Kyleakin Fish Feed Factory

Marine Harvest

Environmental Impact Assessment - Volume 2 of 4: Main Report

Chapter 19: Marine Ecology

Final

May 2017

Contents

19. Marine Ecology

19.1 Introduction

This chapter of the ES addresses the potential impacts on marine ecology and nature conservation as a result of the development.

To inform the assessment of impacts, this chapter provides an overview of the marine ecology in the vicinity of the development. The assessment covers receptors such as European and nationally designated conservation features, marine habitats and their associated communities, fish and marine mammals. Where relevant these receptors will also be subject to a habitats regulations appraisal (HRA) by the appropriate authority.

The assessments carried out within this chapter acknowledge the development activities specific to the marine environment in the construction and operation phase (see **Chapter 2: Project Description**), with particular reference to the assessments and conclusions of **Chapter 16: Navigation**, **Chapter 17: Water Quality**, and also **Chapter 18: Coastal Processes and Geomorphology**. In addition to this, a Report to Inform Appropriate Assessment (RIAA) has been produced to consider the European designated conservation sites and specifically the likelihood of any significant effect on the conservation objectives of these sites (Kyleakin RIAA, 2016). As part of the Marine Licence Application the RIAA has been submitted along with this ES and other supporting documents.

It should be noted that the names Kyle Akin and Kyleakin define slightly different areas. The name Kyle Akin has been used historically to refer to the tideswept channel under and immediately adjacent to the Skye Bridge; whereas Kyleakin is the name of the small town immediately east of the development, on the north coast of Skye. The boundaries of this town also encompass the development area. This terminology has been adopted for this chapter.

Following a formal consultation response from SEPA in January 2017, it was requested that process effluent from the factory be discharged via a long sea outfall (see **section 19.4.1**). In March 2017, following discussions with a number of dredging contactors, it is now anticipated that all dredging would be carried out by backhoe dredger (BHD) (see **Chapter 2**). To facilitate this dredging methodology a temporary jetty is required (**Figure 2.2, Chapter 2**).

To acknowledge the requirement for a marine outfall and the change to dredging methodology, further studies to support the assessments in the ES were carried out. These have included 'initial dilution' modelling (**Appendix 17.1**) and further sediment plume modelling (**Appendix 18.3**).

19.1.1 Structure of Chapter

The structure of this chapter follows the generalised approach of other marine technical chapters and covers:

- Legislation, policy and guidance;
- Methodology;
- Baseline conditions;
- Predicted impacts;
- Mitigation measures;
- Residual impacts; and
- Overview.

19.2 Legislation, Policy and Guidance

An outline is given below of the legislation relevant to the aquatic environment which needs to be acknowledged in the assessment process (**Table 19.1). Chapter 4: Planning Policy Context** provides further information on policies and plans relevant to the development.

Table 19.1 : Legislation, conventions and policies relevant to marine ecology

Conventions and legislation	Brief explanation
International	
The Bern Convention on Conservation of European Wildlife and Natural Habitats 1979	Aims to conserve wild flora and fauna and their natural habitats, in particular endangered and vulnerable species. Effective in the UK through the Wildlife and Countryside Act and Habitats Regulations, it lists sea lamprey *Petromyzon marinus*, river lamprey *Lampetra fluviatilis* and Atlantic salmon (*Salmo salar*) and requires their protection.
The Bonn Convention on Conservation of Migratory Species of Wild Animals 1979	The Bonn Convention aims to achieve the effective management of migratory species across national or jurisdictional boundaries and is implemented in the UK by the Environmental Protection Act 1990.
The Convention on Biological Diversity (CBD)	The CBD was adopted at the Earth Summit in Rio de Janeiro, Brazil in June 1992, and entered into force in December 1993. It was the first treaty to provide a legal framework for biodiversity conservation, with three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits arising from the use of genetic resources. Contracting Parties are required to create and enforce national strategies and action plans to conserve, protect and enhance biological diversity. The UK government ratified the Convention and published the UK Biodiversity Action Plan (UK BAP) in 1994, and to complement the UK BAP, separate biodiversity strategies for each of the devolved governments have been subsequently launched including the Scottish Biodiversity strategy, launched in 2004.
The Convention for the Protection of the Marine Environment of the North East Atlantic (OSPAR)	Annex V of the convention provides a framework for contracting parties 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*.'
The Habitats Directive (92/43/EEC)	The European Union Directive (92/43/EEC) on the Conservation of natural habitats and of wild fauna and flora (EC Habitats Directive) is the means by which the Community meets its obligations as a signatory of the Convention on the Conservation of European Wildlife and Natural Habitats (Bern Convention). The Directive introduces a range of measures including the protection and surveillance of habitats and species. The main aim of the Directive is to promote the maintenance of biodiversity by requiring Member States to take measures to maintain or restore natural habitats and wild species at a favourable conservation status, introducing robust protection for those habitats and species of European importance. The habitats listed in Annex I of the Directive and the species listed in Annex II, are to be protected by means of a network of sites. Each Member State is required to prepare and propose a national list of sites for evaluation in order to form a European network of Sites of Community Importance (SCIs). Once adopted, these are designated by Member States as Special Areas of Conservation (SACs), and along with Special Protection Areas (SPAs) classified under the Birds Directive, form a network of protected areas known as Natura 2000.
The Birds Directive (79/409/EEC)	The European Union Directive on the Conservation of wild birds (79/409/EEC) was adopted in 1979. The Birds Directive is a primary tool for delivering EU obligations under the Convention on Biological Diversity (CBD), the Ramsar and Bonn Conventions. The Birds and Habitats Directives require Member States to take a number of measures/actions in order to protect all bird species, their sites and their habitats, these include: measures to conserve and maintain all naturally occurring bird species across the EU through the designation of SPAs for species listed on Annex I of the Directive and migratory species.
Ramsar Convention	The Convention on Wetlands of International Importance especially as Waterfowl Habitat (Ramsar Convention or Wetlands Convention) was adopted in Ramsar, Iran in February 1971 and entered into force in December 1975. The Convention covers all aspects of wetland conservation and comprises three elements of activity: the designation of wetlands of international importance as Ramsar sites; the promotion of the wise use of all wetlands in the territory of each country; and international co-operation with other countries to further the wise use of wetlands and their resources.

Conventions and legislation	Brief explanation
Water Framework Directive (2000/60/EC) (WFD)	The WFD was transposed into Scottish domestic law under the Water Environment and Water Services (Scotland) Act 2003 (WEWS). The WFD introduced a system of river basin management planning to protected rivers, estuaries, coastal and groundwater and set targets for waterbodies to achieve Good Ecological Status.
European Eel (Council Regulation (EC) No 1100/2007 establishing measures for the recovery of the stock of European eel)	In response to the decline of European eel the EU proposed an Eel Management Plan in 2004 which entered into force in 2007. The aim of the plan is to protect and ensure the sustainable use of European eel stocks. A key objective is to ensure that at least 40% of the potential production of adult European eel (potential production refers to pristine conditions) escape to the sea. Under the resulting Council Regulation each Member State is required to create separate management plans for each river basin district Natura 2000.
Agreement on the Conservation of Small Cetaceans of the Baltic and North Seas (ASCOBANS)	ASCOBANS was concluded in 1991 under the Bonn Convention and entered into force in 1994. The agreement offers protection of all species and subspecies of the Odontoceti with the exception of the sperm whale (ASCOBANS, 2008) through the signing of parties to set up protected areas, promote research, control pollution and increase public awareness). The Agreement originally only covered the North and Baltic Sea but as of 3rd February 2008 the area has been extended to include the marine environment of the Baltic and North Seas and contiguous areas of the northeast Atlantic. Ten countries have so far become Parties to the Agreement, including the UK.
National	
The Wildlife and Countryside Act 1981 (WCA) as amended	The WCA 1981 (as amended) is the principal mechanism for wildlife protection in the UK, originally aimed at consolidating and amending previous legislation to implement the requirements of the Bern Convention and the Birds Directive. Of particular relevance is Schedule 1, which lists birds afforded special protection, Schedules 4-6, which protect various wild animal species from injury, killing or disturbance, and Schedule 8, which confers protection to certain plant species. The statutory designation of Sites of Special Scientific Interest (SSSI) is the main site protection measure in the UK established under the WCA.
UK Marine and Coastal Access Act 2009	The Act provides Scottish Ministers with a framework for sustainable management of Scottish marine waters. It enables designation of Marine Protection Areas (MPAs) in Scottish offshore waters (more than 12 nautical miles from the coast)
Marine (Scotland) Act 2010	The Act makes provisions in relation to functions and activities in the Scottish marine area, including marine plans, licensing of marine activities (such as dredging), the protection of the area and its wildlife including seals, and connected purposes. Marine Scotland was formed to act as a statutory advisor and regulator for the legislation introduced by the Act. As a result of the Act, a Scottish National Marine Plan was published in 2015 **(see Chapter 4**). Within the Plan recognition is given to Scottish natural heritage and how this should be acknowledged by developers, marine planners and decision makers.
Wildlife and Natural Environment (Scotland) Act 2011	This Act received Royal Assent on 7th April 2011 and applies to Scotland only. It updates legislation protecting Scottish wildlife and ensures legislation which regulates and manages the natural environment is fit for purpose. In particular, this Act brings in new provisions governing the introduction of non-native species in Scotland.
Coastal Protection Act (CPA) 1949	This Act sets out the legislative framework for the protection of the coastline against erosion. Consent is required under this Act for any construction, alteration or improvement of any works on, under or over any part of the seashore lying below mean high water spring tide level (MHWS) or the deposit or removal on any object or materials below the levels of MHWS.
Conservation of Habitats and Species Regulations 2010	For any European Protected Species (EPS), Part 3 of the Conservation of Habitats and Species Regulations 2010 makes it an offence to deliberately capture, kill, injure, or disturb any such animal. An EPS Licence is required for any activity that might result in injury to, or disturbance of, an EPS. Deliberate harm to any EPS is not anticipated as part of the development activities; however, inadvertent or accidental disturbance may occur if project activities take place in the presence of an EPS.

Conventions and legislation	Brief explanation
Conservation (Natural Habitats, & c.) Regulations 1994 as amended	These Regulations place a duty on planning authorities to meet the requirements of the Habitats Directive, and to provide protection for priority habitats and species listed in the Habitats Directive outside of protected areas. These Regulations are more onerous in Scotland than in the rest of the UK. Under these regulations, in Scotland it is an offence to knowingly cause or permit to be done an act which is unlawful under Regulation 39 of the act (animals), to deliberately or recklessly harass a wild animal or group of wild animals, to deliberately or recklessly disturb a European protected species (EPS) whilst it is rearing or caring for young, or to knowingly cause or permit to be done an act which is made unlawful by Regulation 43 (plants).
Nature Conservation (Scotland) Act 2004	This Act requires Scottish Ministers to publish a list of habitats and species considered to be of principal importance for biodiversity. This list, the Scottish Biodiversity List, was subsequently published in 2005 and is intended to be a tool for public bodies and others doing their Biodiversity Duty and as an important source of information and guidance for all. The Act has three parts; • Part 1 promotes the conservation of biodiversity whereby all Scottish public bodies and office holders will be obliged to 'further the conservation of biodiversity' in the course of exercising their functions; • Part 2 revises the designation of the SSSI system for protecting Scotland's most precious natural places; and • Part 3 enhances the existing species protection provisions of the WCA 1981, as amended by adding the word 'recklessly' to legislation regarding killing, injury or disturbance of protected species so that 'intent' no longer needs to be proven.
Conservation of Seals Act 1970	This Act prohibits the killing, harming or taking of pinnipeds by certain methods and during closed seasons. The annual closed season for the grey seal (*Halichoerus grypus*) extends from the 1st September to the 31st December inclusive. The annual closed season for the common seal (*Phoca vitulina*) extends from 1st June to the 31st August inclusive.
The Conservation of Seals (Scotland) Order 2004 and 2007	In response to local declines in common seal numbers, the Scottish Government introduced conservation orders under the Conservation of Seals Act 1970 to provide additional protection on a precautionary basis for vulnerable local populations of common seals. In September 2004, the Conservation of Seals (Scotland) Order 2004 to cover common and grey seals in the Moray Firth, and in March 2007, the Conservation of Seals (Scotland) Order 2007 to cover common seals only in the Northern Isles and Firth of Tay. The Marine (Scotland) Act 2010 introduces provisions for existing orders to continue, and for new ones to be introduced administratively as Seal Conservation Areas. The repeal of the Conservation of Seals Act 1970 on 31st January 2011 meant that the existing orders would cease if not replaced by Seal Conservation Areas. The Scottish Government has continued to use these orders in the form of Seal Conservation Areas since 1st February 2010.
The Protection of Seals (Designation of Seal haul-Out Sites) (Scotland) Order 2014	From 30th September 2014 it became an offense to "recklessly or intentionally harass" seals at 194 haul outs around Scotland Under Part 6 of the Marine (Scotland) Act 2010. The nearest haul out site to the development is in the west Scotland (central) seal management area, at WSC-002 (Pabay and Ardnish Peninsula) approximately 5 km from the development.
Water Environment and Water Services (Scotland) Act 2003 (WEWS)	The WEWS implements the WFD in Scotland. The WFD recognises that ecosystem health is the most effective way to assess the environmental quality of water bodies. Under the WFD, the ecological status of watercourses is therefore now the focus of river management and impact assessment.
Regional Planning Policy	Refer to **Chapter 4** for information on planning policies.

Specific acknowledgment is given to the policies described in the Scottish National Marine Plan (Marine Scotland, 2015) (Ref 19-1), in particular GEN 9 '*Natural heritage'* which states '*Development and use of the marine environment must: (a) Comply with legal requirements for protected areas and protected species. (b) Not result in significant impact on the national status of Priority Marine Features. (c) Protect and, where appropriate, enhance the health of the marine area.*'

19.2.1 Guidance

The EIA Report, and specifically the marine ecology assessment, has acknowledged guidance from a number of sources including:

- GB Non-Native Species Secretariat (NNSS) (Available on-line at: http://www.nonnativespecies.org/index.cfm?sectionid=22. Accessed Nov 2016).
- Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester (CIEEM, 2016) (Ref 19-2).
- Institute for Ecology and Environmental Management (IEEM) Guidelines for Ecological Impact Assessment in Britain and Ireland (Marine and Coastal) (IEEM, 2010) (Ref 19-3).
- Marine Scotland – The Protection of Marine European Protected Species from Injury and Disturbance – Guidance for Inshore Waters (Marine Scotland, 2014) (Ref 19-4).
- Scottish Natural Heritage, Advice on Marine Non-Native Species (Available on-line at: http://www.snh.gov.uk/land-and-sea/managing-coasts-and-sea/marine-nonnatives/. Accessed Nov 2016.
- Scottish Natural Heritage, Advice on Marine Planning, including management of Marine Protected Areas (Available on-line at: http://www.snh.gov.uk/planning-and-development/marine-planning/. Accessed Nov 2016).
- In addition to these documents, consideration have been given to the following non-statutory guidance:

Guidance	Brief explanation
Scottish Biodiversity List	The Scottish Biodiversity List (SBL) is a list of species and habitats that Scottish Ministers consider to be of principal importance for biodiversity conservation in Scotland. The Scottish Biodiversity List was published in 2005 to satisfy the requirement under Section 2(4) of The Nature Conservation (Scotland) Act 2004. Species and habitats are listed under Part 1 section 2(4) of the Nature Conservation (Scotland) Act 2004. The list contains 156 marine species and 20 marine habitats.
Scottish Priority Marine Features	The Scottish Marine Nature Conservation Strategy (2011) proposes a system of 'Priority Marine Features' to guide the identification of Marine Protected Areas (MPAs) and provide focus for marine planning and other activities. The strategy recognises the need to improve our understanding of these special features, which will be protected by a range of mechanisms, including licensing and planning. Knowing where Priority Marine Features (PMFs) are located, and how sensitive they are, will promote better integration between marine activities and important wildlife. On 24 July 2014 the Scottish Cabinet Secretary made an announcement on the adoption of the PMF list. The list contains 81 marine habitats and species considered to be of conservation importance in Scotland's seas. In Scotland's National Marine Plan 2015 (Ref 19-1) it is stated that '*impacts of development and use on the national status of Priority Marine Features must be considered when decisions are being made, taking account of the advice of Statutory Advisors. Where planned developments or use have potential to impact PMFs, mitigation, including alternative locations, should be considered. Actions should be taken to enhance the status of PMFs where appropriate.*'

19.3 Methodology

The assessment has been undertaken through:

- consultation;
- application and cognisance of appropriate legislation;
- interpretation of baseline data (including marine sediment analysis and dilution modelling (**Chapter 17)**, and consideration of hydrodynamic and sediment plume modelling (**Chapter 18**);
- review of scientific literature;
- use of relevant websites; and
- the use of professional judgement.

The principles and approach of the Chartered Institute of Ecology and Environmental Management guidance (Ref 19-2) have been acknowledged and standard impact assessment terms have been used, where appropriate, to provide consistency with the other assessments in this ES.

The assessment will use the following sequence of tasks:

- identification of ecological receptors;
- highlighting key attributes of the receptor;
- evaluation of receptor importance;
- outlining the legal protection given to the receptor;
- identification of pathways by which activities in the proposal that may impact on the receptors;
- characterisation of the potential impacts;
- assessing the significance of the impact to a receptor;
- outlining the proposed mitigation measures; and
- assessing the residual impacts of the proposal.

In making this assessment, the ecological feature (receptor) is defined as the habitat, species or ecosystem within the receiving environment that may be influenced by the change. The impact represents the actions resulting in changes to an ecological receptor.

An assessment of impact significance is carried out by first determining the baseline conditions and value/sensitivity (importance) of the receptor, followed by identifying the magnitude of change on the receptor; the impact significance being a combination of these variables.

The importance of an ecological receptor is considered within a defined geographical context (e.g. international, national, regional, authority area and local) and based on conservation designations (**Table 19.2**). Particular consideration is given to the contribution of the receptor to biodiversity, its rarity and the sensitivity of receptors to change. Where available and relevant, information derived from the Marine Life Network website (MarLIN) and the Feature Activity Sensitivity Tool (FEAST) (Scottish Government) (FEAST 2016) (Ref 19-5) have been used to understand the sensitivity of receptors.

The Scottish Biodiversity List (SBL) is used as a guide for decision-makers, such as public bodies, in implementing their duty “to have regard” to the conservation of biodiversity in all their activities. Furthermore, the Priority Marine Feature (PMF) list (as adopted by Scotland in 2014) contains a number of species and habitats identified as having conservation importance in Scottish waters. The SBL and PMF list are referred to in both the medium and high importance categories (**Table 19.2),** as when assigning importance it is necessary to consider a number of factors in relation to a given receptor, including geographical context, rarity, capacity to accommodate change and, where relevant, its contribution to biodiversity. Consequently, professional judgement has been incorporated throughout this process.

Table 19.2 : Guidelines used to assign importance of marine ecological features (receptors)

Importance	Value and Sensitivity Criteria
High	**Value** Ecological feature/receptor possesses characteristics that contribute considerably to the distinctiveness, rarity and character of the site/receptor e.g. designated features of international/national designation/importance e.g. Ramsar, SAC, SSSI, SPA, Nature Conservation Marine Protected Area (MPA). Ecological feature/receptor possesses important biodiversity, social/community and/or economic value e.g. European Protected Species (EPS), Priority Marine Feature (PMF) or is found on the Scottish Biodiversity List (SBL). Ecological feature/receptor is rarely recorded. **Sensitivity** Receptor identified as having a low capacity to adapt to, or recover from, proposed form of change i.e. highly sensitive to change.
Medium	**Value** Ecological feature/receptor possesses characteristics that contribute considerably to the distinctiveness, rarity and character of the site/receptor at the regional and authority area level e.g. designated features of regional/authority area designation/importance e.g. Local Nature Reserves (LNR), Sites of Interest for Nature Conservation (SINC) and District Wildlife Sites (DWS). Ecological feature/receptor possesses biodiversity, social/community and/or economic value e.g. PMF or is found on the SBL. Ecological feature/receptor is occasionally recorded. **Sensitivity** Receptor is identified as having moderate capacity to accommodate proposed form of change i.e. is moderately sensitive.
Low	**Value** Ecological feature/receptor may possess characteristics which are of local importance e.g. saltmarsh. Feature/receptor not designated or only designated at the district or local level e.g. Scottish Wildlife Trust reserves. Ecological feature/receptor does not add to biodiversity, social/community and/or economic value or adds at a local level only e.g. listed on Local BAP. Ecological feature/receptor is commonly recorded. **Sensitivity** Feature/ receptor considered as generally tolerant to the potential biophysical changes identified i.e. of low or slight sensitivity.

19.3.1 Identification of Impacts

The activities that could have a potential impact on a marine ecological receptor were reviewed and assessed. Professional judgement was used to identify those activities associated with the development that could potentially impact on a marine ecological receptor.

A list of potential activities of concern (**Table 19.3**) was derived from a review of the likely construction and operational activities of the development given in **Chapter 2: Project Description.** In addition to the potential impacts the table also provides the impact pathway and likely receptor(s). The potential impacts provided here have been assessed in **section 19.5**.

Table 19.3 : Construction and operation activities, their impact pathways and a description of the potential impacts on marine receptors.

Activity	Impact Pathway	Receptor	Description of Potential Impact
Construction			
Capital Dredging	Seabed disturbance (removal).	Habitats and species	Removal of seabed causing habitat loss and fragmentation.
	Increased sediment load.	Habitats and species	Temporary increase in suspended sediment reducing light, smothering, clogging gills etc.
			Temporary increases in sediment deposition leading to smothering/burial.
	Release of sediment-bound contaminants.	Species	Water quality changes, increased bioavailability of sediment contaminants, potential impairment to individuals / populations.
Piling	Increased levels of underwater noise/vibration.	Species	Potential for injury and disturbance to fauna.
General construction activities	Seabed disturbance (including construction of long sea outfall and temporary jetty).	Habitats and species	Removal/disturbance of seabed causing habitat loss and fragmentation.
	Accidental spills chemicals, oil and fuels into marine environment.	Habitats and species	Water quality changes, potential physiological harm to flora and fauna..
	Light pollution.	Species	Disturbance to fauna, potential avoidance.
Vessel movements	Disturbance of seabed by propellers and/or anchoring of vessels.	Habitats and species	Damage/loss to benthic habitats from scour or anchor placement.
	Introduction of INNS (ballast water and hull attachment)	Habitats and species	Changes to local biodiversity. Displacement of native organisms.
	Propeller impact on fauna.	Species	Injuries to marine mammals.
Operation			
New infrastructure and changes to seabed topography	Effects on coastal processes.	Habitats and species	Localised alterations to habitats from changes in tidal flow, wave climate and sediment transport.
	Footprint of development.	Habitats and species	Loss of seabed habitat.
	Colonisation	Habitats and species	Introduction of new seabed habitat. Changes in local biodiversity. Exploitation of new habitat by INNS.
Vessel movements	Disturbance of seabed by propellers and/or anchoring of vessels.	Habitats and species	Damage/loss to benthic habitats from scour or anchor placement.
	Introduction of INNS (ballast water and hull attachment).	Habitats and species	Changes to local biodiversity. Displacement of native organisms.
	Propeller impact on fauna.	Species	Injuries to marine mammals.
General operation activities	Accidental spills of chemicals, oil and fuels into marine environment.	Habitats and species	Water quality changes, localised changes to seabed habitat. Physiological effects on flora and fauna.

Activity	Impact Pathway	Receptor	Description of Potential Impact
	Operation discharge (long sea outfall) and FW runoff.	Habitats and species	Water quality changes, localised changes to seabed habitat. Physiological effects on flora and fauna.
Maintenance dredging	Seabed disturbance (removal).	Habitats and species	Removal of seabed causing habitat loss and fragmentation.
	Increased sediment load.	Habitats and species	Temporary increase in suspended sediment reducing light, smothering, clogging gills etc.
			Temporary increases in sediment deposition leading to smothering/burial.

Detail on the potential impacts with specific reference to their effects on the marine ecological receptors of concern, is given in **section 19.5**.

19.3.2 Magnitude of Change

For the purposes of this assessment, the term magnitude of change is taken to represent the overall characterisation of positive or negative impacts in accordance with CIEEM guidance (Ref 19-2, Ref 19-3) including:

- likelihood of occurrence (certain / near certain, probable, unlikely or extremely unlikely);
- direct or indirect impact;
- geographical extent;
- size of impact (if different from extent);
- duration (short-term, medium term, long term or permanent);
- reversibility; and
- frequency (single event, recurring or constant).

For potential impacts on marine ecological receptors, duration is considered as short-term (<1 year); medium term (1 – 5 years); long term (>5 years or permanent).

The criteria used to assign magnitude of change to an ecological receptor are shown in **Table 19.4** as negligible, small, medium or large, taking into account the CIEEM characterisation approach, as listed above. As noted with value/sensitivity (above), it is important to consider all criteria, against magnitude of change, upon any given receptor when assigning the category (high, medium, low and negligible). In this regard, professional judgement has been incorporated.

Table 19.4 : Criteria used to assign magnitude of change to a marine ecological receptor.

Magnitude of change	Criteria
High	The activity is likely to permanently affect the integrity of a receptor in terms of the coherence of its ecological structure and function to the ecosystem; and affect the conservation status and/or objectives of a receptor. The receptor is degraded to the extent that populations and/or habitats are destroyed or sensitive lifestages are affected. Receptors experience continuous, irreversible, long-term change. The receptor has low capacity to adapt to change. Recovery, if it occurs, would be expected to be long-term, i.e. >5 years after the source of impact has been removed. Impacts not limited to areas proximal and adjacent to the development, with impacts possibly detectable beyond the study area.

Magnitude of change	Criteria
Medium	The activity is not likely to permanently affect the integrity of a receptor, but may be substantial in terms of its affect on ecological structure and function and may affect the conservation status and/or objectives of a receptor. The receptor is degraded to the extent that populations and/or habitats experience reduction in number or range in the medium to short-term. Receptors experience regular intermittent change which may affect sensitive lifestages. The receptor has medium capacity to adapt to change. Recovery would be expected to occur in the medium-term, i.e. 1 - 5 years after the source of impact has been removed. Impacts generally limited to areas proximal and/or adjacent to the development.
Small	The activity would not permanently affect the integrity of the receptor, but receptors may experience some limited degradation. Disturbance is detectable but experienced within the range of natural variability in the medium to short-term. Receptors experience intermittent irregular change and sensitive lifestages are not affected. The receptor has high capacity to adapt to change. Recovery would be expected to occur in the short-term, i.e. <1 year after the source of impact has been removed. Impacts limited to area proximal to development.
Negligible	The activity would not permanently affect the integrity of the receptor and there would be little or no degradation. The change to baseline conditions is not detectable. Disturbance is experienced within the range of natural variability in the short-term. Receptors experience occasional change and sensitive lifestages are not affected. The receptor has very high capacity to adapt to change. Recovery would be expected relatively quickly, i.e. less than six months after the source of impact has been removed. Impacts limited to area proximal to development.

19.3.3 Impact Significance

The level of significance of a potential impact is determined as a function of the value/sensitivity (importance) assigned to the marine ecological receptor and the magnitude of change. Adoption of the matrix presented in **Chapter 17 (Table 17.3**) is used to determine the impact significance, with the definitions assigned to significance reflecting those provided in **Table 17.4**.

Although professional judgement is the principal factor in determining which effects would be significant, the assessment is guided by the methodology outlined above. Impacts described during the assessment should be considered adverse unless stated otherwise.

19.3.4 Mitigation and Residual Impacts

Mitigation measures seek to avoid, prevent or reduce significant adverse impacts. The assessment of effects have been made based on embedded mitigation having been applied, i.e. measures put in place at the design stage, such as use of modelling outputs, adhering to best practice and by following best available technologies (BAT). After adverse impacts were identified, additional mitigation was proposed following a hierarchical approach and to meet the requirements outlined in the Environmental Impact Assessment (Scotland) Regulations (1999) which require '*a description of the measures envisaged to prevent, reduce and where possible offset any significant adverse effects on the environment'* to be provided. In some cases, compensation may also be required, for example, habitat creation to offset local, site-specific impacts associated with habitat loss and fragmentation.

Specific mitigation was developed where generic mitigation would be inappropriate, ineffective or insufficient. Where there remained a significant residual impact on the ecological receptors after mitigation, the details are given in **section 19.8.**

19.3.5 Study Area

The study areas for the components assessed were identified based on the distribution of potential receptors and the likely area of impact associated with a given activity from the development, either in the construction or operation phase.

CIEEM guidance suggests that the zone(s) of influence for the activities is considered (Ref 19-2). The zone of influence is the area over which ecological features may be subject to significant effects as a result of the development, or a specific activity from the development. For the purposes of this chapter the various study areas represent an area that covers, at least, the likely zone of influence for significant effects on the specific marine ecological receptor identified.

19.3.6 Scope of the Assessment

The receptors that have been considered in this assessment include designated sites (SAC, cSAC and MPA), seabed habitats and their communities, fish populations (including diadromous species) and marine mammals. Due to the proximity of several designated and proposed conservation areas to the development, these have been assessed in their own right against their conservation objectives (as requested by SNH, see **Appendix 1.1).** Consequently consideration of these objectives is given, specifically the qualifying and protected features of these sites, and the potential for direct or indirect impacts on these features from the development in either the construction or operation phase.

Scoping and consultation have been on-going throughout the development of the EIA, ensuring that the scope of the baseline characterisation work and ecological impact assessment have been appropriate to the development and the requirements of the regulators and their advisors.

Acknowledging the comments made in the Scoping Opinion (**Appendix 1.1**) a list of identified marine receptors was put forward to Marine Scotland Science, Scottish Natural Heritage, Highland Council and Scottish Environment Protection Agency prior to a meeting on the 26th July 2016. During and subsequent to the meeting and following a number of defined desk studies and additional baseline survey work, no further marine receptors were identified.

19.4 Baseline Conditions

To fully understand the baseline environment in relation to the marine ecological receptors, a combination of literature review, targeted baseline surveys, consultation and data provision from a range of consultees, has been used. The subsequent information gathered has been disseminated within this section to provide a comprehensive account of the marine ecological receptors. However, where relevant, reference is given to either focussed reports, specific to the area, or more generic scientific literature.

Much of the baseline survey work in relation to the seabed under the footprint of the development (including dredging works), was carried out by WA Marine and Environment in January 2016 and August 2016. Data from these two surveys have been amalgamated into a single technical report (**Appendix 19.1)**, which includes further information on benthic ecology and greater detail on the proximal marine habitats, communities and designated features. Characterisation of the seabed has used these surveys and also the results and observations from the sediment investigative studies (see **Chapter 17**).

Some of the key reference literature, scientific research and consultations acknowledged for the baseline work and assessment process include:

- Scottish Natural Heritage (SNH) – protected site citations; Scottish Priority Marine Feature list
- Scottish Biodiversity List (SBL)
- Joint Nature Conservation Committee (JNCC) – protected site citations; biotope descriptions
- Marine Life Information Network (MarLIN) – habitat and species sensitivity
- Feature Activity Sensitivity Tool (FEAST) (Scottish Government) (Ref 19-5)
- Marine Scotland Licensing Operations Team (MS-LOT) (June, 2016) – EIA Scoping Opinion (Feed Mill Facility) Allt Anavig Quarry, Kyleakin, Isle of Skye (**Appendix 1.1**)

- Benthic ecology baseline surveys (**Appendix 19.1**)
- Aspect Land & Hydrographic Surveys Ltd (2016) Kyleakin Geotechnical Survey (**Appendix 18.2**)
- Scottish Government (Marine Directorate, Sea Fisheries Management Division)
- Highland Biological Records Group (HBRG) (HBRG, 2016) (Ref 19-6) – designated species sightings data
- Sea Watch Foundation (SWF) (2016) Report on cetaceans in the Firth of Forth, 2016 (**Appendix 19.2**).
- Broad scale survey and mapping of the sea bed and shore habitats and biota: Lochs Duich, Long and Alsh pSAC. Scottish Natural Heritage Commissioned Report F97PA05 (Entec, 2000) (Ref 19-7).
- Site condition monitoring: surveys of biogenic and rocky reefs in the Lochs Duich, Long and Alsh cSAC (Emu Ltd., 2006) (Ref 19-8).
- The distribution and condition of selected MPA search features within Lochs Alsh, Duich, Creran and Fyne (Moore *et al*., 2013) (Ref 19-9).
- Infaunal and PSA analyses of benthic samples collected from Loch Alsh, in March 2014 (Allen, 2014) (Ref 19-10).
- Biological analyses of underwater video from research cruises in marine protected areas and renewable energy locations around Scotland in 2014 (Moore, 2015) (Ref 19-11).
- Trends in Adult Return and Abundance Indicators for Scottish Salmon and Sea Trout Stocks 2015 (MSS, 2016) (Ref 19-12).
- Review of migratory routes and behaviour of Atlantic salmon, sea trout and European eel in Scotland's coastal environment: implications for the development of marine renewables (Malcolm *et al.* 2010) (Ref 19-13).
- Skye Fisheries Management Plan (Skye Fisheries Trust, 2010) (Ref 19-14).

19.4.1 Key Consultation Considerations

Within the Scoping Opinions received (see **Chapter 3: Development Design and Alternatives**; **Appendix 1.1)** were a number of comments in relation to the consideration of marine ecological features.

Since receiving the Scoping Opinion on the 27th June 2016 further discussions have taken place with Marine Scotland - Licencing Operations Team (MS-LOT), Marine Scotland Science (MSS), Scottish Natural Heritage (SNH), Scottish Environment Protection Agency (SEPA) and Highland Council (HC). Key to these discussions was a meeting facilitated by SNH that took place on 26th July 2016 at Great Glen House. This meeting was attended by Marine Harvest, Jacobs, Wallace Stone, MS-LOT, SEPA, HC and SNH.

During the meeting proposals were put forward on the marine ecological assessment process for the development. These included:

- Baseline work - carried out and proposed;
- A list of key marine features for assessment;
- Consideration of benthic features beyond the confirmed presence by baseline; and
- Assessment methodology (**see section 19.3**).

Following discussion of these proposals general acknowledgment and agreement of the outcomes was given by all attendees; however, further correspondence with the attendees resulted in a number of advisory points, delivered as emails, from SNH and SEPA, particularly in relation to the proposed hydrodynamic modelling (see **Chapter 18).** Some of the key points specific to marine ecology, acknowledged at the meeting (26/7/16) and within subsequent emails, are provided in **Table 19.5.**

Table 19.5 : Key points from regulator discussions post Scoping Opinion.

Key points	Further information
Consultees content with marine ecological features listed for assessment.	None of the consultees proposed any further features requiring assessment; however, it was acknowledged that further baseline and desk study work may identify additional features.
Consultees content that the combination of the early diving work (in January 2016), supplemented by the additional diving work proposed, would adequately characterise the area in the footprint of proposed dredging activity.	It was acknowledged that there is a need to consider benthic habitats beyond the immediate footprint of works. SNH/MS-LOT content that, following the results of the baseline survey, consideration is made that the habitats beyond the footprint represent a continuation of the same features.
SNH and MS-LOT content with assessment methodology.	A detailed methodology was presented in a memorandum sent on 22nd July 2016 to MS-LOT, SNH, SEPA and HC.
Conservation objectives of MPA should be assessed within the ES.	
Conservation objectives of SAC and cSAC should be assessed within the ES.	
MS-LOT advised that careful consideration to EPS is required.	It is useful to include a shadow EPS assessment in ES; however, applicants may choose to apply for an EPS licence following any grant of consent once construction methods have been finalised.
MS-LOT deferred to comments made by SNH on marine mammals (see Scoping Opinion).	
SNH suggested that consideration be given to the potential effects of propeller wash.	Propeller wash should be modelled separately with the outputs assisting with assessments on potential impacts to marine ecology features.
SNH advised that anchoring locations need to be assessed.	Consideration on this aspect for marine ecology and navigation assessments.
SEPA advised that the operator would be expected to work to IMO guidelines in relation to ballast water.	

During a baseline desk study a single record for each of brown trout (*Salmo trutta*) and European eel (*Anguilla anguilla*) was found from 1990 for the River Anavig, which runs through the site. The potential for these species to be present was not identified during the site walkover, nor raised in previous discussions or consultations. It was acknowledged that the 1990 records for brown trout and European eel pre-date the insertion of a culvert and significant habitat modification to the lower reach of the River Anavig. The River Anavig was culverted initially in 1992, with a further extension and modification of the unculverted reach added to this structure in 2006, whilst the river runs through the Allt Anavig quarry pond on its way to the sea. Today this has resulted in approximately 570m of the downstream reach of the River Anavig being significantly modified, this downstream reach covering the location for these records from 1990. Furthermore, at low tide the River Anavig discharges from a pipe across the foreshore, reducing the potential for migration further.

Consequently, it is considered that the lower reaches of the River Anavig no longer provide a migratory pathway for these species, and as such these species do not require specific consideration within the Environmental Statement within their freshwater habitat. However, a formal consultation was held with SEPA with regard to this issue (November, 2016). Subsequently, on 10/11/16, SEPA replied by email with the following-

'*We agree with the conclusions in your letter and support your approach to the EIA on this matter. The SWR DSFB are the best source of information on this matter given their local knowledge. We are currently looking at the revised watercourse diversion design so we will consider whether any opportunities to encourage fish back into the river are feasible as part of comments.'*

In January 2017 it was requested by SEPA that the discharge from the process water treatment be revised to a discharge point which, as a minimum, is located beyond Mean Low Water Spring (MLWS) mark (see **section 17.1.1**). Cognisant of SEPA's advice, the scope of the Proposed Development includes the construction and operation of a marine outfall, the potential effects on marine ecology receptors being acknowledged within this chapter.

19.4.2 Location and Designated Sites

The development sits just to the west of the Skye Bridge, on the northern coastline of Skye. As such it is subject to the strong tidal flows that characterise the shallow sill at the mouth of Loch Alsh. Some of the strongest tidal streams in the UK are found in this region and support rich communities of epibenthos.

Approximately 800m to the east of the proposed pier is the western boundary of Lochs Duich, Long and Alsh Special Area of Conservation (SAC). Selected on account of its Annex I habitat 'reefs', the SAC includes both rocky reefs and biogenic reefs with a *Modiolus modiolus* (horse mussel) bed located to the south of Kyle Harbour, approximately 2.5 km from the Proposed Development.

Overlapping the SAC is the relatively newly designated Lochs Duich, Long and Alsh Nature Conservation Marine Protected Area (MPA). Since August 2014 this MPA has been designated under the Marine (Scotland) Act 2010 to specifically conserve the marine features of 'burrowed mud' and 'flame shell beds'. The flame shell bed is the largest in the UK and extends through the mouth of Loch Alsh, under the Skye Bridge and into the Inner Sound. The MPA boundary is immediately adjacent to the development with the proposed dredging activity taking place within the boundary of the MPA, but to the south of the southern edge of the flame shell bed. The nearest burrowed mud feature is several km to the east, in Loch Alsh.

The pier lies within the Inner Hebrides and the Minches candidate SAC (cSAC), for which harbour porpoise is the only qualifying feature. The cSAC proposals are currently out to consultation, during which time the area has policy protection. As with the Lochs Duich, Long and Alsh SAC and MPA, there are a number of conservation objectives for the cSAC. The cSAC covers approximately 13,500 km^2, along the west coast of Scotland, from the North Minch down to the southern tip of the Isle of Jura.

The nearest seal haul out area to the development is approximately 5 km to the west at the Pabay and Ardnish Peninsula. To the north of the development (>10 km) is the Kishorn Island and Strome Islands haul out area.

A number of habitats and species found in the area are Scottish Priority Marine Features (PMFs) and/or are covered under the Scottish Biodiversity List (SBL). These were carefully acknowledged in the assessment process as were European Protected Species (EPS) with potential to be present in the area, such as harbour porpoise and bottlenose dolphin.

The designated sites in the vicinity of the development and their conservation objectives are summarised as follows:

Lochs Duich, Long and Alsh MPA

In relation to the protected features of the site – burrowed mud and flame shell beds:

- Maintain or increase the extent of habitat.
- Maintain a healthy structure and function.
- Maintain the diversity and abundance of characteristic species.

Lochs Duich, Long and Alsh SAC

- To avoid deterioration of the qualifying habitat – reefs.
- To ensure for the qualifying habitat (reefs) that the following are maintained in the long term:
  - Extent of the habitat on site.
  - Distribution of the habitat within site.
  - Structure and function of the habitat.
  - Processes supporting the habitat.

- Distribution of typical species of the habitat.
- Viability of typical species as components of the habitat.
- No significant disturbance of typical species of the habitat.

Inner Hebrides and the Minches candidate SAC

In relation to the qualifying feature (harbour porpoise) the draft conservation objectives for this site are:

- To maintain site integrity and ensure the site continues to make a contribution to harbour porpoise remaining at favourable conservation status in UK waters.
- To avoid significant killing, injury, or disturbance of harbour porpoise.
- To maintain the habitat and prey of harbour porpoise in favourable condition.

19.4.3 Benthic Habitats

19.4.3.1 Overview of Area

The Proposed Development sits within the Inner Sound waterbody, but is close (~800 m) to the Loch Alsh waterbody and the mouth of Loch Alsh (**Figure 19.1**). Predicted seabed habitat from the National Marine Plan Interactive (NMPi) website indicates that the broad habitat type to the northwest of the development, in the Inner Sound, is fine sand or muddy sand. Close to the Skye Bridge the NMPi predicts areas of mixed sediments with kelp habitats.

Loch Alsh has three deep basins, separated by shallow sills and narrows. At the mouth of Loch Alsh (Kyle Akin) very strong tidal streams occur through the relatively long, narrow and shallow channel. The seabed in and near the mouth is colonised by faunal turfs with dense brittlestars, a large flame shell bed and, to the east of the bridge, horse mussel beds. The narrow infralittoral zone along the edges of Kyle Akin is colonised by tideswept kelp forests on rock, boulders and cobbles.

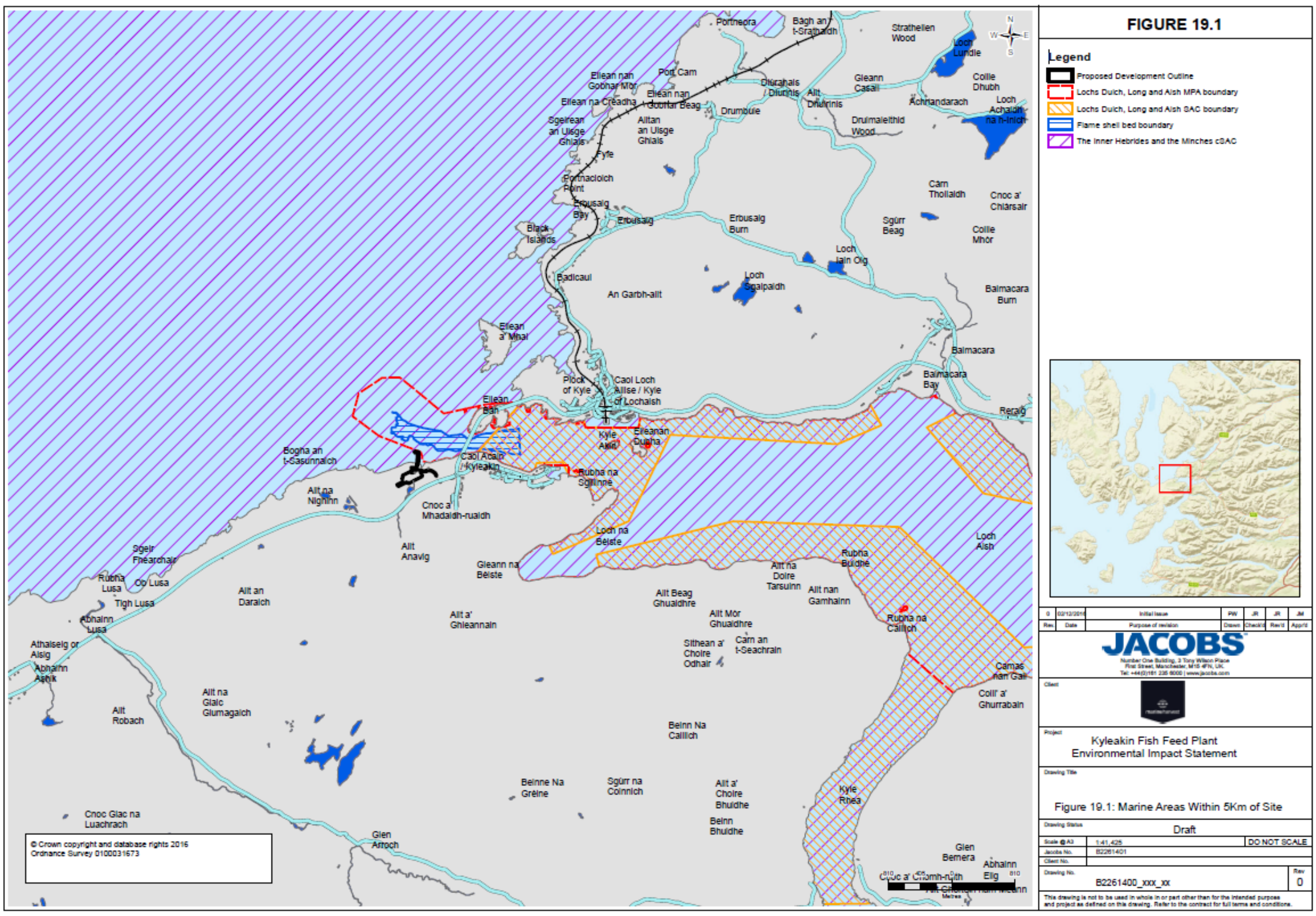

Figure 19.1 : A map of the development site

19.4.3.2 Intertidal Area

The intertidal area extending to over a kilometre immediately to the west of the Proposed Development comprises free draining barren mobile shingle on a gently sloping shore and is impoverished in terms of flora and fauna. This habitat extends a short distance into the infralittoral zone. Immediately adjacent to the southwestern corner of the existing pier the shore is covered with rock armour (**Figure 19.2**). Communities on the rock are impoverished and are best characterised by the broad biotope ‘moderate energy littoral rock’ (LR.MLR).

Likewise, extending to the east of the existing pier the shoreline is comprised of a mix of rock armour and, on the lower shore, barren mobile shingle. The shore to the east has a steeper gradient than is found to the west and notably more rock armouring, extending from the base of the existing pier for several hundred metres along the shore (**Figure 19.3**). As seen to the east, the shore is impoverished in terms of flora and fauna.

Figure 19.2 : View of shoreline looking east towards the existing pier. Rock armouring can be seen at southern base of pier.

Figure 19.3 : View of shoreline looking south towards the existing pier. Rock armouring can be seen at southern base of pier with a continuation of rock armour along the upper shore to the east of the pier.

19.4.3.3 Literature Review

A literature review found a number of SNH commissioned reports that cover the marine area. A mapping report (Ref 19-7) was used at a broad level, with a number of other more specific reports generating a detailed picture of the benthic habitats.

Within the western part of Loch Alsh, along the north coastline of Skye up to the bridge, the shore was recorded as a mix of barren boulders, fucoids and barnacles with a substratum of boulders and cobbles throughout. The sublittoral fringe was unknown or considered dominated by *Laminaria digitata* or *Sacchorhiza polyschides;*

however, elsewhere in the report they state that in tideswept areas the sublittoral fringe is a mix of *L. digitata* and *Saccarhina latissima (*syn. *L. saccharina)*. Patches of muddy sands with polychaetes, cockles, echinoderms and other infauna occur in the middle of the main basin near the entrance to Kyle Rhea, and at the western end near Kyle Akin. Around the edges of the deeper part of the basin are areas of reef, of silty rock and boulders colonised in the circalittoral by a faunal turf including ascidians and brachiopods, and in the infralittoral by silty kelp forests in a narrow zone around the margins of the loch (Ref 19-7).

The main basin of Loch Alsh is both long (~6 km) and deep, with much of the basin exceeding 40 m in depth. The seabed of the main basin is of soft burrowed mud, colonised by seapens, burrowing crustaceans, anemones and dense populations of burrowing brittlestars *(Ophiothrix fragilis* and *Ophiocomina nigra)*, with a variety of other infauna (Ref 19-7, Ref 19-9)). Emu Ltd. (Ref 19-8) noted that in addition to brittlestar beds, there were beds of horse mussel (*Modiolus modiolus*), recorded slightly to the northeast and northwest of the mouth. It was found that the brittlestar beds often overlaid the horse mussels. Moore *et al*., (Ref 19-9) also confirmed the presence of a horse mussel bed approximately 0.5 km directly east of the Skye bridge. However despite extensive examination of the seabed beneath and around the Skye bridge, the historical records of a horse mussel bed could not be validated by Moore *et al*., (Ref 19-9). Moore (Ref 19-11) recorded that in the centre of Loch Alsh (>3 km east of the Skye Bridge) was an area floored by mixed substrates of sand or muddy sand with varying concentrations of gravel, pebbles and cobbles (SS.SMx.CMx). To the east and west of this area mixed sediments give way to muddy sand (SS.SSa.CMuSa) and sandy mud (SS.SMu.CSaMu), and then burrowed muds. The burrowed mud communities here represent PMF biotope complex ‘seapens and burrowing megafauna’ (SS.SMu.CFiMu.SpnMeg and SS.SMu.CFiMu.SpnMeg.Fun), though these were recorded as poorly developed communities with low densities of seapens. Particle size analysis (PSA) of the seabed samples recorded variable sediment types ranging from sandy-muds through to slightly gravelly muddy-sand and gravels. The nearest sample station to the development (GEX7) recorded muddy sandy gravel (Ref 19-10)

The presence of flame shell beds were found at several sites in Loch Alsh during a survey in 1996, these being to the east of the Loch and near the entrance to Loch Duich (Ref 19-7). The flame shell bed in the western end of Loch Alsh was thought to cover approximately 75 ha. This bed was of high quality with most of the seabed covered by dense nest material supporting a rich associated community. In 2014 Allen (Ref 19-10) reported three records of flame shell bed to the north of the development (stations G02, G03 and GEX7). These increased the estimated extent of the known flame shell bed protected feature of the Loch Duich, Long and Alsh MPA. In addition, analysis of video imagery collected in 2014 (Ref 19-11) confirmed that the flame shell bed extended at least one kilometre further west than originally thought (see Ref 19-10). Overlying the flame shell bed was a community of red algae and dense kelp *Laminaria hyperborea*. To either side of the flame shell bed tongue, was a tideswept *L. hyperborea* forest (biotope code IR.MIR.KR.LhypTX.Ft) where the current was stronger.

Elsewhere in Loch Alsh, the Moore *et al.* study in 2013 (Ref 19-9) found no evidence of flame shell presence at sites predicted to support beds by the 1996 broadscale survey by Entec (Ref 19-7). Several other features of interest were noted from the 2013 study such as the presence of the PMF *Arctica islandica* at four sites in Loch Alsh. However, these locations were all more than 2.5 km from the development (Ref 19-10). In addition to the PMF habitats noted by Moore (Ref 19-11) there were also records of two PMF species: the tall sea pen (*Funiculina quadrangularis*) and a potential record of the northern feather star (*Leptometra celtica*); these being recorded in the mid and eastern regions of Loch Alsh.

19.4.3.4 Site Specific Surveys

This section draws upon the findings of several surveys carried out to characterise the seabed proximal to the development. It should be acknowledged that at the time of the Scoping Opinion a dedicated dive survey had already been carried out of the area several months before. Acknowledging this survey SNH stated ‘*further survey work is not essential*’. However, SNH then stipulated that ‘*further survey work may be required in order to fully assess the wider benthic impacts depending on the scale of the impacts predicted by the modelling*’ (**Appendix 1.1**). This issue was discussed at a meeting held by SNH (26/7/16) (see **section 19.4.1**), at which time Marine Harvest confirmed that they would carry out further benthic work using divers in summer 2016, rather than wait for the outputs from the modelling work. This strategy was accepted by the regulators and no other survey work was suggested.

Benthic Survey

In January 2016 and then again in August 2016, a dive survey was carried out in the area covering the footprint of the proposed dredging activity and beyond. These surveys provide the most detailed study of the benthic environment in the specific area of the development and the amalgamated technical report by 'WA Marine and Environment', covering both surveys, should be referred to for additional information (**Appendix 19.1**).

The surveys confirmed that the edge of the flame shell bed was demarcated by the 9.5m to 10m BCD contours. Shallower than this the seabed is a mix of coarse sediment, with varying proportions of sand, gravel, shell and cobbles, with occasional small boulders. At less than 9.5m BCD the communities recorded were tideswept kelp complexes, dominated by *Saccharina latissima* biotopes, specifically '*Saccharina latissima* and robust red algae on infralittoral gravel and pebbles' (SS.SMP.KSwSS.LsacR.Gv) and '*Saccharina latissima* and robust red algae on infralittoral sand' (SS.SMP.KSwSS.LsacR.Sa). The latter biotope was recorded in the shallower waters inshore, where the tidal streams were weaker.

Where larger boulders were present occasional patches of the *Laminaria hyperborea* biotope '*L. hyperborea* forest and foliose red seaweeds on tideswept, upper infralittoral mixed substrata' (IR.MIR.KR.LhypTX.Ft). Around the 9.5m BCD contour the kelp biotopes clearly gave way to flame shell bed (SS.SMX.IMx.Lim).

Hence, the dive surveys recorded a total of four biotopes from a depth of 2.2m BCD to 12.2m BCD, all of which are component biotopes of Scottish PMF habitats:

- *Saccharina latissima* and robust red algae on infralittoral gravel and pebbles (SS.SMP.KSwSS.LsacR.Gv).
- *Saccharina latissima* and robust red algae on infralittoral sand (SS.SMP.KSwSS.LsacR.Sa).
- *Laminaria hyperborea* forest and foliose red seaweeds on tideswept, upper infralittoral mixed substrata (IR.MIR.KR.LhypTX.Ft).
- *Limaria hians* beds in tide-swept sublittoral muddy mixed sediment (SS.SMX.IMx.Lim).

A total of 81 marine taxa were recorded during the dive surveys, of these two invertebrate PMF species were recorded, the horse mussel *Modiolus modiolus* and the ocean quahog *Arctica islandica*; of which a single individual was recorded of each of these two species over the six transect dives. Records of PMF fish species are given in **section 19.4.4.2.**

Photos of the PMF biotopes and species are provided in **Appendix 19.1**. As expected, the surveys confirmed that flame shell beds, a qualifying feature of the Lochs Duich, Long and Alsh MPA, were present in the vicinity of the development but burrowed mud habitats, the other qualifying feature of the MPA, were absent.

In addition to the dive work, a series of observations were made by surveyors during the geotechnical investigative survey (**see Appendix 18.2**). As sediment grabs were recovered from the bed the surveyors recorded the presence of the characterising keystone species, which at almost every sampling station were kelp species. These findings complement the observations made during the dive surveys i.e. that the seabed is dominated by tideswept *S. lattissima* biotopes with occasional patches of *L. hyperborea* tideswept forest. Small patches of sand and shells were also recorded but these are thought too small to constitute a distinct biotope.

Therefore, from the findings of these surveys it is envisaged that the seabed under the footprint of the dredging activity and proximal to the development is covered with tideswept kelp biotopes from the mean low water spring (MLWS) mark to around the 9.5m BCD contour seawards, at which point the seabed is carpeted by the MPA qualifying feature 'flame shell bed'.

It has previously been accepted by SNH that to the north of the development, at a depth of 9.5 m BCD and deeper is a flame shell bed. SNH suggested in the Scoping Opinion that '*the EIA assessment could be based on the assumption that the seabed below 9.5 m BCD is uniform high quality flame shell bed*' (see **Appendix 1.1**).

A similar strategy, as suggested by SNH in relation to the flame shell bed, was discussed at a meeting facilitated by SNH (26/7/16) in relation to infralittoral subtidal features extending east and west of the development, outside the footprint of the works and the extent of the summer 2016 diving survey. Hence, it is assumed that along a similar depth contour, the habitats beyond the footprint of the works represent a continuation of the same features. This is based on the clearly similar physical variables (flows, exposure, topography, substrata etc.) beyond the immediate proximity of the dredged area, to the east and west of the Proposed Development.

The results of the subtidal surveys have confirmed the findings of earlier work (e.g. Ref 19-7; Ref 19-11) i.e. that the seabed around Kyle Akin contains substrata representative of medium to strong tidal flows, with a mixture of coarse sediments throughout. Correspondingly, the benthic assemblages are distinguished by epibenthos adapted to such conditions, with well-developed tideswept kelp communities along the edge of the flame shell bed.

Non-native Species

During the subtidal benthic surveys a number of patches of the invasive non-native alga *Sargassum muticum* were recorded. These were recorded at varying abundances along all of the six transects (see **Appendix 19.1**). No other invasive non-native marine species was recorded.

Non-native species are not considered to be receptors in themselves; however, the potential impacts associated with non-native species will be discussed as part of the marine ecology impact assessments and, where appropriate, the potential effects on the other receptors will be considered. The main vectors for many marine non-native species are the hulls of marine vessels or within the ballast water and consideration is given to their impacts under vessel movements in both the construction and operation phase.

Invasive non-native plant and animal species are a major threat to biodiversity worldwide. They can have negative impacts on native species, intertidal and subtidal habitats. In Scotland, there is a growing problem with marine invasive non-native species and specific acknowledgement is given to the following species which have all been found in Scottish waters: ‘Wakame’ (*Undaria pinnatifida*); ‘Wireweed’ (*Sargassum muticum*); the red alga (*Heterosiphonia japonica*); ‘Orange-striped anemone’ (*Haliplanella lineata*); ‘Darwin’s barnacle’ (*Eliminius modestus*); ‘Striped barnacle’ (*Balanus amphitrite*); ‘Japanese skeleton shrimp’ (*Caprella mutica*); ‘Slipper limpet’ (*Crepidula fornicata*); ‘Leathery sea squirt’ (*Styela clava*); ‘Carpet sea squirt’ (*Didemnum vexillum*); ‘Pacific oyster’ (*Crassostrea gigas*); ‘Chinese mitten crab’ (*Eriocheir sinensis*).

19.4.4 Fisheries

Consideration is given to those fish and shellfish species that could be present within 5km of the development. The constriction at the mouth of Loch Alsh and its relative proximity to the development (<1km) leads to the assumption that marine fish and shellfish species found in the loch are likely, at some time in their life cycle, to passage through the mouth and thus close to the development. Specific acknowledgement is given to those fish and shellfish with spawning grounds that overlap or are proximal to the development, with additional consideration to those fish species with nursery areas in the vicinity.

Following consultation with Marine Scotland Science (**Appendix 1.1**) separate consideration is given to those fish species that are thought to migrate (diadromous) through the waters proximal to the development.

19.4.4.1 Literature Review

Fish and Shellfish

Correspondence with SEPA in July 2016 confirmed that they do not carry out fish monitoring surveys in this area (Inner Sound, Kyle Akin and Loch Alsh).

To understand the utilisation of the wider area by fish and shellfish species a number of data sources were interpreted including published Cefas reports (*i.e.* Coull *et al*., 1998 (Ref 19-15); Ellis *et al*., 2012 (Ref 19-16). Both of these reports contain information on the geographical locations of spawning and nursery grounds of many fish and shellfish species around the UK. Spawning and nursery grounds were assigned a level of intensity (high, undetermined or low) depending on the level of activity thought to occur at each location.

Of the fish and shellfish investigated within the Cefas reports four have spawning grounds that overlap with Kyle Akin and are therefore proximal to the proposed dredging activity. These taxa are the Norway lobster (*Nephrops norvegicus*), sandeel (*Ammodytes* spp.), sprat (*Sprattus sprattus*) and whiting (*Merlangius merlangus*)

The spawning grounds of all of four taxa are extensive across the UK, particularly sprat (Ref 19-15). Spawning times for these species are given in Table 19.6. Spawning of the Norway lobster is not thought to occur over a defined period.

Table 19.6 : Fish and shellfish with spawning areas in the vicinity of the development. Key spawning periods are given for each of the taxa. All data is derived from Coull *et al.*, (Ref 19-15).

Fish taxon	Spawning period (Ref 19-15)
Norway lobster	January to December
Sandeel	November to February
Sprat	May to August
Whiting	February to June

In terms of nursery areas the work by Coull *et al.* (Ref 19-15) and Ellis *et al.* (Ref 19-16) identified a number of species that have nursery grounds that overlap with the part or all of the Inner Sound, Kyle Akin and Loch Alsh including: anglerfish (*Lophius piscatorius*), cod (*Gadus morhua*), common skate (*Dipturus batis*), European hake (*Merluccius merluccius*), herring (*Clupea harengus*), mackerel (*Scomber scombrus)*, Norway lobster (*Nephrops norvegicus)*, saithe (*Pollachius virens*), spotted ray (*Raja montagui*), spurdog (*Squalus acanthias*) and whiting (*Merlangius merlangus*).

However, from the selected species studied by Coull *et al.* (Ref 19-15) and Ellis *et al.* (Ref 19-16) only whiting, spurdog (*Squalus acanthias*) and herring (*Clupea harengus*) have high intensity nursery grounds in close vicinity of the development. All these species have extensive nursery grounds over the UK and therefore the area that overlaps with the development represents a very small proportion.

Work by Coull *et al.,* (Ref 19-15) showed that juvenile saithe utilise much of the Scottish coastline, including Kyle Akin and Loch Alsh. Saithe tend to enter coastal waters in spring and return to deeper waters in winter. In Scottish territorial waters it is the juveniles which are a specific focus of its inclusion as a PMF species.

Other species likely to be present in the area, on account of the coarse sediment and rocky habitats that exist, include Ling (*Molva molva*) and the thornback ray (*Raja clavata*). The NBN Gateway (NBN Gateway, 2016) (Ref 19-17) also has several records for the PMF species cod (*Gadus morhua*) in Loch Alsh along with 3 records for basking shark (*Cetorhinus maximus*) in Loch Alsh and Kyle Rhea since 2009. Work by Southall *et al.,* (Ref 19-58) showing distribution records of basking shark as ascertained from tagging (2001 – 2003), survey sightings (1994 – 2003) and public sightings (1987 – 2004) recorded only three instances of basking shark within 25 km of the Proposed Development.

Although Ellis *et al.* (Ref 19-16) records common skate, European hake and anglerfish as having a low intensity nursery ground in the vicinity of the development, these species' preference for muddy habitat means they are unlikely to be present. Similarly, the Norway lobster constructs burrows in fine or silty mud and consequently is unlikely to be present in the vicinity of the development.

Diadromous Species

Several species of diadromous fish are thought to use the waters in the area of the development for migration and consideration has been given to the comments made by Marine Scotland Science in relation to diadromous species (see **Appendix 1.1**). This included the extent of the life stages likely to be present at the different times of year and the suggestion that the Skye and Wester Ross District Salmon Fishery Boards and Fisheries Trusts should be approached for advice and information.

Specific attention is given to Atlantic salmon (*Salmo salar*), anadromous brown trout (sea trout) (*Salmo trutta*) and European eel (*Anguila anguila*), as these all occur in the vicinity of the Proposed Development. After correspondence with the Wester Ross Fisheries Trust (WRFT), it was also acknowledged that river lamprey (*Lampetra fluviatilis)* may also be present in the wider area (Peter Cunningham (Wester Ross Fisheries Trust), pers. comm).

Data received from the Highland Biological Records Group (HBRG) that covered the period up to June 2016 did not record any diadromous fish within 2km of the development (Ref 19-6). However, review of additional data sources revealed records of Atlantic salmon, sea trout and European eel within 10km of the development and river lamprey within 25km (Ref 19-17). All of these species are on the Scottish PMF list.

A review for each of the diadromous species listed that could potentially occur (Atlantic salmon, sea trout, European eel and river lamprey) is provided (below) along with a table showing their likely migration periods for the area (**Table 19.7**).

Table 19.7 : Main migration periods (upstream/downstream) for diadromous fish species in the region of Kyle Akin; showing both adult and juvenile movements (blue shading). Much of this data is derived from correspondence with the Wester Ross Fisheries Trust (Peter Cunningham, pers. comm). Sea lamprey are not included in this table due to the distance (>80 km) of the nearest record to the development.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Atlantic salmon (adult)												
Atlantic salmon (smolt)												
Sea trout (adult)												
Sea trout (smolt)												
European eel (adults)												
European eel (juv.)												
River lamprey (adults)												
River lamprey (juv.)												

Salmon

Salmon are listed on Annex II of the Habitats Directive, PMF, SBL and UKBAP. The nearest watercourse to the development with salmon records is the River Lusa, approximately 4.5km to the west of the development (Ref 19-17). A report commissioned by Marine Scotland Science (Ref 19-13) identifying a number of rivers where salmon are present or probably present, included the River Lusa. Correspondence with the Skye District Salmon Fishery Board confirmed that the River Lusa is a fairly minor watercourse and that, consequently, they held no data specific to salmon or trout (Jim Rennie, pers. comm).

A recent review by the Wester Ross Fisheries Trust found that rod catches of salmon (*Salmo salar*) were lower in 2013 and 2014 than in the years 2010 – 2012 in their catchment. In 2013 summary statistics from Marine

Scotland Science indicated a total of 64 salmon and 45 sea trout had been caught by rod and line from Loch Long, conversely 3 salmon and no trout were recorded from the River Croe.

Further to the west is the River Broadford in Skye (approximately 10km away), this being considered an important river for salmon migration (Ref 19-14). There are a number of rivers to the east of Kyle Akin, such as the Udalain, Glenmore, Glenbeag, Shiel and Croe, where salmon have been recorded (Ref 19-17). Although all these rivers to the east are more than 10km from the development, migratory salmon are likely to passage through the mouth of Loch Alsh and therefore close to the works.

Juvenile fish surveys carried out by WRFT at the River Udalain found no juvenile salmon at this site. However, juvenile salmon were recorded at Glenmore, Glenbeag, and Shiel rivers. More recently (September, 2016), juvenile salmon, lampreys, eels and trout have been recorded from the River Croe, at the head end of Loch Duich (Peter Cunningham, pers. comm).

Adult salmon and sea trout in this area are known to mainly enter the rivers between June and October inclusive, and go to sea between March and June (Peter Cunningham, pers. comm).

Sea Trout

Sea trout are listed on the SBL, PMF and UKBAP. Rod catches indicate that the number of sea trout (*Salmo trutta*) returning to Scottish rivers has probably been in decline for much of the period 1952-2014. Whilst catches of sea trout in many areas of Scotland are at historically low levels, there have also been notable declines in the last 20 years in central-eastern, south-west and north-west areas of the country (Marine Scotland Science, 2015) (Ref 19-18). However, in 2015 catches of sea trout in the River Carron (approximately 25 km away) were the highest since 2011.

The NBN Gateway (Ref 19-17) indicates that sea trout (*Salmo trutta* subsp. *trutta*) are, or have historically been, present in many of the watercourses in the region. There is a single historic record for sea trout at the River Anavig from 1990 (Biological Record Centre) which is not reflected from a more recent data request to the Highland Biological Record Centre, in June 2016. This 1990 record pre-dates significant modification to the lower River Anavig, including culverting and realignment of the waterbody. The River Anavig is no longer considered to support a pathway for migratory species to ascend past the proposed development site into the headwaters.

Juvenile fish surveys of the watercourses in the area have indicated the presence of sea trout at Glenmore and Shiel rivers and in August 2016 they were recorded at the River Croe (Peter Cunningham, pers. comm). Aside from the Anavig, the next nearest watercourse to the development with a record of sea trout is the River Lusa, approximately 4.5 km to the west, where there are several records (Ref 19-17).

The freshwater brown trout (*Salmo trutta*) does not always undergo metamorphosis and migrate to the sea (becoming sea trout), some residing in freshwater throughout their whole life cycle. For this reason records of brown trout do not necessarily indicate that sea trout are going to be present and using a given watercourse for migration.

In contrast to salmon, sea trout post-smolts do not migrate rapidly out to sea from inshore coastal areas. There is relatively little information on post-smolt swimming depths although observational data generally suggests shallow swimming depths in the upper 10m or so of the water column. No data is currently available on the swimming depths of sea trout adults in the Scottish marine environment (Ref 19-13).

There is only limited information on the timing of migration for both juvenile and adult fish for specific locations on the Scottish coast (Ref 19-13). However, following correspondence with the WRFT (Peter Cunningham, pers. comm) sea trout in this area are thought to mainly enter the rivers between June and October inclusive, and go to sea between March and June.

European eel

Critically endangered, European eel are listed on the PMF, SBL and UKBAP. The NBN Gateway (Ref 19-17) indicates that European eel are, or have historically been, present in many of the watercourses in the region, including a single record at River Anavig in 1990 (Ref 19-17) and several at the River Lusa. The 1990 record on the Anavig pre-dates significant modification to the waterbody. The River Anavig is no longer considered to support a pathway for migratory species to ascend past the proposed development site into the headwaters.

Further afield, there are multiple records from the Broadford, Dalach, Udalain and Croe. During recent juvenile fish surveys carried out by the WRFT in September 2016, European eel have been recorded from the River Croe (Peter Cunningham, pers. comm).

European eel are considered Critically Endangered and on the IUCN Red List, with numbers having declined significantly so that recruitment of current populations is 95% less than that of the 1980s. Declines in numbers are attributed to climate change, exploitation, increased barriers to migration and habitat modification. Although the general life-cycle of European eel (*Anguilla anguilla*) is well known with spawning thought to occur in the Sargasso Sea, it has never been observed. Both juvenile (glass eel) and adult (silver eel) migrations have a seasonal component but, in each case, the season is probably quite protracted. The timing of migration peaks in Scottish waters is poorly recorded but, by inference, it is assumed that glass eel pass through Scottish waters principally from September to December. In Scotland, it is thought that glass eel remain in coastal regions until April or May before river temperatures rise sufficiently for them to enter freshwater. The bulk of the returning silver eel migration is thought to take place from September to January (Ref 19-13).

Runs of silver eel typically occur at night, with migratory movements thought to be correlated with environmental factors that result in increased discharge (e.g. rainfall, flood events) and low light conditions (e.g. increased turbidity, moon phases) (Okamura *et al.*, 2002) (Ref 19-19); whilst glass eel have often been observed at the mouth of estuaries, waiting for darkness before commencing their migration upstream.

Lamprey

River and sea lamprey are listed under Annex II of the Habitats Directive, SBL, PMF and UKBAP. The nearest records of the sea lamprey *Petromyzon marinus* are from the Outer Hebrides on North Uist and Lewis (Ref 19-17) > 80km from the development. Likewise the NBN gateway (Ref 19-17) gives the nearest river lamprey (*Lampetra fluviatilis*) record to the development at River Sheil, approximately 80km away.

Although there are no records from the NBN Gateway of sea or river lamprey within 50 km of the development (Ref 19-17); work by the WRFT has recorded river lamprey ammocetes (juveniles) in the River Carron (Peter Cunningham, pers. comm), approximately 25km from the development. There are also various records of Brook lamprey from watercourses in the region such as the River Broadford on Skye; however, this species is wholly freshwater.

Both species of diadromous lamprey are highly protected and are listed in Annex II of the EU Habitats Directive 92/43/EEC (as amended). In order to meet the requirements outlined in Article 3 of the Habitats Directive, SACs have been designated in Scotland, the closest of which is the River Spey on the east coast of Scotland.

Adult sea lamprey (*Petromyzon marinus*), the largest of the three lamprey species, live mainly in coastal waters as adults. Migration of adult sea lamprey from the sea to the river mainly occurs between February and May (Maitland, 2003) (Ref 19-20). There is some evidence to suggest that, where adult lamprey migrate upstream against the current, they will do so along shallow river margins where flow would be reduced, as seen with river lamprey.

Young sea lamprey live in marginal riverine silt beds feeding for several years, after which time, from about September and into the winter, they begin to travel downstream whilst undergoing metamorphosis to a silvery form, known as a transformer, whose physiology becomes adapted to life in saline conditions

River lamprey adults live primarily within estuaries feeding on a number of estuarine fish. Migration of adult river lamprey, from the sea to the river, occurs mainly from October to December (Ref 19-20). Migration upstream to spawning grounds generally occurs during the hours of darkness: migrants hiding under stones and vegetation during the day.

The young river lamprey live in marginal riverine silt beds feeding for three to five years, after which time, between August and November, they undergo metamorphosis to the silvery transformer (Maitland, 1980) (Ref 19-21). These transformers undergo their downstream migration during the hours of darkness.

Table 19.8 : Main migration periods (upstream/downstream) for diadromous fish species in the region of Kyle Akin; showing both adult and juvenile movements (blue shading). Much of this data is derived from correspondence with the Wester Ross Fisheries Trust (Peter Cunningham, pers. comm). Sea lamprey are not included in this table due to the distance (>80 km) of the nearest record to the development.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Atlantic salmon (adult)												
Atlantic salmon (smolt)												
Sea trout (adult)												
Sea trout (smolt)												
European eel (adults)												
European eel (juv.)												
River lamprey (adults)												
River lamprey (juv.)												

19.4.4.2 Site Specific Fish Surveys

Subtidal

In 2016, during the subtidal dive surveys, a total of 13 fish taxa were recorded in varying abundances from the area proximal to the development (**Appendix 19.1**). The dive surveys demonstrated a clear distinction of the utilisation of this area dependent on the time of year, with five fish taxa recorded in January 2016 and 13 taxa in August 2016. In the winter only gobies were commonly recorded, as compared to the summer when gadoids such as pollack, saithe and poor cod were often recorded, along with gobies and dogfish.

Of those fish recorded the sand goby (*Pomatoschistus minutus*) and saithe (*Pollachius virens*) are both on the Scottish PMF list. Plaice were also recorded during the dive surveys and though not a PMF, the species is on the Scottish Biodiversity List (SBL). No diadromous species were recorded during the dive surveys.

19.4.5 Marine Mammals

To understand the utilisation of the area by marine mammals, baseline studies were carried out by the Sea Watch Foundation (SWF) and Seal Mammal Research Unit (SMRU) and these are provided as technical appendices to this chapter (**Appendices 19.2** and **19.3**).

Due to the large foraging distances of marine mammals, the study area for the collection of the baseline data covered 100km^2 covering a minimum of 50km from the Proposed Development in any direction.

Cetaceans

The waters around the Isle of Skye are some of the richest of any coastal region in the UK for cetaceans, and one of the most important regions in Northwest Europe (Ref 19-22). Sixteen species of cetaceans have been recorded in the vicinity of the Isle of Skye since 1980, eleven of which are either present throughout the year or recorded annually as seasonal visitors. However, although the Hebridean waters are rich in cetacean species only four; minke whale (*Balaenoptera acutorostrata*), harbour porpoise (*Phocoena phocoena*), short-beaked common dolphin (*Delphinus delphis*) and bottlenose dolphin (*Tursiops truncatus*) are likely to regularly occur within the area of interest around Skye (**Appendix 19.2**). These four species represented more than 95% of all cetacean sightings (and numbers of individuals) within the study area since 1980.

Although a large number of sightings were minke whales (29%) and short beaked common dolphin (10.3%), these sightings were heavily concentrated to the north between the north-east coast of Skye and Loch Gairloch, and in the south around the outer Sound of Sleat and Small Isles.

By contrast, sightings of harbour porpoise were much more evenly distributed throughout the study area, occurring far inshore to the southern end of the Inner Sound and through much of the Sound of Sleat.

The report (**Appendix 19.2**) found records of Bottlenose dolphin inshore, including from the Kyle of Lochalsh; however, these are thought represented by a very small population (approximately 30 individuals) which range throughout the study area and all around Skye.

The pier lies within the Inner Hebrides and the Minches candidate SAC for harbour porpoise, which is the only qualifying feature of this cSAC. The SAC proposals are currently out to consultation and in the meantime the area has policy protection. The cSAC covers approximately 13,500 km^2, along the west coast of Scotland, from the North Minch down to the southern tip of the Isle of Jura.

Seals

Based on sightings data from the Highland Biological Recording Group (HBRG) covering 100 km^2 since 1980, two species of pinniped have been recorded around the Isle of Skye- the grey seal (*Halichoerus grypus*) and the harbour (syn. common) seal (*Phoca vitulina*). Both of these species are found throughout the year with harbour seals showing a pattern of increased winter haul-out. The nearest SAC to the Proposed Development that has the primary qualifying feature of harbour seal is the Ascrib, Isay and Dunvegan SAC which is 60km north-west. For grey seals, as the primary qualifying feature, the nearest SAC is the Treshnish Isles SAC which is 100km south.

Seals spend a large proportion of their time on land hauled-out in order to rest, moult and breed, particularly so in August when the seal moulting season takes place. The closest haul-out site cluster to the Proposed Development is located on an island 2km away called Eilean a' Mhal where most recently 197 harbour seals were sighted in 2014. The second closest cluster is the Pabay and Ardnish Peninsula designated haul-out site for harbour seals within the central West Scotland Management Unit and is located 4.5km from the Proposed Development. At this haul-out site 396 sightings of harbour seal were made in 2014 (**Appendix 19.5**).

In comparison, there are much fewer sightings of grey seals with only one sighting in total within both a 10 km radius of the Proposed Development from 2010 to 2015 (2012) (HBRG). Sightings since 1980 show very little usage by grey seals around the Proposed Development area and apart from a single sighting made in 2012 the only local observation of grey seals is from 2002-2005, in Kyle Rhea (8km away), where a total of eight grey seals were sighted. Unlike harbour seals there are no haul out sites where grey seals have been counted over multiple years close to the Proposed Development (within 5km). The closest haul out site where >10 grey seals were counted in one year was 34km from the Proposed Development, where 16 grey seals were counted in 2014 (**Appendix 19.5**).

19.4.6 Receptor Importance

Baseline data were used to identify marine sites, habitats and species that could be affected by the development and determine their importance, being cognisant of recognised legislation and conservation guidance. **Table 19.9** provides a summary of the marine ecological receptors and their importance. Reference should be made to **Table 19.2** for the definition of importance for each category.

Table 19.9 : Evaluation (Importance) of Key Marine Ecological Receptors

Receptor	Importance	Justification
Designated Sites		
Lochs Duich, Long and Alsh SAC	High	The primary reason for section of this site are the presence of the Annex I feature 'Reefs'. The SAC includes both rocky reefs and biogenic reefs with a horse mussel (*Modiolus modiolus*) bed located to the south of Kyle Harbour, approximately 2.5 km from the development.
Lochs Duich, Long and Alsh NC MPA	High	This MPA has been designated under the Marine (Scotland) Act 2010 to specifically conserve 'burrowed mud' and 'flame shell bed' habitats. The MPA boundary is immediately adjacent to the development with the proposed dredging activity taking place within the boundary of the MPA, but south of the flame shell bed.
Inner Hebrides and the Minches cSAC	High	A candidate SAC for harbour porpoise, which is the only qualifying feature of this cSAC. The SAC proposals are currently out to consultation and in the meantime the area has policy protection.
Habitats		
Flame shell beds	High	PMF, SBL and UK BAP habitat. The flame shell bed north of the development is considered the largest in the UK.
Burrowed mud habitats	High	PMF, SBL, UK BAP and OSPAR (regions I, II, III and IV). Example component biotopes of burrowed mud are located in Loch Alsh, the nearest area recorded is about 3 km east of the development.
Reefs (inc. biogenic horse mussel bed)	High	An Annex I feature. The primary reason for designation of Lochs Duich, Long and Alsh SAC. This broad habitat complex covers a variety of biotopes. Some of which are also PMF's e.g. horse mussel beds. Consideration is also given to the tideswept channel present at Kyle Akin. Tideswept channels are also UK BAP habitats.
Kelp and seaweed communities on sublittoral sediment	Medium	Specifically the biotopes '*Laminaria saccharina* and robust red algae on infralittoral gravel and pebbles'; and '*Laminaria saccharina* and robust red algae on infralittoral sand'. Both these are PMF habitats and are found within the footprint of the development. This habitat is not considered rare in Scottish waters.
Tideswept algal communities	Medium	Specifically the biotope '*Laminaria hyperborea* on tideswept infralittoral mixed substrata'. A PMF habitat found within the footprint of the development. It should be noted that this biotope is also a component of the PMF feature 'Kelp beds'. This habitat is not considered rare in Scottish waters
Intertidal benthic communities	Low	Intertidal habitats under the footprint of the works and adjacent to the development are dominated by barren littoral shingle and barren boulders (rock armour). Very little contribution to local biodiversity on account of low levels of macrofauna and flora.
Subtidal benthic communities	High	Subtidal benthic communities provide valuable food resources for a number of key species. In the presence of the development the benthic communities are considered a combination of kelp dominated assemblages and flame shell beds (see above).
Communities		
Migratory (diadromous) fish species	High	Migratory fish species present include Atlantic salmon, sea trout, European eel and river lamprey.
Non-migratory fish species	Medium	Non-migratory fish species include important commercial species and species of conservation concern. Fisheries enrich local biodiversity and are important for local recreational fishing. Many are listed on the PMF, SBL and UKBAP.
Cetacean populations	High	Consisting of the Annex II and IV species, of harbour porpoise and bottlenose dolphins (including populations of harbour porpoise within the Inner Hebrides and the Minches cSAC). All cetaceans are European Protected Species.

Receptor	Importance	Justification
		Harbour porpoise and bottlenose dolphins are both Schedule 5 species.
Pinniped populations	High	Consisting of the Annex II and V species grey and common seal. Grey seals of international importance belonging to the designated SAC population located in the Treshnish Isles SAC. Common seals of national importance, belonging to the designated SAC population located in the Ascrib, Isay and Dunvegan SAC. Nearest haul out site is the Pabay and Ardnish Peninsula approximately 5 km away.'

19.5 Predicted Impacts

This section describes the potential impacts on marine ecological receptors that could arise in the absence of mitigation, during both the construction and operational phases of the development. Consequently, this section presents a worst-case scenario of the potential impacts and it should be noted that the mitigation measures proposed (see section **19.7**) would help reduce or avoid the potential impacts.

It should also be acknowledged that a number of the potential impacts identified in this chapter will be managed through control measures outlined in a Construction and Environmental Management Plan (CEMP). Assuming the Proposed Development progresses, it would be the responsibility of the appointed contractor to update and complete the CEMP (to suit their method of working, plant etc.) and seek the approval of Highland Council before commencing the works. Subsequently, the successful contractor(s) would produce specific environmental management plans, as required by the CEMP.

The CEMP will provide specific sections on the water environment and marine ecology that seek to reduce the likelihood and/or magnitude of impacts (e.g. pollution, piling disturbance) in both the construction and operation phases.

Consideration is given to sources of impacts that could affect designated sites, habitats (intertidal and subtidal) marine mammals and fish. Throughout this section acknowledgement has been given to the outputs of the coastal processes studies, specifically the understanding of wave climate, tidal flow rates and sediment transport mechanisms in the area and the assessments made (**Chapter 18**). Similarly, acknowledgement is given to the conclusions of **Chapter 17** and the results of initial dilution modelling (see **Appendix 17.1**)

19.5.1 Construction Phase Impacts

The key marine construction activities of the development can be separated into the following:

- Construction, operation and removal of temporary jetty.
- Piling (includes piling of quayside and slipway).
- Capital dredging.
- Pier extension (includes construction of the foundation bund and completion of the caisson walls).
- Rock armouring and shore reclamation.
- Long sea outfall (placement of pipe and concrete anchoring on intertidal and subtidal habitats).

As part of these activities will be the requirement for vessel movements to facilitate the work. Consideration is also given to the movements of marine vessels during the construction phase.

As a consequence of these construction activities the potential impacts are:

- Noise and vibration (during piling and general construction activities)
- Sediment dispersion (specifically as a result of capital dredging works) potentially leading to:
    - Increased suspended sediment

- Increased deposition/sedimentation
- Release of sediment bound contaminants.

- Habitat loss and fragmentation (specifically from capital dredging but also consideration of long sea outfall pipe, temporary jetty and vessel anchoring)
- Pollution (including light pollution) (from general marine works, vessel movements, any requirements for dewatering of dredge material)
- Vessel strikes (injury to marine mammals) (from vessel movements)
- Introduction of (invasive) non-native species (from vessel movements).

A summary of the significance for each of the construction impacts identified is provided in **Table 19.10.**

19.5.1.1 Noise and Vibration

Anthropogenic noise, i.e. man-made sound or vibration which intrudes into the natural environment, can affect marine wildlife in a number of ways, including the following:

- it can mask a biologically useful sound;
- it can disturb the natural behaviour of animals;
- it can impair hearing; and
- it can cause injury or death.

During the construction period for the development the noise generated has the potential to impact upon fish and marine mammals. In terms of the marine works (those activities below MHWS) the following construction activities are considered as sources of noise and vibration from the development:

- dredging;
- piling;
- vessel movements; and
- general construction noise (land-based)

Sound or vibration are defined in terms of their frequency (pitch) and amplitude (level or loudness). Frequency is measured in Hertz (Hz) (1Hz = 1 cycle per second), amplitude is measured in units of velocity, e.g. millimetres per second (mm/s), but is often expressed in decibels (dB) in biological applications. Sound pressure level is usually reported in decibels (dB) which is a logarithmic scale that compresses the wide ranging potential source pressures to ease description. For sound underwater this is then standardised by reference to a source pressure of 1μPa at a nominal distance of 1m from the source. Reporting sound pressure levels underwater therefore follows a standard notation that confirms the reference pressure and is displayed as ‘dB re 1μPa’.

An animal’s sensitivity to sound varies according to the sound frequency. The response to sound depends on the presence and levels of noise within the range of frequencies to which an animal is sensitive. For most fish, sound above 1kHz is not audible. Marine mammals such as pinnipeds and cetaceans typically hear best between 1kHz and 100kHz, although baleen whales (for example, the minke whale (*Balaenoptera acutorostrata*)) are known to communicate at frequencies below 100Hz (Ref 19-23) and are therefore assumed to be sensitive to the frequencies of sound they produce.

Piling

Piling operations are required to facilitate the construction of the new pier around the footprint of the existing structure for the development. Piling rigs will be land-based (using the existing pier or temporary structures) with operations extending for 14 weeks (**Chapter 2**). Piling operations will use a combination of combi piling (large diameter tubes with sheet piles between them) and sheet piling. It is intended that piling operations will utilise vibrating hammers to move the pile through the softer sediments, with only impact hammers being used to toe the piles down.

The noise generated during piling operations depends on the method, with impact piling generating higher levels of noise when compared to vibro-piling.

Dredging

Dredging is required to develop berthing pockets for the development with an area of 58000m^2 being dredged and approximately 190000m^3 of material being removed by backhoe dredger (backhoe dredging removes material from the seabed with a boat-mounted excavator which lifts material onto the vessel). It is anticipated that dredging operations will extend over a 14 week period (**Chapter 2**).

Vessel Movements

There will be increased vessel movement around the site during construction, with marine plant and vessels being used to bring equipment to the site. Shipping noise is a major contributor to overall background noise and therefore its inclusion in the assessment is important.

Modelling

A review of underwater sound levels associated with the proposed construction activities at Kyleakin (**Appendix 19.3**) indicated the peak sound levels for the assumed marine activities at various distances from the point of source (**Table 19.10**).

Table 19.10 : Maximum source levels for specific marine construction activities. Source levels are provided at varying distances from the point source.

Activity	Source Level		
	@ 10 m (unless stated)	@ 500 m	@ 750 m
Impact Piling	208dB re 1µPa	182.5dB re 1µPa	180dB re 1µPa
Vibro Piling	182dB re 1µPa	156.5dB re 1µPa	154dB re 1µPa
Dredging (backhoe from ship)	179dB re 1µPa	153.5dB re 1µPa	151dB re 1µPa

Designated Sites

Where applicable, consideration to the qualifying features of each of the designated sites Lochs Duich, Long and Alsh SAC, Inner Hebrides and the Minches candidate SAC; Lochs Duich, Long and Alsh MPA is given in the text below.

Intertidal Habitats

There is little information on the effects of noise on intertidal invertebrates. However, a study by Popper *et al*. (2001) (Ref 19-24) found that decapod sensitivity to sound was poor compared with fish. The effects of underwater noise and vibration on intertidal habitats of low value are assessed as **negligible** impact significance based on a **negligible** magnitude of change.

Subtidal Habitats

It is possible that some mobile benthic fauna (e.g. crabs and lobsters) in the subtidal communities would migrate away from the noise source(s) (i.e. piling) for the duration of the construction activity. The distance of this movement would be dependent on the magnitude of the noise source, the propagation of the sound waves through water, the distance to the original location of the receptor and the amount of disturbance caused to each species. Flame shell beds are not considered sensitive to underwater noise (Ref 19-5) nor are the qualifying features of the Lochs Duich, Long and Alsh SAC (reefs) consequently the conservation objectives of the Lochs Duich, Long and Alsh MPA and SAC would not be affected by potential noise impacts arising from the construction phase of the development.

Given that there would be no readily detectable change from the baseline conditions on this marine feature leads to a **negligible** magnitude of change. Hence, **negligible** impact significance is assessed on subtidal communities of high value from noise and vibration.

Fish

Fish responses to noise are related to the anatomy of the hearing mechanisms (Ref 19-25). The presence of a swimbladder enhances hearing sensitivity as the bladder acts as a pressure transducer, converting sound pressure to particle velocity. Flatfish (e.g. plaice), sea and river lamprey have no functional swimbladder and are relatively insensitive to sound pressure, therefore relying on particle displacement for detection of noise (Ref 19-26). In the herring family the swimbladder is connected to the hearing system via a gas duct. In other fish the connection to the inner ear is formed by a chain of bones known as the Weberian ossicles. These groups of fish are generally the most sensitive to sound.

The anatomical differences among fish mean that fish detect and process sound in different ways and on this basis have, historically, been broadly grouped into three categories: hearing non-specialists, with low sensitivity (no or reduced swimbladder), hearing generalists, with medium sensitivity (no special connection between swimbladder and inner ear) and hearing specialists, with high sensitivity (swimbladder coupled to inner ear). However, more recent work by Popper and Fay (2011) (Ref 19-27) and Popper *et al.* (2014) (Ref 19-28) suggests that these categories are not appropriate.

The ability to detect sound pressure in addition to particle motion serves to increase hearing sensitivity and widen the hearing bandwidth; with species such as cod and European eel able to detect both. However, some fish that have a swim bladder only detect particle motion (e.g. Atlantic salmon). It is worth noting that the relative importance of particle motion vs. sound pressure in the hearing capabilities of such species is likely to vary, and is at least in part related to the distance and connection between the anterior portion of the swim bladder and the inner ear (Ref 19-27). As Ref 19-28 notes, some species with a swim bladder are sound pressure-sensitive at higher frequencies (e.g. cod), while others that have a swim bladder are not (e.g. Atlantic salmon). Predicting approximate hearing sensitivity based on the anatomy of the ear and swim bladder is not always possible due to the variations found in the anatomy of the ears and swim bladders in different species (Ref 19-28). For example, work by Jerkø *et al*. (1989) (Ref 19-29) found that European eel had a relatively narrow audible frequency range, with an upper frequency limit of about 300Hz; the European eel having an extremely long distance between the sim bladder and the ear.

Species with a swim bladder and other gas chambers have a greater potential to suffer from physiological trauma (barotrauma) than those without gas chambers. Consequently, fish species that lack a gas-filled cavity such as lamprey, elasmobranchs, sandeels, some flatfishes and gobies, are not considered as vulnerable to trauma from extreme sound pressure changes as fish with a gas-filled space.

In their recent work, Ref 19-28 have proposed categories of fish sensitivity to noise based on the presence or absence of a swim bladder and on the potential for that swim bladder to improve the hearing sensitivity and range of hearing:

- Fishes with no swim bladder or other gas chamber (e.g. dab and other flatfish). These species are less susceptible to barotrauma and only detect particle motion, not sound pressure. However, some barotrauma may result from exposure to sound pressure.
- Fishes with swim bladders in which hearing does not involve the swim bladder or other gas volume (e.g. Atlantic salmon). These species are susceptible to barotrauma although hearing only involves particle motion, not sound pressure.
- Fishes in which hearing involves a swim bladder or other gas volume (e.g. Atlantic cod, herring and relatives). These species are susceptible to barotrauma and detect sound pressure as well as particle motion.
- Fish eggs and larvae.

Hearing sensitivity in larval fish and eggs is poorly researched. However, evidence reviewed by Ref 19-28 suggests that the hearing frequency range in larvae is similar to that of adults with similar startle thresholds.

In terms of behavioural responses studies have shown that fish might move away from a pile driving source; though it is not possible to say how long behavioural effects, if any, would continue following pile driving (Ref 19-28).

Several species of migratory fish are present in the waters around the development: Atlantic salmon, sea trout, European eel and river lamprey, although the latter are thought to be present in very low numbers based on the limited records.

Sea trout are considered to have hearing abilities similar to the Atlantic salmon and are assessed as being generalists (*fish with swim bladder not associated with hearing*).

River lamprey and European eel are considered to be, at the most, hearing generalists, with little in the way of anatomical adaptation to assist hearing (Ref 19-30). There has been no research to date on the response of lamprey to sound, and Ref 19-30 presented that sound may not be biologically important for lamprey. Owing to the lack of research into the hearing of lamprey, the criteria from Ref 19-30 for '*fish with no swim bladders'* has been adopted for the assessment.

The hearing ability of European eel is also poorly documented with only one known study that looked specifically at hearing in the eel (Ref 19-29). The anatomy of the eel is such that the swim bladder is positioned some distance from the ear. Therefore, for the purposes of this assessment eel are considered to be hearing generalists according to Ref 19-28. Similar to the salmonid smolts, migrating silver eel (the adult migratory form) have been shown to avoid localised, very low frequency sounds in a river.

A number of studies have been carried out to assess the potential effects of noise on salmonids. The sensitivity of Atlantic salmon to sound is considerably less than that of humans with their hearing being at lower frequencies (Ref 19-31). Therefore, it is thought that fish are more at risk of pressure pulses rupturing the swim bladder than effects on hearing (Ref 19-31).

Studies were carried out on caged brown trout (*Salmo trutta*) at varying distances from vibro-piling and impact piling operations (Ref 19-32). The trout were monitored for behavioural and physiological changes and at the end of the experiments examined for signs of physical injury resulting from pressure damage (e.g. swim bladder rupture, haemorrhaging) from the piling operations. Results showed no evidence of gross physical injury or reaction to impact piling noise in any of the trout held in the cage at a distance of approximately 400m from the impact piling (where the sound level would have been approximately 134dB re 1μPa). The indications are, therefore, that noise from impact piling would not cause serious physical injury (swim bladder rupture, haemorrhaging) to salmonids at distances of more than 400m from the sound source. The study also indicated that trout showed little reaction to vibro-piling even at short distances of less than 50m from the noise source.

Underwater noise modelling for the development has identified that of all construction activities, impact piling will generate the highest predicted peak sound pressure levels at 208dB re 1µPa at a distance 10m. Using the criteria stated by Popper *et al*., (Ref 19-28), underwater noise at this level has the potential to cause mortality or mortal injury in fish such as sea trout and Atlantic salmon. However, the main form of piling to be used for the development is likely to be vibro-piling which has a predicted peak sound level of 182dB re 1µPa at a distance of 10m. These noise levels are is unlikely to cause any injury or temporary threshold shift; based on criteria from Popper *et al*. (2014) (Ref 19-28).

Continuous noise sources such as vibro-piling, dredging and vessel movements have no defined sound levels as criteria at which injury or behavioural effects would be observed in fish. Instead arbitrary distances of effect are given, with the level of risk dependent on the hearing ability of the fish. For hearing generalists injury (mortal or recoverable) is considered low risk even at distances close to source, with the potential for behavioural effects being moderate within hundreds of meters.

Migratory species are known from the area, though it is considered that they would only be transiting past the development site during feeding migrations or movement to natal rivers. Sites that are considered of importance for these species are some kilometres from the development site. It is therefore considered that impacts associated with underwater noise on migratory species are of **small** magnitude and **minor adverse** significance as they are unlikely to be detectable, with at most localised displacement.

Baseline data has shown that non-migratory species in the area include species such as gadoids (Pollack, saithe and poor cod), gobies, and dogfish. Noise sensitive clupeids (herring and sprat) are also present in the region (see **section 19.4.4**) and it is considered that these would be susceptible to temporary disturbance from the piling works.

Underwater noise modelling for the development has identified that of all construction activities, impact piling will generate the highest predicted peak sound pressure levels at 208dB re 1µPa at a distance 10m. Using the criteria stated by Popper *et al*. (2014) (Ref 19-28), underwater noise at this level has the potential to cause mortality or mortal injury in noise sensitive species such as clupeids. However, the main form of piling to be used for the development is likely to be vibro-piling which has a predicted peak sound level of 182dB re 1µPa at a distance of 10m. These noise levels are is unlikely to cause any injury or temporary threshold shift; based on criteria from Popper *et al*. (2014) (Ref 19-28).

Continuous noise sources such as vibro-piling, dredging and vessel movements have no defined sound levels as criteria at which injury or behavioural effects would be observed in fish. Instead arbitrary distances of effect are given, with the level of risk dependent on the hearing ability of the fish. For hearing specialists injury (mortal or recoverable) is considered low risk even at distances close to source, with the potential for behavioural effects being high within tens of meters and reducing to moderate within hundreds of meters.

The species identified from the area are common and are prevalent along the wider coastline. There are recognised spawning grounds in the area for sand eel sprat and whiting, but are considered extensive across the UK. Marine construction and underwater noise has the potential to result in temporary displacement of fish from the local area for the duration of marine works which would result in impacts of **small** magnitude on receptors of medium to low importance. From this an impact significance of **negligible** is given for non-migratory fish from underwater noise, based on the short duration and localised impact which would be undetectable beyond the duration of the activity.

Marine Mammals

The auditory system in marine mammals is similar to that in terrestrial mammals, in that hearing apparatus can be divided into the outer ear, an air-filled middle ear and a liquid filled inner ear. In odontocetes (toothed cetaceans), sound is channelled to the middle ear through the lower jaw (Ref 19-32), whilst in mysticetes (baleen whales) sound is channelled in two ways, either through the soft tissue or through the skull itself (Ref 19-33).

Pinnipeds' hearing capabilities both in air and water have been reviewed by Department of Commerce (DoC) (Ref 19-34) (2008) who stated that the hearing range for this group is greatly reduced in air to 1kHz to 22kHz with sensitivity at 12kHz, compared to 1 to 180kHz in water with peak sensitivity at around 32kHz. The common seal has a hearing range from 1kHz to 60kHz (Ref 19-35) with sensitivity between 8 and 35kHz.

The absolute hearing threshold is the minimum sound level at a specific frequency that can be heard in the absence of any other sounds. In mammals, exposure to sound levels above absolute hearing thresholds can result in either a temporary threshold shift (TTS), when hearing sensitivity returns to normal after temporary loss, or a permanent threshold shift (PTS) when hearing is lost permanently.

There have been various studies looking at the effects of noise on marine mammals from which criteria have been established that set noise levels at which PTS and TTS are likely to occur. Southall *et al*. (2007) (Ref 19-36) presented a set of interim criteria for noise levels that may result in PTS or TTS for marine mammals. The Southall *et al*. (Ref 19-36) criteria are generally based on marine mammals grouped by hearing sensitivity as follows:

- Low-frequency cetaceans (7Hz to 22kHz);
- Mid-frequency cetaceans (150Hz to 160kHz);
- High-frequency cetaceans (200Hz to 180kHz);
- Pinnipeds in water (75Hz to 75kHz); and
- Pinnipeds in air (75Hz to 30kHz).

More recent studies for harbour porpoise have indicated that this species is potentially more sensitive than as generalised in the Ref 19-36 study. More strict criteria have therefore been developed (Ref 19-37) based on work by Lucke *et al*. (2009) (Ref 19-38) and Kastelein *et al*. (2012) (Ref 19-39).

Behavioural responses of marine mammals to noise are highly variable and dependent on a suite of internal and external factors (Ref 19-35). Behavioural responses can include changes in surfacing patterns, cessation of vocalisations, active avoidance of or exit from the area (Ref 19-35). It is likely that responses are context-specific, and internal factors include individual hearing sensitivity and tolerance, activity pattern, motivational and behavioural state at the time of exposure, past exposure of the animal to the noise (which may have led to habituation or sensitisation), predation risk and demographic factors such as age, sex and presence of dependent offspring. External factors that influence behavioural responses of marine mammals can include the size of the sound source and whether the sound source is stationary or moving (e.g. a vessel). Physical habitat characteristics can also influence sound transmission, such as being in a confined location or in proximity to a shoreline.

Piling activities are anticipated to be completed from the land with rigs positioned on the existing pier or on temporary pontoons floated into position. Although impact piling is unlikely, it is envisaged that there would be a need to socket the piles to resist shear forces at the southern quay wall. Marine piling work would last approximately 14 weeks.

The noise levels for impact piling that were modelled for the development are below the criteria as defined by Southall *et al*. (2007) (Ref. 19-36) for TTS in high frequency cetaceans. Other criteria from Nehls *et al.* (Ref 19-37) criteria based on data from Lucke *et al.* (Ref 19-38), Kastelein *et al.* (Ref 19-39) for assessing PTS and TTS in harbour porpoise, are:

- PTS in harbour porpoise at levels exceeding 180dB re 1μPa^{2}s unweighted Sound Exposure Level (SEL) (single strike) (using the method described in Ref 19-36, where PTS onset is estimated to occur at 15dB above the level of TTS onset); and
- TTS in harbour porpoise at levels exceeding 165dB re 1μPa^{2}s unweighted SEL (single strike), which was used by Tougaard (Ref 19-40) based on data from Ref 19-38) and Ref 19-39.

There have been limited studies on the effects of piling on marine mammals and the findings have been variable. Piling generates very high sound pressure levels which cover a range of frequencies typically in the order of 20Hz to greater than 20kHz (Ref 19-32).

Studies of pile driving activity on an offshore windfarm construction site recorded a temporary drop in acoustic activity of harbour porpoises during piling. However, the activity returned to baseline levels three to four hours later. Temporary avoidance of the area was also observed up to 15km from the source of the piling noise although no observations were made at a greater distance (Ref 19-40).

A more recent study carried out by Bailey *et al*. (2010) (Ref 19-41) in the Moray Firth region found background noise levels ranged between 104 to 119dB re 1µPa with a maximum of 138dB re 1µPa within 1km of the construction site. Impact piling at a rate of 0.8 hammer blows per second gave an SL of 226dB re 1µPa at 1km decreasing to 152dB re 1µPa at 25km.

These measured noise levels would have induced PTS at 5m (cetaceans) and 20m (pinnipeds) whilst the TTS zone was measured at 10m (cetaceans) and 40m (pinnipeds). Strong avoidance behaviour was expected to a distance of 25km from the source for cetaceans whilst pinnipeds zone was smaller at 14km (Ref 19-41).

It is anticipated that the diameter of the combi piles will be 1220mm and for the infill sheet piles will be 1220-1300mm with H-piles (365x356x133) used for the ship unloader. Additional modelling taking these works into consideration (**Appendix 19.4**) provided outputs for vibro-piling and impact piling in relation to PTS and TTS in harbour porpoise using the criteria in Ref 19-36 and these are shown in **Table 19.11**.

Table 19.11 : Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) from vibro-piling for harbour porpoise using the Southall *et al* (2007) (Ref. 19-35) criteria (Appendix 19.4).

Harbour porpoise TTS and PTS criteria	Tubular piles (1225mm diameter) and Sheet piles (1220–1300mm)		Steel H-piles (365 x 356 x 133mm)	
	Vibro-piling	Impact piling	Vibro-piling	Impact piling
230dB re 1µPa^{2}s (SPL$_{peak}$) (PTS in harbour porpoise)	<1m	<1m	<1m	<1m
218bB re 1µPa^{2}s (SPL$_{peak}$) (**TTS** in harbour porpoise)	<1m	3m	<1m	<1m
215dB re 1µPa^{2}s(M$_{hf}$) (M-Wtd SEL) (**PTS** in harbour porpoise, multiple pulse)	<1m	3m	<1m	<1m

The modelling was based on criteria defined from Nehls *et al.* (2014) (Ref 19-37), Tougaard (2013) (Ref 19-40) and Lucke *et al (*2009) (Ref 19-38), all cited in Barham and Mason (2016) (**Appendix 19.4**) which assumed continuous piling and predicted the following SEL outputs:

- Tubular piles
  - PTS is likely within 1m from the source for vibro-piling and 21m from source for impact piling.
  - TTS is likely up to 19m from the source for vibro-piling and 224m from source for impact piling.
- Sheet piles
  - PTS is likely within 1m from the source for both vibro-piling and impact piling.
  - TTS is likely up to 5m from the source for vibro-piling and 7m from source for impact piling.

For vibro-piling behavioural avoidance could be exhibited up to 250m from the source of sound for tubular piles and up to 68m from the sheet piles. Both vibro-piling tubular and sheet piles allows free movement of harbour porpoise outside this area and no barrier effects preventing transiting to the east of the Proposed Development.

For impact piling of tubular piles behavioural avoidance could extend up to 4.8km from the source of sound and 145m from the source of sound for sheet piles. Owing to the topography of the surrounding area, continuous impact piling of tubular piles could create a barrier effect for the harbour porpoise to the east of the Proposed Development. The level of sound could be such that 145dB SEL prevents harbour porpoise from utilising this area for the duration of the 14 week piling works. Continuous impact piling of sheet piles shows only a very small behavioural impact zone (145m) allowing free movement of harbour porpoise outside this area and no barrier effects preventing transiting to the east of the Proposed Development.

Barham and Mason (2016) (**Appendix 19.4**) also incorporated interim criteria defined from NOAA (2016) (Ref 19-42) and assuming continuous piling predicted the outputs for both tubular and sheet impact piling are shown in Table 19.12.

Table 19.12 : NOAA interim sound thresholds (Level B - Behavioural disruption) for impact piling and vibro-piling on marine mammals (Appendix D).

NOAA Interim Sound Thresholds (Level B behavioural disruption) in Marine Mammals	Tubular piles (1225mm diameter) and Sheet piles (1220–1300mm)	Steel H-piles (365 x 356 x 133mm)
160dB re 1µPa (RMS) (Impulsive noises e.g. impact piling)	490m	160m
120dB re 1µPa (RMS) (Non-pulse noise – e.g. vibro-piling)	11km	3.1km

Modelling outputs for dredging are incorporated into Barham and Mason (2016) (**Appendix 19.4**). It is assumed that backhoe dredging would be the method of choice for the Proposed Development. Outputs for PTS and TTS in harbour porpoise based on the Southall *et al.* (2007) (Ref. 19-35) criteria are shown in Table 19.13.

Table 19.13 : Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) from backhoe dredging for harbour porpoise using the Southall *et al* (2007) criteria (Appendix 19.4).

Harbour porpoise PTS and TTS	Backhoe dredger
230dB re 1µPa^2s (SPL_{peak}) (**PTS** in harbour porpoise)	<1m
218dB re 1µPa^2s (SPL_{peak}) (**TTS** in harbour porpoise)	<1m
215dB re 1µPa^2s(M_{hf}) (M-Wtd SEL) (**PTS** in harbour porpoise, multiple pulse)	<1m

Modelling based on criteria from Nehls *et al.* (2014), Tougaard (2013) and Lucke *et al* (2009) (see **Appendix 19.4**) and assuming continuous backhoe dredging provided the following SEL output:

- Backhoe dredger – PTS is likely at source to less than 1m away with TTS exhibited up to 2m from the source of sound.

Modelling shows that behavioural avoidance would be exhibited up to 14m from the source of sound for backhoe dredging. Therefore beyond 14m would allow for free movement of harbour porpoise and thus no barrier effects preventing transit to the east of the Proposed Development are predicted.

Modelling based on interim criteria defined by Ref 19-42 and used by Barham and Mason (2016) (**Appendix 19.4**), assumed continuous dredging. The outputs from this modelling are given in **Table 19.14**.

Table 19.14 : NOAA interim sound thresholds (Level B - Behavioural disruption) for dredging for marine mammals (Appendix 19.4).

NOAA Interim Sound Thresholds (Level B behavioural disruption)	Backhoe dredging
120 dB re 1 μPa (RMS) (Non-pulse noise e.g. dredging)	220m

It is anticipated that without mitigation, noise from piling may cause TTS or at worst PTS in cetaceans. High source noises emitted at low frequencies are of particular concern for the minke whale which uses the lower frequencies for communication and finding prey. The harbour porpoise may demonstrate avoidance behaviour and a temporary drop in acoustic activity.

Barham and Mason (2016) (**Appendix 19.4**) provided the modelling outputs for vibro-piling and impact piling in relation to PTS and TTS in harbour seal using the Southall *et al.* (2007) criteria. These are shown in **Table 19.14**.

Table 19.15 : Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) from impact piling for harbour seal using the Southall *et al* (2007) criteria (Appendix 19.4).

Harbour seal PTS and TTS	Tubular piles (1225mm diameter) and Sheet piles (1220–1300mm)		Steel H-piles (365 x 356 x 133mm)	
	Vibro-piling	Impact-piling	Vibro-piling	Impact piling
224dB re 1µPa2s (SPL_{peak})	<1m	1m	<1m	<1m
212dB re 1µPa^{2}s (SPL_{peak}) (TTS in harbour seal)	<1m	6m	<1m	<1m
186dB re 1µPa^{2}s(M_{pw}) (M-Wtd SEL) (PTS in harbour seal, multiple pulse)	<1m	340m	<1m	<1m

Both vibro-piling tubular and sheet piles allow free movement of harbour seal outside of the immediate vicinity of the Proposed Development and thus no barrier effects, preventing transiting to the east of the Proposed Development, or any other haul-out sites in the vicinity of the development, are predicted.

Barham and Mason (2016) (**Appendix 19.4**) provided the following modelling outputs using the SPEAR model for dredging on PTS and TTS in harbour porpoise using the Southall *et al.* (2007) criteria. These are shown in **Table 19.15**.

Table 19.16 : Temporary Threshold Shift (TTS) and Permanent Threshold Shift (PTS) from dredging for harbour seal using the Southall *et al* (2007) criteria (Appendix 19.4).

Harbour seal using PTS and TTS	Backhoe dredger
224dB re 1µPa^{2}s (SPL_{peak}) (**PTS** in harbour seal)	<1m
212dB re 1µPa^{2}s (SPL_{peak}) (**TTS** in harbour seal)	<1m

Backhoe dredging allows the free movement of harbour seal beyond 1m from the Proposed Development and thus there are no barriers that prevent transit to the east of the Proposed Development or any of the haul-out sites in the vicinity of the development.

There are many vessel movements within the immediate vicinity of the proposed development. Ships enter and leave Kyle of Lochalsh and also transit around the Isle of Skye (Harland *et al*., 2016) (**Appendix 19.3**). The Proposed Development requires a number of vessels for transportation of goods to and from the works however, it is unlikely that the additional vessel movements will significantly add to the general noise level and so are not considered as a source of significant underwater noise disturbance.

Noise generated from piling activities could cause either TTS or PTS depending on the distance from the source, SL and frequency. It is likely that marine mammals will exhibit avoidance behaviour during the period of piling activity at distances up to 25km from the source (if impact piling is required). However, due to the temporary nature of the noise, the piling activity would not have a permanent effect on marine mammal populations and thus the integrity of this receptor, while any changes to marine mammal behaviour would be considered undetectable within a year after the source of impact is removed. Therefore, the potential impact on marine mammals (cetaceans and pinnipeds) from noise and vibration is assessed as having a **small** magnitude of change and hence an impact significance of **minor adverse** is given.

As there is potential for accidental disturbance of individual cetaceans during the construction phase an EPS licence application will be made following consent (**Table 19.5** and **section 19.6.1.2**).

19.5.1.2 Sediment dispersion - Capital dredging

The main environmental effects in the construction phase are considered to be the potential for increases in suspended sediments and sediment deposition from dredging (see **Table 19.3**). The potential for resuspension of sediment bound contaminants and habitat loss are covered in separate sections below (**section 19.5.1.3** and **19.5.1.4**).

During the construction phase, loss and dispersion of sediment will primarily take place during backhoe dredging excavation.. The extent of the loss will depend on the nature of the material being dredged. **Chapter 18** of this ES considers the sediment plume generated by backhoe dredging and reference is made throughout this section to the conclusions of **Chapter 18** and also the outputs from the directed modelling work (**Appendix 18.3**).

As stated in **Chapter 2,** dredged material will not be disposed at sea during the capital dredging works; and will instead be relocated and stockpiled at the quarry for reuse. Consequently, the potential impact of dredge disposal on marine ecological receptors is not considered further. Although dewatering of the dredged material within the settlement lagoon and into the marine environment will result in some resuspension of fines, this will be minimal due to the dredging methodology employed. The duration of the capital dredging activity will be approximately 14 weeks, with the work being carried out 24 hrs a day and seven days a week (see **Chapter 2**). However, for the purposes of the modelling a continuous duration of 84 days was assumed (**Appendix 18.3**).

Ground investigative work has been carried out to determine the nature and composition of the sediment (**Appendix 18.2**). Composition of the sedimentary material varies in proportions with PSA from grab samples giving a very low silt content (less than 4%) as compared to the vibro cores, which had a higher silt content ranging from 50% to 5% in the sands and only 5% in the sandy gravel. The average silt content was 18% from all the vibro cores.

Sediment Dispersion

All methods of dredging release suspended sediments into the water column with the effect being a localised increase in suspended sediments and turbidity. The plume generation (i.e. extent and concentrations of suspended sediments) is dependent on factors such as quantity, type of sediment, dredging methodology and local hydrodynamic processes (e.g. wave regime and tidal flow). Strong tidal movements in the area will assist with the dispersion of suspended sediments generated during the dredging works. Modelling work by RPS has shown that the strongest tidal flows take place during the peak ebb and peak flood periods, these occurring approximately 1.5 hours before mid-ebb and mid-flood on a typical spring tidal cycle (**Appendix 18.1**).

Directed sediment plume outputs investigated the typical increase in total suspended sediment concentrations (SSCs) from the backhoe dredging. It was found that the increase in SSCs did not generally exceed 30mg/l and where they do, increases are highly localised (<$200m^2$) and very short in duration (see **section 18.6.2** and **Appendix 18.3**). Under normal tidal conditions there were no increases in SSCs greater or equal to 10mg/l beyond either the overall dredge extent or the -9.5m CD contour to the north.

Furthermore, the average increase in SSCs over the dredging campaign indicated that there would be no changes in SSCs >10mg/l either within or beyond the overall dredge extent. Investigation of the maximum SSCs (i.e. the maximum value that occurs at each point in space at any time throughout the dredging operation even if it only occurs for one numerical time step) found that beyond the dredging extent SSCs did not generally increase by more than 30 mg/l. Over the comparatively small area of the flame shell bed that the maximum SSCs plume overlapped the increase was ~15 mg/l (see **Appendix 18.5**). However, the modelling outputs showing the mean total SSCs and typical total SSCs (see **Appendix 18.3**) did not record any increase in SSCs over the flame shell bed.

Modelling outputs of sediment deposition at the end of the backhoe dredging programme showed values of ≤0.10m, while across the majority of the study area deposition was approximately 0.005m (0.5 cm). Across the flame shell bed deposition of sediment was below 0.0005m (0.5mm) (**section 18.6.2** and **Appendix 18.3**).

Investigation of the maximum deposition, encompassing the depth of sediment over the area at any time during the dredging operation and assuming no resuspension, showed minimal increases in deposition (0.005m) beyond the immediate proximity of the dredged area. From the maximum deposition output a very small amount of material (<2mm) was predicted to deposit over a highly localised area of the flame shell bed (see **Figure 18.7** and **Appendix 18.5**)**.** However, this deposition would only occur for a short-time during the turn of the tide i.e. at slack water. This indicates that the flame shell bed area is totally dispersive to any capital dredged plume material generated.

It should also be noted that, subsequent to the completion of the dredge scenario modelling, the decision was taken to reduce the extent of the dredge area along the north western corner (see **Figure 18.5**). This dredge area was adjacent to the localised flame shell area that temporarily received the small amount of deposition (<2mm) predicted by the model. Therefore the subsequent reduction in the dredged area would likely reduce the level of temporary deposition.

Recognition of the above provides a useful foundation for considering the effects of the changes to sediment dispersion on marine ecology receptors during the construction phase. Potential adverse effects on marine flora and fauna from increases in suspended sediment concentrations include the possible reduction of light penetration into the water column e.g. reduction of growth and/or productivity in aquatic flora (Parr *et al*., 1998) (Ref 19-43); the physical action of the increased suspended solids e.g. damage to filter feeders and juvenile fish gills (see Ref 19-43 and Wilbur (1971) (Ref 19-44). Adult fish are likely to move away from or avoid areas of high suspended solids, such as dredging sites, unless food supplies are increased as a result of increases in organic material (ABP Research, 1997) (Ref 19-45).

Once the dredged material settles, it can cover benthic flora and fauna; however, the effect of this deposition is dependent on the sensitivity of the receptor, with specific consideration given to the duration and quantity of deposition. A degree of resuspension of settled material over subsequent tides is predicted, which will further reduce the impact of localised sediment accruement, whilst dispersal of re-suspended material beyond the dredge area will rapidly fall back to natural levels.

Intertidal Habitats

Modelling predictions of the sediment plume showed very limited deposition on the intertidal area (**Appendix 18.3**) and it is considered any changes to baseline conditions would not be readily detectable. Hence, a **negligible** magnitude of change is assigned leading to a **negligible** impact significance based on intertidal habitats of low value.

Subtidal Habitats

Diver surveys confirmed the presence of several kelp biotopes in and around the vicinity of the Proposed Development (**Appendix 19.1**). All of these biotopes are considered PMFs (**section 19.4.3.4**) and have been assigned a value of 'medium'. Further afield, the modelling work has not predicted that either the mean increases in suspended sediment concentrations (SSCs) or sediment deposition levels at the end of the dregding campaign would overlap or occur over the qualifying features of the Lochs Duich, Long and Alsh SAC (reefs) and Lochs Duich, Long and Alsh MPA (flame shells and burrowed mud) (**Appendix 18.3**). Furthermore the dredging programme at Kyleakin would not result in significant changes to the water quality to which the reefs are exposed (**sections 17.6.1.1 and 17.8**); hence, the conservation objectives of these sites would not be affected. The qualifying feature of the Inner Hebrides and the Minches cSAC (harbour porpoise) is considered within marine mammals (below).

As previously noted, both MarLIN and FEAST have been used to derive the level of sensitivity that kelp habitats (tide-swept algal communities, kelp and seaweed communities on sublittoral sediment) have to the effects of sediment dispersion. FEAST lists kelp habitats as having a medium tolerance to changes in water clarity (increased turbidity) and changes in siltation (5 cm deposition) with a high recoverability.

Based on the short term nature of the dredging works, the minimal increase in SSCs and the low level of deposition expected over the majority of the affected area (<0.5cm); combined with the high recoverability of the kelp habitats, a **small** magnitude of change is assigned on kelp habitats. This leads to an impact significance of **minor adverse** for the effect of sediment dispersion on subtidal habitats and specifically the kelp PMFs.

Fish

Elevated suspended solids can cause chronic and acute effects on fish, including clogging and abrasion of gills, thickening and proliferation of the gill epithelium, reduced resistance to disease, reduced growth rate and in extreme cases mortality. However, very high levels are required to induce mortality, for example, Alabaster and Lloyd (1980) (Ref 19-46) exposed rainbow trout to concentrations of 80,000mg/l suspended solids over a period of one day, with concentrations needing to be raised to over 160,000mg/l to induce mortality over the same period.

By comparison the increases in SSCs from the Proposed Development will be minimal, generally equating to no more than 30 mg/l and then only during certain periods of the tidal cycle within highly localised areas. Typical sediment concentrations will be raised above baseline within the dredged area for the duration of the capital dredging, but only in highly localised patches. The minimal increases in SSCs and the small extent of the plume, this also occurring in a west-east rather than north-south orientation, would not prevent migrating fish species from moving through the area. .

By the end of the dredging programme the majority of the area affected by sediment deposition will receive <0.5cm. Although patches exceeding this value are predicted, specifically in the southern area of the dredging extent, the low level of deposition as a whole would not have a detectable effect on fish populations.

Given the above, the magnitude is assigned as **negligible** leading to an impact significance of **negligible** on fish species (including migratory) from sediment dispersion.

Marine Mammals

Given the vast foraging ranges of cetaceans and pinnipeds and their ability to inhabit waters of high turbidity (e.g. Thames estuary), the small plume generated by the dredging programme would not have detectable effect on marine mammals. Hence a **negligible** magnitude of change is assigned and consequently an impact significance of **negligible**.

19.5.1.3 Resuspension of Contaminated Sediments

Subject to the presence of elevated levels of contamination, the process of resuspension and redistribution of sediments, during dredging, can result in the re-distribution of contaminants of concern with consequential effects on water quality and potentially the benthic environment. During any disturbance of sediment and re-suspension in the water column, there would be a risk of pollutants being mobilised into the aquatic environment, becoming bioavailable to ecological receptors. However, this is unlikely as, for example, metals and hydrocarbons are likely to remain preferentially bonded to the fine sediment with fines likely to rapidly dispersed, especially where there are strong currents. Fine sediments form a small component of the proposed dredged material therefore the potential for significant sediment contamination is low.

A number of construction activities have the potential to cause resuspension of sediment bound contaminants within the water column; however, for the Proposed Development capital dredging activity (excavation) will be the predominant source.

Reference is made to the assessment of impact significance made on water quality for the resuspension of contaminated sediments (**section 17.6.1.2**). On the basis of the very low concentrations of contaminants and the strong dispersion and dilution capacity of the water body, an impact significance of **negligible** was given on the potential for effects on water quality.

Hence, a **negligible** magnitude of change is predicted based on the unlikelihood of any detectable effect on the marine ecological receptors. As such, an impact significance of **negligible** is assessed against the potential effects of re-suspended contaminated sediment on all marine ecology receptors identified.

19.5.1.4 Habitat Loss and Fragmentation

Approximately 6.85 ha of marine habitat (below MHWS) will be directly affected by the footprint of the marine works. This will result in temporary and permanent loss of subtidal and intertidal habitat potentially leading to fragmentation. However, in some areas a loss of subtidal habitat will lead to a gain of intertidal habitat (i.e. through placement of rock armour). Conversely, gain of subtidal habitat will lead to a loss of intertidal habitat in other areas (i.e. removal of intertidal area along the south eastern side of the pier to accommodate berthing of vessels).

Of the 6.85 ha affected, approximately 1.4 ha of marine habitat will be lost permanently through the construction of the slipway, extension of the pier, land reclamation and placement of the long sea outfall; however, it is recognised that much of this area is represented by rock armour and barren shingle habitats (see below). Of this 1.4 ha, approximately 0.4 ha of intertidal habitat will be replaced by 0.4 ha of subtidal habitat during construction.

The remaining 5.45 ha of marine habitat will be temporarily affected during the construction phase and, following completion of the construction activities, will provide a suitable environment for recolonization once capital dredging works have ceased. The majority of this area will be represented by the residual dredged extent (approximately 5.2 ha).

Consideration is given to the potential anchoring requirement for construction related vessels. However, construction vessels will generally moor to the existing pier with most craft not directly using the pier for mooring instead using the Kyle of Loch Alsh as a port facility rather than anchoring. Although some limited anchoring may be required by construction related vessels, this will all take place within the boundary of the dredged extent.

Placement of the long sea pipe will likely be achieved by a combination of divers and a small mobile vessel, with no requirement for anchoring or jack up barge (see **Chapter 2)**.

Hence all anchoring in the construction phase will take place within the boundary of the dredged area and would therefore not result in any additional impact on ecological receptors. Given the above, the effects of anchoring are not considered further in the construction phase.

The potential effects of propeller wash on geomorphology in the construction phase were considered in **Chapter 18** and supported by **Appendix 18.1**. It is not expected that propeller wash would have any detectable effect on the seabed adjacent to the dredged area. Hence, it is considered that any changes to the geomorphology would be within the range of natural variability and consequently an assessment of **negligible** has been given for the magnitude of change (**section 18.6.2**). Furthermore, from the conclusions made there will not be any detectable effect from propeller wash on the flame shell bed. Given the above, the effects of propeller wash on marine ecological features are not considered further in the construction phase.

Intertidal Habitats

Approximately 1.2 ha of intertidal area will be directly impacted by the works. Much of this represents an area that has been previously modified, and currently supports rock armouring to the immediate east and west of the pier. Consideration is given to the integrity of the intertidal receptors (i.e. barren mobile shingle and rock armour) and how the removal or modification of habitat would affect the overall intertidal area.

Of the intertidal area impacted by the works it is approximated that 1.1 ha will be permanently lost, with about half of this being represented by barren shingle and the remainder by rock armouring. The barren shingle represents the natural intertidal habitat for this area, extending more than a kilometre to the west and east of the Proposed Development, with the exception of a gap underneath the Skye Bridge. Hence, the barren shingle habitat permanently removed represents a very small portion (<0.1%) of this feature in the area. It is also recognised that the provision of rock armouring on some areas previously represented by barren shingle will provide a more stable habitat and increase local biodiversity.

The long sea outfall pipe and concrete collars will be placed along the intertidal using open cut methods and will temporarily remove approximately 0.05 ha of intertidal habitat; however, given the nature of the mobile shingle in this area, following completion of the construction works the pipe and concrete mattresses will be covered within a few tidal cycles.

Given the above and the very low diversity of the shingle and, to a lesser extent, rock armour habitats, it is not considered that the proposed changes as a result of the construction works would affect the ecological structure or the function of these habitats to the overall ecosystem and hence would not permanently or temporarily affect the integrity of the intertidal features.

Consequently, the magnitude of change has been assigned as **negligible** leading to an impact significance of **negligible** on intertidal features of low value.

Subtidal Habitats

The baseline survey revealed that the subtidal seabed within the footprint of works is a mixture of kelp habitats, comprising component PMF biotopes. On the basis that a similar physical environment exists throughout the local area, to the west and east of the development, it is assumed that along a similar depth contour, the habitats beyond the footprint of the works represent a continuation of the same features i.e. kelp habitats.

The Proposed Development would permanently remove approximately 0.3ha of subtidal habitat (kelp communities on sublittoral sediment).

As a consequence of the dredging the majority of the impacted subtidal habitat will be temporarily removed, the remaining substrata providing material for potential recolonization by kelp, though it is considered that some fragmentation may occur across the dredged area due to the loss of suitable attachment material e.g. cobbles and small boulders.

Extending to the east and west of the Proposed Development is an extensive continuation of the kelp biotopes. Therefore the kelp habitats affected by the works will represent a small percentage of the overall feature in this area and it is not considered that the changes to these features would permanently or detectably affect the ecological structure or the function of these kelp communities to the subtidal ecosystem here or elsewhere in the region.

Dredging will remove the surface layer of the seabed to a depth of 8.5m BCD. The boundary of the flame shell bed to the north of the development is at 9.5m BCD, with the gap between the northern dredging extent and the flame shell bed being >20m in all areas except for a small area where the gap is approximately 17m. There would therefore be no loss of flame shell bed. Consideration is given to the ecological coherence between the adjacent kelp habitat and the flame shell bed; however, there will be a buffer zone of approximately 20m between the dredged area and the flame shell bed, this being represented by kelp communities. Acknowledging that the kelp habitats extend much further to the east and west, along the edges of the flame shell bed and beyond, there would be no detectable effect on the flame shell bed’s community or its health, function and extent.

Given the above conclusions, the potential impact from habitat loss and fragmentation on subtidal habitats is assigned a **small** magnitude of change leading to an impact significance of **minor adverse.**

Fish

A wide range of fish species, encompassing a number of different life histories have been reported from the Inner Sound (section 19.4.4). The subtidal habitats within the proposed dredged area support species with predominantly benthic life histories, utilising the bed for feeding, nursery or prey avoidance. The loss of habitat during capital dredging, therefore, has the potential to result in habitat loss, and displacement of these fish species. Given the extensive presence of similar habitat types (i.e. tideswept kelp habitats on mixed substrata) beyond the dredging area, and the small area impacted from the placement of the outfall pipe, fish will be able to move to adjacent unaffected areas of similar physical and biological character. On completion of the capital dredging works, some recolonization of the subtidal habitat will take place (see above) and fish will occupy this localised area. The rate of recolonization by fish will be determined by the development of habitat complexity across the affected area. Pelagic species, those inhabiting the water column, are unlikely to be significantly affected by the temporary loss and fragmentation of benthic habitat; however, fish species preying on benthic invertebrates and benthic dwelling fish (for example gobies) may be displaced into adjacent areas during the capital dredging activity.

Given the mobility of marine fish species, proximity to alternative habitat and potential for recolonization of the affected area on completion of the capital dredge, the impact significance is assessed as **negligible** for marine fish (including migratory species) from habitat loss and fragmentation.

19.5.1.5 Pollution

This section covers the potential impacts of accidental fuel, oil and chemical spillages, in addition to the potential effects of light pollution, on marine receptors as a result of the general marine works and vessel movements. The impacts of suspended solids from construction are discussed in **section 19.5.1.2.**

Spillages (fuel, oil and chemical)

Accidental spillage and/or leakage from mobile or stationary plant and vessels could result in the release of oils, fuels or chemicals into the water. Many mineral oils and other hydrocarbons are toxic, persistent and bio-accumulate in the environment. Additionally, biodegradation of oils in aquatic systems can lead to oxygen depletion.

The implementation of best practice management measures, during construction and operation, would be the mechanisms to minimise the occurrence and risk of such incidents (fuel, oil and chemical) and their potential effects on the marine receptors (see sections 19.6.1.1). These management measures are therefore considered as generic (embedded) mitigation.

Consideration is given to the total duration of the works (approximately 17 months) and the nature of the activities proposed. Acknowledging the high dilution and dispersion capacity of the receiving water body, the impact significance of accidental oil, fuel and chemical spillages on marine ecology, assuming implementation of the embedded mitigation the residual impact significance is assessed as **negligible** for each of the marine ecological receptors in the construction phase.

Light Pollution

Artificial light will be highly localised around the Proposed Development during the construction phase. Dredging works will be undertaken over 24 hours, 7 days a week for up to 14 weeks. Specific consideration is given to the migratory fish species that utilise the area. Light pollution may create temporary avoidance behaviour in mobile species. It is predicted that any behavioural change will be temporary and short term, and due to the highly localised nature of the artificial lighting from the construction works, lead to a **negligible** magnitude of change and consequently an assessment of **negligible** impact significance on all marine ecology receptors.

19.5.1.6 Vessel Strikes

During the construction phase a number of vessels are anticipated (e.g. dredger, barges and work boats); however, small workboats and crew transfer boats will represent the main movements beyond the immediate proximity of the Proposed Development (see **Appendix 16.1**).

The capital dredging activity, estimated to take up to 14 weeks, would involve the constant presence of a dredger and barge (depending on method employed) with short trips made by the barges between the dredger and temporary jetty. A very low degree of tug boat movements will also take place during the construction phase (see **Appendix 16.1**).

Recognition is given to the potential impact of vessel strikes on marine mammals as a result of increased vessel movements. However, the highly localised and low number of vessels movements in the construction phase is unlikely to have any detectable effect on marine mammal populations.

Given the above a **negligible** magnitude of change is assigned leading to an impact significance of **negligible** on marine mammals from the potential for vessel strikes.

19.5.1.7 Introduction of (invasive) Non-native Species

The increase in vessel movements during the construction phase has the potential to introduce non-native marine species, some of which could be invasive.

During construction, there is potential for vessels transiting to and from the Proposed Development to have originated from different biogeographical locations. These could act as vectors for the introduction of non-native species, potentially invasive species, which could arrive on vessel hulls or in ballast water. In addition, the modification of the substratum under the footprint of the dredge could present an opportunity for colonisation by non-native species. It is difficult to predict the impacts on native habitats and species as this would be dependent on which non-native species were introduced; however, some non-native species are able to colonise quickly and can aggressively out-compete native species.

Sargassum muticum has been recorded from the marine environment adjacent to the Proposed Development (Appendix 19.1). This algal species is capable of rapid growth, has a high fecundity and is able to seed from mobile spores. Recent disturbed sediments, free of competition from other macroalgae may increase the likelihood of this species establishing.

However, consideration is given to the fairly exposed nature of the site, the strong tidal flows and tidal excursion. Unlike sheltered bays and marinas where an artificial and highly sheltered environment is created the area being affected by the Proposed Development will continue to be moderately exposed to strong currents and waves. Given the above, a **small** magnitude of change and, hence, a **minor adverse** impact significance is assessed against the potential for the introduction of non-native species on marine habitats.

19.5.2 Operation Phase Impacts

The key operational activities which could have an impact on the marine environment include the following:

- General facility related activities e.g. loading/unloading of vessels; processing of fish feed.
- Vessel movements – cargo ships transiting to and from the facility.
- Presence of dredged area and extension to the pier.
- Maintenance dredging.

As a consequence of these operation activities the potential impacts identified are:

- Noise and vibration (from vessel movements).
- Pollution – including lighting pollution (general operation activities, long sea outfall, accidental spillages).
- Habitat loss and fragmentation (maintenance dredging, propeller wash, anchoring of vessels).
- Vessel strikes (resulting from vessel movements) injury to marine mammals.
- Introduction of (invasive) non-native species (specifically from vessel movements).
- Changes to coastal processes following dredging and pier extension.

A summary of the significance for each of the operation impacts identified is provided in **Table 19.17**.

19.5.2.1 Noise and Vibration

The Proposed Development will operate seven days a week. Although land based operations will generate noise it is only the vessel movements which are anticipated to produce noise that could result in a potential effect on marine ecological receptors.

It is assumed that vessel movements will be approximately 2 per day; equating to a single vessel arriving and a single vessel leaving in a 24 hour period (see **Chapter 16 and Appendix 16.1**). Using Automatic Identification System (AIS) data from 2015 the number of cargo ships and port service craft transiting past the Proposed Development is approximated (uplift) as 1500 in a year, or 4 per day (**Appendix 16.1**).

The channel running through the Skye Bridge represents an important passage for ships preferring not to transit along the exposed western coast of Skye and therefore experiences regular commercial vessel movements. As vessels approach the Proposed Development they will reduce speed significantly, thus generating less noise than many of the vessels that continue pass the development.

Marine receptors in the vicinity of the development will be habituated to the regular passage of vessels and hence are unlikely to be significantly affected by operational marine traffic from the Proposed Development. Given this a **negligible** magnitude of change has been assigned against all relevant marine ecological receptors; leading to an impact significance of **negligible**.

19.5.2.2 Pollution

This section covers the potential impacts of the process effluent discharge, accidental fuel, oil and chemical spillages, in addition to the potential effects of light pollution, on marine receptors.

Operation discharge

Following primary and secondary treatment, the process effluent would be discharged via a long sea outfall (see **Chapter 2**) approximately 300 m seaward of the MLWS mark (see **Figure 2.2**).

The discharge of treated process effluent would result in highly localised changes in water chemistry in the vicinity of the discharge. Although consideration is given to the physical character of the discharge, it is acknowledged that due to the level of treatment, the low flow rate and the strong dispersive and dilution mechanisms of the receiving waterbody, the discharge would not result in a detectable plume (thermal or suspended solids). Consequently, it is only the potential impact to marine ecological features from changes in water chemistry which is considered further as opposed to any impacts from physical changes.

Specific to the discharge from the Proposed Development will be the elevated levels of ammonia and dissolved inorganic nitrogen (DIN) and the effects these could have on the receiving marine communities. Elevated ammonia has the potential to affect invertebrates and fish communities in the area due to its toxicity. High ammonia concentrations may also affect the dissolved oxygen available within the water column and in the boundary layer between the sediment and the water column, where molluscs, crustaceans and most annelids could be at risk. DIN has the potential to increase the amount of nitrogen available, increasing the risk of eutrophication in the surrounding area.

The assessment in this section uses the conclusions of the dilution modelling (**section 17.5.2** and **Appendix 17.1**) and the resulting assessment on water quality in **Chapter 17** (**section 17.6.2.2**). Specific regard is given to the relevant marine Environmental Quality Standards (EQSs) (Ref 19-50) and the mixing zone (point from the discharge where the EQSs are no longer exceeded). In terms of the effects on water chemistry from the discharge it is acknowledged that meeting the ammonia EQS is the limiting factor. The marine EQS for ammonia is an annual mean concentration of 21µg/l (Ref 19-50).

As noted in **Chapter 2**, the embedded design includes both primary and secondary treatment. The latter is specifically incorporated for nutrient removal, reducing ammonia concentrations to the required level (i.e. an average of 10.5mg/l) before it is discharged into the marine environment. The value of 10.5mg/l has been acknowledged through recognition of the modelled dilutions at the point of discharge, but also consideration of a reduced mixing zone of 40m (**section 17.6.2.2**).

Acknowledgment is given to the highly conservative assumptions made at every step towards the calculation of the 10.5mg/l ammonia threshold. Following primary treatment a worst case of 150mg/l of ammonia is considered present in the discharge, this assumes that all the 'Total Nitrogen' within the discharge is ammonia and that the upper limit of the range is consistently achieved (see **Table 2.4**). Further to this, rather than taking the 100m mixing zone (as set by SEPA) a reduced mixing zone has been adopted of 40m, this distance representing the nearest point of the flame shell bed to the discharge. At this distance (40m) the modelled dilution factor (see Appendix 17.1) of 497:1 has been applied, rather than that given for 100m (729:1).

Given the above, the application of 497:1 dilution factor to an ammonia concentration of 10.5mg/l results in a value of 21ug/l, therefore achieving the marine EQS. It is also noted that the discharge is buoyant, and the model suggests that the discharge will be primarily confined to the surface layer at the 40m mark and, as such, the concentration will be significantly lower at the seabed relative to the surface layer (see **Appendix 17.1**).

Acknowledging the rapid dispersion of the discharge**,** the area affected represents a highly localised region. As already discussed within **Chapter 17 (section 17.6.2.2)**, the highly localised changes to the water quality would not be detectable on the scale of the receiving water body; however, around the mouth of the outfall detectable changes to the subtidal community may occur, with a potential increase in macroalgae cover as a result of nitrogenous enrichment.

As specified in the SEPA guidance (Ref 19-51) the mixing zone for the discharge does not extend to the intertidal (above MLWS). Hence, operation of the discharge will not impact the intertidal zone and this is not considered further.

The discharge would not have any detectable effect on the integrity of marine mammal populations nor would it have the potential for accidental disturbance of individual cetaceans.

Subtidal habitats

It is recognised that the highly localised area of subtidal benthic habitat affected by the discharge will be represented by component PMF kelp biotopes (see section 19.4.3). It is acknowledged that these PMF biotopes dominate the infralittoral zone in this coastal region, extending far to the east and west of the Proposed Development.

As already noted above by way of the reduced mixing zone (from 100m to 40m), specific regard has been given to the potential effect of the process effluent discharge on the flame shell (*Limaria hians*) bed. Whilst specific literature on the effects of ammonia on *Limaria hians* is limited, a number of studies have been carried out on other bivalves. For example work by Kennedy *et al.* (Ref 19-55) and Duncan *et al*. (Ref 19-56) explored the tolerances and toxicity of juvenile blue mussels (*Mytilus edulis*) and the king scallop (*Pecten maximus*), respectively. It was found that ammonia concentrations of 40µg/l could result in mortality within juvenile populations of *Mytilus edulis* (Ref 19-55). The study by Duncan *et al.* (Ref 19-56) indicated about 5% mortality of adult *Pecten maximus* at the lowest concentration of ammonia tested (~7000ug/l) within 96 hours, with around 50% recorded after a further 40 days without ammonia exposure.

Due to the concentrations of ammonia tested in the Kennedy *et al.* (Ref 19-55) study, this provides a more useful proxy for the potential effect of ammonia on *Limaria hians*; however, the different physiology of *Mytilus edulis* and its ability to completely close its shell, as compared to the gaping nature of *Limaria hians*, is acknowledged. As *Limaria hians* are more closely related to scallops (Pectinids) than mussels (Mytilids) it is considered that scallops would offer a more suitable proxy to the effect of ammonia toxicity. Although not a native species to the area, a study on the Atlantic deep sea scallop (*Placopecten magellanicus*) by Abraham *et al* (Ref 19-57) found that a concentration of 1000ug/l of ammonia (at 4°C) resulted in 50% mortality in the population; however, as temperature of the water increased so did the concentration of the ammonia required to result in 50% mortality.

Toxicity to ammonia is related to sea temperature, pH and the duration of exposure. However, at 40m from the discharge the ammonia concentration would be a maximum of 21ug/l and therefore significantly less than the concentrations of ammonia known to result in a lethal effect on Mytilids and the more closely related Pectinids, the latter showing much higher tolerances than mussels (see Ref 19-56 and 19-57).

Further to the above, it is acknowledged that the buoyant nature of the discharge would mean that the concentration of ammonia at 40m would be significantly less at the seabed i.e. at the level of the flame shell community. Given this and the highly conservative assumptions made throughout the assessment, it is logical to assume that the concentration of ammonia would be considerably less than 21ug/l at the nearest point of the flame shell bed to the discharge. Much beyond this point the ammonia concentrations would not be detectable beyond baseline levels. It is therefore considered that there would be no detectable effect from the discharge on the flame shells and their constituent community, therefore the conservation objectives of the MPA would be maintained.

Given that the process effluent discharge would not permanently, or detectably, affect the ecological structure or function of subtidal communities, here or elsewhere in the region, an impact magnitude of **negligible** is assigned. This leads to an impact significance of **negligible** from the potential impact of operational discharge on subtidal habitats.

Fish

Given the mobility of marine fish species, the proximity to suitable alternative habitat and also the highly localised area of effect from the discharge; there would be no permanent or detectable effect on fish populations resulting from operation of the discharge. Consequently, a **negligible** magnitude of change leading to an impact significance of **negligible** is assessed for marine fish (including migratory species) from the potential impact of operational discharge.

Spillages (fuel, oil and chemical)

There would be a small, but detectable, increase in road and sea traffic around the development area which could affect water quality and potentially impact marine ecological receptors. Road runoff from tyre rubber, brake and clutch linings, fuel, de-icing agents, oil and coolant could introduce pollutants including suspended solids, volatile organic compounds, hydrocarbons, copper, zinc and lead.

Stationary and mobile plant use would pose a risk of oil or fuel spillage, which could have an impact on water quality through run-off entering the receiving waters. Similarly, accidental spillage and/or leakage from transiting vessels could result in the release of oils, fuels or chemicals into the water. Many mineral oils and other hydrocarbons are toxic, persistent and bio-accumulate in the environment. Additionally, biodegradation of oils in aquatic systems can lead to oxygen depletion.

The implementation of best practice management measures operation would be the mechanisms to minimise the occurrence and risk of such incidents (fuel, oil and chemical) and their potential effects on the marine receptors (see sections 19.6.1.1). These management measures are therefore considered as generic (embedded) mitigation.

Given the above, with implementation of the embedded mitigation, the residual impact significance is assessed as **negligible** for each of the marine ecological receptors in the operation phase.

Light Pollution

Artificial light will be highly localised around the Proposed Development during the operation phase, restricted to the development frontage and pier structure. Specific consideration is given to the migratory fish species that utilise the area. However, the highly localised artificial lighting generated from the operational activities, leads to a **negligible** magnitude of change and consequently an assessment of **negligible** impact significance on all marine ecology receptors.

19.5.2.3 Habitat Loss and Fragmentation

During the operation phase the potential effect of habitat loss and/or fragmentation is considered in relation to some of the key operation activities. Consideration is first given to the requirement for maintenance dredging to keep the facility operational. Following the conclusions of the modelling report (**Chapter 18** and **Appendix 18.1**) the requirement for maintenance dredging will be small and will occur in the corners of the dredged area as a result of the ship movements acting on fine material deposited.

The effects of propeller wash during the operation phase were also considered in **Chapter 18** and it was found that changes to geomorphology would be highly localised, occurring in the nearshore area within the immediate proximity of the berths. Therefore, no effect would occur on the flame shell bed as a result of propeller wash from vessel movements.

The potential effects of wake generated waves on geomorphological features were scoped out of further consideration in **Chapter 18** (**section 18.5.6**) and are not considered further within this chapter.

Consideration was given to the potential requirement for vessel anchoring during the operation phase (**Appendix 16.1**). Within the study area there are designated anchorages located on the southern side of the Plock of Kyle and in Loch Na Beiste. The seabed in the immediate vicinity of the pier development varies from rock and shells to fine sand. These materials do not provide good holding ground for anchoring and so are unlikely to be used by vessels other than in an emergency situation. Following this, the potential effect of anchoring on subtidal habitats is not considered further.

Given consideration of all of the above, it is recognised that propeller wash and the infrequent requirement for maintenance dredging will result in disturbance, albeit highly localised, to subtidal habitats. However, post-construction these areas, as affected by propeller wash and maintenance dredging, will be characterised by mobile substrata and, hence, populated by opportunistic marine species, characteristic of a disturbed sedimentary environment. On account of the very limited contribution to local biodiversity and ecosystem function, such opportunistic communities are assigned a low value. Furthermore, considering the dynamic nature of the habitat affected the communities present will have a high capacity to adapt to change, with a short-term recovery. Following this, a **negligible** magnitude of change is assigned to the potential impact of subtidal habitat loss and fragmentation in the operation phase, consequently resulting in an impact significance of **negligible.**

19.5.2.4 Vessel Strikes

During the operation phase a total of 676 vessel movements (arriving and departing from the Proposed Development) are anticipated each year (**Chapter 16** and **Appendix 16.1**), equating to a single vessel arriving and a single vessel leaving in a 24 hour period.

As previously mentioned the channel running through the Skye Bridge represents an important passage route for ships and boats, with more than 4 transits expected, on average, per day. The increase in traffic to the area as a result of the Proposed Development is recognised but consideration is also given to the habituation of marine mammals to marine traffic in this region.

As vessels approach the Proposed Development they will reduce speed significantly before turning and approaching the pier. It is assumed that the requirement for ducted propellers will be limited, with vessels only expected to use thrusters to any significant degree when docking at or leaving the berths at the Proposed Development.

Harbour porpoise and, to a lesser extent, common (syn. harbour) seals (*Phoca vitulina*) frequent the area. The high mobility of these animals allows them to avoid marine vessels and this mobility, combined with the low vessel movements (2 per day) leads to a **negligible** magnitude of change, and **negligible** impact significance from vessel strikes.

19.5.2.5 Introduction of (invasive) Non-native Species

During operation there would be a number of vessels transiting to and from the facility. Many of these would originate from different biogeographical locations. These could act as vectors for the introduction of non-native species, potentially invasive species, which could arrive on vessel hulls or in ballast water. In addition, the modification of the substratum under the footprint of the dredge could present an opportunity for colonisation by non-native species. Although the temperature of the process effluent will be elevated above background the low flow rate and the strong dispersive and dilution mechanisms of the receiving water body would not result in any detectable thermal plume and, therefore, would not lead to more favourable growing conditions for non-native species.

It is difficult to predict the impacts on native habitats and species as this would be dependent on which non-native species were introduced; however, some non-native species are able to colonise quickly and aggressively out-compete native species.

Consideration is given to the fairly exposed nature of the site, the strong tidal flows and tidal excursion. Unlike sheltered bays and marinas the environment would reflect the wider area. Given the above a **small** magnitude of change and, hence, a **minor adverse** impact significance is assessed against the potential for introduction of non-native species on subtidal habitats.

19.5.2.6 Changes to Coastal Processes

Changes to the baseline coastal processes will result from the Proposed Development i.e. removal of seabed to 8.5 m BCD; extension of pier. The consequence and magnitude of these changes is covered within **Chapter 18** with the detail of directed model outputs and discrete desk studies provided in **Appendix 18.1**. It should be acknowledged that the presence of the outfall pipe would have no detectable effect on coastal processes (see **Chapter 18**) and thus no indirect effect on geomorphology.

This section assesses the potential for any changes in coastal processes to indirectly impact the marine ecological receptors and is informed by the conclusions of **Chapter 18** with reference made to these assessments as applicable.

A **small** magnitude of change was assessed against the potential effects of changes to flow regime, wave climate and sediment transport (see **section 18.6.3**).

Where changes in flow regime were predicted beyond the immediate vicinity of the development they were very small, being in the order of 0.05 m/s, and these only expected to occur over peak-ebb and peak–flood tides and, in some cases, only during specific storm events. Consequently, they would occur for a very limited time in any given tidal cycle. None of the changes in flow were predicted to occur over the flame shell bed.

Changes in the wave climate did not generally exceed ±0.25m in wave height and were largely to the east of the development. These were modelled under one in one year storm conditions so are considered infrequent when compared to baseline conditions (**Chapter 18** and **Appendix 18.1**).

The sediment transport modelling showed that after a four day, one in one year storm there would be some seabed changes in the nearshore just beyond the immediate vicinity of the works (**Appendix 18.1**). These changes would generally manifest as a reduction in seabed height with a highly localised area showing increases >0.5m in seabed height. The area affected by these sediment transport changes is represented by kelp biotopes, all of which are component PMFs. None of the changes in sediment transport occurred over or adjacent to, the flame shell bed.

Other than the kelp habitat the minimal changes predicted on the coastal processes are not predicted to have a detectable effect on any other marine ecological receptor identified. Given that during certain storm conditions there is the potential for changes to the seabed just beyond the Proposed Development, a localised area of kelp habitat would be affected. Further to the east is a continuation of the kelp habitat and hence the predicted changes would not permanently affect the ecological structure or the function of the kelp habitat to the overall ecosystem

Following this a **small** magnitude of change has been assigned leading to an impact significance of **minor adverse** from the effect of changes in coastal processes on kelp communities (subtidal habitat) of medium value.

Table 19.17: Summary of identified significant impacts during the construction and operation phases of the Proposed Development. All significant impacts are adverse and represent significance before specific mitigation measures have been applied.

Phase/Activity	Receptor	Magnitude of change	Significance
Construction: piling (noise and vibration)	Migratory fish populations	Small	Minor adverse
	Marine mammals (cetacean and pinniped populations)	Small	Minor adverse
Construction: capital dredging (sediment dispersion)	Subtidal habitats	Small	Minor adverse
Construction: capital dredging and general marine works (habitat loss and fragmentation)	Subtidal habitats	Small	Minor adverse
Construction: vessel movements (INNS)	Subtidal habitats	Small	Minor adverse
Operation: vessel movements (INNS)	Subtidal habitats	Small	Minor adverse

Phase/Activity	Receptor	Magnitude of change	Significance
Operation: presence of dredged area, pier extension (changes to coastal processes)	Subtidal habitats	Small	Minor adverse

19.6 Post consent management plans

19.6.1.1 CEMP

A Construction Environmental Management Plan (CEMP) will be produced by the construction contractor. The CEMP will set out the intended methods of effectively managing potential environmental impacts resulting from construction of the Proposed Development. It will contain measures to manage and achieve specific environmental objectives and reduce environmental risks, such as storage of chemicals and use of SEPA's Pollution Prevention Guidelines (PPGs), waterborne piling guidance followed and means of controlling biosecurity e.g. ballast water.

Specific examples of the measures to be included in the CEMP to manage potential spillages into the marine environment are as follows:

- follow pollution prevention procedures including relevant SEPA Pollution Prevention Guidelines (PPGs);
- develop and follow a Code of Construction Practice (CoCP) to consider and address all pollution risks;
- implement a Pollution Emergency Response Plan , including storage of appropriate spillage control kits on site including floating booms, training of staff in the use of spillage control kits, floating booms and the operation of the Pollution Emergency Response Plan;
- Ecological Clerk of Works (ECoW) to be present on site;
- Stockpiling of chemicals/fuel and other materials shall only be conducted away from the water using appropriate containers situated on a bunded waterproof surface. Such areas shall also be covered to avoid washout from rain;
- The use of approved pollution prevention schemes (e.g. oil separators – PPG3) will be installed to prevent potentially polluted surface water from flowing into the water body;

Further detail on the specific nature of the SEPA PPGs is provided in **Chapter 17**. It should be acknowledged that mitigation measures for pollution are considered embedded and will be detailed in the CEMP accordingly once a successful contractor(s) has been appointed.

Adoption of the CEMP management methods, as detailed, will be carried out once the CEMP has been agreed with the relevant bodies. It is therefore likely that several of the mitigation measures outlined below (section 19.7) will be mirrored by those provided in the CEMP.

19.6.1.2 Species Protection Plans

Following the approval of the Marine Licence Application, EPS licences will be sought where necessary, in consultation with the relevant statutory authorities.

An EPS Licence is required for any activity that might result in injury to, or disturbance of, an EPS. Deliberate harm to any EPS is not anticipated as part of the Proposed Development; however, inadvertent or accidental disturbance may occur if activities take place in the presence of an EPS. Following the assessments carried out in this chapter, it has been acknowledged that inadvertent or accidental disturbance to harbour porpoise is possible during the period of piling activity in the construction phase. An EPS licence will be applied for once consent has been granted; however, following dialogue with MS-LOT a shadow EPS assessment will be carried out for the relevant species and submitted to MS-LOT although this will not form part of the Marine Licence application submission.

Species Protection Plans will be prepared for EPS (and other species as determined by the Ecological Clerk of Works (ECoW)) by the contractor as part of the CEMP developed from the environmental commitments identified in this ES. The Species Protection Plans will be prepared to ensure that essential mitigation strategies required for safeguarding protected species are implemented as part of the contract, and will be updated as appropriate if any derogation licences are identified as being required following further surveys.

19.7 Mitigation Measures

As defined by ecological impact assessment guidelines (Ref 19-2), a sequential process should be adopted to avoid, mitigate and compensate ecological impacts. This is often referred to as the ‘mitigation hierarchy’. The mitigation provided in this section provides measures to avoid and reduce adverse (negative) impacts assessed for the marine ecological receptors (features) **(Table 19.17).**

In some instances the mitigation measures provided may not result in the reduction of impact significance. However, these are provided as it is considered that their inclusion strengthens the confidence in the final assessment (residual impact) and/or in some cases, may reduce the likelihood of a given impact, but not reduce its defined impact significance, as assessed. No mitigation measure is proposed to reduce the impact significance (**minor adverse**) on kelp habitat following changes in coastal processes.

19.7.1 Additional Mitigation - Construction

19.7.1.1 Noise and Vibration (piling)

A number of mitigation measures are provided below to avoid potential impacts on fish (migratory) and marine mammals (cetaceans and pinnipeds) from noise and vibration pre-mitigation. Many of the additional measures proposed are adopted from the JNNC piling protocol (2010); however, acknowledging the commitment that no piling would be carried out between the hours of 20:00 and 07:30 (unless in the case of emergency), some variation to the JNCC protocol is provided.

Fish

Whilst piling operations are not considered to result in mortality, there is the potential for avoidance behaviour that could impact on migratory and non-migratory fish populations.

Proposed mitigation measures (mitigation item SM1) are:

- the use of vibro-piling, as much as feasible, to reduce the potential for physical injury to resident fish species and reduce the acoustic barrier for migratory species;
- the use of a ‘soft-start’ approach (as detailed below) whereby the noise level is increased gradually, thereby allowing fish and marine mammals to move away from the area prior to full-scale piling operations. The duration of soft-start will be a minimum of 20 minutes.

Marine Mammals

Piling activity has the potential to cause noise disturbance, hearing impairment – temporary threshold shift (TTS) and/or permanent threshold shift (PTS), mortality or avoidance behaviour to marine mammals.

Proposed mitigation measures to reduce piling impacts on marine mammals are as summarised above (mitigation item SM1) with recognition of the JNCC (2010) protocol (Ref 19-47). Specific measures are as outlined below (mitigation item SM2):

- a trained Marine Mammal Observer (MMO) and/or passive acoustic monitoring (PAM) operative will be present during the piling start-up procedure to enforce a marine mammal mitigation zone. The mitigation zone (MZ) will be set dependent on the predicted / measured noise levels and in consultation with SNH and Marine Scotland but would be no smaller than 500 m radius from the pile head. The MMO/PAM operative will acknowledge JNCC guidance on minimising the risk of disturbance and injury to marine mammals (JNCC, 2010) (Ref 19-47);
- the MZ will be monitored visually by MMOs and/or acoustically using PAM for a minimum of 30 minutes for a pre-piling search. At the start of the working day, if visibility is less than the MZ, then PAM will be used to determine the presence of marine mammals;
- throughout the piling operations a buoy affixed with a hydrophone will be deployed. This will facilitate PAM of the MZ and ensure that full coverage is achieved;
- piling will not commence if marine mammals are detected within the MZ or until at least 20 minutes after the last visual or acoustic detection. The MMO or PAM operative will advise the piling crew when to commence piling activities;
- following confirmation during the pre-piling search that marine mammals are not present in the MZ a 'soft-start approach will be adopted. Given the type and size of piling to be employed at the Kyleakin Pier project the impact piling plant will not be of a type that can gradually have its power ramped up. Alternative methods will instead be adopted to achieve a similar effect of "soft start" build-up of power and marine noise. The noise level will be gradually ramped up from a 7.20am onwards start of onsite (land) works. A formal soft start process will be achieved through a mechanical system, fitted to an existing or newly installed pier pile will be used to continuously create impact noise similar to a piling hammer with soft start capability. This "soft start" noise will be created for at least 20 minutes after MMO/PAM clearance of the area for start of impact piling;
- should marine mammals be detected within the MZ during the soft-start, then piling will either cease or at least the power will not be increased until the mammal leaves the mitigation zone and there is no further detection for 20 minutes. It should be noted that if marine mammals are observed in the mitigation zone once piling activities are fully operational there is no need to cease operations as mammals have moved into the area with a known noise level being generated;
- where reasonably possible the successful contractor will not commence waterborne piling during periods of darkness or poor visibility; however, where there is a commercial need to commence piling during periods of darkness or poor visibility (only within operational piling hours from 07:30 to 20:00) a pre-piling search will be carried out covering the whole mitigation zone using a PAM operative for a period of no less than 20 minutes. If no marine mammals are present within the MZ then the soft-start approach will begin as outlined above;
- once the piling activity is fully operational it is the intention that piling noise will be continuous and hence maintained throughout the working day i.e. that there are no gaps in piling noise exceeding 10 minutes in length during the working day. However, if there is a pause in the piling operations for a period of greater than 10 minutes, then the pre-piling search and soft-start procedure will be repeated before piling recommences. However, as a watch will be kept by the MMO and/or PAM operative during piling operations the MMO or PAM operative should be able to confirm the presence or absence of marine mammals, and it may thus be possible to commence the soft-start immediately and forego the pre-piling search.

The PAM operative and MMO will be:

- appropriately trained and experienced;
- acknowledge JNCC protocol (2010) and best practice guidance for minimising the risk of injury to marine mammals from piling noise;

- be fully cognisant of the mitigation measures outlined.

19.7.1.2 Sediment Dispersion (capital dredging)

Proposed mitigation measures to reduce the overall effects on subtidal habitats, specifically kelp habitat are:

- The dredging contractor would avoid capital dredging at the same time as any other dredging activity is being carried out in the vicinity of the Proposed Development (mitigation item SM3)
- Monitoring of water quality during dredging (mitigation item SM4) e.g. turbidity; if turbidity levels exceed predetermined thresholds at predetermined locations then actions would be taken to reduce levels potentially to the extent of suspending dredging temporarily.

19.7.1.3 Habitat Loss and Fragmentation

Proposed mitigation measures to reduce the potential effects of habitat loss, specifically in relation to the loss/fragmentation of kelp habitat from capital dredging are:

- All reasonable efforts would be taken by the successful dredging contractor to limit the footprint of the capital dredge within the proposed area of the approach channel and, therefore, avoid disturbance of the adjacent seabed (SM5).

19.7.1.4 Introduction of (invasive) Non-native Species

A number of mitigation and management measures (SM6) are proposed which will reduce the potential effects of the introduction of (invasive) non-native species on subtidal habitats are:

- Adherence to the Code of Practice on Non Native Species (NNS) (approved by Scottish Parliament 28 June 2012) and adopting a precautionary approach.
- Production and implementation of a biosecurity plan.
- Training of relevant staff prior and during the construction process in NNS identification and ensuring these staff receive a copy of the biosecurity plan.
- Recognition to guidance produced by SNH for the prevention of introduction of non-native species (Payne *et al*., 2014) (Ref 19-48).
- Vessels involved in the construction and operation activities of the Proposed Development will adhere to the industry recommended guidelines for preventing the introduction of non-native marine species. UKMarineSAC (UKMarineSAC, 2009) (Ref 19-49) recommends that vessels comply with International Maritime Organisation guidance wherever possible, seek guidance from the local port authority regarding areas where ballast water uptake should be avoided (e.g. near sewage outfalls), encourage the exchange of ballast water in the open ocean, and discourage / prohibit the unnecessary discharge of ballast water in port and harbour areas.
- Any vessels using ballast water must comply with the Exchange standards contained in the IMO Ballast Water Management Convention and carry a Ballast Water Management Plan and a Certificate of Compliance.
- Where possible vessels would be procured from within the biogeographic boundaries during the construction phase.
- Avoidance of ballast water discharge inside the Lochs Duich, Long and Alsh SAC and MPA.

19.7.2 Additional Mitigation - Operation

19.7.2.1 Introduction of (invasive) Non-native Species

An impact significance of **minor adverse** was assessed for the potential effects of the introduction of (invasive) non-native species on subtidal habitats. A number of mitigation and management measures (SM6) are proposed which will reduce the potential effects of the introduction of (invasive) non-native species on subtidal habitats (see **section 19.7.1.4**).

19.8 Residual Impacts

Following implementation of the mitigation measures outlined above (**section 19.7**), potential impacts were reassessed and the residual impact determined (**Table 19.18**).

Table 19.18 : Summary of residual impacts (post-mitigation).

Phase/Activity	Receptor	Impact significance (pre mitigation)	Mitigation no.	Residual impact significance
Construction: piling (noise and vibration)	Migratory fish populations	Minor adverse	SM1	Negligible
	Non-migratory fish populations	Minor adverse	SM1	Negligible
	Marine mammals (cetacean and pinniped populations)	Minor adverse	SM1; SM2	Negligible
Construction: capital dredging (sediment dispersion)	Subtidal habitats	Minor adverse	SM3; SM4	Minor adverse
Construction: capital dredging and general marine works (habitat loss and fragmentation)	Subtidal habitats	Minor adverse	SM5	Minor adverse
Construction: vessel movements (INNS)	Subtidal habitats	Minor adverse	SM6	Negligible
Operation: vessel movements (INNS)	Subtidal habitats	Minor adverse	SM6	Negligible
Operation: presence of dredged area, pier extension (changes to coastal processes)	Subtidal habitats	Minor adverse	n/a	Minor adverse

19.9 Summary

This chapter provides an assessment of the potential impacts on marine ecological receptors arising from the construction and operation of the Proposed Development. Following implementation of appropriate embedded and additional mitigation measures, only a limited number of residual significant impacts remain. Furthermore, none of the residual impacts would exceed **minor adverse** significance.

Following application of the proposed mitigation measures in the construction phase the impact of sediment dispersion and habitat loss/fragmentation remain as **minor adverse,** specifically as a result of the potential effects on kelp habitat. The kelp communities recorded in the area represent component PMF biotopes and as such have been assigned a medium value. As recognised by SNH (**Appendix 1.1**) these kelp features are not rare in Scottish waters but are functionally important. Consideration of the effects on the kelp includes the function it has within the wider ecosystem and the contribution of the kelp communities to biodiversity. Recognition is given to the extensive coverage of kelp in this region and therefore the relatively minimal effect that removal, or sediment deposition on the comparatively small area of kelp, would have on the wider kelp community, or those organisms that depend on the kelp communities for food or shelter.

Similarly, during the operation phase of works a **minor adverse** impact remains as a consequence of potential changes to kelp habitat just beyond the immediate proximity of the Proposed Development. As explained above, consideration is given to the overall effect that this impact would have on the wider feature and, given the reasons outlined above, this is considered to be minimal.

Several designated sites in the general area of the Proposed Development have been given specific consideration and the assessments carried out in this chapter have demonstrated that there would be no adverse effect on site integrity of the Lochs Duich, Long and Alsh SAC, the Inner Hebrides and Minches cSAC, the Lochs Duich, Long and Alsh MPA. Overall, the minimal changes that are predicted to the coastal processes would not lead to an indirect effect on these designated sites and, specifically, their qualifying features.

Within the Scoping Opinion (**Appendix 1.1**) particular regard is given by SNH to the flame shell bed that is one of the qualifying features of the Lochs Duich, Long and Alsh MPA. The importance of this feature in Scottish and European waters is well acknowledged, with the bed supporting a highly diverse and rich community (Ref 19-52; Ref 19-53). Previous studies have determined that flame shell beds are highly sensitive to dredging impacts with very slow recovery rates following removal of nest material (Ref 19-54). However, the outcomes of this assessment have determined that there would be no direct or indirect effects on this feature resulting from the Proposed Development. Recognition is given to the design modifications made to the dredging extent in late 2016 to ensure that the dredged area was >10m from the boundary of the flame shell bed This has resulted in the nearest point of the dredged extent being approximately 17m from the edge of the flame shell bed. Furthermore, in terms of the process effluent and compliance with the marine water EQSs (specifically ammonia), a reduced mixing zone of 40m has been considered, this leading to the commitment at the design phase to ensure that secondary treatment will reduce ammonia to 10.5mg/l or less at the point of discharge. These changes to the design have formed part of the internal discussions between Marine Harvest and Jacobs, to make certain that there would be no significant effect on the flame shell bed.

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