further consideration within the EIA.

- 10.6.35 The following pathways have been scoped out of requiring further assessment:

- **Habitat loss during jetty operation:** The footprint of the proposed works will cover a localised area that only constitutes a very small fraction of the known ranges of local fish populations. Furthermore, very few shellfish species which are only present at very low levels of abundance have been recorded within the vicinity of the proposed jetty. The potential for impacts to fish and shellfish feeding, nursery and spawning habitats has therefore been scoped out of the EIA.
- **Noise disturbance during tunnelling:** The proposed tunnelling works have the potential for noise and vibration from boring activities to impact upon fish. However, fish are not anticipated to be affected by the use of long bored techniques, which involves no marine works. Therefore following agreement from the Environment Agency, noise and vibration impacts during tunnelling has been scoped out of the EIA.
- **Noise disturbance during jetty removal:** Dismantling the jetty and the associated vessel movements are only likely to produce low noise source levels (for a short duration) which would not cause injury and only very mild behavioural responses to fish in the direct vicinity of the

works. The potential noise disturbance impacts to fish and shellfish during jetty removal has therefore been also scoped out of the EIA.

- **Water quality during jetty removal:** The steel piles supporting the jetty will be cut at bed level during the dismantling of the jetty and therefore bed disturbance will be negligible. The potential for accidental spillages will also be negligible during this phase of the project through following established industry guidance and protocols. Therefore, the potential for impacts on fish associated with changes in water quality during jetty removal has also been scoped out.

- 10.6.36 The proposed marine works has the potential to affect fish and shellfish receptors during construction, operation and removal of the jetty. The potential impact pathways, associated with each of these project stages based on current Scheme understanding, are discussed and assessed below.

*Construction of the jetty and associated works*

Noise disturbance

- 10.6.37 Elevated noise levels and vibration underwater during marine construction work can potentially disturb fish by causing physiological damage and/or inducing adverse behavioural reactions. To evaluate the potential effects on fish species it is necessary to understand the character of noise propagation underwater and the potential response of fish species to that noise (Ref 10-72; 10-66).
- 10.6.38 The level of sound at any particular point underwater is a function of several factors including: ground geology, ambient background noise, the proximity to anthropogenic noise sources, the level of sound generated by the source (Source Level, SL) and the attenuation of sound as it propagates away from the source.
- 10.6.39 For the purposes of the assessment, it is assumed that approximately 20-32 tubular steel piles approximately 600-700mm in diameter which will be driven into the ground using piling hammer. The noise level (SL) arising from piling activities is related to the size of the pile involved with larger piles generating greater noise levels. Piling hammer (also referred to as percussive piling or impact piling) is known to generate the highest noise SLs of all piling techniques.
- 10.6.40 Piling work is expected to potentially cause injury effects to fish within the direct vicinity (<10m) of the works with strong behavioural reactions

predicted in the range of hundreds of metres. However, the impact of underwater noise upon fish is dependent on the sensitivity of the species likely to be affected. For example, 'hearing specialists' which include sprat and shad are considered more sensitive to noise than other species such as flatfish or sea bass. Dredging and other construction activities are only expected to cause strong behavioural reactions within a few metres of the source and are considered unlikely to cause injury even at very close range. Based on this initial assessment, noise disturbance impacts have the potential to be significant in the absence of effective mitigation measures.

- 10.6.41 Worst case assumptions will be made as to the likely noise levels that will be generated through the construction phase. This will enable completion of the assessment of noise disturbance on fish. The full noise assessment will be based on the latest statutory guidance as well as established methodologies and criterion including Parvin *et al.*, (2008) (Ref 10-66); FHWG, 2008 (Ref 10-73) and Nedwell *et al.*, (2007) (Ref 10-67).
- 10.6.42 The types of mitigation measures that could be required include restrictions on the type/ size of piles used for the jetty and the associated piling technique (including the possibility of soft start procedures). There could also be timing restrictions to avoid the presence of sensitive features (e.g. migratory species).

#### Water quality

- 10.6.43 There is the potential for impacts on fish and shellfish associated with changes in water quality during construction works. There is the potential for elevated contaminant levels in the sediments in the vicinity of the works as a legacy of the historical industrial use of the area, and construction activities (particularly dredging) may increase SSC and release toxic contaminants bound in sediments. This can cause changes in a range of water quality parameters including turbidity and dissolved oxygen level. These changes in turn have the potential to affect the distribution and health of fish and shellfish species Ref 10-75; Ref 10-76).
- 10.6.44 The type of dredging equipment will be dependent on the bed material encountered and could involve water injection dredging, grab dredging and trailer suction hopper dredging.
- 10.6.45 The potential for accidental spillages will be negligible through following established industry guidance and protocols.

- 10.6.46 The significance of these effects will be considered further as part of the final impact assessment taking into account the Scheme design and the results of the hydrodynamic and water quality assessment.
- 10.6.47 Mitigation measures (including the development of a preliminary CoCP, Appendix 4-1 and CEMP) will be incorporated into the Scheme design as required. Monitoring of water quality during the construction works (particularly the dredging) may be required dependent on the outputs of the site specific data and the ongoing water quality assessments. There may also be restrictions with respect to the method of dredging that is permitted.

#### Entrainment

- 10.6.48 During the dredging of the jetty berth pocket there is the potential for fish, fish eggs and shellfish to be directly taken up by the action of the draghead.
- 10.6.49 The type of dredging equipment which will be used to dredge the berth pocket will be dependent on the bed material encountered and could involve water injection dredging, grab dredging and trailer suction hopper dredging.
- 10.6.50 Fish species are likely to avoid dredging areas during operations in response to noise levels and increased turbidity (Ref 10-77). Furthermore, research has shown that fish entrained in a suction dredger appeared physically undamaged, although a limited number of studies have been undertaken on the subject (Ref 10-78).
- 10.6.51 Few infaunal benthic invertebrates (including shellfish species) are able to escape entrainment. Some individuals may survive entrainment and be returned to the sea in the outwash or during screening although heavily shelled shellfish species such as bivalves, snails and crabs are more likely to be retained within the hopper and therefore would be lost with the cargo (Ref 10-77). However, very few shellfish species which are only present in low numbers have been recorded in the Silvertown and the Greenwich Peninsula area.
- 10.6.52 Based on these factors, the impact on fish and shellfish populations as a result of entrainment is not expected to be significant at this stage. However, the significance of these effects will be considered further as part of the final impact assessment taking into account the Scheme

design and site specific benthic data. Specific mitigation measures are considered unlikely to be required.

*Operation of the jetty*

Noise disturbance

- 10.6.53 During the operational phase of the jetty there is the potential for noise disturbance to fish species as a result of vessel movements and localised maintenance dredging in the berth pocket.
- 10.6.54 Operational vessel noise associated with jetty activity is unlikely to be discernible above ambient levels in the Thames Estuary for fish. However, maintenance dredging is likely to produce noise above background conditions and at levels which have the potential to cause strong behavioural reactions within a few metres of the source and mild behavioural responses over greater distances. Despite this, injury even at very close range is considered unlikely. Based on this initial assessment, noise disturbance impacts have the potential to be significant in the absence of effective mitigation measures.
- 10.6.55 Confirmation of maintenance dredging requirements and vessel movements will enable completion of the assessment of noise disturbance on fish. The full noise assessment will be based on the latest statutory guidance as well as established methodologies and criterion including Parvin *et al.*, (Ref 10-66); 10-73; 10-74).
- 10.6.56 Worst case assumptions will be made as to the likely noise levels that will be generated through the operational phase of the jetty. The full noise assessment will be based on the latest statutory guidance as well as established methodologies and criterion including Parvin *et al.*, (Ref 10-66); 10-66; 10-74).. Specific mitigation measures are considered unlikely to be required.

Water quality

- 10.6.57 There is the potential for impacts on fish and shellfish associated with changes in water quality during jetty operation. Maintenance dredging and vessel movements may increase SSC and release toxic contaminants bound in sediments. This can cause changes in a range of water quality parameters including turbidity and dissolved oxygen level. These changes in turn have the potential to affect the distribution and health of fish and shellfish species (Ref 10-75 10-76).

- 10.6.58 The potential for accidental spillages will be negligible through following established industry guidance and protocols.
- 10.6.59 The significance of these effects will be considered further as part of the final impact assessment taking into account the Scheme design and the results of the hydrodynamic and water quality assessment.
- 10.6.60 Mitigation measures (including the development of a preliminary CoCP, Appendix 4-1 and CEMP) will be incorporated into the Scheme design as required. Monitoring of water quality during the maintenance dredging may be required dependent on the outputs of the site specific data and the ongoing water quality assessments. There may also be restrictions with respect to the method of dredging that is permitted.

#### Entrainment

- 10.6.61 During maintenance dredging there is the potential for fish, fish eggs and shellfish to be directly taken up by the action of the draghead. It is currently anticipated that some localised dredging in the berth pocket may be required.
- 10.6.62 Fish species are likely to avoid dredging areas during operations in response to noise levels and increased turbidity (Ref 10-77). Furthermore, research has shown that fish entrained in a suction dredger appeared physically undamaged, although a limited number of studies have been undertaken on the subject (Ref 10-78).
- 10.6.63 Few infaunal benthic invertebrates (including shellfish species) are able to escape entrainment. Some individuals may survive entrainment and be returned to the sea in the outwash or during screening although heavily shelled shellfish species such as bivalves, snails and crabs are more likely to be retained within the hopper and therefore would be lost with the cargo (Ref 10-77). However, very few shellfish species which are only present in low numbers have been recorded in the Silvertown and the Greenwich Peninsula area.
- 10.6.64 Based on these factors, the impact on fish and shellfish populations as a result of entrainment is not expected to be significant at this stage. However, the significance of these effects will be considered further as part of the final impact assessment taking into account the Scheme design and site specific benthic data. Specific mitigation measures are considered unlikely to be required.

Marine mammals

- 10.6.65 The importance (or value) of marine mammals has been assumed to be High in determining the potential impact pathways that will be considered further within the EIA.
- 10.6.66 The following pathways have been scoped out of requiring further assessment:
- **Loss of habitat during jetty operation:** There is the potential for impacts to marine mammal foraging habitat as a direct result of the proposed jetty and berth dredging footprints and also indirectly arising from changes to hydrodynamic and sedimentary transport regimes. However, habitat loss and change as a result of the works will only constitute a very small fraction of the known foraging ranges of these highly mobile species. The potential for impacts to marine mammal foraging habitat has therefore been scoped out of the EIA.
  - **Collision risk and light/visual disturbance (all phases):** Vessels and other activity in construction, operation and removal of the proposed jetty are unlikely to produce visual and lighting disturbance stimuli which will be discernible above the already high levels of anthropogenic activity in the Thames Estuary. Lighting will be directed away from the river itself where possible, and will be the minimum required for safe operation. Vessels involved in all stages will also mainly stationary or travelling at low speeds making the risk of collision very low. Furthermore, through regular exposure to vessel movements, marine mammals using the Thames area will routinely need to avoid collision and are also expected to be habituated to high levels of disturbance stimuli. Therefore, the associated pathways from collision risk, lighting and visual disturbance have been scoped out of the EIA.
  - **Noise disturbance during jetty removal:** Dismantling the jetty and the associated vessel movements are only likely to produce low noise source levels which would not cause injury and only very mild behavioural responses to marine mammals in the direct vicinity of the works. Noise impacts to marine mammals during jetty removal have therefore been scoped out of the EIA.
  - **Water quality (all phases):** Dredging and other construction and operation activities associated with the proposed jetty may increase SCC and release toxic contaminants bound in sediments. This can cause changes in a range of water quality parameters including



turbidity and dissolved oxygen level. However, these temporary and localised changes in water quality are considered unlikely to produce lethal and sub-lethal effects in these highly mobile species. The steel piles supporting the jetty will be cut at bed level and therefore bed disturbance will also be negligible during jetty removal. The potential for accidental spillages will also be negligible during all phases through following established industry guidance and protocols. Potential water quality impacts on marine mammals have also been scoped out of the EIA.

- 10.6.67 The proposed marine works has the potential to affect marine mammal receptors during construction, operation and removal of the jetty. The potential impact pathways, associated with each of these project stages based on current Scheme understanding, are discussed and assessed below.

*Construction of the jetty and associated works*

Noise disturbance

- 10.6.68 During the construction phase there is the potential for noise disturbance to marine mammal species as a result of the works. Piling, dredging and other construction activities are likely to produce noise above background conditions and at levels which have the potential to cause impacts to marine mammals. This will include the avoidance of high noise levels.
- 10.6.69 The impacts of noise on marine mammals can broadly be split into lethal and physical injury, auditory injury and behavioural response. The possibility exists for lethality and physical damage to occur at very high exposure levels. A permanent threshold shift (PTS) is permanent hearing damage caused by very intensive noise or by prolonged exposure to noise. A temporary threshold shift (TTS) involves a temporary reduction of hearing capability caused by exposure to noise. Noise has also been shown to elicit behavioural responses that could lead to displacement in marine mammals (Ref 10-79).
- 10.6.70 The design of the jetty has not been finalised, however, it is currently understood that approximately 20-30 tubular steel piles approximately 600-700mm in diameter which will be driven into the ground using piling hammer. The noise level (SL) arising from piling activities is related to the size of the pile involved with larger piles generating greater noise levels. Piling hammer (also referred to as percussive piling or impact piling) is

known to generate the highest noise SLs of all techniques during construction.

- 10.6.71 Piling work is expected to potentially cause PTS and TTS in marine mammals within the direct vicinity (<10m) of the works with strong behavioural reactions predicted in the range of several kilometres. However, the impact of underwater noise upon marine mammals is dependent on the sensitivity of the species likely to be affected. Dredging and other construction activities are only expected to cause strong marine mammal behavioural reactions within a few hundred metres of the source and are considered unlikely to cause injury even at very close range. Based on this initial assessment, noise disturbance impacts have the potential to be significant in the absence of effective mitigation measures.
- 10.6.72 Worst case assumptions will be made as to the likely noise levels that will be generated through the construction phase. This will enable completion of the assessment of noise disturbance on marine mammals. The full noise assessment will be based on the latest statutory guidance as well as established methodologies and criterion including Southall *et al.*, (2007) (Ref 10-80) and Nedwell *et al.*, (2007) (Ref 10-74).
- 10.6.73 The types of mitigation measures that could be required include restrictions on the type/ size of piles used for the jetty and the associated piling technique (including the possibility of soft start procedures).

*Operation of the jetty*

Noise disturbance

- 10.6.74 During the operational phase of the jetty there is the potential for noise disturbance to marine mammal species as a result of vessel movements and maintenance dredging of the berth pocket.
- 10.6.75 Operational vessel noise associated with the jetty activity is unlikely to be discernible above ambient levels in the Thames Estuary for marine mammals. However, maintenance dredging is likely to produce noise above background conditions and at levels which have the potential to cause strong behavioural reactions within a few metres of the source and mild behavioural responses over greater distances. Despite this injury even at very close range is considered unlikely.
- 10.6.76 Worst case assumptions will be made as to the likely noise levels that will be generated through the operational phase of the jetty. The full noise assessment will be based on the latest statutory guidance as well as

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established methodologies and criterion including Parvin *et al.*, (2008); (Ref 10-66); FHWG, 2008 (Ref 10-73) and Nedwell *et al.*, (2007) (Ref 10-74)). Specific mitigation measures are considered unlikely to be required.

## **10.7 Cumulative impacts**

- 10.7.1 The marine elements of the Scheme will take place alongside other activities and plans or projects. All activities and plans have the potential to result in additional impacts on the same receptors as those identified from the marine works in a cumulative and/or in-combination impact.
- 10.7.2 This section considers that a cumulative/in-combination assessment needs to take account of the total effects of all pressures acting upon all relevant receptors in seeking to assess the overall cumulative/in-combination significance. Consideration is given to activities and plans or projects where spatial overlaps of the impacts are likely to occur. Additionally, consideration is given to any other activities and plans or projects, including any impacts that do not directly overlap spatially, but may indirectly result in a cumulative/in-combination impact.
- 10.7.3 Projects identified which potentially require further assessment in terms of cumulative effects are listed in Table 10-6. The table also identifies the main pathways by which the plans or projects could impact on marine ecology receptors. The cumulative assessment will also include consideration of ongoing activities and the increasing intensity of river usage by in river services. The final cumulative assessment will take into consideration the methodology and timescales of the relevant proposed plans/ projects alongside those of the marine elements of the Scheme.

**Table 10-6 Cumulative impacts**

<b>Planning Application Reference</b>	<b>Development Summary</b>	<b>Potential Cumulative Effects</b>
<p>PA/13/02966 (Approved: 24 Dec 2014)</p>	<p><b>Wood Wharf, Prestons Road:</b> Outline application (all matters reserved) for mixed-use redevelopment of the site known as 'Wood Wharf' comprising of the demolition of existing buildings and structures, including dwellings at Lovegrove Walk and the erection of buildings, including tall buildings and basements comprising of Residential units (C3), a hotel (C1), Business floorspace (B1), Retail (A1-A5), Community and Leisure (D1 and D2), Sui Generis uses including Conference Centres, Theatres, Laundrettes and Data Centres. Associated infrastructure, including the creation of structures in Blackwall Basin, the Graving Dock, and South Dock. Other works incidental to the proposed development include utilities, streets, open spaces, landscaping, bridge links and parking for cars, motorcycles and bicycles</p>	<p>Marine works as part of the proposed basin reclamation including the use of piling and creation of a cofferdam wall have the potential to impact on marine ecology receptors through a number of pathways including noise disturbance, habitat loss and water quality.</p>
<p>11/00856/OUT (Approved: 30 March 2012)</p>	<p><b>Minoco Wharf, North Woolwich Road:</b> Outline planning application for the comprehensive mixed use redevelopment of the whole site for up to 363,000m<sup>2</sup> (GEA) is sought, comprising: Retail (Use Class A1) not exceeding 3,250m<sup>2</sup> (GEA); Financial and professional services (Use Class A2) not exceeding 750m<sup>2</sup> (GEA); Restaurants and cafes (Use Class A3), Drinking establishments (Use Class A4) and Hot food takeaways (Use Class A5) not exceeding 1,500m<sup>2</sup> (GEA); Business (Use Classes B1(a), (b) and (c)) not exceeding 15,000m<sup>2</sup> (GEA), of which not more than 5,000m<sup>2</sup> (GEA) will</p>	<p>The proposed scheme includes the construction of a temporary jetty. This has the potential to impact on marine ecology receptors through a number of pathways including noise disturbance, habitat loss and water quality.</p>

Planning Application Reference	Development Summary	Potential Cumulative Effects
	<p>be offices (Use Class B1(a); Residential (Use Class C3) up to 329,900m<sup>2</sup> (GEA) and not exceeding 3,385 residential units; Non-residential institutions (Use Class D1) not exceeding 9,600m<sup>2</sup> (GEA); Assembly and leisure (Use Class D2) not exceeding 3,000m<sup>2</sup> (GEA); together with: Demolition of all existing buildings; Vehicular, cycle and pedestrian access from North Woolwich Road; Public realm, public open space and private amenity space</p>	
<p>14/01605/OUT (Pending Decision)</p>	<p><b>Silvertown Quays Bounded By Royal Victoria Dock, Connaught Bridge And Mill Road North Woolwich Road:</b> Outline planning application with all matters reserved except for Access for the redevelopment of the site for mixed use purposes, including the alteration, partial demolition and conversion of the Millennium Mills and the construction of buildings across the site to include Brand buildings (Sui Generis), Residential (Use Class C3), Office (Use Class B1), Retail (Use Classes A1-A5), Leisure (Use Class D2), Education (Use Class D1), Hotels (Use Class C1), other Non-Residential floor space such as community use (Use Class D1), provision of public open space, works of repair and restoration of the Dock walls, infilling and excavation of parts of the Dock area, the placing of structures in, on, or over the Dock area, utilities, construction of estate roads and the creation of new accesses to the public highway, works of landscaping and making good, creation of surface and sub-surface car parking areas</p>	<p>The scheme includes infilling of part of the existing dock and repair of the dock walls. These works have the potential to impact on marine ecology receptors through a number of pathways including noise disturbance, habitat loss and water quality.</p>

Planning Application Reference	Development Summary	Potential Cumulative Effects
<p>13/1773/F (Approved: 16 October 2013)</p>	<p><b>Charlton Barge Yard:</b> Redevelopment of the site in 2 phases. Phase 1: Demolition of jetty and associated infrastructure, office and mess building, provision of new jetty and associated infrastructure, office and welfare accommodation, car park, barge washdown area, replacement river wall and ancillary development. Phase 2: Demolition of dry dock, fabrication building and workshop, provision of new barge, fabrication and tug boat buildings and replacement river wall and ancillary development.</p>	<p>The works associated with the demolition of the existing jetty and provision of new jetty has the potential to impact on marine ecology receptors through a number of pathways including noise disturbance, habitat loss and water quality.</p>
<p>15/0716/O (Approved: September 2015)</p>	<p><b>Land at Greenwich Peninsula to the south of the O2, SE10:</b> Planning permission with all matters reserved for the demolition of buildings and mixed use redevelopment comprising Class C3 (dwellings) use up to 12,678 residential dwellings (or up to 1,171,909sqm) and up to 220 serviced apartments (or up to 20,306sqm); Class A1-A5 use (food and non-food retail, restaurants, bars and cafes) up to 23,475sqm; Class B1(a)(b)(c) (business) up to 59,744sqm; Class C1 (hotel) up to 35,999sqm for up to 500 rooms; Class D1 (education facilities) up to 37,900sqm; Class D1 (health care facilities) up to 1,462sqm; Class D1/D2 (visitor attraction) up to 19,526sqm; sui generis use for Film and media studios up to 38,693sqm; residential and non-residential car parking as well as up to 2000 AEG parking spaces (for the O2); cycle parking; associated community facilities; public realm and open space; hard and soft landscaping; a new transport hub and associated facilities; works to the river wall; a ferry jetty terminal; a 5km</p>	<p>The proposal includes improvements to the river wall and a ferry jetty terminal. These works have the potential to impact on marine ecology receptors through a number of pathways including noise disturbance, habitat loss and water quality.</p>

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<b>Planning Application Reference</b>	<b>Development Summary</b>	<b>Potential Cumulative Effects</b>
	running track traversing the entire site (P5K running track); highway and transport works, including amendments to the Thames Footpath and Cyclepath; and, associated ancillary works.	

## **10.8 Further work to be done**

10.8.1 Following a review of available data, the following additional work will be undertaken to inform the EIA and included in the Environmental Statement (ES):

- **Intertidal ecology survey:** As limited information is available on the distribution of intertidal habitats and species in the direct vicinity of the proposed works a Phase 1 habitat mapping and invertebrate survey will be undertaken.
- **Subtidal ecology survey:** As limited information is available on the distribution of subtidal habitats and species in the direct vicinity of the proposed works a subtidal invertebrate survey will be undertaken.
- **Collection and analysis of sediment contaminant samples:** There is the potential for elevated contaminant levels in the sediments in the vicinity of the proposed Scheme. A sediment contaminant survey will therefore be undertaken.
- **Development of mitigation strategy:** A mitigation strategy will be developed as part of the ongoing assessment process.

10.8.2 It is considered that the volume of existing data and the potential significance of environmental effects on fish and marine mammals are such that they do not necessitate the requirement for dedicated surveys for these receptors,

10.8.3 When the above work has been undertaken the impact assessment will be completed to determine the significance of effects in the ES.

## **10.9 NPS Compliance**

10.9.1 The National Policy Statement (NPS) for National Networks aims to reduce overall biodiversity loss, support healthy well-functioning ecosystems and establish coherent ecological networks.

10.9.2 The existing ecological baseline of the site will be fully evaluated prior to completing the final impact assessment. Full compliance with the NPS will depend on the final Scheme design and the overarching mitigation strategy. The comments/suggestions that are received from statutory consultees will be incorporated into this process.



## 10.10 Summary

10.10.1 The marine elements of the Scheme include recommissioning of the existing NABSA (Not Afloat but Safely Aground) berth facility at the Thames Wharf, or the construction, operation, and decommissioning of a new temporary jetty, along with an associated dredge and the disposal of the dredge arisings.

10.10.2 These elements of the Scheme have the potential for impacts on:

- Nature Conservation Protected Areas and Species;
- Marine ecology- benthic habitat and species (including invasive non-native species);
- Fish and shellfish; and
- Marine mammals.

These include features that are of considered to be of high value and importance.

10.10.3 Impacts could arise through a number of key pathways, including:

- Changes in Water Quality (benthic habitats and species; fish and shellfish);
- Indirect changes in habitat extent and quality (benthic habitats and species);
- The introduction of non-native species (benthic habitats and species);
- Direct loss and/or damage to benthic habitats and species (benthic habitats and species);
- Colonisation of new surfaces by invasive non-native species (benthic habitats and species);
- Noise disturbance (fish and shellfish; marine mammals); and
- Entrainment (fish and shellfish).

10.10.4 The assessment of these potential effects is ongoing, and further work is to be undertaken to inform the assessment. This will include an intertidal ecology survey, subtidal ecology survey, and collection and analysis of sediment contaminant samples.

- 10.10.5 Potential mitigation measures to be considered will include the application of established industry guidance and protocols which will be documented in a preliminary CoCP, Appendix 4-1 and CEMP. A review of site specific data (including contamination data) will inform a detailed waste disposal strategy. The construction techniques (including the dredging, piling and tunnelling methods) that are deployed along with the timing of the works will also be reviewed in the context of the sensitivity of marine ecology features. A non-native species risk assessment and management plan will be developed. In addition there could be a requirement for monitoring during the marine works.

**Table 10-7 Summary of key pathways for further detailed assessment within the Environmental Statement**

Receptor	Key Receptors	Value	Stage	Potentially significant impact pathways	Further Assessment	Potential Mitigation Required
Marine ecology-benthic habitat and species (including invasive non-native species)	Phase 1 habitat survey yet to be undertaken. Currently assumed to be characteristic of surrounding area and include: <ul style="list-style-type: none"> <li>• Intertidal mudflat and sandflat;</li> <li>• Subtidal mud and mixed sediment; and</li> <li>• Supported invertebrate assemblages.</li> </ul>	National importance as recognised in rMCZ and BAP.	Construction	Water Quality	<ul style="list-style-type: none"> <li>• Contamination testing of the sediments that will be disturbed.</li> <li>• Characterisation of benthic habitats and species in the vicinity of the Scheme.</li> <li>• Hydrodynamic and water/sediment quality assessments.</li> </ul>	<ul style="list-style-type: none"> <li>• Waste disposal strategy.</li> <li>• CEMP.</li> <li>• Monitoring during marine works.</li> <li>• Restrictions on the method of dredging that is permitted.</li> </ul>
	The presence of non-native species has been			Indirect changes in habitat extent and quality	<ul style="list-style-type: none"> <li>• Characterisation of benthic habitats and species in the vicinity of the Scheme.</li> </ul>	<ul style="list-style-type: none"> <li>• Waste disposal strategy.</li> <li>• CEMP.</li> <li>• Monitoring during marine works.</li> </ul>

Receptor	Key Receptors	Value	Stage	Potentially significant impact pathways	Further Assessment	Potential Mitigation Required
	recorded in the vicinity of the Scheme.				<ul style="list-style-type: none"> <li>Hydrodynamic and water/sediment quality assessments.</li> </ul>	
The introduction of non-native species				<ul style="list-style-type: none"> <li>Review of potential numbers of vessel movements (and origin/geographic movement of vessels).</li> </ul>	<ul style="list-style-type: none"> <li>Non-native species risk assessment.</li> </ul>	
Operational			Direct loss and/or damage to benthic habitats and species	<ul style="list-style-type: none"> <li>Characterisation of benthic habitats and species in the vicinity of the Scheme.</li> </ul>	<ul style="list-style-type: none"> <li>Avoidance of important ecological features where feasible.</li> </ul>	
			Indirect changes in habitat extent and quality	<ul style="list-style-type: none"> <li>Characterisation of benthic habitats and species in the</li> </ul>	<ul style="list-style-type: none"> <li>CEMP.</li> <li>Monitoring during marine works.</li> </ul>	

Receptor	Key Receptors	Value	Stage	Potentially significant impact pathways	Further Assessment	Potential Mitigation Required
					vicinity of the Scheme. <ul style="list-style-type: none"> <li>Hydrodynamic and water/sediment quality assessments.</li> </ul>	
				Water quality	<ul style="list-style-type: none"> <li>Contamination testing of the sediments that will be disturbed.</li> <li>Characterisation of benthic habitats and species in the vicinity of the Scheme.</li> <li>Hydrodynamic and water/sediment quality assessments.</li> </ul>	<ul style="list-style-type: none"> <li>Waste disposal strategy.</li> <li>CEMP.</li> <li>Monitoring during marine works.</li> <li>Restrictions on the method of dredging that is permitted.</li> </ul>
				The introduction of non-	<ul style="list-style-type: none"> <li>Review of potential numbers of</li> </ul>	<ul style="list-style-type: none"> <li>Non-native species risk assessment.</li> </ul>

Receptor	Key Receptors	Value	Stage	Potentially significant impact pathways	Further Assessment	Potential Mitigation Required
				native species	vessel movements (and origin/ geographic movement of vessels).	
				Colonisation of new surfaces by invasive non-native species	<ul style="list-style-type: none"> <li>• Characterisation of benthic habitats and species in the vicinity of the Scheme.</li> <li>• Consideration of suitability of jetty structures to provide habitat for non-native species.</li> </ul>	<ul style="list-style-type: none"> <li>• Non-native species risk assessment.</li> </ul>
			Decommissioning	The introduction of non-native species via decommissioning	<ul style="list-style-type: none"> <li>• Review of potential numbers of vessel movements (and origin/ geographic</li> </ul>	<ul style="list-style-type: none"> <li>• Non-native species risk assessment.</li> </ul>

Receptor	Key Receptors	Value	Stage	Potentially significant impact pathways	Further Assessment	Potential Mitigation Required
				oning vessels	movement of vessels).	
Fish and shellfish	Range of fish species. Including a number of commercially important and environmentally protected species.	Varying importance depending on species, therefore assumed to be of international importance on a precautionary basis.	Construction	Noise disturbance	<ul style="list-style-type: none"> <li>Underwater noise assessment based on latest statutory guidance and established methodologies.</li> <li>Worst case assumptions will be applied for noise sources levels based on available piling/ dredging techniques.</li> </ul>	<ul style="list-style-type: none"> <li>Restrictions on the type/ size of piles.</li> <li>Soft start procedures.</li> <li>Timing restrictions to avoid sensitive marine features.</li> </ul>
				Water quality	<ul style="list-style-type: none"> <li>Contamination testing of the sediments that will be disturbed.</li> <li>Hydrodynamic and water/sediment</li> </ul>	<ul style="list-style-type: none"> <li>Waste disposal strategy.</li> <li>CEMP.</li> <li>Monitoring during marine works.</li> </ul>

Receptor	Key Receptors	Value	Stage	Potentially significant impact pathways	Further Assessment	Potential Mitigation Required
					quality assessments.	<ul style="list-style-type: none"> <li>Restrictions on the method of dredging that is permitted.</li> </ul>
				Entrainment	<ul style="list-style-type: none"> <li>Characterisation of benthic habitats and species in the vicinity of the Scheme.</li> </ul>	<ul style="list-style-type: none"> <li>Specific mitigation measures are considered unlikely to be required.</li> </ul>
			Operational	Noise disturbance	<ul style="list-style-type: none"> <li>Underwater noise assessment based on latest statutory guidance and established methodologies.</li> <li>Worst case assumptions will be applied for noise sources levels.</li> </ul>	<ul style="list-style-type: none"> <li>Specific mitigation measures are considered unlikely to be required.</li> </ul>



Receptor	Key Receptors	Value	Stage	Potentially significant impact pathways	Further Assessment	Potential Mitigation Required
				Water quality	<ul style="list-style-type: none"> <li>Contamination testing of the sediments that will be disturbed.</li> <li>Hydrodynamic and water/sediment quality assessments.</li> </ul>	<ul style="list-style-type: none"> <li>Waste disposal strategy.</li> <li>CEMP.</li> <li>Monitoring during marine works.</li> <li>Restrictions on the method of dredging that is permitted.</li> </ul>
				Entrainment	<ul style="list-style-type: none"> <li>Characterisation of benthic habitats and species in the vicinity of the Scheme.</li> </ul>	<ul style="list-style-type: none"> <li>Specific mitigation measures are considered unlikely to be required.</li> </ul>
			Decommissioning	N/A	N/A	N/A
Marine mammals	The three most commonly occurring marine mammal species	International importance.	Construction	Noise disturbance	<ul style="list-style-type: none"> <li>Underwater noise assessment based on latest statutory guidance and</li> </ul>	<ul style="list-style-type: none"> <li>Restrictions on the type/ size of piles.</li> <li>Soft start procedures.</li> </ul>

Receptor	Key Receptors	Value	Stage	Potentially significant impact pathways	Further Assessment	Potential Mitigation Required
	in the Thames Estuary include: <ul style="list-style-type: none"> <li>• Common seal;</li> <li>• Grey seal; and</li> <li>• Harbour porpoise</li> </ul>				established methodologies. <ul style="list-style-type: none"> <li>• Worst case assumptions will be applied for noise sources levels based on available piling/dredging techniques.</li> </ul>	
			Operational	Noise disturbance	<ul style="list-style-type: none"> <li>• Underwater noise assessment based on latest statutory guidance and established methodologies.</li> <li>• Worst case assumptions will be applied for noise sources levels.</li> </ul>	<ul style="list-style-type: none"> <li>• Specific mitigation measures are considered unlikely to be required.</li> </ul>
			Decommissioning	N/A	N/A	N/A